TeVPA 2023 - Napoli Italy

Report of Contributions

https://agenda.infn.it/e/tevpa2023

Contribution ID: **3** Type: **not specified**

SND@LHC experiment at CERN

Thursday, September 14, 2023 3:40 PM (20 minutes)

SND@LHC is a compact experiment proposed to exploit the high flux of energetic neutrinos of all flavours from the LHC in a hitherto unexplored pseudo-rapidity region of 7.2 < ⍰ < 8.4, complementary to all the other experiments at the LHC. The experiment is located 480 m downstream of IP1 in the unused TI18 tunnel. The detector is composed of a hybrid system based on an 830 kg target mass of tungsten plates, interleaved with emulsion and electronic trackers, also acting as an electromagnetic calorimeter, and followed by a hadronic calorimeter and a muon identification system. The configuration allows efficiently distinguishing between all three neutrino flavours, opening a unique opportunity to probe physics of heavy flavour production at the LHC in the region that is not accessible to ATLAS, CMS and LHCb. This region is of particular interest also for future circular colliders and for predictions of very high-energy atmospheric neutrinos. The physics programme includes studies of charm production, and lepton universality tests in the neutral sector. The detector concept is also well suited to searching for Feebly Interacting Particles via signatures of scattering in the detector target. The first phase aims at operating the detector throughout LHC Run 3 to collect a total of 250 fb−1. The experiment was installed in the TI18 tunnel at CERN and has collected its first data in 2022. A new era of collider neutrino physics has started.

Primary authors: GULER, Ali Murat; COLL., SND@LHC

Presenter: LANTWIN, Oliver (LAPP, CNRS-IN2P3)

Session Classification: PP: Particle Physics

Track Classification: Neutrinos

Contribution ID: **4** Type: **not specified**

NEWSdm : directional dark matter searches with nuclear emulsion

Thursday, September 14, 2023 2:40 PM (20 minutes)

The presence of dark matter can explain several observations in the universe. However, its nature is still unknown. Therefore, the study of dark matter is a rapidly evolving field. New techniques and methods are being applied all the time. The measurement of the direction of WIMP-induced nuclear recoils is a challenging strategy to extend dark matter searches beyond the neutrino floor and provide an unambiguous signature of the detection of Galactic dark matter. The sensitivity of gas detectors are limited by the small achievable detector mass to reach the neutrino floor. NEWSdm is an innovative directional experiment proposal based on the use of a solid target which is made by newly developed nuclear emulsion and read-out systems achieving a position accuracy of 60 nm. The nuclear emulsion technology is the most promising technique with nanometric resolution to disentangle the dark matter signal from the neutrino background. In this talk, we discuss the experiment design, its physics potential, the near-future plans. After the submission of a Letter of Intent, a new facility for emulsion handling was constructed in the Gran Sasso underground laboratory and different measurements have been carried out, including the first directional measurement of sub-MeV neutrons. A Conceptual Design Report is in preparation and will be submitted in 2023.

Primary author: COLL., NEWSdm

Co-author: GULER, Ali Murat

Presenter: SADYKOV, Zhakypbek (University of Naples)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **6** Type: **not specified**

Gamma-ray Nebulae around Recurrent Novae

Monday, September 11, 2023 5:45 PM (15 minutes)

Novae have been recently established as prompt gamma-ray sources in the GeV energies, and also in one case in the TeV energies (RS Oph), lasting for a few days up to a month after the nova optical outburst. We consider a scenario in which electrons, accelerated continuously in the expending nova shell, escape into the surrounding medium forming an extended nebula around recurrent nova. Electrons diffusing through the nova remnant nebula produce gamma-rays as a result of the ICS of the thermal radiation from the companion red giant and the MBR. Predicted steady gamma-ray emission from the nova nebula (RS Oph) is confronted with the sensitivities of the satellite (Fermi-LAT) and the Cherenkov telescopes (CTA).

Primary authors: Prof. SITAREK, Julian; Prof. BEDNAREK, wlodek (University of Lodz)

Presenter: Prof. BEDNAREK, wlodek (University of Lodz)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **8** Type: **not specified**

Probing neutrino-antineutrino interactions from light gauge boson production in proto-neutron stars

Tuesday, September 12, 2023 4:30 PM (15 minutes)

In this talk, I will analyse the effect on the supernova neutrino flux duration of the resonant production of low-mass vector mediators from neutrino-antineutrino coalescence in the core of proto-neutron stars. First, I will argue that, in the regime where neutrino-antineutrino interactions via the new vector mediator dominate over the Standard Model neutrino-nucleon scattering, a redistribution of the neutrino energies might take place, making low-energy neutrinos more trapped. Since this only affects 10% of the neutrino population, it cannot be observed in the SN 1987A data, but it could be analysed with future supernova detection data. I will then focus on small gauge couplings, where the decay length of the new gauge boson is larger than the neutrino-nucleon mean free path, but still smaller than the size of proto-neutron star. I will show for the first time that, in this regime, the resonant production of a long-lived vector mediator and its subsequent decay into neutrinos can significantly reduce the duration of the neutrino burst. By using this argument, we rule out new areas of the parameter space of the well-motivated U(1)Lμ-Lτ model. In particular, we extend cooling bounds to higher couplings, probing values of the coupling to 6x10-8.

Primary authors: CERMEÑO GAVILÁN, Marina (Institute for Theoretical Physics (IFT (UAM/CSIC))); CERDEÑO, David G. (Instituto de Física Teórica); FARZAN, Yasaman

Presenter: CERMEÑO GAVILÁN, Marina (Institute for Theoretical Physics (IFT (UAM/CSIC)))

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **9** Type: **not specified**

The cosmology of viscous generalised Chaplygin gas under the purview of f (T) gravity and the model assessment through a machine learning approach

Tuesday, September 12, 2023 5:30 PM (20 minutes)

In this paper, we present an analysis of the generalised Chaplygin gas (GCG) in the presence of bulk viscosity. Reconstruction techniques have been shown in the context of interacting scenarios and viscous cosmological settings using the Einstein and modified $f(T)$ gravity paradigm (where T is the torsion scalar). Additionally considered are instances that are not viscous. Under different conditions, the equation of state (EoS) parameter has been investigated, and the stability of the models has been assessed using the sign of the squared speed of sound. The GCG interacting with pressure-less dark matter was found to behave like a quintom in the presence of bulk viscosity, and a quintessence-like behaviour was reported in the non-viscous situation. In spite of the existence of bulk viscosity, the reconstructed GCG turns out to be stable against small perturbations. Last but not least, statistical analysis, Shannon entropy, and Gaussian Mixture Model have been used to evaluate the reconstruction method.

Primary author: SAHA, Sanghati (Department of Mathematics, Amity University Kolkata)

Co-author: CHATTOPADHYAY, Surajit (Amity University, Kolkata, India)

Presenter: SAHA, Sanghati (Department of Mathematics, Amity University Kolkata)

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **12** Type: **not specified**

Light dark matter search results from DarkSide-50

Wednesday, September 13, 2023 2:00 PM (20 minutes)

The DarkSide-50 experiment uses a two-phase argon time projection chamber to directly search for dark matter interactions. The energy threshold of the detector can be lowered by including ionization-only events. While background rejection is lost, DarkSide-50's sensitivity is expanded to sub-GeV dark matter candidates. The DarkSide-50's expanded search for several dark matter candidates with improved calibration model, more accurate background model, improved data selection, and larger exposure will be presented. The search has excluded new parameter space for spin-independent dark matter-nucleon coupling, dark matter-electron cross section, the axioelectric coupling constant of galactic ALPs, and the dark photon kinetic mixing parameter.

Primary author: PANTIC, Emilija (UC DAVIS)

Presenter: PANTIC, Emilija (UC DAVIS)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **13** Type: **not specified**

Attacking Heavy Dark Matter on Two Fronts

Thursday, September 14, 2023 11:50 AM (13 minutes)

The indirect detection program looks for annihilation and decay products of dark matter from astrophysical sources. In its high-mass regime, it offers the only way to get 'right here, right now' constraints on many motivated scenarios. I will describe two possible stories for dark matter at or beyond the weak scale, and current & projected limits on them. The first is the case of vanilla electroweak weakly-interacting massive particles (WIMPs) that realize the WIMP miracle. I will specifically focus on the cases of SU(2) triplet (wino) and quintuplet. Secondly, we can consider Ultra-Heavy Dark Matter (UHDM) out to scales well above 1 PeV. Despite a naive unitarity limit of 100-200 TeV for a thermal relic, bound state and/or compositeness effects can easily boost annihilation cross sections in a consistent manner.

Primary author: BAUMGART, Matthew (Arizona State University)

Presenter: BAUMGART, Matthew (Arizona State University)

Session Classification: Plenary

Track Classification: Indirect DM searches

Contribution ID: **14** Type: **not specified**

Recent Low Energy Results from the Recoil Directionality (ReD) Experiment

Wednesday, September 13, 2023 10:05 AM (15 minutes)

The Recoil Directionality Experiment (ReD) aims at understanding if liquid Argon (LAr) experiments can determine the directionality of Dark Matter, as well as improving the measurement of very low energy nuclear recoils. For the latter, we study interactions of neutrons in our dual-phase LAr Time ProjectionChamber, in the 2 - 10 keV recoil energy region, determining its charge yield. This is a crucial measurement for the WIMP searches in LAr below 10 GeV. In this talk it will be shown the preliminary results of our recent measurements in this low energy region, using a 252Cf fission radioactive source. We will also discuss our prospects to improve this measurement even further, using a
neutron generator as the source. The ReD experiment is part of The Global Argon Dark Matter Collaboration, which aims to directly probe Dark Matter.

Primary author: ALBUQUERQUE, Ivone (University of Sao Paulo)

Presenter: ALBUQUERQUE, Ivone (University of Sao Paulo)

Session Classification: Plenary

Track Classification: Direct DM searches

Contribution ID: **15** Type: **not specified**

VHE gamma-ray and hard X-ray followup studies of IceCube astrophysical neutrinos with VERITAS and NuSTAR

Tuesday, September 12, 2023 2:00 PM (15 minutes)

IceCube has reported evidence for neutrino emission from the nearby active galaxy NGC 1068 and the gamma-ray blazar TXS 0506+056. A search for electromagnetic radiation temporally and spatially-correlated with high-energy IceCube neutrino events is an important strategy for exploring the connection between neutrinos and high-energy blazars. Here we report on the very-high-energy gamma-ray and hard X-ray follow up studies of IceCube astrophysical neutrinos with VERITAS and NuSTAR. In particular, we report on multiwavelength target-of-opportunity observations of the blazar PKS 0735+178, located 2.2 degrees away from the best-fit position of the IceCube neutrino event 211208A, detected by IceCube as a track-like event with an energy of about 171 TeV. Hard X-ray observations from NuSTAR, as well as gamma-ray observations at TeV energies, have provided some of the strongest constraints on the hadronic emission from blazars. In the spectral energy distribution for PKS 0735+178, we find that the X-ray data characterizes the transition in the spectrum from the low-energy to the high-energy component. The gamma-ray data show a spectral cut-off near 100 GeV, suggesting the existence of an external photon field in the source. We discuss implications for leptonic and hadronic models of emission in blazars based on these measurements. In addition, we report on other target-of-opportunity observations of IceCube alerts with VERITAS and NuSTAR in the last two years and ask the question whether the observed multi-wavelength spectra are consistent with the neutrino events.

Primary author: MUKHERJEE, Reshmi (Barnard College, Columbia University)

Presenter: MUKHERJEE, Reshmi (Barnard College, Columbia University)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **18** Type: **not specified**

The IceCube Realtime Program

Wednesday, September 13, 2023 5:10 PM (15 minutes)

In 2013, the IceCube collaboration announced the detection of diffuse high-energy astrophysical neutrino flux. The origin of these particles is still unknown as there is still no identification of a source at the 5-sigma level. To answer this question, IceCube releases realtime alerts triggering follow-up observations in multiple wavelengths looking for electromagnetic counterparts to individual neutrinos. One of these alerts led to the association of the high-energy neutrino event IC170922A with the flaring gamma-ray blazar TXS 0506+056 at 3-sigma level. This work presents an overview of the IceCube Realtime Program with a brief exposition of possible future improvements to overcome issues with systematic errors, such as incomplete knowledge of the Antarctic ice.

Primary author: SOMMANI, Giacomo (Ruhr-Universität Bochum)

Presenter: SOMMANI, Giacomo (Ruhr-Universität Bochum)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **19** Type: **not specified**

Electromagnetic Cascades as probes of the High and Ultra-High Energy Universe

Monday, September 11, 2023 3:45 PM (15 minutes)

It is well known that our Universe is opaque to high-energy gamma-rays due to electromagnetic cascades over cosmological distances, resulting in a spectrum of secondary gamma-rays at lower energies. In this talk, we will summarize the physics and features of such cascades and discuss their importance in the context of multimessenger astrophysics up to ultra-high energies. In particular, we demonstrate how one can infer properties of the IceCube neutrino sources from their corresponding cascaded gamma-ray counterparts. We also show how muon pair production can play an important role in the cascade development at high-redshifts, leading to the production of ultra-high energy neutrinos.

Primary authors: Mr ESMAEILI, AmirFarzan (Pontifícia Universidade Católica do Rio de Janeiro); CAPANEMA, Antonio (Pontifícia Universidade Católica do Rio de Janeiro); ESMAILI, Arman (Pontifícia Universidade Católica do Rio de Janeiro); SERPICO, Pasquale Dario (CNRS, Laboratoire d'Annecy-le-Vieux de Physique Théorique (LAPTh), France)

Presenter: CAPANEMA, Antonio (Pontifícia Universidade Católica do Rio de Janeiro)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **20** Type: **not specified**

Energy conservation and axion back-reaction in an external magnetic field

Tuesday, September 12, 2023 5:00 PM (15 minutes)

Coherently oscillating axion clumps can in an external magnetic field emit electromagnetic radiation which causes them to decay. In the presence of plasma, such radiation can become resonant if the clump frequency matches the plasma frequency. In this talk, I discuss how backreaction affects the clump frequency over time enabling clumps with a range of different initial frequencies to become resonant at some point in their time evolution.

Primary author: SIVERTSEN, Lars (Iowa State Univerity)

Presenter: SIVERTSEN, Lars (Iowa State Univerity)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **21** Type: **not specified**

Jet contribution to the γ-ray Flux in NGC 1068

Wednesday, September 13, 2023 4:45 PM (15 minutes)

NGC1068 is a Seyfert II starburst galaxy emitting in a very broad range of frequencies, from radio up until gamma-ray energies. Since the observed high-energy neutrinos and gamma-rays fluxes are different by at least 2 orders of magnitude, it becomes necessary to account for a multi-component model to describe the multimessenger emission by NGC1068. The neutrinos signal can be explained through hadronic processes in the corona of the AGN and the gamma-rays observed by Fermi-LAT can originate from the circumnuclear starburst ring.
In this presentation, the pc-to-kpc scale radio jet of NGC1068 is investigated in terms of its potential gamma-ray contribution via hadronic or leptonic processes. Moreover, the radio data provided by VLBA and ALMA observations at different distances from the central engine is taken into account. So, it can be clearly shown that it is very unlikely that these gamma-rays can be explained by this radio jet.

Primary author: SALVATORE, Silvia

Presenter: SALVATORE, Silvia

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **23** Type: **not specified**

The LHAASO PeVatron bright sky: what we learned

Tuesday, September 12, 2023 3:15 PM (15 minutes)

The recent detection of 12 gamma-ray Galactic sources well above $E > 100$ TeV by the LHAASO observatory has been a breakthrough in the context of Cosmic Ray (CR) origin search.
Although most of these sources are unidentified, they are often spatially correlated with leptonic accelerators, like pulsar and pulsar wind nebulae (PWNe). This dramatically affects the paradigm for which a gamma-ray detection at $E > 100$ TeV implies the presence of a hadronic accelerator of PeV particles (PeVatron). Moreover, the LHAASO results supports the idea that sources other than the standard candidates, Supernova Remnants, can accelerate Galactic CRs.
In this context, the good angular resolution of future Cherenkov telescopes, such as the ASTRI Mini-Array and CTA, and the higher sensitivity of future neutrino detectors, such as KM3NeT and IceCube-Gen2, will be of crucial importance.
In this brief review, we want to summarize the efforts done up to now, from both theoretical and experimental point of views, in order to fully understand the LHAASO results in the context of the CR acceleration issue.

Primary author: Dr CARDILLO, MARTINA (IAPS-INAF)

Co-author: GIULIANI, Andrea (INAF / IASF Milano)

Presenter: Dr CARDILLO, MARTINA (IAPS-INAF)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **24** Type: **not specified**

The search for dark matter in DarkSide

Wednesday, September 13, 2023 3:00 PM (15 minutes)

DarkSide run since mid 2015 a 50-kg-active-mass dual phase Liquid Argon Time Projection Chamber (TPC), filled with low radioactivity argon from an underground source and produced world class results for both the low mass (□<20 □□□/c2) and high mass (□>100 □□□/□2) direct detection search for dark matter.
The next stage of the DarkSide program will be a new generation experiment involving a global collaboration from all the current Argon based experiments. DarkSide-20k, is designed as a 20-tonne fiducial mass dual phase Liquid Argon TPC with SiPM based cryogenic photosensors, and is expected to be free of any instrumental background for an exposure of >100 tonne x year. Like its predecessor, DarkSide-20k will be housed at the INFN Gran Sasso (LNGS) underground laboratory, and it is expected to attain a WIMP-nucleon cross section exclusion sensitivity of 7.4×10−48 cm2 for a WIMP mass of 1□□□/□2 in a 200 t yr run. DarkSide-20k will be installed inside a membrane cryostat containing more than 700 t of liquid Argon and be surrounded by an active neutron veto based on a Gd-loaded acrylic shell. The talk will give the latest updates about the ongoing prototype tests validating the design, the progress of construction and the future plans.

Primary author: DAVINI, Stefano (Istituto Nazionale di Fisica Nucleare)

Co-author: MATTEUCCI, Giuseppe (Istituto Nazionale di Fisica Nucleare)

Presenter: MATTEUCCI, Giuseppe (Istituto Nazionale di Fisica Nucleare)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **27** Type: **not specified**

Asymmetries in Extended Dark Sectors: A Cogenesis Scenario

Thursday, September 14, 2023 3:00 PM (20 minutes)

The observed dark matter relic abundance may be explained by different mechanisms, such as thermal freeze-out/freeze-in, with one or more symmetric/asymmetric components. In this work we investigate the role played by asymmetries in determining the yield and nature of dark matter in non-minimal scenarios with more than one dark matter particle. In particular, we show that the energy density of a particle may come from an asymmetry, even if the particle is asymptotically symmetric by nature. To illustrate the different effects of asymmetries, we adopt a model with two dark matter components. We embed it in a multi-component cogenesis scenario that is also able to reproduce neutrino masses and the baryon asymmetry. In some cases, the model predicts an interesting monochromatic neutrino line that may be searched for at neutrino telescopes.

Primary authors: VATSYAYAN, Drona (Universidad de Valencia - IFIC); Mr HERRERO-GARCÌA, Juan (IFIC and Universidad de Valencia); LANDINI, giacomo (IFIC and Universidad de Valencia)

Presenter: LANDINI, giacomo (IFIC and Universidad de Valencia)

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **28** Type: **not specified**

Ultrafast variability in AGN jets: intermittency and lighthouse effect

Tuesday, September 12, 2023 6:00 PM (15 minutes)

Gamma-ray flares from Active Galactic Nuclei (AGN) show substantial variability on ultrafast timescales (i.e. shorter than the light crossing time of the AGN's supermassive black hole). I will show that ultrafast variability is a byproduct of the turbulent dissipation of the jet Poynting flux. Due to the intermittency of the turbulent cascade, the dissipation is concentrated in a set of reconnecting current sheets. Electrons energised by reconnection have a strong pitch angle anisotropy, i.e. their velocity is nearly aligned with the guide magnetic field. Then each current sheet produces a narrow radiation beam, which dominates the emission from the whole jet when it is directed towards the observer. The ultrafast variability is set by the light crossing time of a single current sheet, which is much shorter than the light crossing time of the whole emission region. The predictions of this model are: (i) The bolometric luminosity of ultrafast AGN flares is dominated by the inverse Compton (IC) emission, as the lower energy synchrotron emission is suppressed due to the pitch angle anisotropy. (ii) If the observed luminosity includes a non-flaring component, the variations of the synchrotron luminosity have a small amplitude. (iii) The synchrotron and IC emission are less variable at lower frequencies, as the cooling time of the radiating particles exceeds the light crossing time of the current sheet. Simultaneous multiwavelength observations of ultrafast AGN flares can test these predictions.

Primary author: SOBACCHI, Emanuele (Hebrew University of Jerusalem)

Presenter: SOBACCHI, Emanuele (Hebrew University of Jerusalem)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **30** Type: **not specified**

Small-Scale Magnetic Fields are Critical to Shaping Solar Gamma-Ray Emission

Thursday, September 14, 2023 3:30 PM (15 minutes)

The Sun emits gamma rays ranging from several hundred MeV to 1 TeV through hadronic cosmic ray interactions with the solar atmosphere. A critical factor influencing this phenomenon is the reflection of cosmic rays by solar magnetic fields in the photosphere and the upper convection zone. In this talk, I will present a simplified solar magnetic flux tube structure that combines network elements and granular sheets, which serve as sites for gamma-ray emissions from hadronic cosmic-ray showers. Our findings reveal a gamma-ray spectrum, including the spectral index and overall magnitude, that aligns well with Fermi-LAT data at 1-200 GeV and HAWC at 1 TeV. I propose that solar gamma-ray observations offer a novel means to probe small-scale magnetic fields in the quiet Sun.

Primary author: LI, Jung-Tsung (Ohio State University)

Presenter: LI, Jung-Tsung (Ohio State University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **31** Type: **not specified**

Dark matter minihalos from primordial magnetic fields

Tuesday, September 12, 2023 2:40 PM (20 minutes)

Primordial magnetic fields (PMFs) can enhance baryon perturbations on scales below the photon mean free path. However, a magnetically driven baryon fluid becomes turbulent near recombination, thereby damping out baryon perturbations below the turbulence scale. In this letter, we show that the growth of baryon perturbations is gravitationally imprinted in the dark matter perturbations, which are unaffected by turbulence and eventually collapse to form $10^{-11} - 10^{3}\ M_{\odot}$ dark matter minihalos. In the process, we analytically derive the evolution of the PMF power spectrum in the viscous drag regime. If the magnetic fields purportedly detected in the blazar observations are PMFs generated after inflation and have a Batchelor spectrum, then such PMFs should also produce minihalos.

Primary author: RALEGANKAR, Pranjal (SISSA)

Presenter: RALEGANKAR, Pranjal (SISSA)

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **32** Type: **not specified**

The Light Dark Matter eXperiment, LDMX

Thursday, September 14, 2023 9:20 AM (20 minutes)

The constituents of dark matter (DM) are still unknown, and the viable possibilities span a very large mass range. Specific scenarios for the origin of dark matter sharpen the focus on a narrower range of masses: the natural scenario where dark matter originates from thermal contact with familiar matter in the early Universe requires the DM mass to lie within about an MeV to 100 TeV. Considerable experimental attention has been given to exploring Weakly Interacting Massive Particles in the upper end of this range (few GeV –~TeV), while the region ~MeV to ~GeV is largely unexplored. Most of the stable constituents of known matter have masses in this lower range, tantalizing hints for physics beyond the Standard Model have been found here, and a thermal origin for dark matter works in a simple and predictive manner in this mass range as well. It is therefore a priority to explore. If there is an interaction between light DM and ordinary matter, as there must be in the case of a thermal origin, then there necessarily is a production mechanism in accelerator-based experiments. The most sensitive way (if the interaction is not electron-phobic) to search for this production is to use a primary electron beam to produce DM in fixed-target collisions. The Light Dark Matter eXperiment (LDMX) is a planned electron-beam fixed-target missing-momentum experiment that has unique sensitivity to light DM in the sub-GeV range. This contribution will give an overview of the theoretical motivation, the main experimental challenges and how they are addressed, as well as projected sensitivities in comparison to other experiments.

Primary author: BRYNGEMARK, Lene Kristian (Lund University)

Presenter: BRYNGEMARK, Lene Kristian (Lund University)

Session Classification: Plenary

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **33** Type: **not specified**

Insights into the high-energy emission of archetypical TeV blazars from the first combined X-ray polarization and VHE measurements

Wednesday, September 13, 2023 3:15 PM (15 minutes)

Blazars are among the most intensively studied sources in high-energy astrophysics. Nevertheless, the exact acceleration processes of high-energy particles and emission mechanisms remain unclear. The recently launched IXPE satellite allows for the first time the measurement of polarisation in the X-ray band, hence opening a new window to the cosmos. The two TeV archetypical blazars Mrk421 and Mrk501 are ideal targets to probe the physics of blazar jets thanks to their brightness and proximity. In the conference, we will report novel insights resulting from the first study using a combined X-ray/TeV dataset with X-ray polarization from IXPE. The data was obtained through two extensive multi-wavelength campaigns simultaneous to the first observations of Mrk421 and Mrk501 by IXPE from March to July 2022. We investigate the energy range from radio up to very high energy (VHE; E>100GeV) gamma rays reaching multi-TeV energies, as measured with the MAGIC telescopes. We find Mrk421 in a variety of emission states, allowing us to correlate different polarisation signatures with the spectral and flux evolution observed at VHE and X-rays. Additional multi-hour NuSTAR observations of Mrk421 simultaneous to IXPE show significant intra-night variability and reveal insights about particle acceleration and cooling processes. For Mrk 501, we find clear evidence for an extreme emission state in March 2022 with a synchrotron component peaking above 1 keV. While the X-ray emission is harder and brighter than usual, the VHE data reveals a far lower inverse-Compton dominance than usual.

Primary author: SCHMUCKERMAIER, Felix (Max-Planck-Institute for Physics)

Co-authors: ARBET-ENGELS, Axel; PANEQUE, David; LIODAKIS, Ioannis; HECKMANN, Lea

Presenter: SCHMUCKERMAIER, Felix (Max-Planck-Institute for Physics)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **34** Type: **not specified**

Fuzzy dark matter confronts rotation curves of nearby dwarf irregular galaxies

Tuesday, September 12, 2023 11:50 AM (15 minutes)

The Fuzzy Dark Matter (FDM) model predicts that dark matter is composed of ultralight scalar field particles which possess macroscopic de Broglie wavelengths in the kpc scale. The wave behaviour of FDM erases structure formation on small scales and leads to the formation of galactic cores or solitons. This has been a subject of great interest in addressing challenges of the ΛCDM model, where simulations have been found to overpredict the number of observed satellite galaxies and generically predict cuspy density profiles, in tension with observations. We test FDM against a set of high-quality rotation curves from a robust sample of nearby isolated dwarf galaxies in the LITTLE THINGS survey, probing whether it can resolve these issues. We also examine the effects of baryonic physics and test against a number of astrophysical scaling relations predicted by the model, as well as the stellar-to-halo and concentration mass relations. We find that fits of cored density profiles show close agreement with the rotation-curve data, but that the particle masses needed to form those cores lead to a much too strong suppression in halo formation to account for observations and are in tension with an independent lower bound on the particle mass. Lastly, we find that that the scaling relations predicted by the model are significantly disfavoured by the data. Our conclusion is that the cores observed in this sample of dwarf galaxies are not consistent with the standard solitons predicted by FDM.

Primary authors: BAÑARES HERNÁNDEZ, Andrés (Instituto de Astrofísica de Canarias, Universidad de La Laguna); Dr CASTILLO, Andrés (Instituto de Astrofísica de Canarias, Universidad de La Laguna); IORIO, Giuliano (Istituto Nazionale di Fisica Nucleare); Dr MARTIN CAMALICH, Jorge (Instituto de Astrofísica de Canarias, Universidad de La Laguna)

Presenter: BAÑARES HERNÁNDEZ, Andrés (Instituto de Astrofísica de Canarias, Universidad de La Laguna)

Session Classification: Plenary

Track Classification: Cosmology

Contribution ID: **35** Type: **not specified**

X-rays constraints on sub-GeV Dark Matter

Monday, September 11, 2023 5:15 PM (15 minutes)

In this talk, I will present updated constraints on 'light' dark matter (DM) particles with masses between 1 MeV and 5 GeV. In this range, we can expect DM-produced $e^{\pm}$ pairs to upscatter ambient photons in the Milky Way via Inverse Compton, and produce a flux of X-rays that can be probed by a range of space observatories. Using diffuse X-ray data from XMM-Newton, INTEGRAL, NuSTAR and Suzaku, we compute the strongest constraints to date on annihilating DM for 200 MeV < m_{DM} < 5 GeV and decaying DM for 100 MeV < m_{DM} < 5 GeV. I will also discuss possible future developments of these results and this technique.

Primary author: KOECHLER, Jordan (LPTHE - Sorbonne Université)

Presenter: KOECHLER, Jordan (LPTHE - Sorbonne Université)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **36** Type: **not specified**

3-year low-state at very high energies of the blazar 1ES1959+650: the broadband SED analysis

Wednesday, September 13, 2023 2:45 PM (15 minutes)

The Spectral Energy Distribution (SED) of blazars consists of two components. The low-energy emission, extending from radio to X-rays, is interpreted as synchrotron radiation from accelerated electrons, while the high-energy radiation, which can reach TeV energies, is produced via inverse Compton scattering of the electrons by lower-frequency photons. The latter can come either from the synchrotron radiation produced by the same population of electrons (Synchrotron Self Compton - SSC - scenario) or from an external photon field. These are called leptonic models. According to hadronic models instead, cosmic ray protons in the jet interact with an (internal or external to the jet) photon field to produce the high-energy peak in the blazar SED.
The investigation of blazar SED plays then a crucial role to determine which of the theoretical models can explain the observed SED and infer the parameters that drive the microphysics of the system. The SED modeling over time allows us to also study the processes during different states of the source. In this context, multiwavelength long-term monitoring programs of blazars are key to successfully adress the basic, fundamental question of the production and emission mechanisms at work around these sources. The blazar 1ES1959+650 represents an ideal laboratory to perform that. It is bright in all the bands of the electromagnetic spectrum and is located at low redshift (z = 0.047) allowing its detection at TeV wavelengths. In addition, some flaring activities from this source have been reported in the past. A long-term multiwavelength (MWL) monitoring of 1ES1959+650 is currently ongoing under the coordination of the MAGIC collaboration. During the last few years, the source is experiencing its lowest state ever reached, mainly at very high energies. This contribution will illustrate the study of the SED, during the last three years of observations of the source. An SSC interpretation of the data will be presented.

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Co-authors: Dr CORNELIA, Arcaro (INFN Sezione di Padova and Università degli Studi di Padova, Via Marzolo 8, 35131 Padova, Italy); Dr ARBET-ENGELS, Axel (Max-Planck-Institut für Physik, 80805 München, Germany); Dr NIGRO, Cosimo (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology, Campus UAB, Bellaterra, 08193 Barcelona, Spain); Dr DORNER, Daniela (Universität Würzburg, Lehrstuhl für Astronomie, Campus Hubland Nord, Emil-Fischer-Straße 31, 97074 Würzburg, Germany); Dr D'AMMANDO, Filippo (INAF - Istituto di Radioastronomia, Via P. Gobetti 101, I-40129 Bologna, Italy); Dr NIEVAS ROSILLO, Mireia (Instituto de Astrofísica de Canarias and Dpto. de Astrofísica, Uni- versidad de La Laguna, 38200 La Laguna, Tenerife, Spain); Dr ZANIN, Roberta (CTA observatory, Via Piero Gobetti 93/3 40129 Bologna, Italy); Dr SAKURAI, Shunsuke (Institute for Cosmic Ray Research (ICRR), The University of Tokyo, Kashiwa, 277-8582 Chiba, Japan)

Presenter: NANCI, Cristina (University of Bologna / INAF-IRA)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **37** Type: **not specified**

Inelastic Dark Matter Through The Ages

Thursday, September 14, 2023 12:16 PM (13 minutes)

The microphysics of Dark Matter (DM) remains an open question in high energy physics and cosmology. Given the diversity of particles in the Standard Model (SM), it is plausible that DM is also composed of more than one type of particle organized in a "dark sector". In case of inelastic or pseudo-Dirac DM, the dark sector consists of two nearly mass-degenerate states. These can participate in exothermic or endothermic reactions, and hence result in novel signatures at cosmological, astrophysical and terrestrial scales.

In this talk, I will use a minimal inelastic DM model to explore its possible (non)-thermal histories and how they map on to observables. In particular, I will investigate the imprints that such a dark sector leaves throughout the history of the universe —in the abundance of light elements, in the cosmic microwave background and in small scale structure—as well as discuss the complementarity between these and terrestrial experiments.

Primary authors: Prof. SCHUTZ, Katelin (McGill University); HEEBA, Saniya (McGill University); Prof. LIN, Tongyan (University of California, San Diego)

Presenter: HEEBA, Saniya (McGill University)

Session Classification: Plenary

Track Classification: Cosmology

Contribution ID: **38** Type: **not specified**

White dwarf cooling through dark sector physics

Monday, September 11, 2023 6:15 PM (15 minutes)

Hot white dwarfs lose energy mainly in the form of neutrinos through plasmon decay from the inner part of the star. Dark sectors, which are being studied to explain a broad collection of anomalies and unknown physics, do have an impact in the energy lost by this mechanism. I will focus on a Three Portal model that connects dark sectors to the Standard Model through a dark scalar (Higgs), a dark photon and dark neutrino states. The aim is to study the impact of the dark photon in the cooling mechanism of a white dwarf.

Primary authors: HOEFKEN ZINK, Jaime (Istituto Nazionale di Fisica Nucleare); Dr RAMIREZ-QUEZADA, Maura (University of Tokyo)

Presenter: HOEFKEN ZINK, Jaime (Istituto Nazionale di Fisica Nucleare)

Session Classification: IDM: Indirect DM searches

Track Classification: Neutrinos

Contribution ID: **41** Type: **not specified**

Precision Measurement of Cosmic Ray Deuterons with Alpha Magnetic Spectrometer

Monday, September 11, 2023 2:50 PM (10 minutes)

Deuterons are the most abundant secondary nuclei in cosmic rays and precise measurement of their properties will allow to test and constrain various cosmic ray propagation models.
The precision measurement of deuteron flux with kinetic energy per nucleon from 0.2 GeV/n to 9 GeV/n based on 15 million deuterons collected by Alpha Magnetic Spectrometer during the first 10 years of operation on the International Space Station is presented. The deuteron-to-proton and deuteron-to-4helium flux ratios are also shown, together with their time evolution over an almost complete solar cycle.

Primary authors: DIMICCOLI, Francesco (Istituto Nazionale di Fisica Nucleare); Dr ZUCCON, Paolo (TIFPA)

Presenter: DIMICCOLI, Francesco (Istituto Nazionale di Fisica Nucleare)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **42** Type: **not specified**

Probing Dark Matter-Proton Interactions with Cosmic Reservoirs

Monday, September 11, 2023 3:45 PM (15 minutes)

Dark Matter (DM) existence is a milestone of the cosmological standard model and, yet, its discovery still remains a complete conundrum. In this contribution, we investigate a unique and original way to probe properties of light-particle dark matter candidates, exploiting the nature of the cosmic-ray (CR) transport inside starburst nuclei (SBNs). Indeed, SBNs are considered CR reservoirs, trapping them for ~10^5 years up to ~ PeVs energies, leading to copious production of gamma-rays and neutrinos. As a result, interactions between DM and protons might indelibly change CR transport in these galaxies, perturbing the gamma-rays and neutrino production. We are going to show that current gamma-ray observations pose strict limits on the elastic cross section down to σ_χp⊠10^-34 cm^-2 for DM masses m_χ≤10^-3 MeV and that they have considerable room for improvement with the future gamma-ray measurements in the 0.1-10 TeV range from the Cherenkov Telescope Array.

Primary author: AMBROSONE, Antonio (Istituto Nazionale di Fisica Nucleare)

Co-authors: MARINELLI, Antonio (Istituto Nazionale di Fisica Nucleare); FIORILLO, Damiano (Niels Bohr Institute, Copenhagen); MIELE, Gennaro (NA); Dr CHIANESE, Marco (Università degli Studi di Napoli Federico II)

Presenter: AMBROSONE, Antonio (Istituto Nazionale di Fisica Nucleare)

Session Classification: IDM: Indirect DM searches

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **43** Type: **not specified**

New physics implications of COHERENT data

Tuesday, September 12, 2023 6:00 PM (15 minutes)

The observation of coherent elastic neutrino nucleus scattering (CEvNS) has opened the window to many physics opportunities. In this talk I will discuss the implication of the observation of CEvNS by the COHERENT Collaboration using two different targets, CsI and argon, on new physics scenarios. These include, for instance, new light mediators and the possible production of a dark fermion.

Primary author: DE ROMERI, Valentina (IFIC UV/CSIC)

Presenter: DE ROMERI, Valentina (IFIC UV/CSIC)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **44** Type: **not specified**

Inflation in Palatini quadratic gravity (and beyond)

Tuesday, September 12, 2023 4:50 PM (20 minutes)

We study single-field slow-roll inflation embedded in a Palatini quadratic $F(R)$ gravity, where the Einstein–Hilbert term has the wrong sign, apparently leading to repulsive gravity. This can be avoided as long as $F'(R)$ and $F''(R)$ stay positive. Surprisingly, consistency of the theory requires the Jordan frame inflaton potential to be unbounded from below. Even more surprisingly, this corresponds to an Einstein frame inflaton potential bounded from below and positive definite. We prove that such a quadratic gravity is a universal limit for all the Palatini $F(R)$ that, for infinite curvature, diverge faster than R^2.

Primary author: Dr RACIOPPI, Antonio

Co-author: DIOGUARDI, Christian

Presenter: Dr RACIOPPI, Antonio

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **45** Type: **not specified**

A New View on Pulsar and Dark Matter Contributions to the Local Cosmic-Ray Electron and Positron Flux

Wednesday, September 13, 2023 2:15 PM (15 minutes)

High-energy cosmic-ray electrons and positrons cool rapidly as they propagate through the Galaxy, due to synchrotron interactions with magnetic fields and inverse-Compton scattering interactions with photons of the interstellar radiation field. Typically, these energy losses have been modelled as a continuous process. However, inverse-Compton scattering is a stochastic process, characterised by interactions that are rare and catastrophic. In this work, we take the stochasticity of inverse-Compton scattering into account and calculate the contributions to the local electron and positron fluxes from different sources. Compared to the continuous approximation, we find significant changes: For pulsars, that produce electron-positron pairs as they spin down, the spectrum becomes significantly smoother. For TeV-scale dark matter particles, that annihilate into electrons and positrons, the signal becomes strongly enhanced around the energy corresponding to the dark matter mass. Combined, these effects significantly improve our ability to use spectral signatures in the local electron and positron spectra to search for particle dark matter at TeV energies.

Primary author: JOHN, Isabelle (Stockholm University)

Presenter: JOHN, Isabelle (Stockholm University)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **46** Type: **not specified**

General dark matter electron interactions in graphene

Thursday, September 14, 2023 3:00 PM (15 minutes)

We employ a non-relativistic effective theory to model dark matter (DM) induced electron ejections from graphene and carbon nanotubes (CNTs), materials currently in the R&D phase for direct detection experiments. The material properties of graphene are modelled using Density Functional Theory, and we obtain observable ejection rates for arbitrary forms of scalar and spin-1/2 DM. We show how the anisotropy of graphene and CNTs cause a strong daily modulation in the rate of electron ejections, a smoking gun signal for DM. We project 3 sigma discovery potential of such a daily modulation pattern, as well as expected exclusion bounds in the case of no observed daily modulation.

Primary author: URDSHALS, Einar (Chalmers Technical University)

Presenter: URDSHALS, Einar (Chalmers Technical University)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **47** Type: **not specified**

The most conservative accretion bounds on Primordial Black Holes

Monday, September 11, 2023 4:30 PM (15 minutes)

Primordial Black Holes (PBHs) may exist and constitute a portion of the Dark Matter. Their discovery would have profound consequences on fundamental physics and possibly solve some outstanding puzzles in cosmology, such as the existence of high-redshift supermassive black holes.

Baryonic matter would be inevitably attracted towards these objects and form structures such as accretion disks, capable of emitting copious amounts of photons in a wide spectrum of energies. This consideration allowed to set upper limits on the abundance of PBHs by investigating both astronomical and cosmological data. Regarding the former, the requirement not to overshoot the number of observed X-ray sources in the Galactic Ridge region is the key to get the result. Regarding the latter, the accurate measurements of the anisotropies in the Cosmic Microwave Background provide the constraining power needed to exclude the presence of a large fraction of DM in the form of massive PBHs.

However, it is compelling to carefully assess the astrophysical uncertainties involved in these limits. Therefore, we reconsider here both the astronomical and cosmological bounds putting under the spotlight the role of the modeling of accretion physics in first place, together with the uncertainties in the PBH properties (most importantly, their velocity distribution) and the properties of the baryonic gas itself. We aim at assessing the most conservative bound in both contexts that turns out to be compatible with such large uncertainties.

Primary author: GAGGERO, Daniele (Istituto Nazionale di Fisica Nucleare)

Presenter: GAGGERO, Daniele (Istituto Nazionale di Fisica Nucleare)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **48** Type: **not specified**

Testing the Sterile Baryonic Neutrino with Direct Detection and Spallation Source Experiments

Wednesday, September 13, 2023 5:00 PM (15 minutes)

In this talk, I will explore the potential for uncovering new neutrino physics through the use of dark matter direct detection experiments and its complementarity with spallation source experiments. In particular, I will analyse the Sterile Baryonic Neutrino Model, an extension of the SM in which we add a sterile massive neutrino. I will show how the sterile neutrino can be generated through the inelastic scattering of an active neutrino with the target material of the previously mentioned experiments, giving rise to a characteristic spectrum. This might allow for a reconstruction of the neutrino mass (in the event of a positive detection), which is limited by the experiment energy threshold and resolution. Direct detection experiments, being sensitive to the solar tau neutrino flux, add extra complementary information that allows to improve the determination of the sterile neutrino couplings and its mass.

Primary authors: BARIEGO-QUINTANA, Adriana (IFT (UAM-CSIC)); ALONSO-GONZÁLEZ, David (IFT (UAM-CSIC)); CERDEÑO, David G. (Instituto de Física Teórica); AMARAL, Dorian W.P. (IPPP (Durham U.) and Rice U.); DE LOS RIOS, Martín (ICTP-SAIFR); COLOMA, Pilar (Instituto de Fisica Teorica UAM/CSIC)

Presenter: ALONSO-GONZÁLEZ, David (IFT (UAM-CSIC))

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **49** Type: **not specified**

Freeze-in: Problems and Opportunities

Wednesday, September 13, 2023 5:45 PM (15 minutes)

FIMP dark matter is produced via the freeze-in mechanism that generally implies tiny couplings between the Dark Matter (DM) and the Standard Model particles, making DM direct detection hopeless. When the interaction is non-renormalizable the coupling is automatically suppressed by the scale of new physics and the production depends strongly on the reheating temperature. A natural candidate, in this case, is a spin 3/2 DM since it only couples to the Standard Model via dimension 5 or higher operators. We notice that given the standard mass range for DM (few keV - TeV) the reheating temperature (TR) needed for this particle to be the DM is also in the GeV - TeV range. Finally, we show that when TR is comparable to the DM mass direct detection and collider bounds play a fundamental role in constraining the parameter space. We show the viability of the model and discuss the details of the production mechanism and future experiments that can falsify it.

Primary authors: COSTA, Francesco (University of Goettingen, ITP); COVI, Laura (Institute for theoretical physics)

Presenter: COSTA, Francesco (University of Goettingen, ITP)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **50** Type: **not specified**

Search for Dark Matter Annihilation from the Milky Way Dwarf Spheroidal Galaxies with Fermi-LAT

Monday, September 11, 2023 2:15 PM (15 minutes)

The Milky Way (MW) dwarf spheroidal satellite galaxies (dSphs) are particularly intriguing targets to search for gamma rays from dark matter (DM) annihilation or decay. They are nearby, DM-dominated, and lack significant emission from standard astrophysical processes. Previous studies using the Fermi Large Area Telescope (LAT) of DM-induced emission from dSphs provide some of the most stringent constraints on DM properties, such as the annihilation cross section and mass. However, there are now several additional years of gamma-ray data since the most recent dwarf DM analysis from the Fermi-LAT Collaboration, as well as an improved census of Milky Way satellites thanks to data from large-scale optical surveys, offering an excellent opportunity for an updated dwarf DM analysis. I will discuss in this presentation the updated DM analysis of the Milky Way dSphs and our preliminary results.

Primary author: MCDANIEL, Alex (Clemson University)

Presenter: MCDANIEL, Alex (Clemson University)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **51** Type: **not specified**

Detection of UHE emission from Binary system with LHAASO

Thursday, September 14, 2023 2:45 PM (15 minutes)

The binary system is an idea astrophysical laboratory to test physical laws at very extreme environment. With the improvement of sensitivity for gamma ray telescopes, gamma ray signals from high mass binary systems have also been detected. However, the detection of gamma rays from binary system is difficult due to the low flux and instability of signal, and the mechanism for emission is under debate. LHAASO is a multi-purpose detector working at ultra-high energy range. It can also operate at almost full duty-cycle and has a wide field of view, which is suitable for binary detection. With the operation of LHAASO, there are hints for UHE emission from binary systems, which may open a new window to get knowledge of these systems. This report will give a introduction for binary detection with LHAASO.

Primary author: LI, Cong

Presenter: LI, Cong

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **52** Type: **not specified**

Detection of sub-GeV Dark Matter using Superfluid Helium-3 with the QUEST-DMC Detector

Thursday, September 14, 2023 3:15 PM (15 minutes)

To date, the majority of experimental dark matter searches have been focused on the on the Weakly Interacting Massive Particle (WIMP) in the 100-1000 GeV/c^2 mass range, which would be a natural extension to the Standard Model. However, there are well-motivated theoretical models which postulate that the properties and interactions of dark matter in the early universe generated the abundance of matter over anti-matter that we observe. These models naturally predict dark matter candidates in the sub-GeV mass range. The QUEST-DMC experiment aims to use superfluid He-3 instrumented with quantum sensors to probe this remarkably less studied parameter space.

The experiment is comprised of a superfluid He-3 target operated at sub-100 microKelvin temperatures, contained in small cubic cells that are instrumented with nanomechanical resonators, which are read out by SQUIDs. Superfluid He-3 is an ideal target medium for sub-GeV dark matter searches, in particular spin-dependent interactions. The small superfluid energy gap for quasiparticle excitations, 1E-7 eV, makes the system an extremely sensitive bolometer. Combined with a very low noise readout strategy, QUEST-DMC has the potential to reach ultra-low energy thresholds, below the eV scale. Here, we will present work on understanding and optimising the experiment's sensitivity, including background assay results and GEANT4 simulations, modelling of the detector response, and readout noise. The resulting projected sensitivity of QUEST-DMC will be presented. In addition, we will show recent development of the key enabling technologies, in nanowire fabrication, bolometric measurements, and in quantum sensor readout.

Primary author: KEMP, Ashlea (Royal Holloway, University of London)

Presenter: KEMP, Ashlea (Royal Holloway, University of London)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **53** Type: **not specified**

Mineral Detection of Dark Matter

Thursday, September 14, 2023 3:30 PM (15 minutes)

Minerals are solid state nuclear track detectors - nuclear recoils in a mineral leave latent damage to the crystal structure. Depending on the mineral and its temperature, the damage features are retained in the material from minutes to timescales much larger than the age of the Solar System. The damage features from the fission fragments left by spontaneous fission of heavy unstable isotopes have long been used for fission track dating of geological samples. Laboratory studies have demonstrated the readout of defects caused by nuclear recoils with energies as small as ~1 keV. Using natural minerals, one could use the damage features accumulated over geological timescales to measure astrophysical neutrino fluxes (from the Sun, supernovae, or cosmic rays interacting with the atmosphere) as well as search for Dark Matter. Research groups in Europe, Asia, and America have started developing microscopy techniques to read out the nanoscale damage features in crystals left by keV nuclear recoils. The research program towards the realization of such mineral detectors is highly interdisciplinary, combining geoscience, material science, applied and fundamental physics with techniques from quantum information and Artificial Intelligence. In this talk, I will highlight the scientific potential of Dark Matter searches with mineral detectors and briefly describe status and plans of the Mineral Detection of Neutrinos and Dark Matter (MDvDM) community.

Primary author: STENGEL, Patrick (Istituto Nazionale di Fisica Nucleare)

Presenter: STENGEL, Patrick (Istituto Nazionale di Fisica Nucleare)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **54** Type: **not specified**

The Status of the Galactic Center Gamma-Ray Excess

Thursday, September 14, 2023 4:30 PM (15 minutes)

The Galactic Center Gamma-Ray Excess has a spectrum, angular distribution, and overall intensity that agree remarkably well with that expected from annihilating dark matter particles in the form of a ~50 GeV thermal relic. Previous claims that these photons are clustered on small angular scales or trace the distribution of known stellar populations once appeared to favor interpretations in which this signal originates from a large population of unresolved millisecond pulsars. More recent work, however, has overturned these conclusions, finding that the observed gamma-ray excess does not contain discernible small scale power, and is distributed with approximate spherical symmetry, not tracing any known stellar populations. In light of these results, it now appears significantly more likely that the Galactic Center Gamma-Ray Excess is produced by annihilating dark matter.

Primary author: HOOPER, Dan (Fermilab/University of Chicago)

Presenter: HOOPER, Dan (Fermilab/University of Chicago)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **55** Type: **not specified**

LHAASO measurements on very-high-energy gamma-ray emissions from the Sun

Thursday, September 14, 2023 3:00 PM (15 minutes)

A robust spectrum of gamma-ray emissions from solar disk reaches up to 200 GeV with no cut-off has been reported with Fermi-LAT. Recent results from HAWC also extended the energy up to 1 TeV. Many startling mysteries and open questions have shown up along with the unknown mechanism to understand its spectrum, time variability, and morphology. Any significant observation signals or a strong upper limit at high-energy range would provide valuable information on gamma-ray production from the Sun.
The Large High Altitude Air Shower Observatory (LHAASO) is a ground-based multi-targets observatory, located in Daocheng, Sichuan province, southwest China. The sub array in LHAASO, Water Cherenkov detector array (WCDA) and electromagnetic-muon particle detector array (KM2A), are dedicated for observing gamma-ray emissions from sub-TeV to hundreds TeV.
In this work, we report the excess gamma-ray event from the Sun with LHAASO-WCDA. A significant detection with statistical significance above 5 sigma was obtained at sub TeV. Physical implications of gamma-ray emission from the Sun will also discussed.

Primary author: LI, Zhe (Institute of High Energh Physics)

Presenter: LI, Zhe (Institute of High Energh Physics)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **56** Type: **not specified**

Neutrino Portal to FIMP Dark Matter with an Early Matter Era

Tuesday, September 12, 2023 4:30 PM (20 minutes)

In this talk, I will discuss the freeze-in production of Feebly Interacting Massive Particle (FIMP) dark matter candidates through a neutrino portal, in the case where an early matter-dominated era took place for some period between inflation and Big Bang Nucleosynthesis. In this model, we consider a hidden sector comprised of a fermion and a complex scalar, with the lightest one regarded as a FIMP candidate, and three heavy neutrinos, responsible for mediating the interactions between the Standard Model and the dark matter sectors and for generating the masses of the Standard Model neutrinos. I will present the dynamics of the dark matter candidate throughout the modified cosmic history, evaluate the relevant constraints of the model, and discuss the consequences of the duration of the early matter-dominated era for dark matter production. Finally, I will show that, under some circumstances, this scenario becomes testable through indirect detection searches.

Primary authors: COSME, Catarina (U. Coimbra); YANG, Litao; DUTRA, Maíra; MA, Teng; WU, Yongcheng

Presenter: COSME, Catarina (U. Coimbra)

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **57** Type: **not specified**

New Physics through a Multimessenger Lens: Searching for Axion-like Particles from Transient Astrophysical Events

Tuesday, September 12, 2023 3:30 PM (15 minutes)

Axion-like particles (ALPs) are a well-motivated candidate for constituting a significant fraction of dark matter in the Universe. They are produced in high-energy environments of core-collapse supernovae (CCSNe) or binary neutron star (BNS) mergers via Primakoff process. As they enter the Milky Way's magnetic field, ALPs could undergo conversion into gamma rays, resulting in a characteristic spectrum peaking in the MeV energy range. As CCSNe and BNS mergers are progenitors of gamma-ray bursts (GRBs), studying the gamma-ray spectra of GRBs can be used as a probe of the physical properties of ALPs.
Here, we present the results from ALP searches using the *Fermi* Large Area Telescope (LAT) observations of long-duration GRBs using both the standard and LAT's Low Energy (LLE) technique. Using the LLE technique, we report the *Fermi* sensitivity limits to detect ALPs to distances up to ~10 Mpc, which is comparable to the standard LAT analysis results. We also share the preliminary constraints on the ALP-photon coupling using the LAT-detected long-duration GRBs with precursors. Furthermore, we offer an overview and motivation for utilizing the already-in-place multimessenger infrastructure for future ALP searches from BNS mergers and short-duration GRBs. Finally, we introduce new venues for exploring new physics guided by the current and future multimessenger efforts, which will allow us to establish competitive upper limits on the ALP parameter space.

Primary author: CRNOGORCEVIC, Milena (University of Maryland and Stockholm University/OKC)

Presenter: CRNOGORCEVIC, Milena (University of Maryland and Stockholm University/OKC)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **59** Type: **not specified**

High-Energy Neutrino and Gamma Ray Production in Clusters of Galaxies

Thursday, September 14, 2023 2:15 PM (15 minutes)

We estimated the contribution from clusters of galaxies to the diffuse neutrino and $\gamma-$ray background. Due to their unique magnetic-field configuration, CRs with energy $\leq 10^{17}$ eV can be confined within these structures over cosmological time scales, and generate secondary particles, including neutrinos and gamma-rays, through interactions with the background gas and photons. We used 3D-MHD simulations of galaxy formation to model the turbulent intergalactic and intracluster media. We propagate CRs in these environments using multi-dimensional Monte Carlo simulations across redshifts (from $z \sim 5$ to $z = 0$), considering all relevant photohadronic, photonuclear, and hadronuclear interactions. We find that for CRs injected with a spectral index $1.5 - 2.7$ and cutoff energy $E_{\rm max} = 10^{16} - 10^{17}$~eV, clusters contribute to a substantial fraction to the diffuse fluxes observed by the IceCube and Fermi-LAT, and most of the contribution comes from clusters with $M > 10^{14}\, M_{\odot}$ and redshift $z < 0.3$. We also estimated the contribution from Perseud-like clusters within a distance of about 75 Mpc.

Primary author: HUSSAIN, Saqib (GSSI, Istituto Nazionale di Fisica Nucleare)

Co-authors: Prof. DE GOUVEIA DAL PINO, Elisabete M. (Institute of Astronomy, Geophysics and Atmospheric Sciences (IAG), University of S\~ao Paulo (USP), R. do Matão, 1226, 05508-090, S\~ao Paulo, Brazil.); Prof. PAGLIAROLI, Giulia (GSSI, INFN-LNGS); Dr ALVES BATISTA, Rafael (Instituto de F\'isica Te\'orica UAM-CSIC, C/ Nicol\'as Cabrera 13-15, 28049 Madrid, Spain.)

Presenters: Prof. PAGLIAROLI, Giulia (GSSI, INFN-LNGS); Dr ALVES BATISTA, Rafael (Instituto de F\'isica Te\'orica UAM-CSIC, C/ Nicol\'as Cabrera 13-15, 28049 Madrid, Spain.); HUSSAIN, Saqib (GSSI, Istituto Nazionale di Fisica Nucleare)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **60** Type: **not specified**

TeV Gamma-Ray Afterglow in Shallow Decay Phases of GRBs

Tuesday, September 12, 2023 5:15 PM (15 minutes)

In gamma-ray bursts, X-ray afterglows frequently show a shallow decaying emission in their first few thousand seconds. Possible models for the shallow decay phase are continuous energy injection, late catch-up of lately launched ejecta, the evolution of microscopic parameters, thin wind profile of the circumstellar medium, and so on. Depending on the models, the TeV emission of the early afterglow will show different behaviors. We show model calculations of multi-wavelength lightcurves based on our time-dependent simulation code. The detection of early TeV afterglows will provide a clue to distinguishing the models of the shallow decay phase.

Primary author: ASANO, Katsuaki (Institute for Cosmic Ray Research, The University of Tokyo)

Presenter: ASANO, Katsuaki (Institute for Cosmic Ray Research, The University of Tokyo)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **62** Type: **not specified**

Multi-wavelength Emission from Jets and Magnetically Arrested Disks in Radio Galaxies

Wednesday, September 13, 2023 4:30 PM (15 minutes)

The emission mechanisms and regions of multi-wavelength photons from radio galaxies are unknown. The emission from Magnetically Arrested Disks (MADs) with strong magnetic fields at the center of radio galaxies can explain the high-energy gamma-ray data, but the MAD model cannot explain the observational X-ray data. One possible scenario to explain radio to X-ray data is the emission from jets. We construct the model of multi-wavelength emission from the jets and the MADs using the particle injection model based on magnetic reconnection in the black hole magnetosphere. We apply the hybrid model to M87 and compare it with the observed data. High magnetization parameter in the jets is required to explain the multi-wavelength observational data. Due to the high magnetization parameter, the synchrotron self-Compton in the jets does not contribute to the observational high-energy gamma-ray data. In this case, the magnetic field in the jets is consistent with the estimated value from the radio core shift observation.

Primary author: KUZE, Riku (Tohoku University)

Co-authors: Dr KIMURA, Shigeo (Tohoku University); Dr TOMA, Kenji (Tohoku University)

Presenter: KUZE, Riku (Tohoku University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **63** Type: **not specified**

Updated constraints from cosmic-ray upscattering of GeV-scale dark matter

Wednesday, September 13, 2023 5:15 PM (15 minutes)

Dark matter particles with sub-GeV masses can be notoriously difficult to probe, because their typical momenta are insufficient to induce nuclear recoils above the thresholds of conventional direct detection experiments. In fact, it has repeatedly been claimed that even very strongly interacting dark matter could hide in this mass range, supposedly evading all observational bounds. In this talk I present updated constraints resulting from the irreducible component of relativistic halo dark matter, due to cosmic rays continuously upscattering initially non-relativistic dark matter particles. I will demonstrate the importance of accurately modelling the momentum-transfer dependence of the scattering cross section in deriving such constraints, as well as the impact of inelastic scattering events of dark matter particles on their way through atmosphere and soil to the detector location. With all these effects taken properly into account, it turns out that the effect of cosmic-ray upscattering robustly closes a significant part of otherwise unconstrained parameter space for dark matter at the GeV scale.

Primary author: BRINGMANN, Torsten (University of Oslo)

Presenter: BRINGMANN, Torsten (University of Oslo)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **64** Type: **not specified**

The LEGEND Experiment for Neutrinoless Double Beta Decay

Tuesday, September 12, 2023 5:45 PM (15 minutes)

Elucidating the Majorana-Dirac nature of the neutrino remains a long-standing question, a discovery of which would provide unique and powerful insight into the building blocks of our Universe. The LEGEND (Large Enriched Germanium Experiment for Neutrinoless double beta Decay) experiment is designed to answer this very question. Using a large array of high-purity germanium (HPGe) detectors enriched in the candidate isotope of Ge-76, LEGEND will search for neutrinoless double beta decay in a phased approach. These detectors are operated in a bath of LAr, from which scintillation light is detected via optical fibers connected to Si photomultipliers (SiPMs) to veto external backgrounds. The first phase is LEGEND-200, which is currently taking data and uses up to 200 kg HPGe detectors at LNGS in the existing GERDA cryostat. The next phase is the next-generation LEGEND-1000, which will employ 1000 kg of HPGe detectors in a quasi-background free environment, thanks to excellent radiopurity of components, high energy resolution of the HPGe detectors, and the utilization of underground-sourced LAr. The experiment will run at a to-be-determined underground facility, where we expect to have less than one background count in the neutrinoless double beta decay region-of-interest and to lead to an unambiguous discovery in the case of the inverted hierarchy of neutrino masses. In this talk, I will discuss the underlying principles of the LEGEND experiment, the current status of LEGEND-200, and the prospects of LEGEND-1000.

This work is supported by the U.S. DOE and the NSF, the LANL, ORNL and LBNL LDRD programs; the European ERC and Horizon programs; the German DFG, BMBF, and MPG; the Italian INFN; the Polish NCN and MNiSW; the Czech MEYS; the Slovak SRDA; the Swiss SNF; the UK STFC; the Russian RFBR; the Canadian NSERC and CFI; the LNGS, SNOLAB, and SURF facilities.

Primary author: WATKINS, Samuel (Los Alamos National Laboratory)

Presenter: WATKINS, Samuel (Los Alamos National Laboratory)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **65** Type: **not specified**

Progress report of the ALPACA experiment

Thursday, September 14, 2023 5:15 PM (15 minutes)

We started a new air shower observation experiment, ALPACA, to observe cosmic gamma rays and cosmic rays of several TeV or more from the southern sky of the galaxy.
The ALPACA's location is at an altitude of 4,740 m on the hillside in Chacaltaya, Bolivia,
The ALPACA consists of a ground-based air shower detector array of 401 scintillation detectors and a large-area water Cherenkov-type underground muon detector array.
For a prototype experiment of the ALPACA, the ALPAQUITA air shower array has been partially installed and in operation since 2022.
We will report the construction status and initial data analysis of ALPAQUITA.

Primary author: KATAYOSE, Yusaku

Presenter: KATAYOSE, Yusaku

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **66** Type: **not specified**

Detection of the young massive star cluster R136 with H.E.S.S.

Monday, September 11, 2023 5:15 PM (15 minutes)

Although supernova remnants are thought to be responsible for the bulk of the flux of cosmic rays in our Galaxy, their ability to produce the highest-energy Galactic cosmic rays is challenged by observations. Measurements of TeV gamma rays from several supernova remnants suggest cut-offs in the underlying particle spectra significantly below PeV energies. On theoretical grounds, young massive star clusters appear to possible avenues to achieving higher energies. An observational confirmation of this hypothesis is still lacking, however, and only few star clusters have been identified as cosmic-ray sources through associating them with sources of high-energy gamma rays.

In this contribution we report on the detection of very-high-energy gamma-ray emission with H.E.S.S. from the young massive star cluster R136 in the Large Magellanic Cloud. This cluster is more than twice as luminous as Westerlund 1, the most massive known young star cluster in the Milky Way. We interpret our results in the framework of the theoretical models that propose young massive star clusters as major cosmic-ray factories.

Primary author: MOHRMANN, Lars (Max Planck Institute for Nuclear Physics, Heidelberg)

Co-author: KOMIN, Nukri (Wits Centre for Astrophysics)

Presenter: MOHRMANN, Lars (Max Planck Institute for Nuclear Physics, Heidelberg)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **67** Type: **not specified**

Minimal sterile neutrino dark matter

Tuesday, September 12, 2023 3:40 PM (20 minutes)

We propose a novel mechanism to generate sterile neutrinos ν_s in the early Universe, by converting ordinary neutrinos ν_α in scattering processes $\nu_s\nu_\alpha \to \nu_s\nu_s$. After initial production by oscillations, this leads to an exponential growth in the sterile neutrino abundance. We show that such a production regime naturally occurs for self-interacting sterile neutrinos, and that this opens up significant new parameter space where sterile neutrinos make up all of the observed dark matter. Our results provide strong motivation to further push the sensitivity of X-ray line searches, and to improve on constraints from structure formation.

Primary author: DEPTA, Paul Frederik (Max-Planck-Institut für Kernphysik)

Co-authors: BRINGMANN, Torsten (University of Oslo); HUFNAGEL, Marco (Service de Physique Théorique, Université Libre de Bruxelles); KERSTEN, Jörn (University of Bergen); RUDERMAN, Joshua (New York University); SCHMIDT-HOBERG, Kai (Deutsches Elektronen-Synchrotron DESY)

Presenter: DEPTA, Paul Frederik (Max-Planck-Institut für Kernphysik)

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **68** Type: **not specified**

IceCube Starting Events For Diffuse Astrophysical Neutrino Measurements

Thursday, September 14, 2023 5:45 PM (15 minutes)

The IceCube Neutrino Observatory measures astrophysical and atmospheric neutrinos from the entire sky. The detector array measures Cherenkov light emitted when neutrinos interact in the ice and produce charged leptons. The presence of astrophysical neutrinos has been established by the High Energy Starting Events (HESE) selection. HESE measures these astrophysical neutrinos at energies above 60 TeV using a veto-based selection. At energies lower than 60 TeV this event selection is dominated by atmospheric muons and neutrinos. In this talk, we present the Medium Energy Starting Event (MESE), that utilizes additional veto techniques to further suppress atmospheric muons at lower energies for starting events. This veto of muons also helps in reducing the rate of atmospheric neutrinos that accompany these muons, especially in the Southern sky. The MESE sample uses neutrinos with energies above 1 TeV to measure the all-sky astrophysical spectrum using 11.3 years of data. The dataset includes neutrinos of all flavours from both the Southern and the Northern Hemisphere, and is therefore also used to measure the astrophysical flavour ratio of neutrinos.

Primary author: BALAGOPAL V., Aswathi

Co-author: BASU, Vedant (University of Wisconsin-Madison)

Presenter: BALAGOPAL V., Aswathi

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **69** Type: **not specified**

AGILE results and interpretation of the exceptional long gamma-ray burst GRB 221009A

Tuesday, September 12, 2023 4:45 PM (15 minutes)

High-energy gamma rays are extremely important for the interpretation of explosive cosmic events related to the formation of neutron stars and black holes. The long-duration gamma-ray burst GRB 221009A was a recent powerful event that - with its remarkable intensity, spectral features, and duration - was clearly detected also by the AGILE satellite in the MeV-GeV energy range. Through its gamma-ray detection, estimated flux and spectral energy distribution, AGILE provides crucial information regarding the early phases of GRB 221009A, during which also TeV gamma-ray emission was detected.
In this contribution, we report on the experimental measurements of GRB 221009A by the AGILE detectors. AGILE had good exposure during the GRB initial crucial phases, detecting hard X-ray/MeV emission in the prompt phase of the event, and very intense GeV gamma-ray emission in the prompt and early afterglow phase, up to 10'000 s. These data suggest that GRB 221009A belongs to a class of GRBs showing the dramatic transition between prompt and afterglow emission with a phase of coexistence of MeV and GeV emissions of very different spectral properties.
AGILE results, together with the all available multiwavelength information, lead us to discuss a theoretical interpretation of this event in terms of a relativistic fireball model.

Primary author: FOFFANO, Luca (INAF)

Presenter: FOFFANO, Luca (INAF)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **70** Type: **not specified**

Neutrinos from interactions between the relativistic jet and large-scale structures of BL Lac objects investigated through their gamma-ray spectrum

Monday, September 11, 2023 3:15 PM (15 minutes)

Absorption and emission lines in the optical spectrum are typically used to investigate the presence of large-scale environments in active galactic nuclei (AGNs). BL Lac objects - which are a category of AGNs with the relativistic jet pointing directly to the observer - are supposed to represent a late evolution stage of AGNs. Their large-scale structures are probably poorer of material, which is distributed with lower densities throughout the circumnuclear environment. Their accretion disk is weak and weakly reprocessed, making the non-thermal continuum of the relativistic jet dominate their optical spectrum and preventing us from identifying the thermal emission of the photon fields produced by such large-scale structures. However, these photon fields may still exist and eventually interact with the gamma rays traveling in the blazar jet via gamma-gamma pair production, producing observable effects such as absorption features in their spectral energy distribution.
Interestingly, the same photon field might also lead to the production of high-energy neutrinos, acting as targets for proton-photon interactions. In this contribution, we present the results of a set of simulations over a wide parameter space describing both the blazar jet and the photon field properties. We discuss the most effective conditions that may produce fluxes of neutrinos compatible with the sensitivities of the current and the next generation of neutrino detectors. We will also discuss how the possible neutrino flux would be related to the properties of the large-scale structures investigated indirectly through the analysis of the gamma-ray spectrum of the BL Lac object.

Primary author: FOFFANO, Luca (INAF)

Co-authors: CERRUTI, Matteo (Université Paris Cité); VITTORINI, Valerio (iaps inaf rome)

Presenter: FOFFANO, Luca (INAF)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **71** Type: **not specified**

Neutrino and electromagnetic cascade models for tidal disruption events

Thursday, September 14, 2023 2:45 PM (15 minutes)

Recent observations have revealed that Tidal Disruption Events (TDEs), caused by the gravitational disruption of a massive star close to a supermassive black hole (SMBH), can produce intense flares of radiation with the duration of months to years. Notably, three TDE candidates (AT2019dsg, AT2019fdr, and AT2019aalc) are likely associated with IceCube astrophysical neutrinos. In this talk, I will review the observations and modeling of neutrino emission from these three TDEs based on the work by Winter & Lunardini (2023). I will also present new results on the EM cascade emissions by numerically solving the coupled time-dependent transport equations and discuss the implications for the radiation zones of AT2019dsg and AT2019fdr using the upper limits of gamma-ray flux from *Fermi*. We find that a multi-messenger diagnosis, incorporating the EM cascades, can provide valuable insights into the physical conditions of the particle acceleration and radiation zones, such as their magnetic fields and sizes.

Primary author: Dr YUAN, Chengchao (Deutsches Elektronen-Synchrotron DESY)

Co-authors: Dr WINTER, Walter (Deutsches Elektronen-Synchrotron DESY); Prof. LUNARDINI, Cecilia (Department of Physics, Arizona State University)

Presenter: Dr YUAN, Chengchao (Deutsches Elektronen-Synchrotron DESY)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **72** Type: **not specified**

XENONnT direct dark matter searches: the latest results

Wednesday, September 13, 2023 9:25 AM (20 minutes)

The XENONnT experiment, located deep-underground in Laboratori Nazionali del Gran Sasso (Italy), is operating since 2020 with the aim of detecting dark matter direct interaction signals.
By exploiting a 5.9 t liquid Xenon target equipped with a Time Projection Chamber, as well as a combination of active veto systems and advanced purification techniques, the XENONnT experiment has reached an unprecedented level of electronic-recoil background, amounting to approximately 16 events per keV-tonne-year.
Thanks to this outstanding achievement, with the first data taking campaign of about 100 days, the Collaboration has reported new results for several dark matter candidates, including WIMPs.
This talk will focus on both the XENONnT experiment techniques and its latest results.

Primary author: FERRARI, Cecilia (GSSI & Istituto Nazionale di Fisica Nucleare)

Presenter: FERRARI, Cecilia (GSSI & Istituto Nazionale di Fisica Nucleare)

Session Classification: Plenary

Track Classification: Direct DM searches

Contribution ID: **73** Type: **not specified**

Overcoming limitations to ALP parameter inference using Neural Ratio Estimation

Tuesday, September 12, 2023 4:30 PM (15 minutes)

In the hunt for new physics phenomena, such as dark matter, it is crucial to compare experimental data to theoretical models. During this step, the most likely values of the model's parameters —such as particle masses and cross sections —are inferred. However, a rigorous statistical treatment of such an inference is oftentimes not practically feasible without making significant simplifying assumptions. In many cases, this may dramatically decrease the sensitivity and reliability of the inference analysis. Recently, new inference techniques based on machine learning have emerged to help overcome these limitations. In particular, "Neural Ratio Estimation"(NRE) stands out with its reported accuracy and efficiency. NRE achieves such success by avoiding explicit integration or optimization over large parameter spaces, which are typical in traditional inference techniques. Instead, in NRE, a neural network is trained to distinguish between the likely and the unlikely parameter values of any given observation. The training set consists of model simulations, which implicitly contain the necessary information for an inference. In this contribution, I will discuss how NRE, and some of its variants, can be applied to problems in gamma-ray astroparticle physics. Its applications in forward-folding problems and the inclusion of nuisance parameters will also be addressed. In particular, I will apply NRE to the search for Axion-like particles (ALPs) with the upcoming Cherenkov Telescope Array (CTA). This analysis is particularly relevant, because ALPs are popular dark matter candidates, whose detection (or exclusion) in gamma-ray observations is especially difficult using conventional inference techniques.

Primary authors: KLUGE, Gert (University of Oslo); Dr D'AMICO, Giacomo; Prof. SANDAKER, Heidi; Dr DJUVSLAND, Julia

Presenter: KLUGE, Gert (University of Oslo)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **74** Type: **not specified**

Recents results on high-energy emissions from the Milky Way

Friday, September 15, 2023 11:45 AM (20 minutes)

The Milky Way is the most prominent feature of the sky in all wavelengths of light. At the highest energies, the gamma-ray emission can tell us the story of cosmic rays in the Galaxy, but does not give us the possibility to distinguish between leptonic or hadronic emissions. This multi-wavelength scenario can be complemented by the observation of neutrinos; indeed, neutrinos can only come from hadronic emission mechanisms and would allow to directly track cosmic rays in the Milky Way.

In this contribution, the most recent results in multi-messenger searches for high-energy emissions from the central parts of our Galaxy will be reviewed; an overview of the latest results from neutrino telescopes will be given, their connection with gamma-ray and cosmic-ray measurements will be presented, and the perspectives for the next-generation of observatories will be addressed.

Primary author: FUSCO, Luigi Antonio (Istituto Nazionale di Fisica Nucleare)

Presenter: FUSCO, Luigi Antonio (Istituto Nazionale di Fisica Nucleare)

Session Classification: Plenary

Track Classification: Neutrinos

Contribution ID: **77** Type: **not specified**

Direct detection of light dark matter from evaporating primordial black holes

Wednesday, September 13, 2023 10:20 AM (10 minutes)

Light Dark Matter has recently gained a lot of attention. Generally, direct detection of sub-GeV Dark Matter is challenging since it induces low recoil energies. The problem is solved by considering light Dark Matter with considerable kinetic energies. In this talk, we point out that Primordial Black Hole evaporation is a source of boosted light dark Matter with energies of tens to hundreds of MeV. Considering XENON1T data, we constrain the mixed parameter space of Primordial Black Holes and sub-GeV Dark Matter.

Primary authors: FIORILLO, Damiano (Niels Bohr Institute, Copenhagen); Dr CHIANESE, Marco (Università degli Studi di Napoli Federico II); SAVIANO, Ninetta (Istituto Nazionale di Fisica Nucleare); CALABRESE, Roberta (Istituto Nazionale di Fisica Nucleare)

Presenter: CALABRESE, Roberta (Istituto Nazionale di Fisica Nucleare)

Session Classification: Plenary

Track Classification: Direct DM searches

Contribution ID: **79** Type: **not specified**

The CYGNO project for directional Dark Matter searches

Thursday, September 14, 2023 2:20 PM (20 minutes)

We are going to present the CYGNO/INITIUM project for the development of an high precision optical readout gaseous Time Projection Chamber (TPC) for directional Dark Matter search and solar neutrino spectroscopy, to be hosted at Laboratori Nazionali del Gran Sasso (LNGS). CYGNO peculiar features are the use of sCMOS cameras and PMTs coupled to GEMs amplification of an helium-fluorine based gas mixture at atmospheric pressure. The goal is to achieve 3D tracking with head tail capability and background rejection down to O(keV) energy, to boost sensitivity to low WIMP masses for both Spin Independent and Spin Dependent coupling. We will illustrate the commissioning and the underground operation of the 50 L prototype LIME, the largest developed so far by the collaboration, and its capability to measure and identify low energy nuclear and electron recoils. We will outline the design and prospects for the development of the already funded O(1) m3 demonstrator to be hosted in Hall F of LNGS and illustrate the physics reach of a possible future O(30) m3 experiment emerging from these developments. We will furthermore discuss the R&D results obtained by the collaboration towards the maximisation of the CYGNO potentialities, and in particular the recent demonstration of negative ion drift operation at atmospheric pressure with optical readout obtained in synergy with the ERC Consolidator Grant project INITIUM.

Primary author: BARACCHINI, Elisabetta (Istituto Nazionale di Fisica Nucleare)

Presenter: Mr PRAJAPATI, Atul (Istituto Nazionale di Fisica Nucleare)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **80** Type: **not specified**

The CYGNUS project

Wednesday, September 13, 2023 3:45 PM (15 minutes)

The CYGNUS proto-collaboration aims to establish a Galactic Directional Recoil Observatory at the ton-scale that could test the DM hypothesis beyond the Neutrino Floor and measure the coherent and elastic scattering of neutrinos from the Sun and possibly Supernovae. A unique capability of CYGNUS will be the detailed measurement of topology and direction of low-energy nuclear and electron recoils in real time. Other key features of CYGNUS are modular, recoil sensitive TPCs (electron and/or negative ion drift operation) filled with a Helium-Florine based gas mixture at atmospheric pressure for sensitivity to low WIMP masses for both Spin Independent and Spin Dependent couplings. Installation in multiple underground sites (including the Southern Hemisphere), with a staged expansion, is foreseen to mitigate contingencies, minimise location systematics and improve sensitivity. Current and near-term, m^3-scale detectors can be used for precision studies of final state topology, such as measurements of the Migdal effect, and searches for beyond the Standard Model (BSM) physics at beam dumps and neutrino beams. Next generation, 10 m^3 detectors should allow measurements of CNO solar neutrinos via coherent elastic scattering, and produce improved limits on spin-dependent DM scattering. A ton-scale observatory would probe unexplored DM parameter space, including below the neutrino floor, and can be used to confirm the galactic origin of a dark matter signal. We will review the key features and expected physics reach of CYGNUS, and the programs currently underway in several laboratories to optimise gas mixture, technologies and algorithms towards the realisation of this concept.

Primary authors: BARACCHINI, Elisabetta (Istituto Nazionale di Fisica Nucleare); Prof. LANE, Gregory (Australian National University); MIUCHI, Kentaro (Kobe University); SPOONER, Neil (University of Sheffield); VAHSEN, Sven

Presenter: BARACCHINI, Elisabetta (Istituto Nazionale di Fisica Nucleare)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **81** Type: **not specified**

Searching for temporary gamma-ray dark blazars associated with IceCube neutrinos

Tuesday, September 12, 2023 3:45 PM (15 minutes)

According to the observations up to date, there is more flux in cosmic neutrinos at lower energies (<100 TeV) than that could be expected from gamma rays, if they have the same sources. The diffuse gamma-ray sky observed by the Fermi Gamma-ray Space Telescope is dominated by blazars (~80%), while recent studies suggest blazars might be only subdominant sources of the diffuse high-energy neutrino sky detected by the IceCube Neutrino Observatory at the South Pole. By analyzing Fermi-LAT data, we show that most of the neutrino-source candidate blazars we found in our previous work, including TXS 0506+056, were in a temporary gamma-ray dip (local or global minimum) when IceCube recorded the respective neutrinos. We propose a model which resolves the longstanding theoretical problem of reconciling the high gamma fluxes (around the time of the neutrino) and neutrino production, such that at the time of efficient neutrino production the observed gamma-flux simply drops. We show that optical depth is the key factor of whether a blazar is gamma-ray dark or bright during the neutrino emission. Importantly, our results also indicate that the identification of additional neutrino-blazar connections is substantially simpler than previously thought, since, because at least for a population of blazars, one can focus on local gamma minima in the blazar light curve, preferably during high states of radio flux density. With this we aim to test existing neutrino observations to establish whether blazars are the origin of IceCube's high-energy neutrino flux, one of the main open questions of astroparticle physics today.

Primary authors: FRANCKOWIAK, Anna (Astronomical Institute, Ruhr University Bochum, Germany); KUN, Emma (Astronomical Institute and Theoretical Physics IV, Ruhr University Bochum, Germany); HALZEN, Francis (Deptartment of Physics, University of Wisconsin, Madison, USA); BARTOS, Imre (Department of Physics, University of Florida, USA); BECKER TJUS, Julia (Theoretical Physics IV: Plasma-Astroparticle Physics, Faculty for Physics and Astronomy, Ruhr University Bochum, Germany); BIERMANN, Peter L. (Max Planck Institute for Radio Astronomy, Bonn, Bochum)

Presenter: KUN, Emma (Astronomical Institute and Theoretical Physics IV, Ruhr University Bochum, Germany)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **82** Type: **not specified**

Indirect dark-matter searches with gamma-rays experiments : status and future plans from KeV to TeV

Monday, September 11, 2023 2:00 PM (15 minutes)

Detection of gamma rays and cosmic rays from the annihilation or decay of dark matter particles is a promising method for identifying dark matter, understanding its intrinsic properties, and mapping its distribution in the universe. I will review rthe current status and discuss the prospects for indirect searches to robustly identify or exclude a dark matter signal using upcoming experiments at energies below and above Fermi energy range.

Primary author: Dr MORSELLI, Aldo (Istituto Nazionale di Fisica Nucleare)

Presenter: Dr MORSELLI, Aldo (Istituto Nazionale di Fisica Nucleare)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **83** Type: **not specified**

Boosting sterile neutrino dark matter production with self-interactions

Thursday, September 14, 2023 2:00 PM (20 minutes)

Sterile neutrinos are a well-motivated and simple dark matter (DM) candidate. However, sterile neutrino DM produced through oscillations by the Dodelson-Widrow mechanism are in tension with current X-ray observations. To preserve the attractive features of this scenario, self-interactions among sterile neutrinos have been proposed as a minimal extension of the production mechanism. In this work, we analyze how sterile neutrino self-interactions mediated by a scalar affect the production of keV sterile neutrinos for a wide range of mediator masses. We find that there are four distinct regimes of production characterized by different phenomena, including partial thermalization for low and intermediate masses and resonant production for heavier mediators. We show that significant new regions of parameter space become available for mediator masses up to 1.5 GeV.

Primary authors: DIAS, Maria (University of Freiburg); Prof. VOGL, Stefan (University of Freiburg)

Presenter: DIAS, Maria (University of Freiburg)

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **84** Type: **not specified**

Inflationary attractors in Palatini F (R, X) gravity

Tuesday, September 12, 2023 5:50 PM (20 minutes)

Palatini $F(R)$ gravity proved to be powerful tool in order to realize asymptotically flat inflaton potentials. Unfortunately it also inevitably implies higher-order inflaton kinetic terms in the Einstein frame that might jeopardize the evolution of the system out of the slow-roll regime. We prove that a $F(R-X)$ gravity, where X is the inflaton kinetic term, solves the issue. Moreover, when F is a quadratic (or higher order) function such a choice easily leads to a new class of inflationary attractors, fractional attractors, that generalizes the already well-known polynomial α-attractors.

Presenter: Dr RACIOPPI, Antonio

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **85** Type: **not specified**

The Southern Wide-field Gamma-ray Observatory

Thursday, September 14, 2023 5:30 PM (15 minutes)

The Southern Wide-field Gamma-ray Observatory (SWGO), currently in the R&D phase, is the project to design and build the first wide-field ground-based observatory in the Southern hemisphere, for the detection of gamma-rays from a few hundred GeV to a few PeV. The extensive air shower array, planned for deployment at an altitude greater than 4400 m a.s.l., will be primarily based on water Cherenkov detectors units and will provide an unprecedented view of the Southern Sky at the most extreme gamma-ray energies. SWGO will complement CTA in terms of technical capabilities, and the existing ground-based particle detectors of the Northern Hemisphere, namely HAWC and LHAASO, in terms of geographical location, delivering a rich science programme. The collaboration is highly invested in the evaluation of different detector and array configurations, prototyping of detector units, and in the process of site search. In this talk, I will present an overview of the project's objectives, its current status and future perspectives.

Primary author: BARRES DE ALMEIDA, Ulisses (Centro Brasileiro de Pesquisas Físicas)

Presenter: BARRES DE ALMEIDA, Ulisses (Centro Brasileiro de Pesquisas Físicas)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **87** Type: **not specified**

A four-year baseline characterization for the Pacific Ocean Neutrino Experiment (P-ONE) in the Cascadia Basin

Monday, September 11, 2023 4:45 PM (15 minutes)

The STRings for Absorption length in Water (STRAW) and its successor STRAW-b are the pathfinders for the future Pacific Ocean Neutrino Experiment (P-ONE). Both experiments are mooring lines instrumented with several light emitter and receiver modules. The goals of the pathfinders are to measure the water's attenuation length of water, characterize the background light spectrum and perform long-term monitoring of the environmental and the optical properties of the 2.6km-deep site of the future P-ONE.
Here we present analyzed data collected over four years of STRAW and two years of STRAW-b operation, revealing periodical bioluminescence emission correlated with water current speed. We demonstrate the method to retrieve these results. We also report measurements of typical bioluminescence spectrum spectra and show camera pictures of emitting species. These observations are vital for P-ONE, providing empirical measurements of the bioluminescence background and input for our Monte-Carlo simulations of the ambient background.
Such monitoring data, as presented here from STRAW and STRAW-b, are vital for deep-sea neutrino experiments. However, they also are highly interdisciplinary, covering topics beyond physics, such as biology, oceanography, and climatology.

Primary authors: Mr VEENSTRA, Braeden (University of Alberta); Mr HOLZAPFEL, Kilian (Technical University of Munich); Mr HATCH, Patrick (Queen's University); LI, Ruohan (Technical University of Munich); Ms LOIPOLDER, Sophie (Technical University of Munich)

Presenter: LI, Ruohan (Technical University of Munich)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **88** Type: **not specified**

Observation of an astrophysical gamma-ray source HESS J1843-033 with the Tibet air shower array and its muon detector array

Monday, September 11, 2023 6:00 PM (15 minutes)

Gamma-ray observation in the sub-PeV range provides a method of investigating accelerators of the Galactic PeV cosmic rays, so-called PeVatrons. However, the detection of PeVatrons has not been established yet, and a large fraction of sub-PeV gamma-ray sources still has an unknown origin, which requires detailed studies for individual gamma-ray sources. A TeV gamma-ray source HESS J1843-033 is such a source. LHAASO and HAWC have detected nearby gamma-ray sources above 56 TeV and 100 TeV, respectively, but the relations between these gamma-ray sources and their origin are still to be elucidated due to the lack of detailed studies. This study discusses the origin of gamma rays coming from HESS J1843-033 and the nearby gamma-ray sources based on the analysis of data taken by the Tibet air shower array and its underground muon detector array. The presentation gives the results of our data analysis and the discussion of the origin of the gamma rays.

Primary author: KATO, Sei (Institute for Cosmic Ray Research)

Co-author: COLLABORATION, The Tibet ASgamma

Presenter: KATO, Sei (Institute for Cosmic Ray Research)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **90** Type: **not specified**

Status and prospects of SuperCDMS SNOLAB

Wednesday, September 13, 2023 3:15 PM (15 minutes)

The SuperCDMS Collaboration is currently building a direct dark matter detection experiment at SNOLAB (Canada) consisting of an array of germanium and silicon crystals, with a total payload of 25 kg and 3.6 kg, respectively. Each crystal is instrumented to measure either a combination of phonon and ionization signals (iZIP detectors) or the phonon signal caused by charge carriers via the Neganov-Trofimov-Luke effect (HV detectors). Because of its low detector thresholds and background suppression, SuperCDMS SNOLAB will provide leading sensitivity to dark matter particles with mass from 5 GeV down to 500 MeV, under the standard elastic nuclear recoil assumption. In this talk, I will first explain the SuperCDMS SNOLAB detector concept and its current status, and then I will present the scientific reach of the experiment, including a detailed discussion on its sensitivity projections.

Primary author: LOPEZ ASAMAR, Elias

Presenter: LOPEZ ASAMAR, Elias

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **91** Type: **not specified**

Time variability of the Galactic cosmic ray distribution and the associated multi-messenger interstellar emissions

Wednesday, September 13, 2023 3:15 PM (15 minutes)

Cosmic rays (CRs) are trapped within the Milky Way and diffuse through the interstellar medium (ISM) for millions of years. This confinement and propagation process creates a pervasive "sea" of relativistic particles that interact with the diffuse gas, radiation, and magnetic fields in the ISM to produce secondary emissions over a broad energy range from all directions on the sky.

The Fermi Large Area Telescope has measured the diffuse gamma-ray emissions for >100 MeV energies with high statistics, and recent results from H.E.S.S., HAWC, LHAASO, and the Tibet Air-shower Array show also that these diffuse emissions are produced up to PeV energies. The different energy ranges are connected due to the common origin of the CR particles injected by individual sources and propagating through the ISM. However, the properties of the ensemble of CR sources, including their injection spectra and relative proportion of different source classes (e.g., supernova remnants, pulsars), are not well understood.

In this contribution we use the latest v57 release of the GALPROP framework to make fully 3D models for the activity of ensembles of discrete spatial/temporal CR sources in the Milky Way, and make predictions for the diffuse secondary emissions from GeV to PeV energies. We discuss our results within the context of the data collected by space- and ground-based instruments, including possible constraints for the distributions of CRs and other ISM components.

Primary author: TROY, Porter (Stanford University)

Co-authors: ROWELL, Gavin (University of Adelaide); JOHANNESSON, Gudlaugur; MOSKALENKO, Igor (Stanford University); MARINOS, Peter (University of Adelaide)

Presenter: TROY, Porter (Stanford University)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **92** Type: **not specified**

Sourcing axions in the magnetospheres of neutron stars

Tuesday, September 12, 2023 3:15 PM (15 minutes)

Neutron stars can host strong electromagnetic fields deep in their magnetospheres capable of sourcing axions. Low mass axions are produced relativistically and can resonantly convert into radio photons as they escape the magnetosphere. For heavier axions an increasing fraction will instead end up populating a cloud of bound states around the parent neutron star. In this talk I will discuss the fundamental physics driving both axion production and conversion in these scenarios, followed by an end-to-end analysis pipeline that facilitates an accurate description of the prospective radio flux. This is finally compared with radio observations of nearby pulsars to derive some of the strongest constraints to date on the axion-photon coupling.

Primary author: NOORDHUIS, Dion (University of Amsterdam)

Presenter: NOORDHUIS, Dion (University of Amsterdam)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **93** Type: **not specified**

Long-term monitoring of the radio-galaxy M87 in gamma-rays: joint analysis of MAGIC, VERITAS and Fermi-LAT data

Wednesday, September 13, 2023 3:45 PM (15 minutes)

M87 was discovered as a very-high-energy gamma-ray emitter (VHE, E > 100 GeV) with HEGRA in 2003, even before its high-energy gamma-ray emission (HE, E > 100 MeV) was detected. These observations established M87 as the first extragalactic source with a tilted jet detected up to the TeV energies. After the major VHE flares in 2005, 2008, and 2010, M87 has been mainly observed in a quiescent low flux state with the exception of smaller-scale flares. MAGIC and VERITAS, two stereoscopic Cherenkov telescope arrays located at Roque de los Muchachos Observatory (Canary Islands, Spain) and the Fred Lawrence Whipple Observatory (Arizona, US), have been continuously monitoring M87 for more than 10 years since the last major flare in 2010. In this work, we present the first joint analysis with combined data from the two arrays and Fermi-LAT, studying the long-term evolution of the source flux and its broadband gamma-ray spectral energy distribution.

Primary author: MOLERO GONZALEZ, Miguel

Co-authors: PUESCHEL, Elisa (DESY); FORSTSON, Lucy (University of Minnesota); Dr NIEVAS ROSILLO, Mireia (Instituto de Astrofísica de Canarias (IAC)); VÁZQUEZ ACOSTA, Mónica (Instituto de Astrofísica de Canarias (IAC)); SILVA BATISTA, Pedro (DESY)

Presenter: MOLERO GONZALEZ, Miguel

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **94** Type: **not specified**

Latest Updates in agnpy: Implementing hadronic processes and analyzing FSRQ data

Thursday, September 14, 2023 3:45 PM (15 minutes)

In this contribution, we present the latest updates introduced to agnpy - an open-source python package for modeling broadband spectra of blazars.

Among the significant updates, we discuss the implementation of hadronic radiative processes. The agnpy software now implements proton synchrotron radiation and we are working also to implement the photohadronic process. Additionally, we introduce newly added fitting tools for observational data, allowing for the identification of the best theoretical model fitting the broadband emission from radio to gamma rays. of a given object. In particular, we describe the application of these techniques to the analysis of FSRQ (Flat Spectrum Radio Quasars) objects, which are among the brightest gamma-ray sources in the sky. We also demonstrate the application of a new numerical method for calculating absorption in the photon field of a broad line region emitting several lines.

In conclusion, our contribution showcases the latest improvements in agnpy, emphasizing the value of this package as a tool for data analysis and blazar modeling. The presented updates, make agnpy an even more versatile and useful tool for scientists studying jetted Active Galactic Nuclei.

Primary author: GLIWNY, Paweł (University of Lodz)

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Presenter: GLIWNY, Paweł (University of Lodz)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **95** Type: **not specified**

Cosmic-Ray Lithium and Beryllium Isotopes with the Alpha Magnetic Spectrometer

Monday, September 11, 2023 2:30 PM (10 minutes)

Lithium and Beryllium nuclei in cosmic rays are expected to be secondaries produced by the fragmentation of primary cosmic rays during their propagation in the Galaxy. Therefore, their fluxes contain essential information on cosmic ray propagation and sources. Secondary-to-primary flux ratios provide measurements of the material traversed by cosmic rays in their journey through the Galaxy. The Li and Be isotopic compositions provide crucial complementary information. In particular, the 10Be/9Be ratio measures the cosmic ray propagation volume in the Galaxy, and the 6Li/7Li ratio tests the existence of primordial lithium. Current measurements of the 6Li/7Li and 10Be/9Be ratios are limited to energies below 1 GeV/n and 2 GeV/n, respectively, and are affected by large uncertainties. Individual fluxes of 6Li and 7Li, and of 7Be, 9Be and 10Be, have only been measured below 0.3 GeV/n and 0.4 GeV/n, respectively. In this contribution, we present the measurement of the 6Li and 7Li fluxes and their ratio, and of the 7Be, 9Be, 10Be fluxes and their ratios, in the uncharted energy region ranging from 0.4 GeV/n to 12 GeV/n based on data collected by AMS during its first 10 years of operation on the International Space Station.

Primary author: GIOVACCHINI, francesca (CIEMAT)

Co-authors: WEI, Jiahui (Shandong Institute of Advanced Technology (SDIAT)); DEROME, Laurent; PANICCIA, Mercedes (University of Geneva (CH))

Presenter: GIOVACCHINI, francesca (CIEMAT)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **96** Type: **not specified**

Galactic cosmic rays results from HEPD-01 detector on board CSES-01 satellite

Monday, September 11, 2023 5:00 PM (15 minutes)

The High Energy Particle Detector 01 (HEPD-01) is hosted on board of the China Seismo-Electromagnetic Satellite (CSES-01). It was launched on the 2nd of February 2018 and it is on a Sun-Synchronous orbit at an altitude of 500 km. HEPD-01 is completely developed by the Italian part of the CSES-Limadou collaboration. It is dedicated to the detection of charged particles: electrons (about 3-100 MeV), protons (about 30 −300 MeV), light nuclei (up to a few hundreds of MeV/nucleon). The instrument is composed of a tracking system, a trigger made by a segmented layer of plastic scintillator, a calorimeter made by a tower of plastic scintillators and an array of LYSO cubes and a veto system. Thanks to the wide angular acceptance, HEPD-01 is capable to provide measurements on different topics with a good statistic. In this contribution the main scientific results obtained with the HEPD-01 detector will be reported, focusing on the measurements of protons and helium fluxes obtained in the first period of the flights. Also the analysis on cosmic ray solar modulation for proton and helium spectra will be shown.

Primary author: PANICO, Beatrice (University of Naples Federico II - INFN Sez. Napoli)

Presenter: PANICO, Beatrice (University of Naples Federico II - INFN Sez. Napoli)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **97** Type: **not specified**

Unique Properties of the 3rd Group of Cosmic Rays: Results from the Alpha Magnetic Spectrometer

Monday, September 11, 2023 2:20 PM (10 minutes)

We will report the latest results on the properties of nitrogen (N), sodium (Na), and aluminum (Al) cosmic rays in the rigidity range 2.15 GV to 3.0 TV based on 5 million N, 0.58 million Na and 0.64 million Al nuclei collected by the AMS. We observe all three fluxes are well described by the sums of a primary cosmic ray component and a secondary cosmic ray component. With our measurements, the abundance ratios at the source of N/O, Na/Si, and Al/Si are determined independent of cosmic ray propagation.

Primary author: Ms LIANG, Meijun (Institute of High Energy Physics, Chinese Academy of Sciences)

Presenter: Ms LIANG, Meijun (Institute of High Energy Physics, Chinese Academy of Sciences)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **98** Type: **not specified**

Developments in sub-GeV dark matter direct detection: Nanomaterials and Molecules

Thursday, September 14, 2023 3:45 PM (15 minutes)

As the WIMP draws under increasing tension thanks to the ever increasing sensitivity of direct detection experiments, the majority of dark matter parameter space outside of the weak scale remains unexplored. Molecular and nano-scale systems are particularly well-suited to look for sub-GeV DM since their eV-scale electronic transitions may be excited through light dark matter interactions. Here, I will discuss the importance of molecular and mesoscopic systems as new directions in the direct detection of dark matter, focusing on the use of quantum dots (QDs) and organic crystals as detector targets. I will show that QDs present a particularly interesting target with inherently low-background signals and low-cost scalability. I will present the molecular Migdal effect as a new directional method to detect DM nuclear recoils using molecular systems. Finally, I will discuss the potential synergy between nanomaterials and molecules as well as applications of these formalisms for indirect detection.

Primary author: BLANCO, Carlos (Princeton University & Stockholm University)

Presenter: BLANCO, Carlos (Princeton University & Stockholm University)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **99** Type: **not specified**

X-ray observations of a PeVatron candidate HESS J1641-463

Tuesday, September 12, 2023 2:45 PM (15 minutes)

HESS J1641-463 is an unidentified gamma-ray source characterized by a hard TeV gamma-ray spectrum, thus it has been proposed to be a primary candidate for cosmic-ray acceleration up to PeV energies (a PeVatron candidate). The source spatially coincides with a radio SNR G338.5+0.1, but has not yet been explored in the X-ray band. We here present a new 82 ks NuSTAR observation and archival 19 ks Chandra X-ray observations of this source. The NuSTAR observation is affected by stray light and the background; and while we detect a nearby stellar cluster, Mercer 81, we do not find an X-ray counterpart to HESS J1641-3463. Combining the NuSTAR with the archival Chandra data, we derived an upper limit of $\sim 4\times10^{-13}$ erg cm^{-2} s^{-1} in the 0.5-20 keV band. If the gamma-rays are originated from pion decay produced in interactions between cosmic-ray protons and the ambient materials, secondary electrons in the proton-proton interactions can potentially emit synchrotron photons in the X-ray band. We present a detailed broadband SED modeling, and demonstrate how the secondary synchrotron component (for which we derive an upper limit with the present study) can be detected in sensitive, dedicated X-ray observations, particularly with future hard X-ray missions.

Primary author: TSUJI, Naomi

Co-authors: Prof. TANAKA, Takaaki (Konan University); Prof. SAFI-HARB, Samar (Manitoba University); AHARONIAN, Felix (DIAS, Dublin)

Presenter: TSUJI, Naomi

Session Classification: GRA: Gamma Ray Astronomy

Contribution ID: **100** Type: **not specified**

A Preliminary Look at the 4HWC Very-High-Energy Gamma-Ray Source Catalog

Monday, September 11, 2023 2:00 PM (15 minutes)

The High Altitude Water Cherenkov (HAWC) observatory is highly suitable for large-scale survey work. The high duty time (95+%), large instantaneous FoV (2 sr), and sensitivity over the 300 GeV to more than 100 TeV energy range make it ideal for creating a catalog of very high energy (VHE) sources. Over the lifetime of the HAWC observatory, 4 catalogs have been produced 3 of which were constructed utilizing the full HAWC energy range while another used a restricted (>56 TeV) range. This talk will focus on the status of the planned 4HWC (full energy range) catalog including the newly developed Multi-Source Fit algorithm inspired by the Fermi Extended Source search method for the galactic plane. Using over 1000 additional days of data, improved event reconstruction algorithms using HAWC's newly completed fifth pass through its dataset, and the improved search algorithm we expect to see a major improvement in the sensitivity and accuracy compared to previous catalogs. The previous full energy range (3HWC) catalog found 65 sources at over 5 sigma and I anticipate the 4HWC search will result in more than 100 significant sources. In addition, the new search is much more suited to fitting extended sources and disentangling more complex regions in the data. While the 3HWC catalog found that 56 out of 65 sources were associated with pulsars it will be of great interest to see how if at all the distribution of source types evolves as a result of the greater sensitivity of the 4HWC catalog. In addition to a discussion surrounding the creation of the 4HWC catalog, I will present a preliminary look at the results of the new catalog search method in several regions of interest in HAWC maps such as the Crab Nebula, Cygnus Cocoon, and near the Geminga pulsar.

Primary author: GROETSCH, Samuel (Michigan Technological University)

Presenter: GROETSCH, Samuel (Michigan Technological University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **101** Type: **not specified**

Perspectives for CCSNe detection with the next generation of gravitational wave detectors

Wednesday, September 13, 2023 3:10 PM (15 minutes)

Core collapse supernovae are among the most energetic explosions in the modern Universe and one of the long-standing riddles of stellar astrophysics. The detection of a gravitational wave signal coming from a core collapse supernovae would be extremely interesting, due to the fact that it would give us the chance to probe the core dynamics of a dying massive star and, eventually, enlighten the mechanism driving supernova explosion.
A new method based on machine learning will be presented. The method takes advantage of the most common and peculiar features of the gravitational wave signal emitted in the core collapse supernova and it is based on a classification procedure of the time-frequency images of the network data performed by a convolutional neural network.
This contribution reports the resulting perspectives for the next generation of gravitational wave detectors, taking into account different detector configurations among the ones proposed up to the present day.

Primary authors: VEUTRO, Alessandro (Istituto Nazionale di Fisica Nucleare); DI PALMA, Irene (Istituto Nazionale di Fisica Nucleare); DRAGO, Marco (Istituto Nazionale di Fisica Nucleare)

Co-authors: PORTILLA LOPEZ, Melissa (Department of Physics, Utrecht University); CERDA DURAN, Pablo (Departamento de Astronomía y Astrofísica, Universitat de València); RICCI, Fulvio (Istituto Nazionale di Fisica Nucleare)

Presenter: VEUTRO, Alessandro (Istituto Nazionale di Fisica Nucleare)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **102** Type: **not specified**

Physics Beyond the Standard Model with NA62

Thursday, September 14, 2023 3:20 PM (20 minutes)

The NA62 experiment at CERN took data in 2016–2018 with the main goal of measuring the $K^+ \to \pi^+\nu\bar{\nu}$ decay. The NA62 dataset is also exploited to search for light feebly interacting particles produced in kaon decays. Searches for $K^+ \to e^+N$, $K^+ \to \mu^+N$ and $K^+ \to \mu^+\nu X$ decays, where N and X are massive invisible particles, are performed by NA62. The N particle is assumed to be a heavy neutral lepton, and the results are expressed as upper limits of $O(10^{-8})$ of the neutrino mixing parameter $|U_{\mu 4}|^2$. The X particle is considered a scalar or vector hidden sector mediator decaying to an invisible final state. Upper limits of the decay branching fraction for X masses in the range 10–370 MeV/c^2 are reported. An improved upper limit of 1.0×10^{-6} is established at 90% CL on the $K^+ \to \mu^+\nu\nu\nu$ branching fraction.
Dedicated trigger lines were employed to collect di-lepton final states, which allowed establishing stringent upper limits on the rates of lepton flavor and lepton number violating kaon decays. Upper limits on the rates of K^+ decays violating lepton flavour and lepton number conservation, obtained by analysing this dataset, are presented.
The NA62 experiment can be run as a "beam-dump experiment" by removing the Kaon production target and moving the upstream collimators into a "closed" position. More than 10^{17} protons on target have been collected in this way during a week-long data-taking campaign by the NA62 experiment. We report on the search for visible decays of exotic mediators from data taken in "beam-dump" mode, with a particular emphasis on Dark Photon and Axion-like particle Models.

Primary authors: ROMANO, Angela (University of Birmingham); SPEAKER, OTHER

Presenter: RAGGI, Mauro (Istituto Nazionale di Fisica Nucleare)

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **105** Type: **not specified**

Observation of Active Galactic Nuclei Through the Eyes of CTA-LST-1

Wednesday, September 13, 2023 2:15 PM (15 minutes)

The next generation facility for gamma-ray ground-based observations is the Cherenkov Telescope Array (CTA) observatory, which encompasses three distinct sizes of imaging atmospheric Cherenkov telescopes (IACTs). Among these, the Large-Sized Telescopes (LSTs) of CTA, featuring a mirror dish with a diameter of 23 meters, are engineered to detect the faint atmospheric showers from the lowest energy gamma-rays accessible through the Cherenkov imaging technique, being sensitive to energies from about 20 GeV up to a few TeV. The first prototype LST, LST-1, was officially inaugurated at the Observatorio del Roque de Los Muchachos in La Palma (Canary Islands, Spain) in 2018, and is presently in the commissioning phase. As of the present date, it has accumulated more than 1400 hours of observational data. From 2020 to 2022, in addition to the detection of notable Galactic sources (e.g. Crab Nebula, Crab Pulsar, RS Ophiuchi nova), LST-1 has detected several known gamma-loud active galactic nuclei (AGN), including Mrk 421, Mrk 501, 1ES 1959+650, 1ES 0647+250, PG 1553+113, among others. In this talk, we present analyses of energy spectra and the light curves reconstructed from those observations, down to energies of a few tens of GeV, close to the energy threshold of the LST design, and further demonstrating its capabilities. Additionally, we explore the potential for detecting AGN flaring events using LST-1, discussing the prospects and implications for future astrophysical research.

Primary author: BAXTER, Joshua (ICRR, Japan)

Co-authors: BAQUERO, Andres (UCM); ARBET-ENGELS, Axel (Max-Planck-Institut für Physik, 80805 München, Germany); PRIYADARSHI, Chaitanya (IFAE); GREEN, David (Max Planck Institut für Physik); SANCHEZ, David (Universidad Politécnica de Valencia); PONS, Estelle (Laboratoire d'Annecy de Physique des Particles); DI MARCO, Gaetano (University of Padova); LUIS CONTRERAS GONZÁLEZ, José (UCM); HECKMANN, Lea; NICKEL, Lukas (TU Dortmund); LÁINEZ, María (UCM); NIEVAS ROSILLO, Mireia (Instituto de Astrofísica de Canarias and Dpto. de Astrofísica, Uni- versidad de La Laguna, 38200 La Laguna, Tenerife, Spain); VÁZQUEZ ACOSTA, Mónica (Instituto de Astrofísica de Canarias (IAC)); BIEDERBECK, Noah (TU Dortmund); ALVAREZ CRESPO, Nuria (TO); TAKEISHI, Ryuji (ICRR, Japan); CAROFF, Sami (PhD); FALLAH RAMAZANI, Vandad (Tuorla observatory)

Presenter: BAXTER, Joshua (ICRR, Japan)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **106** Type: **not specified**

Gamma-Ray Burst observations by HEPD-01 space detector on board CSES-01 as an anticipation of future ones by HEPD-02 on CSES-02

Tuesday, September 12, 2023 3:45 PM (15 minutes)

Gamma-Ray Bursts (GRBs) are among the brightest and most energetic events in the Universe, in the form of violent extragalactic explosions of gamma rays, which are detected at the top of the Earth's atmosphere by high-energy photon detectors. Although not specifically designed for gamma-ray detection, the High-Energy Particle Detector (HEPD-01), operational since 2018 on a low-Earth orbit, clearly detected five strong events, namely GRB190114C, GRB190305A, GRB190928A, GRB200826B and GRB211211A, between 2019 and 2021. For each event, HEPD-01 electron-flux time profiles closely match the time evolution of GRB photons detected by dedicated gamma-ray instruments like PICsIT and SPI-ACS on board the INTEGRAL satellite. The origin of these electron-triggered signals in HEPD-01 has been investigated through a Monte Carlo simulation, and it has been found out to be the result of low-energy electrons produced in the interaction of high-energy GRB photons with passive and active structures of the detector itself. The GRB observation by HEPD-01 presented here is valuable *per se*, as an independent source of data, given the 5-yr uninterrupted observation, and in view of the forthcoming launch of HEPD-02 on board the CSES-02 satellite. In actual fact, unlike HEPD-01, the second-generation detector will be equipped with a dedicated trigger system for gamma-ray detection, which is likely to allow the future mission to contribute to a wider, real-time GRB alert program.

Primary author: Dr PALMA, Francesco (Istituto Nazionale di Fisica Nucleare)

Presenter: Dr PALMA, Francesco (Istituto Nazionale di Fisica Nucleare)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **107** Type: **not specified**

New Bounds on Monopoles from Intergalactic Magnetic Fields

Monday, September 11, 2023 6:00 PM (15 minutes)

Monopoles are inevitable predictions of GUT theories. They are produced during phase transitions in the early universe, but also mechanisms like Schwinger effect in strong magnetic fields could give relevant contributions to the monopole number density. I will show that from the detection of intergalactic magnetic fields we can infer additional bounds on the magnetic monopole flux. I will also discuss the implications of these bounds for minicharged monopoles, for magnetic black holes, for monopole pair production in primordial magnetic fields and for terrestrial experiments.

Primary author: Mr PERRI, Daniele (SISSA, Trieste)

Presenter: Mr PERRI, Daniele (SISSA, Trieste)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **110** Type: **not specified**

Anomaly aware machine learning for dark matter direct detection at DARWIN

Wednesday, September 13, 2023 4:45 PM (15 minutes)

This talk presents a novel approach to dark matter direct detection using anomaly aware machine learning techniques in the DARWIN next-generation dark matter direct detection experiment. I will introduce a semi-unsupervised deep learning pipeline that falls under the umbrella of generalized Simulation Based Inference (SBI), an approach that allows one to effectively learn likelihoods straight from simualted data, without the need for complex functional dependence on systematics or nuiscance parameters. I also present an inference procedure to detect non-background physics utilizing an anomlaly function derrived from the loss functions of the semi-unsupervised arcvhitecture. The pipeline's performance is evaluated using pseudo-data sets in a sensitivity forecasting task, and the results suggest that it offers improved sensitivity over traditional methods.

Primary author: SCAFFIDI, Andre (SISSA)

Presenter: SCAFFIDI, Andre (SISSA)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **111** Type: **not specified**

Reconstruction and identification methods of sub-PeV gamma rays at the IceCube Neutrino Observatory

Thursday, September 14, 2023 5:00 PM (15 minutes)

The IceCube Neutrino Observatory is situated at the geographic South Pole. IceCube is composed of two detectors. One is an in-ice optical array that is sensitive to high-energy muons from air showers as well as particle cascades that are induced by high-energy neutrino interactions in the ice. The other detector, called IceTop, is an array of ice-cherenkov tanks on the surface above the in-ice array detecting cosmic-ray air showers.
The current surface and in-ice detectors of IceCube has been utilized to study cosmic rays and to search for PeV gamma rays. Previous IceCube gamma-ray searches started at 2 PeV.
With the aim to enhance the sensitivity of IceCube for detecting gamma rays, the reconstruction method of surface events is optimized for gamma rays below 1 PeV. Additionally, the gamma-hadron separation needed for the search for gamma-ray point sources is improved. To achieve this, machine learning techniques, including deep learning, are utilized to effectively separate gamma rays from hadronic cosmic rays.

Primary author: BONTEMPO, Federico

Co-author: COLLABORATION, IceCube

Presenter: BONTEMPO, Federico

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **112** Type: **not specified**

Is there evidence for gamma-ray emission from the Sagittarius dwarf galaxy?

Thursday, September 14, 2023 2:00 PM (15 minutes)

More than a decade ago, the Large Area Telescope aboard the Fermi Gamma-ray Space Telescope unveiled the existence of two gigantic gamma-ray lobes known as the Fermi Bubbles. While their origin is still unknown, various studies identified intricate structures within the bubbles. One prominent region, the cocoon, has recently been associated with gamma-ray emissions from the Sagittarius dwarf spheroidal (Sgr dSph) galaxy.
In this talk, we present our ongoing research aiming to scrutinize the gamma-ray emissions linked to the Sgr dSph within the cocoon region using adaptive template fitting and pixel count statistics methods. Our approach introduces a substantial advancement in data interpretation by enabling a data-driven optimization of astrophysical background models, thereby significantly diminishing the inaccuracies resulting from background mis-modelling.
Our study focuses on the robustness of the previously reported gamma-ray emission of the Sgr dSph against our optimized background representations. We also investigate the proposed hypothesis that the gamma-ray emission from the Sgr dSph results from its resident population of millisecond pulsars by inspecting the flux distribution of point sources within the region.

Primary authors: ECKNER, Christopher (LAPP, CNRS); CALORE, Francesca (LAPTh, CNRS); Dr MANCONI, Silvia (LAPTh, CNRS)

Presenter: ECKNER, Christopher (LAPP, CNRS)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **113** Type: **not specified**

Unique Properties of Secondary Cosmic Rays: Results from the Alpha Magnetic Spectrometer

Monday, September 11, 2023 2:10 PM (10 minutes)

We present high statistics measurements of the secondary cosmic rays Lithium, Beryllium, Boron, and Fluorine based on 11.5 years of AMS data. The properties of the secondary cosmic ray fluxes and their ratios to the primary cosmic rays Li/C, Be/C, B/C, Li/O, Be/O, B/O, and F/Si are discussed. The systematic comparison with the latest GALPROP cosmic ray model is presented.

Primary author: OCAMPO PELETEIRO, Jose (CIEMAT)

Presenter: OCAMPO PELETEIRO, Jose (CIEMAT)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **114** Type: **not specified**

Implications of Space Plasma Instabilities for TeV Astrophysics and Light Dark Matter

Tuesday, September 12, 2023 4:45 PM (15 minutes)

TeV blazars dominate the extragalactic gamma-ray sky and highly energetic pair beams arising from such blazar jets underproduce gamma rays in the GeV band while inverse-Compton scattering off the cosmic microwave background. Isotropic gamma ray background measurements strongly suggest that when the intergalactic magnetic field is feeble, space plasma instabilities can play a crucial role in alleviating this GeV-TeV tension by draining the pair beam energy into the background plasma of the intergalactic medium (IGM). Importantly, as can be realised in laboratory astrophysics experiments, energy losses through instabilities and widening of pair beams via momentum diffusion follow a closed-form Fokker-Planck evolution. This has profound implications not only for TeV astrophysics, but also the strength of the intergalactic magnetic field and nature of dark matter. A direct consequence of the instability losses and IGM heating is the modification of thermal history at late times, which suppresses structure formation particularly in baryonically underdense regions, potentially holding a clue towards resolving the small-scale crisis in cosmology. Depending on the degree of heating, the constraints on the fuzzy dark matter or light axion-like particles are modified.

Primary author: GHOSH, Oindrila (Stockholm University & the Oskar Klein Centre)

Presenter: GHOSH, Oindrila (Stockholm University & the Oskar Klein Centre)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **115** Type: **not specified**

The preliminary measurement of mean logarithmic mass of cosmic rays in the knee region with muon contents by LHAASO-KM2A

Friday, September 15, 2023 10:10 AM (20 minutes)

The kilometer-square array (KM2A) of the Large High Altitude Air Shower Observatory (LHAASO, located at 4410 m above sea level with an atmospheric depth of 600) can simultaneously measure air shower sizes of both electromagnetic particles and muon contents with high precision for cosmic rays with energies in the knee region. The energy is reconstructed by combining parameters of muons and electromagnetic particles, which is weakly dependent on the mass composition of cosmic rays. The number of muons observed at the ground from air showers is sensitive to the mass composition of cosmic rays. The preliminary results of mean logarithmic mass of cosmic rays as derived from the number of muons is presented. The systematic uncertainty of hadronic interaction models on the mean logarithmic mass is discussed.

Primary author: Dr ZHANG, Hengying (institute of high energy physics, Chian)

Co-authors: FENG, Cunfeng (Shandong University); Prof. HE, Huihai (institute of high energy physics, Chian)

Presenter: FENG, Cunfeng (Shandong University)

Session Classification: Plenary

Track Classification: Charged Cosmic Rays

Contribution ID: **116** Type: **not specified**

Measurement of the muon content in EAS with muon detectors of LHAASO-KM2A

Wednesday, September 13, 2023 5:15 PM (15 minutes)

LHAASO-KM2A is composed of 5915 scintillation detectors and 1188 muon detectors. The muon detectors cover 4% of the total array area, with an inter-detector spacing of 30 meters. This report is based on the data samples recorded by LHAASO-KM2A from August 2021 to July 2022 with zenith angle $< 40°$, which energy is estimated around $10^{14} - 10^{16.7}$eV. The Monte Carlo samples are produced for five cosmic ray components using CORSIKA for air shower simulation and GEANT4 for KM2A detector response simulation. Both hadronic interaction models EPOS-LHC and QGSJET-II-04 of CORSIKA are utilized. The lateral distribution of muons in the vertical air shower is studied within a 500-meter radius around the air shower axis, divided into five energy bins. The average muon content per shower energy is measured as the shower energy increases, and the relative fluctuation of muon content is also investigated. When comparing the results with the simulation results, no obvious deviation from the data is observed. The attenuation length of muon content in the air shower is also measured with one constant-intensity-cut method, and the variation of the attenuation length with reconstruction energy is presented. Same increasing tendency as energy is found in the simulation samples. The seasonal effect of the attenuation length also will be present.

Primary author: FENG, Xiaoting (Shandong Universty)

Co-author: Mr FENG, Cunfeng (Shandong Universty)

Presenter: FENG, Xiaoting (Shandong Universty)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **117** Type: **not specified**

Latest results on observations with the CALorimetric Electron Telescope (CALET) on the International Space Station

Friday, September 15, 2023 9:50 AM (20 minutes)

The CALorimetric Electron Telescope (CALET) is a Japan-led experiment installed on the International Space Station (ISS) in collaboration with Italy and the United States. It was developed with the purpose to carry out precision measurements of high energy cosmic-rays (CR), to investigate their origin, the mechanisms of acceleration and galactic propagation, and the presence of possible nearby astrophysical CR sources.
Optimized for the measurement of the electron+positron spectrum, CALET is collecting data since October 2015 with excellent performance and with no major interruptions.
The instrument consists of a CHarge Detector (CHD) made of two layers of segmented plastic scintillators, a 3 radiation length thick tungsten-scintillating fiber IMaging Calorimeter (IMC) and a 27 radiation length thick PWO Total AbSorption Calorimeter (TASC). CALET is able to obtain precise measurements of the fluxes of CR electrons and ɣ rays up to rays up to the TeV region, the energy spectra of CR nuclei from proton to nickel up to hundreds of TeV, secondary-to-primary ratios of individual elements from proton to iron and relative abundances up to Z=40.
In this contribution, we present the highlights of CALET observations based on the data taken during the first seven years of observation, including a direct measurement of the electron+positron spectrum, proton spectrum from 50 GeV to 60 TeV and helium spectrum from 40 GeV to 250 TeV, together with a direct measurement of other nuclei up to nickel. Some results on the electromagnetic counterpart search for LIGO/Virgo
gravitational wave events are also included.

Primary author: STOLZI FOR THE CALET COLLABORATION, Francesco (Istituto Nazionale di Fisica Nucleare)

Presenter: STOLZI FOR THE CALET COLLABORATION, Francesco (Istituto Nazionale di Fisica Nucleare)

Session Classification: Plenary

Track Classification: Charged Cosmic Rays

Contribution ID: **118** Type: **not specified**

Connection between neutrinos and flaring activity in radio and optical bands in blazar jets

Tuesday, September 12, 2023 2:45 PM (15 minutes)

Identifying the most likely sources for high-energy neutrino emission has been one of the main topics in high-energy astrophysics ever since the first observation of high-energy neutrinos by the IceCube Neutrino Observatory. Active galactic nuclei with relativistic jets pointing close to our line of sight, blazars, have been considered to be one of the main candidates due to their ability to accelerate particles to high energies. In our earlier study, we investigated the connection between radio emission and IceCube neutrino events using data from the Owens Valley Radio Observatory and Metsähovi Radio Observatory blazar monitoring programs. While not all neutrinos arrive during strong radio flares, our results suggest that when they do, it is unlikely to be a random coincidence. In this talk, I will give an update on these results using three years of additional data. I will also show the first results from our study investigating the connection between optical flares and neutrino arrival times.

Primary author: KOUCH, Pouya M.

Co-authors: LINDFORS, Elina (Tuorla Observatory, University of Turku); LIODAKIS, Ioannis (KIPAC, Stanford University); Dr KOLJONEN, Karri (Norwegian University of Science and Technology); HOVATTA, Talvikki (Tuorla Observatory)

Presenter: KOUCH, Pouya M.

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **121** Type: **not specified**

Beyond TeV: Searching for Ultrahigh Energy Neutrinos with PUEO

Monday, September 11, 2023 5:45 PM (15 minutes)

In recent years, significant strides have been made in the field of neutrino astronomy, with the discovery of the TeV/PeV astrophysical neutrino flux by the IceCube collaboration. However due to the limitations of current detectors, the neutrino flux at EeV+ energies has yet to be observed. Probing this energy region is essential for understanding the extreme-energy universe at all distance scales. The Payload for Ultrahigh Energy Observations (PUEO) is a balloon-borne experiment intended to study the ultrahigh energy neutrino regime by utilizing the Askaryan effect to observe neutrino interactions in the Antarctic ice. PUEO builds upon the previously successful Antarctic Impulsive Transient Antenna (ANITA) program, and boasts an improved design that is expected to have world-leading sensitivity to the ultrahigh-energy neutrino flux above 1 EeV. This talk will discuss the science goals, recent developments, and timeline of the PUEO experiment.

Primary author: LUSZCZAK, William

Presenter: LUSZCZAK, William

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **122** Type: **not specified**

Searching for Gamma-Ray Counterparts of IceCube Neutrino Events in the AGILE Public Archive

Tuesday, September 12, 2023 2:15 PM (15 minutes)

The search for gamma ray counterparts of IceCube neutrino events is crucial for understanding the role of blazars as possible sources of cosmic neutrinos. We have searched the counterparts for IceCube neutrinos events in the AGILE gamma-ray satellite public archive in the interval 2018-2020.
We present the candidate sources in the regions centered on the detected neutrinos and their light curves and Spectral Energy Distributions, providing estimates of the gamma ray flux above 100 MeV for the AGILE detections. The possible associations with blazars are discussed.

Primary authors: PITTORI, Carlotta (Istituto Nazionale di Fisica Nucleare); GASPARRI, Elena; LUCARELLI, Fabrizio (INAF-OAR & ASI-SSDC); GIOMMI, Paolo (Agenzia Spaziale Italiana); Prof. POGGIANI, Rosa (Universita' di Pisa)

Presenter: Prof. POGGIANI, Rosa (Universita' di Pisa)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **123** Type: **not specified**

Galactic Center Observation with the CTA LST Prototype

Monday, September 11, 2023 6:15 PM (15 minutes)

The Galactic Center is one of the most studied regions of the sky. Of particular interest is the supermassive black hole Sagittarius A, *whose proximity provides an opportunity for morphological investigations into the acceleration of cosmic rays in an extreme environment. Previous observations with very-high-energy gamma rays, in particular the detection of a diffuse emission component on a scale of hundreds of parsecs, suggest a potential connection between the extended emission and the black hole. However, the limited sensitivity and angular resolution of current telescopes hinder a definitive confirmation of this connection. To gain further insights into this important but complex region, more in-depth spectral and morphological studies, built upon deeper and wider observations with next-generation instruments including the Cherenkov Telescope Array (CTA), are required. Currently, Large-Sized Telescope prototype (LST-1) for CTA is under commissioning. Looking ahead to the forthcoming CTA Observatory, we employ the newly developed analysis chain and analyze about 40 hours of data from Galactic Center observations with LST-1 in 2021 and 2022. We detect Sagittarius A* and SNR G0.9+0.1, and obtain their spectral energy distributions consistent with the results from the current telescopes, with a broad energy coverage owing to the large-zenith-angle observation and the low energy threshold of LST-1.

Primary author: ABE, Shotaro (Institute for Cosmic Ray Research, University of Tokyo)

Co-authors: VOVK, Ievgen (ICRR, University of Tokyo); STRZYS, Marcel (ICRR, University of Tokyo); DIB, Marion (University and INFN Padova); TESHIMA, Masahiro (Max-Planck-Institut für Physik); DORO, Michele (University and INFN Padova); INADA, Tomohiro (ICRR, University of Tokyo); OHTANI, Yoshiki (ICRR, University of Tokyo)

Presenter: ABE, Shotaro (Institute for Cosmic Ray Research, University of Tokyo)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **125** Type: **not specified**

Probing Dark Matter, Matter-Antimatter Asymmetry, and Neutrino Masses with Gravitational Waves

Wednesday, September 13, 2023 3:25 PM (15 minutes)

Some of the most important open questions in particle physics are: What is dark matter? What is the origin of the domination of matter over antimatter in the Universe? How are neutrino masses generated? I will discuss how gravitational wave experiments can help us probe theories proposing solutions to the above puzzles. I will concentrate on a class of models in which baryon and lepton number are promoted to the status of gauge symmetries, and provide a concrete example of a model with an SU(2) lepton gauge group. Such theories contain dark matter particles, generate the observed matter-antimatter asymmetry, and accommodate nonzero neutrino masses. Gravitational waves are generated through first order phase transitions, as well as through the dynamics of topological defects: cosmic strings and domain walls. The expected gravitational wave spectrum is within the reach of upcoming gravitational wave detectors, including LISA, DECIGO, Big Bang Observer, Cosmic Explorer and Einstein Telescope. This presents an entirely novel way of probing this type of theories, otherwise inaccessible in conventional particle physics experiments.

Primary author: FORNAL, Bartosz (Barry University, Miami)

Presenter: FORNAL, Bartosz (Barry University, Miami)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **126** Type: **not specified**

Testing Dark Matter and Unification of Forces with Gravitational Waves

Wednesday, September 13, 2023 3:40 PM (10 minutes)

I will show that a new gravitational wave signature is expected in extensions of the Standard Model with extra gauge symmetries broken at vastly different energy scales. The spectrum contains a characteristic double-peak structure consisting of a sharp peak from domain walls and a smooth bump from a first order phase transition in the early Universe. I will provide an example of such a model, with baryon number and color unified into an SU(4) gauge group and lepton number promoted to an SU(2) gauge symmetry. The model contains two types of dark matter particles, accommodates leptogenesis, and provides nonzero neutrino masses. I will discuss how future gravitational wave experiments, such as LISA, Big Bang Observer, DECIGO, Einstein Telescope, and Cosmic Explorer, can be used to look for this novel signature.

Primary author: GARCIA, Kassandra (Barry University, Miami)

Co-authors: FORNAL, Bartosz (Barry University, Miami); PIERRE, Erika (Barry University, Miami)

Presenter: GARCIA, Kassandra (Barry University, Miami)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **127** Type: **not specified**

Gravitational Wave Probes of Models with Extra U(1) Gauge Symmetries

Wednesday, September 13, 2023 3:50 PM (10 minutes)

I will discuss new types of gravitational wave signatures which arise in extensions of the Standard Model with two U(1) gauge symmetries broken at high energy scales, focusing on the case when those symmetries are gauged baryon and lepton number. Such theories accommodate dark matter, leptogenesis, and the seesaw mechanism for neutrinos. The gravitational wave spectrum consists of contributions from first order phase transitions, cosmic strings and domain walls. The new signatures are within the reach of future experiments, such as Cosmic Explorer, Einstein Telescope, DECIGO, Big Bang Observer, and LISA.

Primary author: DELGADO, Zoraida (Barry University, Miami)

Co-authors: LEON, Alejandra (Barry University, Miami); FORNAL, Bartosz (Barry University, Miami); BOSCH, Jessica (Barry University, Miami)

Presenter: DELGADO, Zoraida (Barry University, Miami)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **128** Type: **not specified**

Constraining milli-charged particles with tip of the red giant branch brightness

Thursday, September 14, 2023 5:45 PM (15 minutes)

Milli-charged particles (MCP) can be produced through the decay of plasmon in stellar interiors and escape stars without interactions. This extra cooling could alter the brightness of low mass stars at the tip of the red giant branch (RGB). While the current stellar cooling bounds were obtained by estimating the total expected heat loss given the current stellar properties, we improve the bounds by using stellar evolution code to model the cumulative effect of MCP on the RGB tip brightnesses of selected globular clusters.

Primary authors: Prof. VINCENT, Aaron (Queen's University); FUNG, Audrey (Queen's University); SCHUTZ, Katelin (McGill University); LIU, Qinrui (Queen's University); HEEBA, Saniya (McGill University); Mr MURALIDHARAN, Varun (McGill University)

Presenter: FUNG, Audrey (Queen's University)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **129** Type: **not specified**

The cosmic-ray electron spectrum measured with the MAGIC telescopes

Monday, September 11, 2023 3:20 PM (15 minutes)

Cosmic-ray electrons and positrons (CREs) of TeV energies suffer severe energy losses during their propagation limiting their traveling distances to just a few kpc and, therefore, their measurement provides a unique channel to constrain local Galactic cosmic-ray sources. However, at high energies their detection is intrinsically difficult due to their low abundances and steep spectrum. In this context, ground-based imaging atmospheric Cherenkov telescopes (IACTs), such as MAGIC, can profit from their large collection areas to perform studies of CREs at energies where space-borne detectors are less sensitive. In this presentation, we will present two methods - a template fit method and a tight cut method - designed to detect and study CREs with IACTs. We will then apply these methods on data collected by the MAGIC telescopes to measure the energy spectrum of CREs between 300 GeV and 7 TeV. Additionally, we will provide a detailed analysis of the systematic errors that may affect this measurement.

Primary authors: KERSZBERG, Daniel (IFAE-BIST); ISHIO, Kazuma; MANGANO, Salvatore; CHAI, Yating

Presenter: KERSZBERG, Daniel (IFAE-BIST)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **130** Type: **not specified**

Search for dark matter annihilation with a combined analysis of dwarf spheroidal galaxies from Fermi-LAT, HAWC, H.E.S.S., MAGIC and VERITAS

Monday, September 11, 2023 2:45 PM (15 minutes)

Dwarf spheroidal galaxies (dSphs) are among the most dark matter (DM) dominated objects, with negligible expected astrophysical gamma-ray emission. This makes nearby dSphs ideal targets for indirect searches of a DM particle signal. The accurate knowledge of their DM content makes it possible to derive robust constraints on the velocity-weighted cross section of DM annihilation. We report on a joint analysis of 20 dSphs observed by Fermi-LAT, HAWC, H.E.S.S., MAGIC, and VERITAS using a common maximum likelihood approach in order to maximize the sensitivity of DM searches towards these targets. Results for seven annihilation channels and spanning a range of DM masses from 5 GeV to 100 TeV will be presented. Furthermore, the systematic uncertainties coming from the astrophysical J-factors calculated from the dSph dynamics will be discussed by comparing results obtained using two different sets of J-factors.

Primary authors: ZITZER, Benjamin; ARMAND, Celine; GIURI, Chiara; KERSZBERG, Daniel (IFAE-BIST); SALAZAR-GALLEGOS, Daniel; PUESCHEL, Elisa; MOULIN, Emmanuel; CHARLES, Eric; HARDING, J. Patrick; RICO, Javier; TOLLEFSON, Kirsen; OAKES, Louise; RINCHIUSO, Lucia; DI MAURO, Mattia; MIENER, Tjark; POIREAU, Vincent

Presenter: KERSZBERG, Daniel (IFAE-BIST)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **131** Type: **not specified**

Dark correlations

Tuesday, September 12, 2023 10:10 AM (20 minutes)

In this talk I will focus on a promising novel line of research for dark matter indirect detection, called the cross-correlation technique. This novel technique aims to correlate two distinctive features of DM: on one side, an electromagnetic signal, which is a manifestation of the particle nature of DM and, on the other side, a gravitational tracer of the DM distribution in the Universe. A positive signal in this cross-correlation would indicate that the cause of the gravitational anomalies –which we call DM - indeed consists of exotic physics. One of the main advantages in principle is the ability to disentangle the astrophysical background from a potential dark matter signal by exploiting the different redshift distribution. Complementary information can be derived by considering different types of signals (photons, neutrinos, etc) and different gravitational tracers (21cm line of neutral hydrogen, galaxy catalogs, galaxy clusters, weak lensing, etc). In this talk, I will revise the current status of this line of research and the prospects for the future. In particular, I will explore a recent idea to use cosmic voids as a new tracer.

Primary author: PINETTI, Elena (Fermilab)

Presenter: PINETTI, Elena (Fermilab)

Session Classification: Plenary

Track Classification: Indirect DM searches

Contribution ID: **132** Type: **not specified**

Unraveling Geminga TeV halo with the Cherenkov Telescope Array

Monday, September 11, 2023 4:30 PM (15 minutes)

Galactic pulsars, such as Geminga, are surrounded by a bright and extended TeV emission. This radiation is compatible with multi-TeV electrons scattering off low-energy photons via the inverse-Compton scattering process. To date, about 10 TeV halos have been observed around known pulsars. Next-generation gamma-ray detectors, such the Cherenkov Telescope Array (CTA), will have unprecedented sensitivity to the extended emission around pulsars. In this talk I will illustrate how CTA will enable us to unravel with extraordinary precision some key properties of Geminga and its surrounding environment, including the injection spectrum, the spin down luminosity and the diffusion coefficient. Last but not least, TeV halo might represent a novel and revolutionary way to detect new pulsars, allowing us to build larger pulsar catalogues and better understand these fascinating neutron stars.

Primary author: PINETTI, Elena (Fermilab)

Presenter: PINETTI, Elena (Fermilab)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **133** Type: **not specified**

Dark Matter indirect detection, news and reviews

Tuesday, September 12, 2023 9:00 AM (25 minutes)

I will discuss the current status of various dark matter indirect probes, some recent new developments, and possible new directions in the future.

Primary author: NG, Kenny Chun Yu (Department of Physics, The Chinese University of Hong Kong)

Presenter: NG, Kenny Chun Yu (Department of Physics, The Chinese University of Hong Kong)

Session Classification: Plenary

Track Classification: Indirect DM searches

Contribution ID: **134** Type: **not specified**

Constraints on dark matter from strong gravitational lensing in the era of JWST

Tuesday, September 12, 2023 9:50 AM (20 minutes)

Strong lensing provides a direct, purely gravitational method to infer the abundance and internal structure of dark matter halos, which in turn depend on the particle nature of dark matter. Follow up of quadruple image strong lens systems with JWST will deliver more precise and constraining measurements than currently possible with HST, leading to unprecedented constraints on the nature of dark matter. I will discuss the latest bounds on warm and self-interacting dark matter from quadruple-image lenses observed in late 2022 and mid 2023 by JWST, and discuss the future of strong lensing constraints on dark matter with an increasing sample size of lens systems.

Primary author: GILMAN, Daniel (University of Chicago)

Presenter: GILMAN, Daniel (University of Chicago)

Session Classification: Plenary

Track Classification: Cosmology

Contribution ID: **135** Type: **not specified**

Particle Astrophysics Counterparts of Cosmological Gravitational Wave Signals

Wednesday, September 13, 2023 4:30 PM (25 minutes)

Understanding the gravitational wave signals from cosmological sources, such as first order phase transitions and cosmic strings, is currently a popular and active area of research. Such sources can also produce energetic particles, such as gamma rays, neutrinos, and dark matter, thereby producing distinct particle astrophysics signals. This talk will provide a broad discussion of the challenges involved in calculating such signals, as well as salient observational features that could lead to discovery.

Primary author: SHAKYA, Bibhushan (DESY)

Presenter: SHAKYA, Bibhushan (DESY)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **136** Type: **not specified**

Overview of the recent results of the Telescope Array experiment

Wednesday, September 13, 2023 3:30 PM (15 minutes)

The Telescope Array (TA) experiment is the largest observatory for ultra-high energy cosmic rays (UHECRs) in the northern hemisphere. The TA experiment, along with its low-energy extension (TALE), employs plastic scintillator detectors and fluorescence detectors to observe cosmic-ray-induced air showers ranging from 2 PeV and 100 EeV. In this presentation, we provide an overview of the current status and recent results obtained from the TA experiment, focusing on cosmic-ray anisotropy, energy spectrum and mass composition analyses. We also discuss the future prospects of the TA experiment.

Primary author: FUJISUE, Kozo (ICRR, the University of Tokyo)

Presenter: FUJISUE, Kozo (ICRR, the University of Tokyo)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **137** Type: **not specified**

Recent IceCube results on the origin of cosmic neutrinos

Monday, September 11, 2023 2:00 PM (15 minutes)

IceCube's discovery of the astrophysical neutrino flux in the TeV-PeV range marked a crucial milestone in the development of high-energy neutrino astronomy. Recent searches identified the blazar TXS 0506+056 and the Seyfert Galaxy NGC 1068 as the first candidates for extragalactic neutrino emitters, standing out above the largely isotropic neutrino flux. While both objects are classified as Active Galactic Nuclei, their neutrino emission spectra differ substantially: TXS 0506+056 emits neutrinos with a hard energy spectrum, whereas NGC 1068 emits neutrinos with a soft spectrum. This difference hints at multiple source populations, adding complexity to the cosmic puzzle we aim to solve. Expanding our understanding of the neutrino sky, IceCube now confirmed the long-sought galactic neutrino flux in addition to the dominant extragalactic flux. Multiple models for galactic neutrino emission were tested, but no clear preference of one model compared to the others was found. In this talk, we will present an overview over these recent IceCube results on the origin of the galactic and extragalactic neutrino flux.

Primary author: Dr SCHUMACHER, Lisa (Erlangen Centre for Astroparticle Physics (ECAP))

Presenter: Dr SCHUMACHER, Lisa (Erlangen Centre for Astroparticle Physics (ECAP))

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **138** Type: **not specified**

Signatures of and constraints on Primordial Black Holes as dark matter

Tuesday, September 12, 2023 9:25 AM (25 minutes)

I will review the Primordial Black Hole (PBH) hypothesis for explaining the dark matter in the universe. I will focus on the peculiar 'asteroid mass range'where this possibility remains viable, discussing a number of signatures that have been proposed to search for them, and present current constraints. I will conclude highlighting some perspectives for the foreseeable future.

Primary author: SERPICO, Pasquale Dario (CNRS, Laboratoire d'Annecy-le-Vieux de Physique Théorique (LAPTh), France)

Presenter: SERPICO, Pasquale Dario (CNRS, Laboratoire d'Annecy-le-Vieux de Physique Théorique (LAPTh), France)

Session Classification: Plenary

Track Classification: Indirect DM searches

Contribution ID: **139** Type: **not specified**

Broad-band energy modelization of AGNs observed with CTA LST-1

Wednesday, September 13, 2023 2:00 PM (15 minutes)

Jetted AGNs, also called blazars when the jet is oriented toward the observer, are the brightest persistent γ-ray sources in the extragalactic sky.
The next generation Cherenkov Telescope Array Observatory (CTAO) will include telescopes with three different size to cover the full range of energy (from 20 GeV up to 300 TeV) in order to reach unpreceded capabilities in the observation of the gamma-ray sky, opening a new window in the study of very-high-energy gamma-ray emission from AGNs. The prototype of the Large-Sized Telescopes (LSTs), called LST-1, covering an energy range from 20GeV to a few TeV, is already operating at La Palma, in the Canary Islands, and has detected some well known high-energy AGNs.
In order to fully interpret the highest γ-ray emission, the spectral modeling of multi-frequency data allows us to better understand the physics behind the formation of AGN jets and to identify deviations from the standard radiative model of blazars. To model the broad-band energy emission of blazars, powerful analysis tools are required.
In this talk, firstly I will present the spectral analysis of LST-1 observations of two AGNs, PG1553+113 and 1ES067+250. Then I will introduce an open virtual environment for modeling the multi-wavelength spectral energy distribution of blazars and, in particular, the results obtained for the two aforementioned sources.

Primary author: PONS, Estelle (LAPP / CNRS)

Presenter: PONS, Estelle (LAPP / CNRS)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **140** Type: **not specified**

An indirect search for Dark Matter with a combined analysis of dwarf spheroidal galaxies from VERITAS

Monday, September 11, 2023 2:30 PM (15 minutes)

The nature and characteristics of dark matter (DM) have long been a mystery in cosmology and astrophysics. Various DM theories propose that weakly interacting massive particles (WIMPs; mass ~ 1 TeV) can decay or annihilate into standard model particles, producing electromagnetic radiation, specifically very-high-energy (VHE) gamma rays exceeding 100 GeV. Additionally, ultra-heavy DM (mass > 100 TeV) has been proposed as another possible candidate for DM.

The Very Energetic Radiation Imaging Telescope Array System (VERITAS) consists of four imaging atmospheric Cherenkov telescopes (IACTs) that can indirectly detect VHE gamma rays in the energy range of 100 GeV to over 30 TeV. Dwarf spheroidal galaxies (dSphs) are considered excellent targets for the search for DM signal due to their high DM density and low gamma-ray emissions from other sources.

This study uses a larger dataset and improved analysis methods than previous VERITAS DM searches. The analysis results of the extended VERITAS dSph dataset, including the derived upper limits on the DM velocity-weighted cross section, will be presented in this contribution.

Primary author: TAK, Donggeun (Seoul national university)

Presenter: TAK, Donggeun (Seoul national university)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **141** Type: **not specified**

Constraints on axion-like particles with the Perseus Galaxy Cluster with MAGIC

Tuesday, September 12, 2023 3:45 PM (15 minutes)

Axion-like particles (ALPs) are a class of pseudo-Nambu-Goldstone bosons that have been proposed as potential candidates for dark matter. When propagating through astronomical environments embedded with magnetic fields, very high-energy gamma rays can convert to ALPs, modifying the spectral energy distribution of the observed target. Our study employs around 40 hours of data from the MAGIC telescopes obtained from the observations of the Perseus Galaxy Cluster, in particular, the radio galaxy NGC1275 and the high frequency peaked BL Lac object IC310. Given its proximity and strong magnetic field, which extends up to several hundreds of kpc, Perseus is a viable candidate for such a study. By searching for distinctive spectral signatures and introducing a new statistical approach to the analysis, we confirmed constraints on ALPs with masses in the neV-μeV range and established the most stringent limits for ALPs with masses around 40 neV. Furthermore, the results of this research unveiled new prospects for performing similar studies with the new upcoming gamma-ray ground-based instruments.

Primary authors: BATKOVIC, Ivana (Istituto Nazionale di Fisica Nucleare); D'AMICO, Giacomo; DORO, Michele (University and INFN Padova); Dr MANGANARO, Marina

Presenter: BATKOVIC, Ivana (Istituto Nazionale di Fisica Nucleare)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **142** Type: **not specified**

Radio and Neutrino Constraints on Cosmic Ray Acceleration in Massive Galaxy Clusters

Thursday, September 14, 2023 6:00 PM (15 minutes)

Galaxy Clusters are considered to be efficient containers of cosmic rays (CRs). In their formation history, CRs are accelerated by active galactic nuclei, and cosmological shocks and turbulence, and they are accumulated in the intra-cluster space. The magnetic field and cosmic ray electrons in massive clusters have been proved with the observations diffuse radio emission. However, the content of cosmic ray protons is highly uncertain. We study the acceleration of CR electrons and protons in galaxy clusters by modeling the multi-wavelength emission in various clusters with different formation histories. We use the so-called merger tree method to simulate the merger history of clusters. The long-term evolution of the CR distribution is followed by solving the Fokker-Planck equations incorporating the CR re-acceleration by turbulence, which is thought to be the dominant mechanism of the diffuse radio emission. We find that the combination of radio surveys and the stacking analysis of neutrino background gives meaningful constraints on the CR proton content in massive clusters even in the presence of the re-acceleration.

Primary author: NISHIWAKI, Kosuke (ICRR)

Co-authors: ASANO, Katsuaki (Institute for Cosmic Ray Research, The University of Tokyo); MURASE, Kohta

Presenter: NISHIWAKI, Kosuke (ICRR)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **145** Type: **not specified**

Searches for anisotropy in arrival directions of UHECRs with the Pierre Auger Observatory: updates and prospects

Wednesday, September 13, 2023 4:30 PM (15 minutes)

The origin of cosmic rays has been one of the motivating questions of the astrophysics field for over a century, an open and exciting topic since then. To help answer this question, the Pierre Auger Observatory investigates the anisotropies of the ultra-high-energy cosmic rays (UHECRs) —with energies above $\sim$32 PeV —at small, intermediate, and large angular scales. The Observatory has been collecting data for over 19 years, reaching more than 135 000 km^2 yr sr of accumulated exposure, with the surface detectors spread over 3000 km^2. So far, the most significant discovery is a large-scale dipole structure with a total amplitude of approximately 7%. This results from the observed modulation in right ascension in the inclusive energy bin above 8 EeV, where the computed dipole equatorial component has a statistical significance of over 5σ. In this contribution, we present the latest updates on anisotropy searches. In addition to the limits on modulation in right ascension constrained from $\sim$32 PeV to $\geq$32 EeV, the results outlined in this presentation include catalog-based and overdensity searches, with a reported excess around the Centaurus region. Finally, we discuss the prospects of anisotropy searches in light of mass-composition information of Phase II of the Pierre Auger Observatory, AugerPrime.

Primary author: MARTINS, Edyvania Emily (on behalf of the Pierre Auger Collaboration)

Presenter: MARTINS, Edyvania Emily (on behalf of the Pierre Auger Collaboration)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **146** Type: **not specified**

Antiproton Flux and Properties of Elementary Particle Fluxes in Primary Cosmic Rays Measured with the Alpha Magnetic Spectrometer on the ISS

Monday, September 11, 2023 3:10 PM (10 minutes)

Latest results by AMS on the fluxes and flux ratios of charged elementary particles in the absolute rigidity range from 1 up to 2000 GV reveal unique properties of cosmic charged elementary particles. In the absolute rigidity range ~60 to ~500 GV, the antiproton flux and proton flux have nearly identical rigidity dependence. This behavior indicates an excess of high energy antiprotons compared with secondary antiprotons produced from the collision of cosmic rays. More importantly, from ~60 to ~500 GV the antiproton flux and positron flux show identical rigidity dependence. The positron-to-antiproton flux ratio is independent of energy and its value is determined to be a factor of 2 with percent accuracy. This unexpected observation indicates a common origin of high energy antiprotons and positrons in the cosmos.

Primary author: Dr TANG, Zhicheng (Institute of High Energy Physics, Chinese Academy of Sciences)

Co-authors: Dr CHOU, Hsin-Yi (Institute of Physics, Academia Sinica, Taiwan); Dr WENG, Zhili (Massachusetts Institute of Technology)

Presenter: Dr TANG, Zhicheng (Institute of High Energy Physics, Chinese Academy of Sciences)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **147** Type: **not specified**

Understanding the Origin of Cosmic-Ray Electrons

Monday, September 11, 2023 3:00 PM (10 minutes)

We present the latest precision measurements of the electron flux based on 57 million electron events collected by the Alpha Magnetic Spectrometer on the International Space Station during first eleven years of operations. These results on cosmic-ray electrons in the energy range from 0.5 GeV to 2 TeV reveal new features that are crucial for providing insights into their origins. Comparing the behavior of the electron spectrum with the spectrum of positrons measured by AMS, we found that at lower energies below few hundred GeV these two spectra have distinctly different magnitudes and energy dependences. This shows that at lower energies these two species of cosmic ray particles have very different origins. At high energies we observe that the source of high energy positrons, which has either particle or astrophysical origin, also manifests itself in the electron spectrum. This is the first indication of the existence of identical charge symmetric source term both in the positron and in the electron spectra and, as a consequence, the existence of new physics.

Primary authors: KRASNOPEVTSEV, Dimitrii (Massachusetts Inst. of Technology (US)); Dr WENG, Zhili (Massachusetts Institute of Technology)

Presenter: KRASNOPEVTSEV, Dimitrii (Massachusetts Inst. of Technology (US))

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **148** Type: **not specified**

Understanding the Origin of Cosmic-Ray Positrons

Monday, September 11, 2023 2:40 PM (10 minutes)

We present the precision measurements of eleven years of the cosmic-ray positrons flux in the energy range from 0.5 GeV to 1.4 TeV based on 3.9 million positrons collected by the Alpha Magnetic Spectrometer on the International Space Station. The positron flux measured by the AMS exhibits complex and unexpected energy dependence. Its distinctive properties are: a significant excess starting from ~20 GeV and a sharp drop-off above 260 GeV. In the entire energy range the positron flux is well described by the sum of a power-law term associated with the positrons produced in the collision of cosmic rays, which dominates at low energies, and a new source term of positrons, which dominates at high energies. This new source has a finite energy cutoff, which is established with a significance of ~5σ. These unique experimental data on cosmic ray positrons show that, at high energies, they predominantly originate either from dark matter annihilation or from a new astrophysical source.

Primary authors: Dr WENG, Zhili (Massachusetts Institute of Technology); KRASNOPEVTSEV, Dimitrii (Massachusetts Inst. of Technology (US))

Presenter: Dr WENG, Zhili (Massachusetts Institute of Technology)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **150** Type: **not specified**

Decay of heavy dark matter at future ultra-high-energy neutrino telescopes: enhanced potential of joint energy and angular analysis

Monday, September 11, 2023 5:45 PM (15 minutes)

Upcoming neutrino telescopes will have an unprecedented sensitivity to ultra-high-energy (UHE) neutrinos, above 10 PeV. This achievement will allow to test physics beyond the Standard Model at a very high energy scale, including the decay of heavy dark matter particles. Previous works acknowledged this possibility, showing that the total number of detected events will allow to set competitive bounds on dark matter lifetime in the mass range above 10 PeV. We adopt a detailed modeling of the radio array at IceCube-Gen2 to investigate how these bounds are improved by a full spectral and angular analysis of the detected events. In the case of non-existence of heavy dark matter, an angular analysis strengthens the projected bounds, due to the characteristic signal anisotropy towards the Galactic center; in the case of its existence, such an anisotropy may provide a signature allowing discrimination between UHE neutrinos from dark matter and those of astrophysical origin.

Primary authors: FIORILLO, Damiano (Niels Bohr Institute, Copenhagen); BUSTAMANTE, Mauricio (Niels Bohr Institute, Copenhagen); VALERA, Victor (Niels Bohr Institute, Copenhagen); WINTER, Walter (DESY Zeuthen)

Presenter: FIORILLO, Damiano (Niels Bohr Institute, Copenhagen)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **151** Type: **not specified**

CR antinuclei predictions and their detectability in the next years

Tuesday, September 12, 2023 2:00 PM (15 minutes)

The creation of anti-nuclei in the Galaxy has been has been discussed as a possible signal of exotic production mechanisms such as primordial black hole evaporation or dark matter decay/annihilation, in addition to the conventional production from cosmic-ray (CR) interactions. Tentative observations of CR antihelium by the AMS-02 collaboration have re-energized the quest to use antinuclei to search for physics beyond the standard model.
In this talk, we show state-of-art predictions of the antinuclei spectrum from both astrophysical and standard dark matter annihilation models obtained from combined fits to high-precision antiproton data as well as CR nuclei measurements (specially B, Be, Li). Astrophysical sources are capable of producing $\mathcal{O}(1)$ antideuteron event and $\mathcal{O}(0.1)$ antihelium events over 15~years of AMS-02 observations. Standard dark matter models could potentially produce $\mathcal{O}(1)$ antihelium event, while the production of a larger antihelium flux would require more novel dark matter model building. We also discuss that annihilation/decay of a QCD-like dark sector could potentially explain the AMS-02 preliminary observations of antihelium-3 and antihelium-4.

Primary author: DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University)

Presenter: DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **152** Type: **not specified**

Scrutinizing current uncertainties on cosmic-ray positron predictions

Wednesday, September 13, 2023 2:00 PM (15 minutes)

Cosmic-ray (CR) antiparticles have the potential to reveal signatures of unexpected astrophysical processes and new physics. Recent CR detectors have provided accurate measurements of the positron flux, revealing the so-called positron excess at high energies. However, the uncertainties related to the modelling of the positron flux are still too high, significantly affecting our models of positron emission from pulsars and current dark matter searches.
In this talk, I'll show state-of-the-art predictions of CR positrons at Earth, focusing on the treatment of the secondary production of these particles. We show new cross sections derived from the FLUKA code and discuss the uncertainties related to cross sections, as well as to the other main sources of uncertainties affecting our predictions of CR positrons. Finally, we comment on the impact of these uncertainties in the evaluation of the positron emission from nearby pulsars and current WIMP searches with positrons.

Primary authors: Prof. MAZZIOTTA, Mario Nicola (INFN Bari); DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University)

Presenter: DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **153** Type: **not specified**

Simulation of radio signals from cosmic-ray cascades in air and ice as observed by in-ice Askaryan radio detectors

Wednesday, September 13, 2023 5:30 PM (15 minutes)

To detect the cosmic neutrino flux at the highest energies, Askaryan radio detectors are being deployed in the polar regions. These detectors use the radio detection technique to cover multi-gigaton detection volumes to probe neutrino interactions in the polar ice. Cosmic ray showers can serve as essential calibration sources for in-ice Askrayan radio detectors. However, if not well understood, radio emissions from cosmic ray showers pose an essential background signal in the neutrino search. The neutrino signal is almost perfectly mimicked by cosmic-ray particle cascades moving from air to ice. We present a simulation framework to model the radio emissions from cosmic-ray showers by combining the in-air and in-ice radio emission frameworks to fully characterize the cosmic-ray radio signal as observed by the in-ice antennas. The framework involves a CoREAS-based code to simulate in-air radio emissions and a GEANT4-based code for in-ice radio emissions from cosmic-ray showers as seen by an in-ice antenna. The cosmic-ray shower particles that reach the ice surface at the end of the CORSIKA 7 simulation are injected into the GEANT4-based shower simulation code that takes the cosmic-ray shower particles and propagates them further into the ice sheet. The CoREAS-based and the GEANT4-based codes have been adapted to account for curved ray paths caused by the exponential refractive index profiles of air and ice.

Primary authors: Mr DE KOCKERE, Simon (VUB); Dr LATIF, Uzair (VUB)

Co-authors: Mr VAN DEN BROECK, Dieder (VUB); Prof. DE VRIES, Krijn (VUB); Prof. VAN EIJNDHOVEN, Nick (VUB); Prof. BUITINK, Stijn (VUB); Prof. HUEGE, Tim (KIT,VUB)

Presenter: Dr LATIF, Uzair (VUB)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **155** Type: **not specified**

High energy neutrinos as probes of soft lepton number violation

Tuesday, September 12, 2023 4:45 PM (15 minutes)

Ever since the discovery of neutrinos, we have wondered if neutrinos are their own antiparticles, and whether lepton number is violated or not. One remarkable possibility is that lepton-number violation in the Standard Model is soft. In such scenarios, neutrinos have a pseudo-Dirac nature, with a tiny mass difference between active and sterile states, having oscillations driven by this tiny mass difference. Such oscillations can only be visible over very long distances. In this talk, I will discuss how analyzing the neutrino data from far away sources like supernovae as well as other high energy neutrino sources in the light of active-sterile oscillations can be used to test the possible, albeit tiny, violation of lepton number.

Primary author: SEN, Manibrata (Max-Planck-Institut für Kernphysik)

Presenter: SEN, Manibrata (Max-Planck-Institut für Kernphysik)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **156** Type: **not specified**

Real-time analysis framework for multi-messenger astronomy with the KM3NeT neutrino telescope

Wednesday, September 13, 2023 6:05 PM (25 minutes)

KM3NeT is a multi-site and multi-purpose neutrino telescope under construction in the depth of the Mediterranean Sea. It consists of two Cherenkov telescopes, ARCA (in Italy) and ORCA (in France), both of which are currently taking data with partial detector configurations. Among the primary scientific goals of KM3NeT is the observation of cosmic neutrinos and the identification of their sources. Although having different primary goals, ARCA and ORCA allow for the exploration of neutrino astronomy from MeV to tens of PeV, being optimized in complementary energy ranges. KM3NeT is involved in a global multimessenger programme, which includes sending public/private neutrino alerts in real-time to the astronomy community to trigger electromagnetic follow-up observations of interesting events, as well as searching for neutrinos in spatial and temporal coincidence with promising transient astrophysical sources seen in gravitational waves, X rays, gamma rays, and other wavelengths. Neutrino data provide improved power to detect high-energy transient sources: contrary to traditional telescopes, underwater Cherenkov-based neutrino detectors have a field of view comprising the whole sky, thus they are ideally suited to detect and promptly inform other research infrastructures about interesting events. As emission from transient astrophysical sources can rapidly fade, neutrino alerts need to be shared with low latency, in order to allow for a prompt follow-up in the multi-messenger and multi-wavelength domains, particularly for the detection of transient and variable sources. In the case of poorly localized triggers, such as gravitational waves, KM3NeT can provide refined pointing directions, representing a further advantage.
The real-time multimessenger analysis framework is currently being implemented in KM3NeT. This contribution reports on the status of the software architecture that is being implemented for a fast reconstruction and classification of events occurring in both ORCA and ARCA, as well as the first results achieved though online analyses.

Primary authors: VEUTRO, Alessandro (Istituto Nazionale di Fisica Nucleare); TANASIJCZUK, Andres Jorge (Simon Fraser University); TANASIJCZUK, Andres; ZEGARELLI, Angela (Istituto Nazionale di Fisica Nucleare); GIORGIO, Emidio Maria (Istituto Nazionale di Fisica Nucleare); LE GUIRRIEC, Emmanuel (Aix Marseille Univ, CNRS/IN2P3, CPPM, Marseille, France); FILIPPINI, Francesco (Istituto Nazionale di Fisica Nucleare); VANNOYE, Godefroy; PALACIOS GONZÁLEZ, Juan; DE FAVEREAU, Jérome; MASTRODICASA, Massimo (ROMA1); DEMIN, Pavel (CP3); LE STUM, Sebastien; CELLI, Silvia (Istituto Nazionale di Fisica Nucleare); DORNIC, damien (cnrs)

Presenter: ZEGARELLI, Angela (Istituto Nazionale di Fisica Nucleare)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **157** Type: **not specified**

Effect of Trans-Planckian Environment on Primordial Spectra and Non-Gaussianity

Tuesday, September 12, 2023 5:10 PM (20 minutes)

We investigate the impact of stochastic quantum noise due to trans–Planckian effects on the primordial power spectrum for gravity waves during inflation. Given an energy scale Lambda, expected to be close to the Planck scale m_Pl and larger than the Hubble scale H, this noise is described in terms of a source term in the evolution equation for comoving modes k which changes its amplitude growth from early times as long as the mode physical wavelength is smaller than Λ^{-1}. We model the source term as due to a gas of black holes in the trans–Planckian regime and the corresponding Hawking radiation. In fact, for energy scales larger than, or of the order of Lambda, it is expected that trapped surfaces may form due to large energy densities. At later times the evolution then follows the standard sourceless evolution. We find that this mechanism still leads to a scale-invariant power spectrum of tensor perturbations, with an amplitude that depends upon the ratio Λ/m_{Pl}. This result is compatible with recent observations and can allow the slow-roll parameter space to scan a new range of values. Finally, we also discuss, for a more general model, the forecast on the primordial tensor non-gaussianity in the presence of stochastic sources.

Primary authors: Prof. MANGANO, Gianpiero (Università di Napoli Federico II & INFN Sezione di Napoli); Dr FASIELLO, Matteo (IFT - Madrid); CIELO, Mattia (Istituto Nazionale di Fisica Nucleare); Prof. PISANTI, Ofelia (Università di Napoli Federico II & INFN Sezione di Napoli)

Presenter: CIELO, Mattia (Istituto Nazionale di Fisica Nucleare)

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **159** Type: **not specified**

GRB-UHECRs connection after detection of the B.O.A.T. GRB 221009A

Wednesday, September 13, 2023 11:25 AM (25 minutes)

Gamma-ray bursts have been hypothesized as the sources of ultrahigh-energy cosmic rays. The direct evidence, however, is still missing. Recent detection of gamma-rays exceeding 10 TeV from the record-breaking "brightest of all time"or the B.O.A.T. burst GRB 221009A provides clues to whether UHECRs are accelerated and responsible for producing very high energy gamma rays. In this talk I will give an overview of UHECR acceleration in GRBs and focus on VHE emission from GRB 221009A induced by UHECRs.

Primary author: RAZZAQUE, Soebur (University of Johannesburg Centre for Astro-Particle Physics)

Presenter: RAZZAQUE, Soebur (University of Johannesburg Centre for Astro-Particle Physics)

Session Classification: Plenary

Track Classification: Gamma Ray Astronomy

Contribution ID: **160** Type: **not specified**

A study of super-luminous stars with the Fermi Large Area Telescope

Monday, September 11, 2023 5:00 PM (15 minutes)

The -ray emission from stars is induced by the interaction of cosmic rays with stellar atmospheres and photon fields. This emission is expected to come in two main components: a stellar disk emission, where -rays are mainly produced in atmospheric showers generated by hadronic cosmic rays, and an extended halo emission, where the high density of soft photons in the surroundings of stars create a suitable environment for -ray production via inverse Compton (IC) scattering by cosmic-ray electrons. Besides the Sun, no other disk or halo from single stars has ever been detected in -rays. However, by assuming a cosmic-ray spectrum similar to that observed on Earth, the predicted -ray emission of super-luminous stars, like e.g. Betelgeuse and Rigel, could be high enough to be detected by the Fermi Large Area Telescope (LAT) after its first decade of operations. In this work, we use 12 years of Fermi-LAT observations along with IC models to study 9 super-luminous nearby stars, both individually and via stacking analysis. Our results show no significant -ray emission, but allow us to restrict the stellar -ray fluxes to be on average $< 3.3 \times 10^{-11}$ ph cm^{-2} s^{-1} at a 3 confidence level, which translates to an average local density of electrons in the surroundings of our targets to be less than twice of that observed for the Solar System.

Primary author: DE MENEZES, Raniere Maciel (Istituto Nazionale di Fisica Nucleare)

Co-author: ORLANDO, Elena (University of Trieste/Istituto Nazionale di Fisica Nucleare and Stanford University)

Presenter: DE MENEZES, Raniere Maciel (Istituto Nazionale di Fisica Nucleare)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **161** Type: **not specified**

Development of a new IceCube realtime alert using multiplet signal for optical follow-up

Wednesday, September 13, 2023 5:25 PM (15 minutes)

Multimessenger observation of neutrino sources is a key for identifying the origin of astrophysical neutrinos, and it led to the identification of the blazar TXS 0506+056 as the first candidate in 2017. When the IceCube observatory detects likey astrophysical neutrino events, alerts are sent to the other telescopes to trigger follow up observations. A newly proposed algorithm is optimized to find long timescale doublets and triplets, where two or three astrophysical neutrino event candidates are observed from the same direction within 30 days. This signature selects neutrino sources close to our galaxy, and makes it easier to do the follow up observation by optical telescopes. To characterize the alert before live operation, an archival analysis was performed using 12 years of data collected from 2011 to 2022 and confirmed the validity of the algorithm. The archival analysis will be presented along with the sensitivities to future alerts.

Primary author: SHIMIZU, Nobuhiro (The University of Tokyo)

Presenter: SHIMIZU, Nobuhiro (The University of Tokyo)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **162** Type: **not specified**

How the dynamical properties of globular clusters impact their γ-ray and X-ray emission

Monday, September 11, 2023 3:30 PM (15 minutes)

The X-ray and γ-ray emission of globular clusters (GCs) is attributed to their large fraction of compact binary systems, especially those with millisecond pulsars (MSPs). We analyze a population of 124 Galactic GCs to investigate how their dynamical properties affect the formation and evolution of compact binary systems and how this can be translated into the clusters' observed X-ray and γ-ray emission. We use mainly Chandra X-ray Observatory and Fermi Large Area Telescope observations to achieve our goals and start by detecting 39 GCs in γ rays, seven of which are not listed in previous Fermi-LAT catalogs. Additionally, we find that the total number of X-ray sources within a GC and its γ-ray luminosity are linearly correlated with the stellar encounter rate, indicating that compact binary systems are mainly formed via close stellar encounters. We also find an unexpected rise in the number of X-ray sources for GCs with low rates of stellar encounters, suggesting that there is a dynamical threshold where the formation of X-ray sources is dominated by stellar encounters. Furthermore, we use the Heggie-Hills law to find that subsequent stellar encounters in these compact binaries will, on average, make the binaries even harder, with basically no possibility of binary ionization. Finally, we find that all GCs are point-like sources in γ rays, indicating that the MSPs are concentrated in the clusters' cores, likely due to dynamical friction.

Primary author: DE MENEZES, Raniere Maciel (Istituto Nazionale di Fisica Nucleare)

Presenter: DE MENEZES, Raniere Maciel (Istituto Nazionale di Fisica Nucleare)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **163** Type: **not specified**

The very-high-energy emission of the Crab pulsar with MAGIC

Monday, September 11, 2023 2:30 PM (15 minutes)

The Crab pulsar (PSR J0534+2200), whilst being among the best studied objects in the sky, still challenges our understanding of the very-high-energy (VHE) emission processes in pulsars. Pulsed gamma rays are detected beyond 1 TeV, with a phase-folded lightcurve that presents two characteristic peaks joint by a "bridge". The trailing peak progressively becomes more dominant as energy increases from the 100 MeV range towards the 100 GeV scale, mirroring the behavior observed in X-rays. While generally involving a synchro-curvature and inverse-Compton component, different theoretical frameworks disagree in the identification of the emission region and its dynamics.

In this talk, we will present extensive observations of the Crab pulsar by the MAGIC telescopes, focussing in the low-energy range between 20 GeV and 400 GeV, and totalling to more than 100 h of good quality data. Phase-resolved spectra are derived and compared with the high-energy emission obtained from Fermi-LAT, resulting in a unique and novel joint dataset of the flux development both in energy and phase. The stability of the VHE emission over timescales of weeks to months is also assessed for the first time.

MAGIC consists of two twin imaging atmospheric Cherenkov telescopes operating jointly in stereoscopic mode on the Canary island of La Palma, in Spain.

Primary author: Dr CERIBELLA, Giovanni (Max-Planck-Institut for Physics)

Co-authors: Dr D'AMICO, Giacomo (University of Bergen); Dr MIRZOYAN, Razmik (Max-Planck--Institut for Physics)

Presenter: Dr CERIBELLA, Giovanni (Max-Planck-Institut for Physics)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **165** Type: **not specified**

Limits on light primordial black holes from high-scale leptogenesis

Tuesday, September 12, 2023 3:00 PM (20 minutes)

Among mechanisms for generating the baryon asymmetry of the universe, leptogenesis is attractive since it simultaneously explains the small neutrino masses via the seesaw mechanism. Experiments offer some valuable constraints, but the parameter space of even minimal leptogenesis models are high-dimensional and difficult to probe directly. However considering a simple and well studied realisation, the SM is extended by three right-handed neutrinos N_i with $M_{N_i} > 10^{12}$GeV, the parameter space of leptogenesis can be indirectly and severely constrained by populations of Primordial Black Holes (PBHs). PBHs may form via the collapse of inflationary perturbations and inject particles and entropy into the universe. For $M_{PBH} < 10^{9}$GeV they evaporate completely before Big Bang Nucleosynthesis, potentially altering the dynamics of leptogenesis. While previous works have pointed out that PBHs can extend viable leptogenesis parameter space, in this talk I will discuss how PBHs may also rule out certain leptogenesis scenarios (and vice versa), by characterising the strong incompatibility between PBHs and the simple case of high-scale leptogenesis we study.

Primary authors: Prof. MIELE, Gennaro; GUNN, Jacobwilliam (Istituto Nazionale di Fisica Nucleare); Dr CHIANESE, Marco; Prof. SAVIANO, Ninetta; CALABRESE, Roberta (Istituto Nazionale di Fisica Nucleare); Prof. MORISI, Stefano

Presenter: CALABRESE, Roberta (Istituto Nazionale di Fisica Nucleare)

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **167** Type: **not specified**

X-ray binaries as cosmic ray and neutrino sources

Thursday, September 14, 2023 3:15 PM (15 minutes)

Since their discovery, cosmic rays (CRs) remain among the most mysterious phenomena of modern Physics. The dominant sources, as well as the exact acceleration mechanisms, remain unknown. The CRs up to the "knee"have traditionally been considered to originate entirely in the shock waves of supernova remnants (SNRs), however, due to the lack of a "smoking-gun"TeV counterpart in many cases, as well as the new population of non-SNR Galactic PeVatrons, this scenario has been recently questioned. In this talk, I will motivate how the small-scale analogues of active galactic nuclei, namely black-hole X-ray binaries (BHXBs), can potentially contribute to the Galactic CR spectrum. Based on a new multi-zone, lepto-hadronic jet model to take advantage of the entire broadband multiwavelength spectra observed by BHXBs, I will discuss how to properly estimate the neutrino and γ-ray emissions and how these two compare to current observations. Finally, I will discuss the contribution of these sources to the diffuse γ-ray and neutrino spectra detected by Fermi and HESS, and IceCube, respectively.

Primary author: KANTZAS, Dimitrios

Co-authors: GAGGERO, Daniele (Istituto Nazionale di Fisica Nucleare); CALORE, Francesca (LAPTh, CNRS); PETROPOULOU, Maria (National and Kapodistrian University of Athens); DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University); Prof. MARKOFF, Sera (UvA)

Presenter: KANTZAS, Dimitrios

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **170** Type: **not specified**

Imprints of high-scale non-thermal leptogenesis in cosmic microwave background

Tuesday, September 12, 2023 3:20 PM (20 minutes)

We study the imprints of high-scale non-thermal leptogenesis on cosmic microwave background (CMB) from the measurements of the inflationary spectral index (n_s) and tensor-to-scalar ratio (r), which otherwise is inaccessible to the conventional laboratory experiments. We argue that non-thermal production of baryon (lepton) asymmetry from subsequent decays of inflaton to heavy right-handed neutrinos (RHN) and RHN to SM leptons is sensitive to the reheating dynamics in the early Universe after the end of inflation. Such dependence provides detectable imprints on the $n_s - r$ plane which is well constrained by the Planck experiment. We investigate two separate cases, (I) inflaton decays to radiation dominantly, and (II) inflaton decays to RHN dominantly which further decays to the SM particles to reheat the Universe adequately. Considering a class of $\alpha-$ attractor inflation models, we obtain the allowed mass ranges for RHN for both cases and thereafter furnish the estimates for n_s and r. The prescription proposed here is quite generic and can be implemented in various kinds of single-field inflationary models given the conditions for non-thermal leptogenesis is satisfied.

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Presenter: NANDA, Dibyendu (Korea Institute for Advanced Study)

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **171** Type: **not specified**

Core-collapse Supernovae to constraint neutrino mass with future neutrino detectors

Monday, September 11, 2023 5:30 PM (15 minutes)

Supernova (SN) explosions are the most powerful cosmic factories of all flavors, MeV-scale, neutrinos. Their detection is of great importance not only for astrophysics, but also to shed light on neutrino properties. Since the first observation of a SN neutrino signal in the 1987, the international network of SN neutrinos observatories has been greatly expanded, in order to detect the next galactic SN explosion with much higher statistics and accuracy in the neutrino energy-time-flavor space. In this contribution, I will discuss the constraints that we expect to achieve with next-generation neutrino experiments like DUNE and Hyper-Kamiokande, on the absolute value of the neutrino mass, obtained by considering the time delay in the propagation of massive neutrinos from production in the SN environment to their detection. Furthermore, the comparison of sensitivities achieved for the two possible neutrino mass orderings is discussed, as well as the effects due to propagation in the Earth matter.

Primary authors: POMPA, Federica; CAPOZZI, Francesco (Università degli Studi dell'Aquila); SOREL, Michel; MENA REQUEJO, Olga (INFN)

Presenter: POMPA, Federica

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **172** Type: **not specified**

The fourth Data Release of the fourth Fermi LAT source catalog

Monday, September 11, 2023 2:15 PM (15 minutes)

The fourth release of the Fourth Catalog of Fermi-LAT Sources (4FGL-DR4), based on 14 years of data between 50 MeV and 1 TeV, is presented. Improvements in the analysis method relative to the original 4FGL catalog and new features are reviewed. The 4FGL-DR4 includes about 500 more sources than the previous release (4FGL-DR3, obtained with 12 years of data) and about 2100 more sources than 4FGL. About 40% of the new sources are associated with counterparts at other wavelengths, which are mostly blazar candidates. The properties of the sources reported in the catalog are discussed, with particular attention to those unassociated lying close to the Galactic plane.

Primary authors: LOTT, Benoit (CENBG); GASPARRINI, Dario (Istituto Nazionale di Fisica Nucleare); BALLET, Jean (AIM/SAp, CEA Saclay); BRUEL, Philippe (LLR CNRS/IN2P3 - Ecole Polytechnique); BURNETT, Toby (University of Washington)

Presenter: GASPARRINI, Dario (Istituto Nazionale di Fisica Nucleare)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **177** Type: **not specified**

The contribution to the diffuse γ-ray emission from young massive stellar clusters

Monday, September 11, 2023 5:30 PM (15 minutes)

In the last decades, several young massive star clusters (YMSC) have been associated with extended γ-ray sources, suggesting that some acceleration process, able to produce particles at least up to hundreds of TeV, is at work. The number of YMSCs exhibiting γ-ray emission is around ten, while the possible sources amount to a significantly higher number, potentially reaching several hundred. It is plausible that many of such objects have not been observed yet because of their low surface brightness. However, the collective emission of such unresolved sources may contribute to the diffuse Galactic γ-ray background. In this work, we aim to estimate the total contribution of unresolved YMSCs to the diffuse γ-ray flux, considering a synthetic population created from observed properties of nearby clusters located within 2 kpc from the Sun. We simulate the Galactic population of YMSCs using a Montecarlo approach. For every cluster, we build the stellar population so as to estimate the collective wind luminosity and mass loss rate. The γ-ray emission of each object is then calculated assuming a pure hadronic scenario, where protons are accelerated at the wind termination shock of the stellar cluster and subsequently interact with the material embedded inside the wind-blown bubble. We also account for different scenarios for the particle diffusion inside the system, which determines both the maximum energy and the escape time from the bubble, thus affecting the final gamma-ray spectrum. The results are then compared with measurements of the diffuse gamma-ray flux in different regions of the Galactic plane provided by several telescopes, such as EGRET, Fermi-LAT, ARGO, Tibet-ASγ, and LHAASO. Preliminary results indicate that the diffuse emission from the unresolved cluster population could be nonnegligible between 1-10 TeV.

Primary author: Dr MENCHIARI, Stefano (INAF - Osservatorio Astrofisico di Arcetri)

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Presenter: Dr MENCHIARI, Stefano (INAF - Osservatorio Astrofisico di Arcetri)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **179** Type: **not specified**

First Views of the VHE sky from the LST-1 prototype

Friday, September 15, 2023 9:30 AM (20 minutes)

The Large-Sized Telescope (LST-1) is the first 23-m-diameter prototype telescope for the Cherenkov Telescope Array Observatory (CTAO) and it is able to perform high-sensitivity observations in the energy band from 20 GeV to 20 TeV. The telescope is in its commissioning phase and is performing regular observations on a wide range of astrophysical sources in order to verify its scientific capabilities. In this contribution, I will report about the first scientific results achieved using the LST-1.

Primary author: CAROSI, Alessandro

Presenter: CAROSI, Alessandro

Session Classification: Plenary

Track Classification: Gamma Ray Astronomy

Contribution ID: **180** Type: **not specified**

Calibrating Mass Modeling Methods with Numerical Simulations of Galaxies

Tuesday, September 12, 2023 2:00 PM (20 minutes)

Understanding the particle nature of dark matter (DM) based on its distribution in galaxies is impossible without a complete knowledge of the distribution of baryons within those systems. However, the true distribution of baryons in observed galaxies remains highly uncertain, due in part to model degeneracies. We use the NIHAO zoom-in cosmological hydrodynamical simulations, for which the true distributions of baryons and DM particles are known, to investigate the errors associated with typical (disk) galaxy mass models. We find excellent agreement between the observationally inferred and the 'true'DM mass profiles at large galactocentric radii. However, in the central parts of galaxies, the mass offset can be as significant as 50%. The discrepancies between modeled and true mass profiles must be accounted for in indirect DM searches based on assumed DM distributions, especially in the central parts of galaxies.

Primary author: BASTI, Zahra

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Presenter: BASTI, Zahra

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **181** Type: **not specified**

First results from the WIMP dark matter search with the LZ experiment

Wednesday, September 13, 2023 9:45 AM (20 minutes)

The LUX-ZEPLIN (LZ) experiment utilises a dual-phase xenon technology to search for dark matter in a wide range of WIMP masses. The setup includes xenon time projection chamber, xenon skin region and the outer detector made of Gd-loaded liquid scintillator. The detector is operating at the Sanford Underground Research Facility in Lead, South Dakota, USA. The detector has been calibrated with a varierty of beta, gamma-ray and neutron sources to accurately study its performance in searching for dark matter WIMPs and rejecting unwanted backgrounds. We present here the results of the first science run with the live time of 60 days and a fiducial mass of 5.5 tonnes of liquid xenon. A comprehensive analysis based on profile likelihood ratio has not revealed any statistically significant excess over expected backgrounds. The absence of the signal has led to very strong limits on the spin-independent WIMP-nucleon cross-section for WIMP masses greater than 9 GeV. We report also the limits on spin-dependent WIMP-proton and WIMP-neutron cross-sections.

Primary author: KUDRYAVTSEV, Vitaly (University of Sheffield)

Presenter: KUDRYAVTSEV, Vitaly (University of Sheffield)

Session Classification: Plenary

Track Classification: Direct DM searches

Contribution ID: **182** Type: **not specified**

Investigating the Quiescent State of the TeV-emitting Radio Galaxy 3C 264

Wednesday, September 13, 2023 5:30 PM (15 minutes)

The catalog of TeV-emitting sources (TeVCat) comprises six Fanaroff-Riley type I (FR I) radio galaxies. Unlike blazars, the jets of radio galaxies point away from the observer's line of sight. Therefore, despite their small number, these sources, not entirely dominated by the jet component, offer a unique opportunity to investigate high-energy processes from a different perspective.

Among TeV radio galaxies, 3C 264 is one of the most intriguing sources ever detected. Its observation by VERITAS during a flare was interpreted as an indication that the jet was structured. Its high-state Spectral Energy Distribution (SED) seems to require two components: the core emission, almost persistent (and probably dominant in the quiescent state), plus a (transient) component located along the jet, responsible for the flux increase at high and very high energy during the flare.

In this work, we investigate the quiescent state of 3C 264 in the TeV band to test the multi-component model. We reduced and analyzed multi-wavelength data from 2019 to 2022, in particular in the radio (VLBI), optical-UV (*Swift*-UVOT), X-ray (XMM-*Newton*, *NuSTAR*, *Swift*-XRT), and gamma-ray (*Fermi*-LAT, MAGIC) bands. If the structured model were correct, high and low states would allow us to investigate different regions and processes in 3C 264.

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Presenter: BRONZINI, Ettore (University of Bologna - INAF/OAS)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **183** Type: **not specified**

Unveiling the mysteries of the early universe

Thursday, September 14, 2023 2:30 PM (15 minutes)

Particle physics is at a crossroads: new physics is there, but we do not know where to search for it. Astrophysics and cosmology offer many opportunities to reduce the parameter space for new physics. In this talk, I will focus on a potential relic that could bring us invaluable information about processes in the early universe and, thus, about new physics. Strong hints from gamma-ray astronomy suggest that a large-scale intergalactic magnetic field (IGMF) exists in the voids and occupies most of the volume of our universe. Intergalactic magnetic fields likely have a primordial origin and could become a new pillar of cosmology. To achieve this ambitious goal, the properties of the IGMF should be robustly measured and studied in detail. I will review dedicated efforts in gamma-ray (CTA) and radio (SKA) astronomy, as well as the progress in understanding galaxy formation and active galactic nuclei to differentiate the primordial component of the IGMF.

Primary authors: BOYARSKY, Alexey (Leiden University); NERONOV, Andrii (University of Geneva); SEMIKOZ, Dmitri (APC, Paris); VOVK, Ievgen (ICRR, University of Tokyo); SOKOLENKO, Anastasia (UChicago/Fermilab)

Presenter: SOKOLENKO, Anastasia (UChicago/Fermilab)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **185** Type: **not specified**

Exploring Gamma-Ray Burst at Very High Energy : Insights from 15 Years of H.E.S.S. Observations

Tuesday, September 12, 2023 4:30 PM (15 minutes)

The detection of GRBs at very high energy (> 100 GeV) was a long-awaited result, and many observations by multiple instruments were needed before achieving this goal. The study presented here for the first time is based on a complete re-analysis of 15 years of H.E.S.S. GRBs observations, aiming to understand the reasons behind the previous lack of detections.
Through the utilisation of advanced reconstruction techniques, we have improved the sensitivity and lowered the energy threshold compared to previous results. This work also includes numerous unpublished observations. By comparing these observations with recent detections of GRB in the VHE domain, we seek to enhance our understanding of the physical properties of GRBs and the necessary conditions for their detection at VHE gamma-rays.
Furthermore, we have identified the most interesting events within our dataset and conducted a thorough investigation into the constraints that can be derived from these specific observations.

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Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **186** Type: **not specified**

Investigating Millimeter-Bright AGN as IceCube's Astrophysical Neutrino Sources

Tuesday, September 12, 2023 3:00 PM (15 minutes)

In the last decade, the IceCube South Pole Neutrino Observatory has observed an astrophysical neutrino flux with unexpected implications for the environments of extragalactic accelerators. The discovery of the high-energy, transient neutrino source TXS 0506+056 has drawn further attention to blazars, and the traditional correlation of their activity with gamma-ray emission. However, gamma-ray correlated analyses have not found a significant population of contributing sources, and the majority of astrophysical diffuse emission remains unassociated. More recently, the opacity of such environments to high-energy photons has been highlighted. Here, we discuss millimeter-wavelength observations of variable AGN as an alternative tracer for neutrino activity. New light curves representing over two hundred of the brightest AGN observed by the Atacama Cosmology Telescope are considered. The relation of synchrotron emission at these wavelengths to neutrino production is explored, with additional focus on the time-varying intensity and spectrum of TXS 0506+056. Results from a first correlation with IceCube data are presented, investigating emission from this millimeter-bright source class and from individual objects.

Primary author: KOCHOCKI, Alina (Michigan State University)

Presenter: KOCHOCKI, Alina (Michigan State University)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **187** Type: **not specified**

Mapping the blazar γ-ray luminosity function into neutrino emission

Tuesday, September 12, 2023 2:30 PM (15 minutes)

A remarkable detection was recently made when a high-energy neutrino event detected by IceCube was linked to the *Fermi*-LAT detected blazar TXS 0506+056. However, our knowledge of observable neutrino-emitting blazars is limited, hindering future investigations. To address this issue, we combine a physically motivated model with three key free parameters capable of producing both electromagnetic and neutrino emissions, along with a classification system based on observational trends, with a recent description of the cosmic blazar distribution through a luminosity function (LF). The LF and model are combined by mapping the dependence of LF parameters, i.e., a source's γ-ray luminosity (L_γ) and γ-ray photon index (Γ), to the model parameters, i.e., magnetization (σ) and bulk Lorentz factor (Γ_j). We then produce a γ-ray LF that is parameterized in terms of a radiation model capable of reproducing the spectral features and luminosities of different blazar subclasses. Using the parameterized LF, we compute the contribution of blazar subclasses to the diffuse neutrino flux and identify the most likely multi-messenger candidates.

Primary author: DAVIS, Zachary (Purdue University)

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Presenter: DAVIS, Zachary (Purdue University)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **188** Type: **not specified**

The energy spectrum measured with the Pierre Auger Observatory and its astrophysical interpretation

Wednesday, September 13, 2023 3:45 PM (15 minutes)

In this contribution, we present the energy spectrum using data acquired from the Pierre Auger Observatory. By integrating six distinct methodologies, we measured the spectrum from 6×10^{15} eV up to beyond 10^{20} eV. With an accumulated exposure of over 80,000 km^2 sr yr above the ankle region, it represents the most accurate spectrum estimation ever achieved within this energy range. Using the wide zenith angle coverage provided by the Pierre Auger Observatory and its considerable exposure, we were also able to measure the spectrum in various regions of the celestial sphere. In addition to the description of the spectrum and the various measurement techniques, we will discuss the interpretation of the observed features in light of the most up-to-date astrophysical models.

Primary author: Dr CONVENGA, Fabio (Pierre Auger Collaboration)

Presenter: Dr CONVENGA, Fabio (Pierre Auger Collaboration)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **189** Type: **not specified**

Characteristics of the HEPD-02 detector for the CSES-02 space mission

Monday, September 11, 2023 4:45 PM (15 minutes)

The China Seismo-Electromagnetic Satellite (CSES) project is composed of a series of Italian-Chinese space missions, dedicated to monitoring the near-Earth environment. The High-Energy Particle Detectors (HEPD-02) is one of the scientific instruments aboard the second satellite of the CSES mission, CSES-02, which is expected to be put into sun-synchronous orbit in early 2024.
The HEPD-02 detector is composed of a high-precision tracking system followed by a calorimeter tower combining plastic scintillators and large LYSO crystals, with dimensions never used in space. It is designed to identify particles in a wide range of energies, from 3 to 100 MeV for electrons, 30 to 200 MeV/n for protons and light nuclei.
The apparatus is fully integrated and is in an intense phase of spatial qualification tests and performance characterization with cosmic rays in the laboratory and beam tests in beam facilities.
We will present the main characteristics of the apparatus and the results of the experimental tests carried out.

Primary author: MOHAMMED SAHNOUN, Fatma Zouleikha (Istituto Nazionale di Fisica Nucleare)

Presenter: MOHAMMED SAHNOUN, Fatma Zouleikha (Istituto Nazionale di Fisica Nucleare)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **190** Type: **not specified**

Latest results from the CUORE experiment

Tuesday, September 12, 2023 5:15 PM (15 minutes)

The Cryogenic Underground Observatory for Rare Events (CUORE) is the first bolometric experiment searching for $0\nu\beta\beta$ decay that has successfully reached the one-tonne mass scale. The detector, located at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy, consists of an array of 988 TeO_2 crystals arranged in a compact cylindrical structure of 19 towers. CUORE began its first physics data run in 2017 at a base temperature of about 10 mK and has been collecting data continuously since 2019, reaching a TeO_2 exposure of 2 tonne-year in spring 2023. This is the largest amount of data ever acquired with a solid state cryogenic detector, which allows for further improvement in the CUORE sensitivity to $0\nu\beta\beta$ decay in ^{130}Te. In this talk, we will present the new CUORE data release, based on the full available statistics and on new, significant enhancements of the data processing chain and high-level analysis.

Primary author: COLLABORATION, The CUORE

Presenter: RESSA, Alberto (Istituto Nazionale di Fisica Nucleare)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **191** Type: **not specified**

AugerPrime: the Upgrade of the Pierre Auger Observatory

Wednesday, September 13, 2023 4:45 PM (15 minutes)

The Pierre Auger Observatory is the largest facility for the study of ultra-high energy cosmic rays (UHECRs). After nearly 20 years of successful operation, the observatory has provided many new insights about the spectrum, anisotropies and composition of UHECRs. However, more precise measurements are needed to obtain a complete picture about the nature and origin of these particles, to understand the cause of the observed flux suppression at the highest energies, to solve the puzzle of the missing muons in models of air showers, and to assess the existence of ultra-high energy neutrinos and photons.

To tackle these questions, the installation of an upgrade of the Auger Observatory, called AugerPrime, is underway. It consists in scintillation detectors and radio antennae placed above the water Cherenkov surface detectors, the addition of a small PMT, and the replacement of the surface detector electronics. In addition, in a more densely filled subset of the array, underground muon detectors will provide a direct determination of the number of muons in air showers produced by UHECRs.

We will give an overview of the AugerPrime upgrade, its scientific motivations, the status of its installation and commissioning, and the performance of the new systems, based on first data already available.

Primary authors: Dr ALLEKOTTE, Ingomar (CNEA); THE PIERRE AUGER COLLABORATION

Presenter: Dr ALLEKOTTE, Ingomar (CNEA)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **192** Type: **not specified**

Understanding the effects of pile up in the DEAP-3600 detector

Wednesday, September 13, 2023 2:20 PM (20 minutes)

DEAP-3600 is a single phase direct dark matter detector located at SNOLAB in Ontario, Canada. 255 photomultiplier tubes surround a spherical acrylic vessel to detect scintillation light from ~3300 kg of liquid argon. DEAP-3600 was designed to search for spin independent weakly interacting massive particles (WIMPs) and holds the leading WIMP exclusion using liquid argon.
Identifying background events is vital in WIMP searches. To precisely model backgrounds, pile up—multiple interactions happening in a single triggered event—must be understood. Pile up can be studied using our periodic trigger—a 40 Hz, threshold-less trigger—which provides snapshots of what is occurring in the detector at random moments.
A data-driven method to study pile up in DEAP-3600 is by mixing the raw waveforms of periodic trigger events with physics events. Using this technique, we investigate the ability of pile up to mimic a WIMP signal.

Primary author: BINA, Catherine (University of Alberta, DEAP Collaboration)

Presenter: BINA, Catherine (University of Alberta, DEAP Collaboration)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **193** Type: **not specified**

Multi-messenger signatures from choked delayed jets in TDEs

Thursday, September 14, 2023 3:00 PM (15 minutes)

Recent radio observations of tidal disruption events (TDEs) show that some TDEs exhibit late time emission, which may be due to delayed jet launch from the central engine. The multi-messenger observations of several TDEs (AT2019dsg, AT2019fdr, and AT2019aalc) by IceCube and optical telescopes also provide evidence for the possibility of late time engine activity. In this work, we address this scenario where the jet is launched with a delay time $t_{\rm lag} \sim$ days - months, to examine whether choked jets can explain the late time emission in TDEs. In our model, we consider the interaction of the relativistic jet with the spherically symmetric debris expanding with velocity $v_{\rm w}$. This eventually decides whether the jet breaks out or not, and also leads to cocoon formation which can eventually collimate the jet. We discuss the effects of $t_{\rm lag}$ and $v_{\rm w}$ on the outcomes of jet breakout and collimation, in particular, for the ranges of jet luminosity where we find choked jets. We find that for $t_{\rm lag} \sim 10^7$s, jets with $L_{\rm j,iso} \leq 10^{46}\,{\rm erg\,s^{-1}}$ would be choked. Finally, we study the observational signatures of such delayed choked jets in the EM and neutrino channels, where we find that optical and X-ray observations can be possible for a nearby TDE ($z = 0.05$) with current detectors like LSST and Chandra respectively, but radio observations are less optimistic.

Primary author: MUKHOPADHYAY, Mainak (Pennsylvania State University)

Co-authors: MURASE, Kohta; Dr BHATTACHARYA, Mukul (Pennsylvania State University)

Presenter: MUKHOPADHYAY, Mainak (Pennsylvania State University)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **194** Type: **not specified**

High energy emission component and population of gamma-ray emitting radio galaxies

Wednesday, September 13, 2023 5:15 PM (15 minutes)

In this study, we systematically studied the X-ray to GeV gamma-ray spectra of 61 Fermi/LAT-detected radio galaxies. We found an anticorrelation between peak frequency and peak luminosity in the high-energy spectral component of radio galaxies, similar to blazars. With this sample, we also constructed a gamma-ray luminosity function (GLF) of gamma-ray-loud radio galaxies. We found it is a blazar-like GLF shapes, but the log$N$-log$S$ relation prefers models with more low-z radio galaxies. This indicates many low-z gamma-ray-loud radio galaxies. We further investigated the nature of gamma-ray-loud radio galaxies. Compared to radio or X-ray flux-limited radio galaxy samples, the gamma-ray selected sample tends to lack high radio power galaxies like FR-II radio galaxies. We also found that only $\sim$10\% of radio galaxies are GeV gamma-ray loud. X-ray spectra of GeV emitting radio galaxies are less absorbed in the soft band than that of radio galaxies not detected by Fermi/LAT. These suggest that radio galaxies detected by Fermi/LAT have a more aligned jet toward our line of sight.

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Presenter: FUKAZAWA, Yasushi (Hiroshima University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **195** Type: **not specified**

Efficient Magnetic Energy Dissipation by Internal Shocks

Wednesday, September 13, 2023 3:30 PM (15 minutes)

Relativistic outflows or jets with more than 99% of the light speed emerge in pulsar wind nebulae, gamma-ray bursts, and active galactic nuclei. Such relativistic jets are thought to be launched through magnetic processes, which implies magnetically dominated outflows. However, a multi-wavelength spectrum suggests that jets must be kinetically dominated at the gamma-ray emission region. This means the magnetic energy should dissipate into the thermal energy while propagation. Although the traditional shock dissipation mechanism so-called internal shock is thought to be inefficient for magnetically dominated ejecta, a kinetically dominated matter between ejecta may play an important role in magnetic energy dissipation by shock waves.
We demonstrate the efficient internal shock dissipation through the multiple interactions between magnetically dominated relativistic ejecta with kinetically dominated winds by performing our spherically symmetrical 1-Dimensional Special Relativistic Magneto-HydroDynamic (1DSRMHD) simulation code with adaptive mesh refinement. Our numerical results show that almost 10% of the magnetic energy in the ejecta can be converted into the thermal energy of the relativistic and low-magnetized outflows via shocks in the rarefaction waves or the winds. Such hot and less magnetized outflows are relevant for observed non-thermal emissions in blazars or gamma-ray bursts.

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Presenter: KUSAFUKA, Yo (ICRR, The University of Tokyo)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **196** Type: **not specified**

Forging anti-helium in a dark matter crucible

Tuesday, September 12, 2023 2:30 PM (15 minutes)

The cosmic-ray experiment AMS-02 has reported the possible detection of ~ 10 anti-helium events. Conventional production mechanisms struggle to explain the similar fluxes observed for both isotopes $^4\overline{\mathrm{He}}$ and $^3\overline{\mathrm{He}}$. In this talk, I discuss how these species could be created through "anti-nucleosynthesis" occurring in fireballs of standard model antiquarks, leptons, and photons expanding with a relativistic bulk velocity. Such fireballs may be initiated by collisions between heavy composite states in the dark sector that carry negative baryon number. Since the fireballs are thermalized, our explanation has the distinction of being agnostic to the particular dark matter model employed. It has the additional advantage of naturally producing nuclei travelling relativistically with $\gamma \sim 10$, as observed.

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Presenter: MATHUR, Anubhav (Johns Hopkins University)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **198** Type: **not specified**

Hadronic processes at work in 5BZB J0630-2406

Tuesday, September 12, 2023 3:15 PM (15 minutes)

Recent observations are shedding light on the important role that active galactic nuclei (AGNs) play in the production of high-energy neutrinos. Despite the growing evidence that blazars are good candidates to be neutrino emitters, our understanding of the physical processes and locations of production remains limited.
In this contribution we present the study of one promising object, 5BZB J0630-2406, which is among the blazars that are associated with neutrino emission (Buson et al., 2022). Modeling its spectral energy distribution (SED), we explore various scenarios from purely leptonic to lepto-hadronic models, testing the inclusion of external photon fields. Our model allows us to derive a neutrino spectrum, which we compare with observations from the IceCube experiment.
These results show that hadronic models predict a detectable neutrino flux, within the reach of the IceCube detector, and compatible with IceCube's observations. As a reprove, the shape of the multi-wavelength SED suggests the presence of sub-dominant processes related to very energetic protons. Furthermore, our modelling indicates that this source displays peculiar physical properties, similar to TXS 0506+056.

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Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **200** Type: **not specified**

Neutrino emission associated with late-time emissions of gamma-ray bursts

Thursday, September 14, 2023 3:45 PM (15 minutes)

Gamma-ray bursts (GRBs) have late-time emission components lasting 100-1000 seconds, such as extended emission of short GRBs and X-ray flares of long GRBs. These components could be explained by the internal dissipation of the jets produced by prolonged central engine activity, and could be influenced by the materials around the jet. The prompt jet interacts with the progenitor star or the ejected material, leading to formation of a cocoon. 100-1000 seconds after the prompt emission, the cocoon covers the dissipation region of the prolonged jets, and photons filled in the cocoon should diffuse into this region. We calculated the neutrino emission from the prolonged jets, taking into account the interactions between the cocoon photons and the cosmic rays accelerated in the jets.The cocoon photons enhance the neutrino production efficiency in the PeV - EeV energies, regardless of the values of the Lorentz factor of the jets. We will discuss the detectability of neutrino signals associated with the late-time emission of gamma-ray bursts by IceCube and IceCube-Gen2. Even if we do not detect neutrinos, we can place constraints on the dissipation radius and the baryon loading factor for the prolonged jets.

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Presenter: MATSUI, Riki (Tohoku University)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Contribution ID: **201** Type: **not specified**

Exploring nearly degenerate higgsinos using mono-Z/W signal

Thursday, September 14, 2023 2:20 PM (20 minutes)

We propose a new search strategy for higgsinos. Assuming associated production of higgsino-like pairs with a W or Z boson, we search in the missing energy plus hadronically-tagged vector boson channel. We place sensitivity limits for (HL-)LHC searches assuming (1–3.5 GeV) mass differences between the lightest neutral and charged states. We point out that using the $E_T^{\rm miss}$ distribution significantly increases the sensitivity of this search. We find the higgsinos up to 110 (210) GeV can be excluded with 139 (300) fb^{-1} data. The full data of the HL-LHC will exclude (discover) the higgsinos up to 520 (280) GeV. This talk is based on arXiv:2110.04185 [hep-ph] published in PLB.

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Presenter: KAWAMURA, Junichiro (IBS-CTPU)

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **202** Type: **not specified**

Observation and multi-wavelength modeling of GRB 190829A and GRB 201015A by the MAGIC telescopes

Tuesday, September 12, 2023 5:00 PM (15 minutes)

Starting from the first unequivocal detection of very high energy (VHE) emission from the luminous gamma-ray burst (GRB) GRB 190114C by the MAGIC telescopes, five detections of VHE emission from GRBs by ground-based instruments were reported as of today. Such new energetic components have become a new probe to explore GRB physics. GRB 201015A was a long GRB detected by the Swift/BAT and we started fast follow-up observations of GRB 201015A with the MAGIC telescopes about 30 seconds after its onset under good observing conditions. Subsequent optical observations measured the redshift of the host galaxy as 0.42 and found the associated type Ic-BL supernova. The total isotropic equivalent energy of the prompt emission is then estimated to be the order of 10^50 erg, which is approximately 3 orders of magnitude below GRB 190114C. In this sense, GRB 201015A may have similar properties to GRB 190829A whose VHE emission was detected by the H.E.S.S. telescopes. GRB 190829A was also observed by the MAGIC telescopes 30 hours after its onset under good observing conditions. The MAGIC data analysis of GRB 201015A and GRB 190829A confirms the strong hint of detection from both GRBs, and the marginal signal from GRB 201015A implies a significant energy release in the TeV range, comparable with that of the prompt emission in the keV-MeV band. In order to unravel the origin of the possible VHE emission, we modeled the multi-wavelength data of both GRBs with off-axis one-component jet model, taking into account the prompt emission energetics of the two GRBs. The off-axis one-component model well reproduces the observed multi-wavelength light curve of GRB 190829A, whereas it was difficult to reproduce the multi-wavelength light curve of GRB 201015A due to optical peak around 200 seconds after its onset. Therefore, we used the on-axis one-component model instead to model the multi-wavelength light curve of GRB 201015A, and successfully reproduced the early-time optical and x-ray light curve. However, if the gamma-ray signal of GRB 201015A is real, the inferred VHE flux of GRB 201015A is about one order of magnitude larger than the SSC flux calculated from modeling. Our modeling suggests that both GRBs have a jet with small opening angle of about 1 degree. In this presentation, we report these observational results and theoretical interpretation of GRB 190829A and GRB 201015A.

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Co-authors: Dr NODA, Koji (Chiba University); Prof. YAMAZAKI, Ryo (Aoyama Gakuin University)

Presenter: TERAUCHI, Kenta (Kyoto University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **204** Type: **not specified**

Ring closing on transient sources of ultra-high energy cosmic rays

Wednesday, September 13, 2023 5:00 PM (15 minutes)

We explore two generic hypotheses for tracing the sources of ultra-high energy cosmic rays (UHECRs) in the Universe: star formation rate density or stellar mass density. For each scenario, we infer a set of constraints for the emission mechanisms in the accelerators, for their energetics and for the abundances of elements at escape from their environments. From these constraints, we generate sky maps above 40~EeV expected from a catalog that comprises 410,761 galaxies out to 350~Mpc and provides a near-infrared flux-limited sample to map both stellar mass and star formation rate over the full sky. Considering a scenario of intermittent sources hosted in every galaxy, we show that the main features observed in arrival directions of UHECRs can in turn constrain the burst rate of the sources provided that magnetic-horizon effects are at play in clusters of galaxies.

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Presenter: DELIGNY, Olivier (CNRS/IN2P3 - IPN Orsay)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **205** Type: **not specified**

Correlations between X-rays and TeV gamma-rays in HBL Blazars.

Wednesday, September 13, 2023 3:00 PM (15 minutes)

Observational studies have revealed correlations between the fluxes of X-rays and TeV gamma-rays in blazars, particularly in the context of the leptonic Synchrotron Self-Compton (SSC) model. The HBL blazar Mrk 421 exhibits a linear correlation between these two energy ranges, although it breaks down at the highest gamma-ray fluxes, suggesting the involvement of additional mechanisms like hadronic and lepto-hadronic contributions. Understanding the strength of the correlation between X-rays and gamma-rays can provide insights into the relative contributions of the leptonic and hadronic mechanisms responsible for the gamma-ray emission in blazars. In this study, we extend the analysis to four HBL blazars: Mrk 501, 1ES 1959+650, PKS 2155-304, and 1ES 2344+514, utilizing gamma-ray data from ground-based Imaging Atmospheric Cherenkov Telescopes and X-ray data from satellite observations. Our analysis reveals flux correlations described by a power law function with indices ranging from 1 to 2, similar to the observed correlation in Mrk 421. However, a deviation from the correlation is also observed at high-energy gamma-ray fluxes, emphasizing the complexity of the emission region in blazars and highlighting the need for further investigation. This research was supported by the UNAM-PAPIIT project number IG101323 and the Gestiona I+D 02-2021 project of the Secretaria Nacional de Ciencia y Tecnología de Guatemala (SENACyT).

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Presenter: SACAHUI, Rodrigo (Universidad de San Carlos de Guatemala)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **206** Type: **not specified**

IceCube Search for High Energy Neutrino Emission from X-ray Bright Seyfert Galaxies

Thursday, September 14, 2023 2:30 PM (15 minutes)

Recently IceCube observed TeV neutrino emission from the nearby Seyfert type-II Galaxy, NGC 1068, which suggests that AGN could potentially be one type of source of the diffuse high-energy astrophysical neutrino flux. Disk-corona models, which predict neutrino emission using the observed keV X-rays luminosity from the Seyfert galaxies, are employed to search for similar sources. In this presentation, using 10 years of IceCube track events, we report on the IceCube search for neutrino emission from these Seyfert galaxies.

Primary author: YU, Shiqi

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Presenter: YU, Shiqi

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **207** Type: **not specified**

Constraints on LIV using Mrk421 flare from 2014

Thursday, September 14, 2023 5:15 PM (15 minutes)

Some candidates for the theory of quantum gravity allow for Lorentz invariance violation (LIV). If Lorentz's invariance is violated, it may cause an observable effect on the very high energy (VHE, E > 100 GeV) light curves and spectra of cosmic sources emitting gamma-ray photons. One of the possible consequences of the LIV is in-vacuo dispersion which implies that the photon group velocity is energy dependent. In this line of LIV studies, one needs a fast variable source and the highest possible photon energies. So, in order to explore the possibility of a LIV effect, we analysed an exceptional VHE flare from the blazar Mrk 421 detected by the MAGIC telescopes in April 2014. The flare reached energies up to 10 TeV with fast intra-night variability. Through an innovative time-binned likelihood analysis, we searched for arrival-time delays that increase linearly or quadratically with the photon energy. We were unable to significantly detect any energy-dependent time delay, which enabled us to establish stringent limits on the expected energy scale for LIV.

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Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **208** Type: **not specified**

The Fermi high-energy view of GRB 221009A, the ”brightest of all time” or B.O.A.T. GRB

Wednesday, September 13, 2023 11:50 AM (20 minutes)

In October 2022, an extremly powerful and rare Gamma-Ray Burst, GRB 221009A, was observed by tens of space- and ground-based observatories, including both instruments onboard the Fermi Mission, the Large Area Telescope (LAT) and the Gamma-Ray Burst Monitor (GBM). The triggering pulse, detected by Fermi-GBM, was followed by a prompt phase lasting a few hundred seconds, and by an extended emission which was detected by Fermi-LAT for over two days.
Here we present the highlights from the LAT analysis of this exceptional event.
The high-energy (>10 MeV) emission was measured by the LAT in the triggering pulse one second before the associated low-energy component detected by GBM. During the burst prompt phase, the extreme intensity of the burst in hard X-rays compromised the LAT data quality, resulting in the definition of Bad Time Interval (BTI) for a total of 63 seconds. The LAT late time emission shows a power law decay, but its extrapolation based on the first 450 seconds suggests that the afterglow started during the prompt emission. Furthermore, we found that the high-energy events detected by the LAT cannot have a Synchrotron origin but, during the prompt emission, they are probably associated with an additional Self Synchrotron Compton (SSC) component. Late time high-energy events are instead harder to explain as products of SSC or TeV electromagnetic cascades, which raises questions regarding their origin. Overall, GRB221009A, stands out compared to other Fermi-LAT GRBs, indicating that it is an exceptionally rare event.

Primary author: BISSALDI, Elisabetta (Istituto Nazionale di Fisica Nucleare)

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Presenter: BISSALDI, Elisabetta (Istituto Nazionale di Fisica Nucleare)

Session Classification: Plenary

Track Classification: Gamma Ray Astronomy

Contribution ID: **210** Type: **not specified**

Exploring Cosmic Ray acceleration and escape in the W44 region with Fermi-LAT and MAGIC

Monday, September 11, 2023 3:45 PM (15 minutes)

W44 is a middle-aged Supernova Remnant (SNR) largely investigated to probe acceleration of Cosmic Rays (CRs). Previous studies already showed the presence of gamma-ray emission not only from the remnant, but also from its surroundings, thought to be due to high-energy CRs escaping from the forward shock of the remnant.
We present a detailed morphological and spectral analysis of Fermi-LAT data above 100 MeV related to the W 44 region. The morphological analysis was performed for energies above 1 GeV, to exploit the improved angular resolution of the instrument, deriving an accurate description of the region's morphology.
The W 44 region was also observed in the very high-energy gamma-ray band by the MAGIC telescopes. We carried out a likelihood analysis exploiting the spatial information derived from the Fermi-LAT analysis above 1 GeV, focusing on the northwestern side of the remnant. The combined Fermi-LAT and MAGIC spectra provide useful constraints on the diffusion of the escaped CRs.
In this talk we describe the analysis results and a model that includes the temporal evolution of the acceleration and escape process of high-energy particles from the remnant's shock.

Primary author: DI TRIA, Riccardo (Istituto Nazionale di Fisica Nucleare)

Co-authors: Dr DI VENERE, Leonardo (INFN Bari); BISSALDI, Elisabetta (Istituto Nazionale di Fisica Nucleare); GIORDANO, Francesco (Istituto Nazionale di Fisica Nucleare); GREEN, David (Max Planck Institut für Physik); HAHN, Alexander (Max Planck Institute for Physics); MORLINO, Giovanni (INAF/Oss. Astrofisico di Arcetri); PANTALEO, Francesca Romana (Istituto Nazionale di Fisica Nucleare); STRZYS, Marcel (ICRR, University of Tokyo)

Presenter: DI TRIA, Riccardo (Istituto Nazionale di Fisica Nucleare)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **211** Type: **not specified**

CUPID the next generation 0νββ bolometric experiment

Tuesday, September 12, 2023 5:30 PM (15 minutes)

Neutrinoless double-beta decay (0νββ) is a key process to address some of the major outstanding issues in particle physics, such as the lepton number conservation and the Majorana nature of the neutrino. Several efforts have taken place in the last decades in order to reach higher and higher sensitivity on its half-life. The next-generation of experiments aims at covering the Inverted-Ordering region of the neutrino mass spectrum, with sensitivities on the half-lives greater than 10^{27} years. Among the exploited techniques, low-temperature calorimetry has proved to be a very promising one, and will keep its leading role in the future thanks to the CUPID experiment. CUPID (CUORE Upgrade with Particle IDentification) will search for the neutrinoless double-beta decay of
100Mo and will exploit the existing cryogenic infrastructure as well as the gained experience of CUORE, at the Laboratori Nazionali del Gran Sasso in Italy. Thanks to about 1600 scintillating Li2MoO4 crystals, enriched in 100Mo, coupled to ~1700 light detectors, CUPID will have simultaneous readout of heat and light that will allow for particle identification, and thus a powerful alpha background rejection. Numerous studies and R&D projects are currently ongoing in a coordinated effort aimed at finalizing the design.

Primary author: LOAIZA, Pia (IJCLab, CNRS/IN2P3 and Université Paris Saclay)

Presenter: KHALIFE, Hawraa

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **212** Type: **not specified**

Observation of sub-TeV gamma-ray emission from GRB 201216C at redshift 1.1

Tuesday, September 12, 2023 5:30 PM (15 minutes)

Gamma-ray bursts (GRBs) are the most luminous explosions in the Universe. Thanks to the recent observations by ground-based gamma-ray telescopes, we now know that at least a class of GRBs are able to emit very-high-energy (VHE) gamma-ray emission. Starting from GRB 190114C detected by the MAGIC telescopes, in total there are five reports of VHE detection so far from MAGIC, H.E.S.S. and LHAASO. Currently, the most accredited radiation process able to explain this component is the Synchrotron-Self Compton (SSC) emission. The MAGIC second GRB detected is a long GRB 201216C at redshift of 1.1, which is the furthest source ever detected by ground-based gamma-ray telescopes. The MAGIC telescopes started follow-up of the GRB at 56 seconds after the Swift-BAT trigger and continued the observation for 2.2 hours. We analyzed the MAGIC data, optical data from Liverpool Telescope and the Swift-XRT data, and performed modeling of the multi-wavelength emission. We find that a single-zone SSC model can explain the data from the optical to the VHE band. In this contribution, we present the final results of our analysis of GRB 201216C and discuss the impact that these results have on the GRB afterglow theory.

Primary authors: SUDA, Yusuke (Hiroshima University); BERTI, Alessio (Max Planck Institute for Physics); FUKAMI, Satoshi (ETH Zuerich/ICRR); LOPORCHIO, Serena (INFN Bari); NAVA, Lara (INAF)

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Presenter: SUDA, Yusuke (Hiroshima University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **213** Type: **not specified**

The vanishing of the primary emission region in PKS 1510-089

Wednesday, September 13, 2023 5:00 PM (15 minutes)

PKS 1510-089 is the only known flat spectrum radio quasar with persistent very-high-energy (E>100GeV) gamma-ray emission. It also showed varying and complex variability and correlation patterns, which were hard to explain within a single-zone emission model. Here, we present recent observations with H.E.S.S., Fermi, Swift, ATOM and SALT. These suggest that PKS 1510-089 used to have at least two active emission regions. On the one hand, the primary emission region was probably located within the broad-line region. On the other hand, the bulk of the VHE emission originated from the second zone located beyond the BLR. These conclusions can be drawn from the apparent vanishing of the primary emission region, which has been been revealed by a significant flux drop in the high-energy (E>100MeV) gamma-ray and optical energy bands. Additionally, SALT observations reveal a disappearance of the polarization, which makes it possible to explain the optical/UV data with emission from the accretion disk and BLR alone.

Primary authors: ZACHARIAS, Michael (LSW Heidelberg); BARNARD, Joleen; BOETTCHER, Markus (North-West University); SCHUTTE, Hester; HESS COLLABORATION

Presenter: ZACHARIAS, Michael (LSW Heidelberg)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **214** Type: **not specified**

Cosmic ray interaction models applied to a large blazar sample

Monday, September 11, 2023 5:30 PM (15 minutes)

I present the results of cosmic ray interaction models applied to an unprecedentedly large sample of blazar AGN. The modeling was performed using an efficient, self-consistent and time-dependent numerical framework newly published as open-source software. I show that for a large number of sources, the X-ray and very-high-energy gamma-ray fluxes can be explained by cascades triggered by cosmic ray proton interactions in the jet. I briefly discuss the implications of these results for future multi-messenger searches and for understanding the role of blazars as IceCube sources.

Primary author: RODRIGUES, Xavier (European Southern Observatory)

Presenter: RODRIGUES, Xavier (European Southern Observatory)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **215** Type: **not specified**

Energy-dependent Morphology of J1825-137 with HAWC

Monday, September 11, 2023 3:30 PM (15 minutes)

The luminous pulsar wind nebula (PWN) HESS J1825-137 was the first object in gamma-ray astronomy that was discovered to have energy-dependent morphology. In addition to its detection and this discovery by H.E.S.S., J1825-137 and the region around it have been explored and characterized also using the VERITAS, Fermi-LAT, HAWC, and LHAASO instruments. Its exceptional TeV luminosity has been associated with a potentially very short pulsar birth period and it is one of the most powerful emitters in the sky also at ultra-high energies (several hundred TeV). Recently, HAWC has been able to resolve the individual sources in this complex region. In this contribution, we present an energy-dependent morphological study of J1825-137 based on HAWC observations up to ultra-high energies.

Primary author: GOKSU, Hazal (Max-Planck-Institut für Kernphysik (Max Planck Institute for Nuclear Physics))

Presenter: GOKSU, Hazal (Max-Planck-Institut für Kernphysik (Max Planck Institute for Nuclear Physics))

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **216** Type: **not specified**

The Canfranc Axion Detection Experiment (CADEx): a novel haloscope search for Dark Matter axions in the mass range 330–460 μeV

Wednesday, September 13, 2023 3:30 PM (15 minutes)

A range of haloscope searches are currently probing axions in the mass range ~2-40 μeV. However, simulations of the axion field in the early Universe are increasingly pointing towards heavier masses if we want the axion to comprise all of the Dark Matter in the Universe. I will briefly review these developments and then I will present The Canfranc Axion Detection Experiment (CADEx), a proposed haloscope search in the well-motivated but currently under-explored mass range 330-460 μeV. CADEx, to be installed at the Canfranc Underground Laboratory, will consist of an array of microwave resonant cavities in a static magnetic field, coupled to a highly sensitive detecting system based on Kinetic Inductance Detectors. I will present the timeline for CADEx as well as forecasts for its sensitivity to axions, dark photons, and more. Finally, I will discuss the complementarity of CADEx with other proposed lab-based and astrophysical searches for axion-photon conversion.

Primary author: KAVANAGH, Bradley

Presenter: KAVANAGH, Bradley

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **217** Type: **not specified**

A search for neutrinos from dark matter in the Galactic Centre with IceCube

Thursday, September 14, 2023 5:00 PM (15 minutes)

The nature of Dark Matter is one of the important unresolved questions in fundamental physics. It is assumed in many Beyond Standard Model theories that dark matter candidates can have weak coupling to Standard Model (SM) particles. In heavy cosmological objects, like galaxies, the Sun, or the Earth, dark matter can be gravitationally accumulated to a high abundance such that it can decay or annihilate into the anomalous flux of SM particles detectable by various detector types. In this analysis, we aim at searching for neutrino signals from dark matter annihilation and decay in the Galactic Centre using ~9 years of IceCube DeepCore data with an optimized selection for low energy. The IceCube sensitivities on the thermally averaged dark matter self-annihilation cross-section and decay lifetime for dark matter masses ranging from 5 GeV up to 8 TeV will be presented.

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Presenter: CHAU, Nhan (Université libre de Bruxelles)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **218** Type: **not specified**

A joint Fermi-LAT and H.E.S.S. analysis of the Crab nebula

Monday, September 11, 2023 3:00 PM (15 minutes)

The Crab pulsar wind nebula is one of the best-studied objects in the gamma-ray sky. Recently, its angular extension in the gamma-ray domain could be resolved in separate analyses of Fermi-LAT and H.E.S.S. data, which provides crucial information about the spatial distribution of relativistic particles in the nebula. In this contribution we provide, for the first time, a measurement of the energy spectrum and extension of the nebula over five decades of energy with a joint Fermi-LAT and H.E.S.S. analysis. We obtain clear evidence for a shrinking of the nebula with energy, as is expected from theoretical models. However, taking into account the multi-wavelength data, we find that none of the tested theoretical models succeed in simultaneously describing both the energy spectrum and angular extension over the full energy range.

Primary authors: MOHRMANN, Lars (Max Planck Institute for Nuclear Physics, Heidelberg); MEYER, Manuel (University of Southern Denmark); UNBEHAUN, Tim (Friedrich-Alexander-Universität Erlangen-Nürnberg)

Presenter: MOHRMANN, Lars (Max Planck Institute for Nuclear Physics, Heidelberg)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **220** Type: **not specified**

High energy neutrino emission from a global accretion flow around a supermassive black hole based on a GRMHD simulation model

Monday, September 11, 2023 2:30 PM (15 minutes)

The accretion flows around supermassive black holes would be a part of emission sources of the IceCube neutrinos. The effects of the global structure of the magnetized accretion flows on the neutrino SEDs are, however, still uncertain. We, therefore, carry out the calculation of SEDs of high energy neutrinos by using three dimensional general relativistic magnetohydrodynamic (GRMHD) simulation data of a radiatively inefficient accretion flow around a black hole. The time evolution of the cosmic-ray proton SEDs in the accretion flows are computed by using tracer particles, on which the Fokker-Planck equations are solved by assuming the turbulent acceleration and the effects of compressions. The high energy neutrino SEDs are calculated by taking into account the effects of pp collisions. We have found that the resulting neutrino SEDs becomes flatter than those of 1-zone models, attributed to a global structure effect, i.e., superposition of the various neutrino SEDs emitted at different positions. These moderately flat neutrino SEDs will be consistent with the diffuse neutrino SEDs observed by IceCube.

Primary author: Dr KAWASHIMA, Tomohisa (Institute for Cosmic Ray Research, The University of Tokyo)

Co-author: ASANO, Katsuaki (Institute for Cosmic Ray Research, The University of Tokyo)

Presenter: Dr KAWASHIMA, Tomohisa (Institute for Cosmic Ray Research, The University of Tokyo)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **221** Type: **not specified**

Gamma-ray emission from Puppis A with Fermi-LAT telescope evidence for proton acceleration

Tuesday, September 12, 2023 2:00 PM (15 minutes)

Supernova Remnants (SNRs) are the primary suspect among Galactic sources to accelerate particles via diffusive shock acceleration up to the necessary PeV energies.The gamma-ray emission of SNRs can provide direct evidence of leptonic (inverse Compton and bremsstrahlung) and hadronic (pion-decay from proton-proton interactions) processes.
Puppis A is a middle-aged SNR interacting with interstellar clouds which has been observed in a broad energy band, from radio to gamma-rays. We analyzed its gamma-ray emission with 14 years of Fermi-LAT observations.The remnant shows a clear asymmetry in high-energy flux between East and West sides corresponding to the asymmetry found in its X-ray emission. The same asymmetry has not been found in the spectral analysis, which suggests the same origin for the gamma-ray emission in the global remnant. Moreover, we analyzed two gamma-ray sources located close to the remnant. The hardness of their spectra suggests that the gamma-ray emission can be due to particles escaping from the shock of Puppis A.

Primary author: Mrs GIUFFRIDA, Roberta (Università degli studi di Palermo - Osservatorio Astronomico di Palermo)

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Presenter: Mrs GIUFFRIDA, Roberta (Università degli studi di Palermo - Osservatorio Astronomico di Palermo)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **222** Type: **not specified**

Small scale frictions in the LCDM cosmology

Tuesday, September 12, 2023 11:25 AM (25 minutes)

Dwarf galaxies are the lowest mass galaxies in the Universe but they are key laboratories for understanding galaxy formation processes, since their properties are sensitive to how these processes are in play. Moreover they are strong probes for cosmology and dark matter properties. There are long standing debates in the literature on whether the observed properties of dwarf galaxies are consistent with the predictions of the standard model of cosmology. In this overview, I will go over some of the key challenges of understanding dwarf galaxies in the cosmological context of galaxy formation, in particular "missing satellite", the "too big to fail", the "cusp vs core" problems. I will discuss how some of these historical "tensions"have been (or can be) addressed in recent cosmological simulations that include complex physics of galaxy formation.

Primary author: FATTAHI, Azadeh (Durham University)

Presenter: FATTAHI, Azadeh (Durham University)

Session Classification: Plenary

Track Classification: Cosmology

Contribution ID: **224** Type: **not specified**

Proton synchrotron, an explanation for possible extended VHE gamma-ray activity of TXS 0506+056 in 2017

Thursday, September 14, 2023 2:15 PM (15 minutes)

TXS 0506+056, source of the extreme energy neutrino event, IceCube-170922A, has an interesting environment to study the lepto-hadronic emissions. The Fermi-LAT detector reported high energy (HE) γ-ray flare between 100 MeV and 100 GeV starting from 15 September 2017 from this source. Several follow-ups to trace the very high energy (VHE) gamma-ray counterparts around the IceCube-170922A resulted in no success around 22 September 2022. Only after 28 September, the Major Atmospheric Gamma-ray Imaging Cherenkov (MAGIC) telescopes observed the first VHE gamma rays from the blazar above 100 GeV. The ~41 h survey resulted in VHE γ-ray activity until 31 October 2017, nearly 45 days after the HE flare. Here we propose the extended GeV γ rays can be explained by taking two production channels, electron synchrotron self Compton and proton synchrotron for HE and VHE emissions, respectively. The 45 days of VHE emission from the peak of the HE flare can be explained with L′p⊠1047 erg/sec in the jet frame and magnetic field of 2.4 G, consistent with the LEdd for a blackhole mass 5×109 M⊠. With the same luminosity of accelerated protons, we explained the observed neutrino flux with proton-varying-ambient interaction.

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Presenter: ., Sunanda (Indian Institute of Technology Jodhpur, India)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **225** Type: **not specified**

Could quantum gravity slow down neutrinos?

Wednesday, September 13, 2023 5:40 PM (15 minutes)

In addition to its implications for astrophysics, the hunt for neutrinos from Gamma-Ray Bursts (GRBs) could also be significant in quantum-gravity research, since they are excellent probes of the microscopic fabric of spacetime. Over the last few years one of the most studied candidate effects of quantum gravity has been in-vacuo dispersion, a phenomenon suggesting an energy-dependent speed variation for ultrarelativistic particles, also associated with Lorentz Invariance Violation (LIV). In this study, we investigated the hypothesis that some neutrinos detected by the IceCube observatory might be GRB neutrinos, with their travel times affected by energy-dependent speed. Our findings provide intriguing indications that these neutrinos might indeed experience a delay relative to the detection time of the GRB, proportional to the neutrino's energy.

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Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **227** Type: **not specified**

Diffuse Emission of Neutrino Sources beyond the Discovery Horizon

Monday, September 11, 2023 3:30 PM (15 minutes)

Resolving the origin of diffuse TeV-PeV neutrino emission measured by the IceCube Observatory is a key part of multi-messenger astronomy. We study the neutrino emission of Galactic and extragalactic source populations by investigating the relation between IceCube's point-source discovery potential and diffuse flux observations. For Galactic sources, we show that the flux of unresolved neutrino sources can contribute significantly to the Galactic diffuse emission at 100 TeV at a level comparable to that expected from cosmic ray interactions in the interstellar medium. For extragalactic sources, we explore avenues for improving existing constraints on candidate source populations via improved statistical methods and/or population models. We also examine whether Galactic and extragalactic candidate sources can be probed by current and planned future neutrino detectors.

Primary author: GROTH, Kathrine Mørch (Niels Bohr Institute, University of Copenhagen)

Presenter: GROTH, Kathrine Mørch (Niels Bohr Institute, University of Copenhagen)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **229** Type: **not specified**

Multi-messenger lifetime constraints on heavy decaying dark matter

Monday, September 11, 2023 5:30 PM (15 minutes)

Dark matter is one of the ingredients of the standard cosmological model although we do not know its fundamental nature. Huge effort has been made in order to perform a direct detection of this dark matter component but up to now we have only seen it interacting gravitationally. In this regard the indirect detection is a promising method to search for dark matter, where we try to look at signatures of the dark matter on the astrophysical messengers, such as gamma-rays and neutrinos.
Heavy dark matter with $m_{\rm DM} > 10^7$ GeV leads to higher fluxes in the decaying scenario rather than the annihilating one. In this work we focus on heavy decaying dark matter particles and we revisit the dark matter lifetime bounds placed by the gamma-ray measurements by means of the spectra provided by the recent code HDMSpectra. We provide lifetime limits for dark matter particles with $m_{\rm DM} = [10^7 - 10^{15}]$ GeV for a set of decay scenarios, where we take into account their neutrino and gamma-ray production.

Primary authors: FIORILLO, Damiano (Niels Bohr Institute, Copenhagen); MIELE, Gennaro; CHIANESE, Marco; SAVIANO, Ninetta; HAJJAR MUÑOZ, Rasmi (SSM - IFIC (CSIC-UV)); MORISI, Stefano (Università federico II Napoli)

Presenter: HAJJAR MUÑOZ, Rasmi (SSM - IFIC (CSIC-UV))

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **230** Type: **not specified**

Results from searches for astrophysical neutrino sources in the southern sky and galactic plane using IceCube starting track events

Thursday, September 14, 2023 4:30 PM (15 minutes)

Over the past decade, the IceCube detector has gone from the discovery of an astrophysical neutrino flux at earth to the identification of two neutrino sources, TXS 0506+056 and NGC 1068. However, efforts continue within IceCube to pull more astrophysical neutrino events out of the data. Here, we present the results from a new IceCube event sample which selects for starting track events created by muon neutrinos that interact inside of the IceCube detector. Selecting for this morphology allows us to remove not only the incoming muon background but also atmospheric neutrinos in the southern sky, which can be accompanied into the detector by muons from the same air shower. This additional background rejection creates a high purity astrophysical neutrino sample at energies below 100 TeV improving IceCube's sensitivity to the southern equatorial sky. We conducted four analyses looking for an excess of events coming from any given direction and from the direction of bright gamma-ray sources, galactic plane TeV gamma-ray source classes, and the entire galactic plane. While the analyses using this starting track event selection did not return any statistically significant results, we set competitive upper limits on the neutrino emission from pulsar wind nebulae and on the diffuse galactic plane emission. We also show that our results are consistent with the recent IceCube results for NGC 1068 and diffuse galactic plane emission

Primary author: MANCINA, Sarah Louise (Univeritá degli Studi di Padova)

Presenter: MANCINA, Sarah Louise (Univeritá degli Studi di Padova)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **231** Type: **not specified**

Fast and accurate AMS-02 antiproton likelihoods for global dark matter fits

Tuesday, September 12, 2023 2:15 PM (15 minutes)

Cosmic-ray antiprotons from AMS-02 offer valuable information about the nature of dark matter, but their interpretation is complicated by large uncertainties in the modeling of cosmic ray propagation. In this talk, I intend to present a novel framework to efficiently marginalize over various uncertainties in order to obtain robust AMS-02 likelihoods for arbitrary dark matter models. The three central ingredients of this framework are the neural emulator DarkRayNet for predictions of the antiproton flux, the likelihood calculator pbarlike, and the global fitting framework GAMBIT. Systematic uncertainties from propagation, the secondary antiproton production cross section, solar modulation, and correlation in the AMS-02 data are taken into account. I plan to illustrate our approach and the limits on the annihilation cross section of WIMP dark matter in the context of a state-of-the-art global fit of the scalar singlet dark matter model, including also recent results from direct detection and the LHC.

Primary author: KORSMEIER, Michael (The Oskar Klein Centre, Department of Physics, Stockholm University)

Co-authors: KAHLHOEFER, Felix (DESY); NIPPEL, Kathrin (RWTH Aachen University); MANCONI, Silvia (LAPTh, CNRS); BALAN, Sowmiya

Presenter: KORSMEIER, Michael (The Oskar Klein Centre, Department of Physics, Stockholm University)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **232** Type: **not specified**

SST-1M: Design, Performance, and Commissioning Results of a Single-Mirror Small Size Telescope for Gamma-ray Astrophysics

Tuesday, September 12, 2023 6:15 PM (15 minutes)

SST-1M is a single-mirror Small Size Telescope prototype developed by a consortium of institutes from Poland, Switzerland and the Czech Republic. The design of the SST-1M follows the Davies-Cotton design, with a 9.42m^2 multi-segment mirror. With a wide field of view of 9 degrees, SST-1M is designed to detect gamma rays in the energy range between 1 and 300 TeV. The two SST-1Ms that have been built are equipped with the DigiCam camera, which features a fully digital readout and trigger system using 250 MHz ADC, and a compact Photo-Detector Plane composed of 1296 pixels, each made of a hexagonal light guide coupled to a silicon photomultiplier.

Two SST-1M telescopes are currently being commissioned at the Ondrejov Observatory in the Czech Republic, where they have collected numerous hours of observations, accumulating valuable data and successfully observing Cerenkov events in stereo.
This contribution will present an overview of the telescope and camera design. Performance evaluation of the SST-1M telescopes will be discussed. Additionally, preliminary results obtained from the commissioning data collected at the observatory will be shown.

Primary authors: TAVERNIER, Thomas (FZU, Prague, Czech Republic); SST-1M COLLABORATION

Presenter: TAVERNIER, Thomas (FZU, Prague, Czech Republic)

Session Classification: GRA: Gamma Ray Astronomy

Contribution ID: **233** Type: **not specified**

Latest Fast Radio Burst Observations with VERITAS

Tuesday, September 12, 2023 5:45 PM (15 minutes)

The search for multi-wavelength counterparts to fast radio bursts (FRBs) remains critical for understanding the underlying emission mechanisms of these interesting cosmological probes. The deepest limits come from telescopes with the fastest sampling rates in every band, meaning Imaging Atmospheric Cherenkov Telescopes (IACTs) are some of the most effective instruments to investigate these systems. VERITAS continues to monitor in parallel with radio instruments interesting new burst storms from repeating sources of FRBs like FRB 20220912A and provide the deepest observations in both the optical and the very high energy (VHE; >100 GeV) bands for measured FRBs. We will present simultaneous radio and gamma-ray observations from the burst storm of FRB 20220912A and present our observations in the context of previously unprobed emission models. We will also briefly discuss the general optical program of VERITAS and ongoing upgrades that serve as a prototype for parasitic optical observations for the next generation of IACTs.

Primary author: LUNDY, Matthew (McGill University)

Presenter: LUNDY, Matthew (McGill University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **235** Type: **not specified**

Simulating TeV gamma-ray morphologies of shell-type supernova remnants

Wednesday, September 13, 2023 2:30 PM (15 minutes)

Supernova remnants shocks are considered the best sites for the production of Galactic cosmic rays. The interactions of cosmic rays produced at supernova shocks with photon fields and the interstellar medium generate a multi-wavelength spectrum from radio to gamma rays. In particular, TeV gamma-ray emission may originate from both hadronic and leptonic interactions. Recent results from kinetic simulations suggest that the acceleration of cosmic ray ions strongly depends on the relative angle between the shock normal and the local magnetic field orientation. This means that the underlying topology of the interstellar magnetic field in which the supernova remnant expands determines the emission morphology.
Using 3D magneto-hydrodynamical simulations with the code AREPO, we study the effect of the obliquity dependent shock acceleration on the emission morphology of bright supernova remnants. We apply the results of idealised cases to well-known bright supernova remnants assuming a hadronic model to reproduce different emission morphologies. From the TeV gamma-ray morphology we predict the local composition of the interstellar medium and the coherence scale of the interstellar magnetic field. Furthermore we study the impact of different interstellar environments, such as the case of a clumpy medium for core-collapse supernova remnants. We show that the hadronic model provides a good match for both the observed morphologies and the spectra.

Primary author: PAIS, Matteo (The Hebrew University of Jerusalem)

Co-authors: Prof. PFROMMER, Christoph (Leibniz Institute for Astrophysics); Dr EHLERT, Kristian (Leibniz Institute for Astrophysics); Dr WINNER, Georg (Leibniz Institute for Astrophysics); Dr WERHAHN, Maria (Max Planck Institute for Astrophysics)

Presenter: PAIS, Matteo (The Hebrew University of Jerusalem)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **237** Type: **not specified**

Dark Matter Capture and Thermalization in Neutron Stars

Tuesday, September 12, 2023 2:45 PM (15 minutes)

Neutron stars (NSs) are promising cosmic laboratories to test the nature of dark matter (DM). DM captured by the strong gravitational field of these stellar remnants transfers kinetic energy to the star during the collision. This can produce anomalous heating of old neutron stars. Further thermalization and DM annihilation can add an extra source of heating. We improve former calculations of the DM capture rate, thermalization, and capture-annihilation equilibrium timescales in NSs, which rely on approximations. We account for the stellar structure, gravitational focusing, relativistic kinematics, Pauli blocking, strong interactions and nucleon structure. In NSs, DM can be captured via collisions with strongly interacting baryons or relativistic leptons. We project the NS sensitivity to DM-nucleon and DM-lepton scattering cross sections which greatly exceeds that of direct detection experiments, especially for low mass DM. In addition, we determine the region of the DM parameter space where kinetic heating dominates over kinetic plus annihilation heating, for different DM interactions with NS constituents, in light of possible observations of local old NSs with infrared telescopes.

Primary author: ROBLES, Sandra (Fermilab)

Presenter: ROBLES, Sandra (Fermilab)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **239** Type: **not specified**

Search for ultra-high energy photons and neutrinos in the multi-messenger context at the Pierre Auger Observatory

Wednesday, September 13, 2023 2:40 PM (15 minutes)

The Pierre Auger Observatory, the largest ultra-high energy cosmic ray detector ever constructed, has an unprecedented sensitivity to neutral primaries above 10^17 eV.

After almost 20 years of data taking, stringent limits to the diffuse flux of photons and neutrinos have been derived, excluding many exotic models for the origin of UHE cosmic particles. Furthermore, targeted searches and follow-up analyses connected to the detection of gravitational waves have been carried out showing the high potential of the Observatory for high-energy multi-messenger astronomy.

We report here about the current activities and latest results of diffuse and targeted searches, along with the perspectives for the upgraded detector, which will further improve the Auger sensitivity providing new insights on the most extreme phenomena in the Universe.

Primary author: SCHERINI, Viviana (Istituto Nazionale di Fisica Nucleare)

Presenter: SCHERINI, Viviana (Istituto Nazionale di Fisica Nucleare)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **242** Type: **not specified**

Detection of early (prompt) emission from short GRBs in the VHE gamma-rays: ET, CE and CTA in action

Wednesday, September 13, 2023 12:10 PM (20 minutes)

The production of the early emission of gamma-ray bursts (GRBs) is still highly debated. We mostly rely on the wide field of view gamma-ray instruments in the range of 10 keV-10 MeV. However, at higher energies (above 100 GeV), apparently, it is a critical job to catch it in flagrante. I will discuss the multi-messenger observational strategies to detect the early emission of short GRBs at very-high-energies (VHE; E > 30 GeV) in the era of the third-generation gravitational wave detectors Einstein Telescope (ET) and Cosmic Explorer (CE) in association with Cherenkov Telescope Array (CTA). I will describe the capabilities to detect and localize gravitational wave events in the inspiral phase of the compact binaries and provide an early-warning alert for upcoming short GRBs, thanks to the proposed low-frequency response of ET. I will discuss possible VHE components from the synchrotron self Compton components in the leptonic GRB model, the high energy tail of the hadronic GRB model as well as external inverse Compton emission as viable candidates in the energy band of 10 GeV - 10 TeV. The recent discovery of the GeV component from a compact binary merger boosted the possibility of having GeV to sub-TeV emission from a compact binary merging event.

Primary author: BANERJEE, Biswajit

Presenter: BANERJEE, Biswajit

Session Classification: Plenary

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **243** Type: **not specified**

Investigating the blazar-neutrino connection with public IceCube data

Thursday, September 14, 2023 5:15 PM (15 minutes)

The IceCube collaboration has recently found evidence for connecting the blazar TXS 0506+056 to high-energy neutrino events. Observations of spatial correlations between neutrino hotspots and locations of blazars have also hinted at a blazar-neutrino connection (Buson et al. 2022, 2023). Several other studies have independently investigated the hypothesis of blazars as neutrino emitters with mixed results, including constraints on the contribution of these sources to the observed astrophysical neutrino flux. As such, open questions remain regarding the proposed neutrino production mechanisms, connection to multi-messenger signals, and population properties.
Motivated by these challenges, we present open-source statistical analysis frameworks to investigate possible sources with publicly available IceCube data. Our tools enable complementary frequentist and Bayesian approaches. The frequentist framework implements a standard IceCube point source analysis, while the Bayesian approach includes more free model parameters and offers a unique perspective on source discovery. We apply these tools to investigate possible blazar-neutrino connections with blazars from the Roma-BZCAT that have been linked to IceCube hotspots and present the first results. We further demonstrate the advantages of the novel Bayesian approach and the implications of our results for the blazar-neutrino connection.

Primary author: KUHLMANN, Julian (MPP)

Co-author: CAPEL, Francesca (Max Planck Institute for Physics)

Presenter: KUHLMANN, Julian (MPP)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **245** Type: **not specified**

High-energy diffuse emission from the Milky Way, a new multi-messenger perspective

Friday, September 15, 2023 12:05 PM (20 minutes)

Being for centuries a magnificent and enigmatic environment in the low energy regime, the Milky Way became, during the last decades, the prominent astrophysical lab to understand the high-energy diffuse emission produced by charged particles propagation and interactions with the interstellar medium. A Galactic cosmic-ray transport model featuring non-homogeneous transport has been developed over the latest years. This setup is aimed at reproducing γ-ray observations in different regions of the Galaxy (with particular focus on the progressive hardening of the hadronic spectrum in the inner Galaxy) and was shown to be compatible with the very-high-energy γ-ray diffuse emission recently detected up to PeV energies and with the local cosmic-ray measurements. In this contribution we show the diffuse high-energy neutrino emission expected, following a recent update of this model, for the whole Galaxy and for the Central Molecular Zone where the massive clouds of Sagittarius are placed. Considering the last improvements on events reconstruction of neutrino telescopes a possible detection of this diffuse ν signal seems behind the corner. Such a discovery can break the degeneracy between this model and other scenarios featuring prominent contributions from unresolved sources and TeV halos. Moreover the Galactic cosmic-ray cutoff would be well defined.

Primary author: MARINELLI, Antonio (Dipartimento di Fisica, Università Federico II, Napoli)

Co-authors: EVOLI, Carmelo (Gran Sasso Science Institute); GAGGERO, Daniele (Istituto Nazionale di Fisica Nucleare); GRASSO, Dario (Istituto Nazionale di Fisica Nucleare); DE LA TORRE LUQUE, Pedro (Oskar Klein Centre, Stockholm University); BOZZA, Riccardo Maria (Dipartimento di Fisica, Università Federico II, Napoli)

Presenter: MARINELLI, Antonio (Dipartimento di Fisica, Università Federico II, Napoli)

Session Classification: Plenary

Track Classification: Neutrinos

Contribution ID: **246** Type: **not specified**

tilepy: rapid tiling strategies in mid/small FoV observatories

Wednesday, September 13, 2023 5:55 PM (10 minutes)

The challenges inherent to time-domain multi-messenger astronomy require strategic actions to perform suited, optimized follow-up observations efficiently. Poorly localized events require dedicated tiling and/or targeted follow-up campaigns so that the source location can be efficiently covered, increasing the chances to detect the multi-wavelength counterpart. We have developed the python package "tilepy" to rapidly derive the observation scheduling of large uncertainty localization events by small/mid-FoV instruments. Developed initially to provide a rapid response to gravitational wave (GW) alerts by Imaging Atmospheric Cherenkov Telescopes (IACTs), they have been proven successful, as shown by the GW follow-up during O2 and O3 with the H.E.S.S. telescopes, and particularly in the follow-up of GW170817, where the first obtained tile covered the true location of the binary neutron star (BNS) merger.
We present "tilepy", a publicly available python package tha comprises several mature follow-up scheduling strategies. These range from the use of parallel, low-resolution grids, to the full integration of sky regions and targeted observations using galaxy catalogs. These algorithms consider the visibility constraints of customisable observatories and allow to schedule observations in both astronomical darkness and in moonlight conditions. We will present a generalization and improvements that enable to use these rapid strategies in a large variety of observatories and for other astrophysical events, alerts showing large uncertainties in the localization, as Gamma-Ray Burst (GRB) alerts from Fermi-GBM or high-energy neutrinos. We will conclude by describing the latest developments that include a publicly available cloud computing platform that allows easy access to the "tilepy"scheduling without the need for a local installation. We will finally describe use-cases of this tool and illustrate the integration into the Astro-COLIBRI multi-messenger platform.

Primary author: SEGLAR ARROYO, Monica (IFAE)

Co-authors: Dr SCHÜSSLER, Fabian (CEA Saclay); Dr ASHKAR, Halim (LLR); Dr DE BONY, Mathieu (CEA-Saclay)

Presenter: SEGLAR ARROYO, Monica (IFAE)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **247** Type: **not specified**

Low-luminosity jetted AGN as particle multi-messenger sources

Monday, September 11, 2023 5:45 PM (15 minutes)

The detection of cosmic gamma rays, high-energy neutrinos and cosmic rays (CRs) signal the existence of environments in the Universe that allow particle acceleration to extremely high energies. These observable signatures from putative CR sources are the result of in-source acceleration of particles, their energy and time-dependent transport including interactions in an evolving environment and their escape from source, in addition to source-to-Earth propagation.
Low-luminosity AGN jets constitute the most abundant persistent jet source population in the local Universe. The dominant subset of these, Fanaroff-Riley 0 (FR0) galaxies, have recently been proposed as sources contributing to the ultra-high-energy cosmic ray (UHECR) flux observed on Earth. This presentation assesses the survival, workings and multi-messenger signatures of UHECRs in low-luminosity jet environments, with focus on FR0 galaxies. For this purpose we use our recently developed, fully time-dependent CR particle and photon propagation framework which takes into account all relevant secondary production and energy loss processes, allows for an evolving source environment and efficient treatment of transport non-linearities due to the produced particles/photons being fed back into the simulation chain.
Finally, we propagate UHE cosmic-ray nuclei and secondary cosmogenic photons and neutrinos from FR0 galaxies to Earth for several extragalactic magnetic field scenarios using the CRPropa3 framework, and confront the resulting energy spectra and composition on Earth with the current observational situation.

Primary author: REIMER, Anita (University of Innsbruck)

Co-authors: BOUGHELILBA, Margot (University of Innsbruck); MERTEN, Lukas (Ruhr-University Bochum & RAPP Center); DA VELA, Paolo (University of Innsbruck); LUNDQUIST, Jon Paul (University of Nova Gorica); VOROBIOV, Serguei (University of Nova Gorica)

Presenter: REIMER, Anita (University of Innsbruck)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **248** Type: **not specified**

Prospects for the candidate PeVatron SNR G106.3+2.7 with the ASTRI Mini-Array

Tuesday, September 12, 2023 3:00 PM (15 minutes)

The SNR G106.3+2.7, with its associated molecular cloud complex, is one of the candidate TeV counterparts of LHAASO J2226+6057, one of the 12 LHAASO Galactic Pevatrons. The other candidate is the Boomerang PWN, associated with the PSR J2229+6114. Different gamma-ray facilities have detected this VHE region with an elongated morphology: the SNR is located in the "tail" of the VHE emission and the PWN on the "head". Identifying the exact location of the emission at > ~100 TeV is a key factor in distinguishing between the hadronic or leptonic origin of the gamma-ray emission constraining the acceleration mechanism. The MAGIC telescopes resolved this TeV region for the first time, finding that E>10 TeV emission comes only from the tail region, where the SNR G106.3+2.7 resides. However, additional and more precise measurements are required to confirm these results.
In this context, the ASTRI Mini-Array, an array of nine small-sized (4-m diameter) imaging atmospheric Cherenkov telescopes at the Observatorio del Teide (Tenerife), can play a crucial role. With its unprecedented sensitivity and, in particular, angular resolution in the multi-TeV energy band, this facility will make an important contribution to understanding the nature of the TeV emission shedding light on its possible relation with CR origin.
Taking advantage of the latest important results reported by the MAGIC collaboration, this work aims at investigating the potential of ASTRI-MiniArray in studying the complex morphology of this source and showing the potential improvements which can be obtained thanks to deep observation of the source.

Primary authors: Dr TUTONE, Antonio (INAF - Osservatorio Astronomico di Roma); Dr CARDILLO, Martina (INAF); Dr D'AÌ, Antonino (INAF); Dr AMATO, Elena; Dr MORLINO, Giovanni; Dr OLMI, Barbara

Presenter: Dr TUTONE, Antonio (INAF - Osservatorio Astronomico di Roma)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **249** Type: **not specified**

Cosmological implications of photon-flux upper limits at ultra-high energies in scenarios of Planckian-interacting massive particles for dark matter

Thursday, September 14, 2023 6:00 PM (15 minutes)

Instantons can give rise to decay of particles otherwise forbidden. Using data collected at the Pierre Auger Observatory, we present a search for signatures of such instanton-induced decay processes that could be at work for super-heavy particles produced sufficiently during the post-inflationary epoch to match the relic abundance of dark matter inferred today. The non-observation of these signatures allows us to derive a bound on the reduced coupling constant of gauge interactions in the dark sector: $\alpha \leq 0.09$, for $10^9 \leq m/\mathrm{GeV} < 10^{19}$. Conversely, we obtain that, for instance, a reduced coupling constant $\alpha = 0.09$ excludes masses $\geq 3 \times 10^{13}$ GeV. In the context of dark matter production from gravitational interactions alone, we illustrate how these bounds are complementary to those obtained on the Hubble rate at the end of inflation from the non-observation of tensor modes in the cosmological microwave background.

Primary author: DELIGNY, Olivier (CNRS/IN2P3 - IPN Orsay)

Presenter: DELIGNY, Olivier (CNRS/IN2P3 - IPN Orsay)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **250** Type: **not specified**

Earth tomography with supernova neutrinos at future neutrino detectors

Thursday, September 14, 2023 6:15 PM (15 minutes)

Earth neutrino tomography is a realistic possibility with current and future neutrino detectors, complementary to geophysics methods. The two main approaches are based on either partial absorption of the neutrino flux as it propagates through the Earth (at energies about a few TeV) or on coherent Earth matter effects affecting the neutrino oscillations pattern (at energies below a few tens of GeV). In this work, we consider the latter approach focusing on supernova neutrinos with tens of MeV. Whereas at GeV energies, Earth matter effects are driven by the atmospheric mass-squared difference, at energies below
~100 MeV, it is the solar mass-squared difference what controls them. Unlike solar neutrinos, which suffer from significant weakening of the contribution to the oscillatory effect from remote structures due to the neutrino energy reconstruction capabilities of detectors, supernova neutrinos can have higher energies and thus, can better probe the Earth's interior. We revisit this possibility, using the most recent neutrino oscillation parameters and up-to-date supernova neutrino spectra. The capabilities of future neutrino detectors, such as DUNE, Hyper-Kamiokande and JUNO are presented, including the impact of the energy resolution and other factors. Assuming a supernova burst at 10 kpc, we show that the average Earth's core density could be determined within ⊠10% at 1σ confidence level, being Hyper-Kamiokande, with its largest mass, the most promising detector to achieve this goal.

Primary authors: MENA REQUEJO, Olga (INFN); HAJJAR MUÑOZ, Rasmi (SSM - IFIC (CSIC-UV)); PALOMARES-RUIZ, Sergio (IFIC (UV-CSIC))

Presenter: HAJJAR MUÑOZ, Rasmi (SSM - IFIC (CSIC-UV))

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **251** Type: **not specified**

A combined Flavour composition measurement of astrophysical neutrinos using multi-sample IceCube data

Thursday, September 14, 2023 4:45 PM (15 minutes)

IceCube, a cubic-kilometer Cherenkov Neutrino detector located at the South Pole has been able to put constraints on the diffuse astrophysical neutrino flavour ratio measured on Earth by establishing the existence of the astrophysical tau neutrino component of the neutrino flux. This measurement was made using the High Energy Starting Event (HESE) sample collected for over 7.5 years containing all-flavour, all-sky neutrino events with energies above 60 TeV. A dedicated particle identifier was used to reconstruct 'Double Cascade' event topologies, which are specific to tau neutrino charged current interactions. In this study, we present an updated measurement of the flavour composition using approximately 12 years of IceCube HESE data, applying a novel method of Monte-Carlo simulations to take detector systematics into consideration in a reliable and self consistent way. We show that this measurement delivers tighter constraints on the flavour composition of the astrophysical neutrino flux than previous IceCube analyses, especially when it is integrated in a combined fit with high statistics samples of through-going tracks and cascades.

Primary author: LAD, Neha (DESY Zeuthen)

Presenter: LAD, Neha (DESY Zeuthen)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **252** Type: **not specified**

Performance of the joint observations with LST-1 and MAGIC

Monday, September 11, 2023 2:45 PM (15 minutes)

The next generation ground-based instrument for very-high-energy gamma-ray observations will be the Cherenkov Telescope Array Observatory (CTAO). At one of the two planned sites, La Palma (Canary Islands, Spain), the first prototype of a Large-Sized Telescope, LST-1, is already operational and is currently under commissioning. The two MAGIC Cherenkov telescopes have been operating in stereoscopic mode since 2009 at the same site. The proximity of these three telescopes allows to observe the same gamma-ray events and to perform a joint analysis. This three-telescope system provides a better reconstruction of the events, both in terms of angular and energy resolution, as well as discrimination between showers initiated by gamma rays and cosmic rays. This results in an improvement of the sensitivity of over 60% and 40% compared to LST-1 or the two MAGIC telescopes operated separately, respectively. In this contribution, we will report on results from data taken on the Crab Nebula with the pipeline developed for the analysis of joint LST-1 and MAGIC observations, and show the improved performance evaluated using both real and simulated data.

Primary authors: BERTI, Alessio (Max Planck Institute for Physics); Ms VISENTIN, Elisa (University of Torino); Ms JOBST, Elli (Max Planck Institute for Physics); DI PIERRO, Federico (Istituto Nazionale di Fisica Nucleare); SITAREK, Julian (University of Lodz); OHTANI, Yoshiki (ICRR, University of Tokyo); SUDA, Yusuke (Hiroshima University)

Presenter: BERTI, Alessio (Max Planck Institute for Physics)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **255** Type: **not specified**

Pulsar wind nebula beyond reverberation

Monday, September 11, 2023 3:15 PM (15 minutes)

Reverberation starts when the PWN is reached by the reverse shock of the supernova remnant. Depending on the internal to the outer pressure balance, it might induce a compression of the PWN. This period has a large (even huge) effect on the subsequent dynamical and spectral evolution.
In this talk, we shall present numerical evidence for that the shell accumulated at the PWN boundary is far from being ideally thin, and that maintaining this approximation through the whole evolution may lead to incorrect estimates of the dynamical, and consequently spectral, properties of PWNe. Moreover, we shall show that thin-shell-based models are forced to assume a simplified, and rather arbitrary, structure for the supernova remnant. But this, especially the pressure profile, is a fundamental ingredient for the interaction between the PWN and the SNR, and a rough model is source of artificial modifications of the compression. We shall introduce a brand new solution to this problem that puts together the strengths of all past approaches: a numerical model that couples radiative one-zone and lagrangian treatments, able to correctly reproduce the PWN interaction with the SNR during reverberation and to consistently evolve the particle spectrum beyond.

Primary authors: Prof. OLMI, Barbara (INAF); TORRES, Diego F. (ICREA & Institute of Space Sciences (ICE, CSIC)); Prof. BUCCIANTINI, Niccolo (INAF); Prof. BANDIERA, Rino (INAF)

Presenter: TORRES, Diego F. (ICREA & Institute of Space Sciences (ICE, CSIC))

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **256** Type: **not specified**

On the gamma-ray emission of Milky Way satellites and globular clusters

Monday, September 11, 2023 3:15 PM (15 minutes)

One of the most elusive unknowns in particle physics and astrophysics today is the fundamental nature of dark matter. It is theoretically well-motivated that dark matter is a weakly interacting massive particle (WIMP) – a particle lying within the GeV to TeV energy ranges that interacts very weakly with Standard Model particles. Such behavior makes dark matter extremely difficult to detect with terrestrial detectors. However, there are still many ways to probe the fundamental nature of dark matter. One such way is by searching for astrophysical signatures of dark matter annihilation. Supposing that dark matter is a WIMP which self-annihilates, we can look for inexplicable excesses of Standard Model particles from astrophysical sources. In particular, we can look for high-energy gamma-rays with energies in the range of GeV to TeV. In this talk, I will discuss recent results on both the dark matter distributions and gamma-ray emissions of a selection of Milky Way satellites and globular clusters with an emphasis on the Sagittarius dwarf galaxy system and the Omega Centauri globular cluster.

Primary author: EVANS, Addy (Texas A&M University)

Presenter: EVANS, Addy (Texas A&M University)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **258** Type: **not specified**

Searches for exotic objects among Fermi-LAT gamma-ray sources with (weakly) supervised machine learning

Monday, September 11, 2023 4:45 PM (15 minutes)

This contribution presents our approach to identify potential exotic objects in the gamma-ray sky using the Fermi-LAT 4FGL-DR3 catalog. We employ both supervised and unsupervised classification techniques to analyze the gamma-ray spectra of sources in the catalog.
For the supervised approach, we simulate realistic gamma-ray spectra and utilize them to train a classifier specifically designed to identify exotic objects, such as dark matter subhalos. These simulated spectra also play a crucial role in validating the performance of our unsupervised approach. By using weakly supervised learning, our goal is to identify subhalo-like objects without explicitly training the algorithm on spectra simulated from a specific dark matter model, thus generalizing towards model independent searches for exotic sources.
Our results demonstrate the effectiveness of both approaches in identifying subhalo-like objects. Overall, our work contributes to the ongoing search for dark matter subhalos and highlights the potential of utilizing a combination of supervised and unsupervised techniques in the exploration of exotic gamma-ray sources.

Primary author: NIPPEL, Kathrin (RWTH Aachen University)

Co-authors: Prof. KRÄMER, Michael (RWTH Aachen University); MANCONI, Silvia (LAPTh, CNRS)

Presenter: NIPPEL, Kathrin (RWTH Aachen University)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **259** Type: **not specified**

Inelasticity studies using TeV-scale starting track neutrino events in IceCube

Thursday, September 14, 2023 5:00 PM (15 minutes)

Starting track events in the IceCube Neutrino Observatory, a gigaton ice-Cherenkov detector at the South Pole, arise from muon neutrino and antineutrino charged-current interactions in the detector. By reconstructing the energies of the hadronic shower and secondary muon separately, one can obtain the inelasticity of the event. This observable enables various measurements, including the ratio of atmospheric neutrinos to antineutrinos, neutrino-induced charm production, and the fraction of astrophysical tau neutrinos. We report on progress towards these measurements using a 10-year TeV-scale sample.

Primary author: MOULAI, Marjon (University of Wisconsin, Madison)

Presenter: MOULAI, Marjon (University of Wisconsin, Madison)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **262** Type: **not specified**

Illuminating the Invisible: deep underground dark matter search with COSINUS using NaI cryogenic calorimeters

Wednesday, September 13, 2023 2:40 PM (20 minutes)

The COSINUS experiment (Cryogenic Observatory for SIgnatures seen in Next generation Underground Searches) is a low-threshold, cryogenic experiment being set up at Laboratori Nazionali Del Gran Sasso, Italy. It aims to provide a model independent cross-check of the DAMA/LIBRA findings of a potential dark matter-like modulation signal.
COSINUS utilizes a two-channel readout system based on transition edge sensors (TESs) that allows for particle discrimination. It consists of ultrapure scintillating sodium iodide (NaI) crystals, read out using a novel remoTES scheme to measure the phonon signal of a particle interaction. A silicon beaker surrounding the crystal is used to measure the light signal from the same particle interaction. Results from the latest prototypes and updates on the setup will be presented in this contribution.

Primary author: RAGHUNATH BHARADWAJ, Mukund

Presenter: RAGHUNATH BHARADWAJ, Mukund

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **263** Type: **not specified**

Galactic Cosmic Ray accelerators and Their multi-messenger Signals

Wednesday, September 13, 2023 2:45 PM (15 minutes)

The origin and acceleration mechanisms of Galactic cosmic rays (CRs) are still unknown. Gamma-ray observations have been crucial in identifying potential sites of CR acceleration. However, understanding these observations is challenging because both hadronic and leptonic processes can produce gamma rays, and different mechanisms may be responsible for accelerating various CR species. A multi-messenger approach that includes current and potential observations of radio, X-ray, gamma-ray, and neutrino signals is necessary to disentangle these complex acceleration mechanisms and emission processes. In this talk, I will present the latest findings from our research involving semi-analytical methods and accurate numerical simulations to study the multi-messenger emissions produced by nearby very-high-energy astrophysical accelerators, particularly wind bubbles associated with compact star clusters, and pulsar wind nebula.

Primary author: LI, Youyou (GRAPPA, University of Amsterdam)

Co-authors: PERETTI, Enrico; AHLERS, Markus (Niels Bohr Institute); Dr MACIAS, Oscar (GRAPPA, University of Amsterdam)

Presenter: LI, Youyou (GRAPPA, University of Amsterdam)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **264** Type: **not specified**

Unresolved gamma-ray point sources in the inner Galaxy at E>10 GeV

Thursday, September 14, 2023 4:45 PM (15 minutes)

The nature of the GeV gamma-ray Galactic center excess (GCE) in the data of Fermi-Large Area Telescope (LAT) is still to be unveiled. While the GCE photon flux is peaked at about few GeV, a high energy tail extending up to tens of GeV has been reported by various studies. If confirmed, such high-energy photons are naturally explained by the inverse Compton emission of electrons and positrons emitted by a population of millisecond pulsars in the Galactic bulge. In this contribution we present preliminary results of our new investigation of the GCE at high energies (> 10 GeV). This is performed combining adaptive template fitting and pixel count statistical methods, in order to assess the role of sub-threshold point sources to the GCE, while minimizing the mismodelling of Galactic diffuse emission backgrounds. We characterize the properties of the gamma-ray emission in the inner Galaxy by reconstructing the flux distribution of point sources well below the Fermi-LAT detection threshold, and by measuring their radial and longitudinal profiles. The consequences of our results for upcoming surveys of the inner Galaxy with the Cherenkov Telescope Array are also discussed.

Primary author: Dr MANCONI, Silvia (Laboratoire d'Annecy-le-Vieux de Physique Théorique, CNRS)

Co-authors: DONATO, Fiorenza; CALORE, Francesca (LAPTh, CNRS)

Presenter: Dr MANCONI, Silvia (Laboratoire d'Annecy-le-Vieux de Physique Théorique, CNRS)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **265** Type: **not specified**

Towards a TeV blazar sequence

Wednesday, September 13, 2023 2:30 PM (15 minutes)

The most recent catalog of extragalactic gamma-ray sources, based on data collected over a period of 10 years by the Fermi satellite, double its cataloge the number of blazars with respect to the previous catalog.
In this contribution, we study the updated blazar sequence built with this extended dataset and investigate the properties of the TeV-detected subsample of sources.

This study serves two purposes: firstly, to examine the properties of TeV-detected blazars within the framework of the Fermi blazar sequence, and secondly, to incorporate the TeV band into the luminosity-dependent spectral energy distribution (SED) models.

Furthermore, using the Synchrotron Self-Compton model over the broadband spectral energy distributions, we have extract the average physical parameters for each luminosity bin.

Primary author: RIGHI, Chiara (INAF - OABrera)

Co-authors: PRANDINI, Elisa; GHISELLINI, Gabriele; COSTAMANTE, Luigi

Presenter: RIGHI, Chiara (INAF - OABrera)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **266** Type: **not specified**

Prospects on detections of Gamma-Ray Bursts from Binary Neutron Star mergers, with the Cherenkov Telescope Array Observatory

Wednesday, September 13, 2023 2:00 PM (25 minutes)

GW170817-GRB170817A provided the first direct evidence that at least a fraction of binary neutron star mergers (BNSs) are progenitors of short Gamma-Ray Bursts (sGRBs). More BNS signals are expected from the upcoming observation runs of the gravitational wave (GW) interferometers. In these systems, each messenger carries unique information about the astrophysical processes at the source. The detection of very-high-energy (VHE) gamma rays from merging binaries will improve our understanding of the BNS-sGRB connection, by revealing the acceleration processes in extreme conditions. The Cherenkov Telescope Array Observatory (CTAO) is the ideal instrument to search for the VHE gamma-ray counterparts thanks to its unprecedented sensitivity, rapid response and capability to monitor large sky areas. We will present potential observing modes and follow-up strategies which are being developed for CTAO to rapidly cover the localisation area of GW events, typically larger than the CTAO field of view. We will provide estimates on the expected number of sGRBs connected to GW events observable and detectable with CTAO, considering both on- and off-axis emission and various timescales of observation after the merger.

Primary author: SEGLAR ARROYO, Monica (IFAE)

Co-authors: CAROSI, Alessandro; STAMERRA, Antonio; PATRICELLI, Barbara; SCHÜSSLER, Fabian; GREEN, Jarred; NAVA, Lara

Presenter: SEGLAR ARROYO, Monica (IFAE)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **267** Type: **not specified**

Searching for high-energy neutrino emission from hard X-ray AGN with IceCube

Thursday, September 14, 2023 5:30 PM (15 minutes)

AGN are powerful sources that are believed to be capable of accelerating particles to high energies. In environments with gas or photon targets, cosmic-ray interactions transpire leading to the production of pionic gamma rays and neutrinos. Since the AGN environment is rich in gas, dust and photons, they are promising candidate sources of high-energy astrophysical neutrinos. While the neutrinos manage to escape, the gamma rays may further interact and cascade down to hard X-rays in environments with sufficiently large photon or gas targets. This is consistent with the detection of a neutrino flux from NGC 1068 by IceCube that is well above the observed gamma-ray flux. We have used 12 years of IceCube data to perform a stacked search and a point source search for high-energy neutrino emission from hard X-ray AGN sampled from Swift-BAT Spectroscopic Survey (BASS). In this talk I will describe the search and present the results, including upper limits of high-energy neutrino emission from different populations of AGN and a measurement of a 2.9σ excess from the seyfert galaxy NGC 4151.

Primary author: GOSWAMI, Sreetama (University of Alabama)

Co-author: DELAUNAY, James (University of Alabama)

Presenter: DELAUNAY, James (University of Alabama)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **268** Type: **not specified**

The role of the Galactic Centre region at TeV energies: a study of diffuse emission phenomenological models

Wednesday, September 13, 2023 3:00 PM (15 minutes)

The central region of the Milky Way is a peculiar target even for observations at the highest energies in the gamma-ray regime. For that reason the Galactic Centre (GC) represents an ideal laboratory where studying physical processes and testing theories and models. A definitive and conclusive explanation of the measured flux at GeV and TeV bands is still unknown. Among the most plausible interpretations there are the emission associated with the supermassive black hole SgrA*, annihilation of Dark Matter, a nowadays unresolved population of millisecond pulsars and/or pulsar wind nebulae and/or supernova remnants and/or particle accelerators associated with strong winds of massive stars. The key-role assumed by the diffuse gamma-ray emission in such complex region has to be considered as part of the observed flux since it is measured both at GeVs —first by EGRET and then by*Fermi*-LAT —and TeVs, as recently shown by Tibet AS-γ and LHAASO experiments.
In view of the next generation gamma-ray experiments and observatories, a detailed analysis of several phenomenological models for the dubbed Cosmic-Ray Sea —computed with DRAGON and GAMMASKY codes —is scrutinised in comparison with the observed spectra from the inner Galaxy. This study assumes a fundamental role in the analysis-chain of such data since represents the only method providing the background model for analyzing extended sources, as the GC region, and unveiling the nature and origin of the emission.

Primary author: VENTURA, Sofia (Istituto Nazionale di Fisica Nucleare)

Presenter: VENTURA, Sofia (Istituto Nazionale di Fisica Nucleare)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **270** Type: **not specified**

The QCD axion: theory, phenomenology, and searches

Thursday, September 14, 2023 11:25 AM (25 minutes)

The QCD axion – which emerges as a solution to the strong CP problem – would unavoidably contribute both the dark matter and dark radiation in the early and present Universe. The rich phenomenology brought in by the theory of the QCD axion depends on various components such as the axion energy scale, the details of the production mechanism, and the thermal history of the early Universe. We revise the recent improvements on the theory, astrophysics, and phenomenology of the QCD axion, as well as the search strategies that will look for these particles in the coming years. Talk based on https://arxiv.org/abs/2003.01100

Primary author: VISINELLI, Luca (Shanghai Jiao Tong University)

Presenter: VISINELLI, Luca (Shanghai Jiao Tong University)

Session Classification: Plenary

Track Classification: Cosmology

Contribution ID: **271** Type: **not specified**

The Compton Spectrometer and Imager (COSI)

Thursday, September 14, 2023 6:00 PM (15 minutes)

The Compton Spectrometer and Imager (COSI) is a Small Explorer satellite mission selected by NASA and scheduled to launch in 2027. COSI employs a novel Compton telescope consisting of a compact array of cross-strip germanium detectors. Owing to its wide field-of-view and excellent energy resolution, COSI will achieve an unprecedented sensitivity in the MeV range, especially for gamma-ray emission lines in the 0.2-5 MeV energy band. In this talk, I will provide an overview of the instrumental design of COSI and its four key science goals, the origin of Galactic positrons, nucleosynthesis in the Galaxy, polarization studies of gamma-ray bursts, and multi-messenger astrophysics. Also, I will present the current status of the project and the publicly-available data challenges released every year.

Primary author: Dr YONEDA, Hiroki (Julius Maximilians Universität Würzburg)

Co-authors: Dr ZOGLAUER, Andreas (University of California, Berkeley); Dr HARTMANN, Dieter (Clemson University); Dr TOMSICK, John (University of California, Berkeley); THE COSI SCIENCE TEAM

Presenter: Dr YONEDA, Hiroki (Julius Maximilians Universität Würzburg)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **272** Type: **not specified**

Title: Searching for GRBs Coincident with Gravitational Waves with Swift BAT GUANO

Wednesday, September 13, 2023 2:55 PM (15 minutes)

The joint detection of a short GRB and gravitational waves had long been a goal by astronomers that was finally realized with GRB/GW 170817A. The GRB emission was much less luminous than expected though, with a peak luminosity more than two orders of magnitude lower than any other short GRB known. This implies that there is a population of low-luminosity short GRBs and greatly motivates more sensitive GRB searches. In 2019 GUANO, a system for saving time-tagged event data on command was implemented, enabling more sensitive searches to be run on the ground around times of interest. The most sensitive of these searches, NITRATES is a likelihood based analysis that increases the distance that a GRB 170817a-like burst can be detected at by ~50% over the onboard analysis. In this talk I will discuss the planned followup analyses by Swift BAT GUANO to gravitational wave triggers during O4 along with any preliminary results.

Primary author: DELAUNAY, James (University of Alabama)

Presenter: DELAUNAY, James (University of Alabama)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **273** Type: **not specified**

A New Component from the Quiet Sun from Radio to Gamma Rays: Synchrotron Radiation by Galactic Cosmic-Ray Electrons

Monday, September 11, 2023 4:30 PM (15 minutes)

The quiet Sun, i.e., in its nonflaring state or nonflaring regions, emits thermal radiation from radio to ultraviolet. The quiet Sun also produces nonthermal radiation observed in gamma rays due to interactions of Galactic cosmic rays (GCRs) with the solar atmosphere and photons. We report on a new component: the synchrotron emission by GCR electrons in the solar magnetic field. To the best of our knowledge this is the first time this emission has been theoretically claimed and modeled. We find that the measured GCR electrons with energies from tens of GeV to a few TeV produce synchrotron emission in X-rays, which is a few orders of magnitude lower than current upper limits of the quiet Sun set by RHESSI and FOXSI, with no energy losses included. For a radially decreasing solar magnetic field we find the expected synchrotron intensity to be almost constant in the solar disk, to peak in the close proximity of the Sun, and to quickly drop away from the Sun. We also estimate the synchrotron emission from radio to gamma rays, and we compare it with current observations, especially with LOFAR. While it is negligible from radio to UV compared to the solar thermal radiation, this emission can potentially be observed at high energies with NuSTAR and more promising future FOXSI observations. This could potentially allow for constraining GCR densities and magnetic-field intensities at the Sun. This study provides a more complete description and a possible new way for understanding the quiet Sun and its environment. Based on Orlando, Petrosian, Strong (2023) ApJ 943, 173

Primary author: ORLANDO, Elena

Co-authors: PETROSIAN, Vahe'; STRONG, Andrew

Presenter: ORLANDO, Elena

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **276** Type: **not specified**

Implications of photon-ALP oscillations in extragalactic neutrino source TXS 0506+056

Tuesday, September 12, 2023 5:15 PM (15 minutes)

Photon-ALP oscillation results in the survival of gamma-rays from distant sources above TeV energies. Studies of CAST, Fermi-LAT, and IACT observed events that constrain the ALP parameters. We investigate the effect of photon-ALP oscillations on the gamma-ray spectra of the first extragalactic neutrino source, TXS 0506+056, for the observations of Fermi-LAT and MAGIC around the IC170922-A alert. Importantly, we studied the implications of photon-ALP oscillation on the counterpart γ-rays of the sub-PeV neutrinos observed from TXS 0506+056. We also show the diffuse γ-ray flux and their observability from the classes, FSRQs, HSP, and LISP, assuming similar gamma-ray emissions as TXS 0506+056.

Primary author: PANT, Bhanu Prakash (Indian Institute of Technology Jodhpur)

Co-authors: ., Sunanda (Indian Institute of Technology Jodhpur, India); MOHARANA, Reetanjali (Indian Institute of Technology Jodhpur, India); Mr S, Sarathykannan (Indian Institute of Technology Jodhpur)

Presenter: PANT, Bhanu Prakash (Indian Institute of Technology Jodhpur)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **278** Type: **not specified**

The Pacific Ocean Neutrino Experiment - Development of the first detector line

Monday, September 11, 2023 4:30 PM (15 minutes)

The Pacific Ocean Neutrino Experiment is a new neutrino telescope in the Pacific Ocean that is planned to consist of at least 70 instrumented mooring lines and span more than one cubic kilometre. Using the existing underwater infrastructure of Ocean Networks Canada, P-ONE aims to detect neutrinos with energies ranging from TeV to PeV, and will complement the sky coverage of both IceCube and KM3NeT.

Following two successful pathfinder missions, the P-ONE collaboration is now developing the first mooring line of the full detector. The 1000 m long line will hold 20 optical and calibration modules along a novel underwater cable design, and is planned to be deployed in 2024/25.

The presentation will show the design and current status of the first P-ONE line.

Primary author: GAERTNER, Andreas (University of Alberta)

Presenter: GAERTNER, Andreas (University of Alberta)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **279** Type: **not specified**

Updated Interstellar Inverse Compton Models and Dependency from the Large-Scale Magnetic Field

Wednesday, September 13, 2023 5:45 PM (15 minutes)

Standard models of the large-scale interstellar emission officially adopted so far for studies of the Fermi-LAT data are very uncertain and show some discrepancies with respect to the data especially in the inner Galaxy where the degeneracy with the various components is large, underlining the necessity of more realistic models.
We focus here on the large-scale Inverse Compton (IC) component of the interstellar emission, which is produced by cosmic-ray (CR) electrons and positrons on the CMB and Galactic photons. We have updated the IC model accounting for latest precise CR measurements, with AMS02 and Voyager, and for a more realistic magnetic field model consistent with synchrotron emission, which is observed in radio, produced by the same electrons and positrons. We show the effects of such improvements in the spectral and spatial distribution of the IC model.
For example, we found that the updated magnetic field model, which we constrain by synchrotron observations, produces a more peaked IC emission in the inner Galaxy with respect to the standard models used to analyze Fermi LAT data so far.
Predictions for future missions at MeV, such as AMEGO and GECCO, are also shown.

Primary author: ORLANDO, Elena

Presenter: ORLANDO, Elena

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **281** Type: **not specified**

New constraints on multiply-interacting ultra-heavy dark matter from the LUX-ZEPLIN (LZ) experiment

Thursday, September 14, 2023 2:00 PM (20 minutes)

Despite the wealth of gravitational evidence, little is known about the nature of dark matter. Searches for dark matter with liquid xenon (LXe) Time Projection Chamber (TPC) experiments have focused on the traditional mass range of weakly interacting massive particle (WIMP) dark matter candidates from a few GeV/c^2 to hundreds of TeV/c^2. The lack of WIMP signal thus far motivates a broader search for dark matter at less traditional masses. Dark matter candidates heavier than the unitarity limit of a few hundred TeV/c^2 for particles produced by thermal freeze-out could form for example as composite states bound by an attractive hidden sector force. In this talk, we present an analysis of the first science run (SR1) of the LUX-ZEPLIN (LZ) experiment to extend sensitivity to ultra-heavy dark matter (UHDM) with high cross section. The signal topology consists of multiple deposits in the active region forming a straight line. Rich information is available in such a dark matter signal, including the means to reconstruct the incident particle's full velocity vector on an event-by-event basis. This search sets new experimental limits on spin-independent dark matter-nucleus interactions to masses above 10^{17} GeV/c^2.

Primary author: SMITH, Ryan (UC Berkeley)

Presenter: SMITH, Ryan (UC Berkeley)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **282** Type: **not specified**

Observation of High-Energy Neutrinos from the Galactic Plane

Monday, September 11, 2023 2:15 PM (15 minutes)

IceCube has discovered a flux of astrophysical neutrinos and presented evidence for the first neutrino sources, a flaring blazar known as TXS 0506+056 and the active galaxy NGC 1068. However, the sources responsible for the majority of the astrophysical neutrino flux remain elusive. High-energy neutrinos can be produced when cosmic rays interact at their acceleration sites and during propagation through the interstellar medium. The Galactic plane has therefore long been hypothesized as a neutrino source.

Recent results from Galactic neutrino searches are presented in this contribution, with focus on an IceCube analysis on 10 years of cascade events. An improved cascade dataset, built upon recent advances in deep-learning-based reconstruction methods, is utilized for searches of neutrino emission in the Galactic plane. This work presents the first observation of high-energy neutrinos from the Milky Way Galaxy, rejecting the background-only hypothesis at 4.5 σ. The neutrino signal is consistent with diffuse emission from the Galactic plane, potentially in combination with emission by a population of sources.

Primary author: HÜNNEFELD, Mirco (TU Dortmund University)

Presenter: HÜNNEFELD, Mirco (TU Dortmund University)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **284** Type: **not specified**

Probing Star-forming Environments with KM3NeT/ARCA: expectations for the full detector

Monday, September 11, 2023 5:00 PM (15 minutes)

On behalf of the KM3NeT Collaboration.

Strong star-forming activity in astrophysical environments leads to an enhancement of hadronic gamma-ray and neutrino emissions. In this contribution, we explore the capability of the full KM3NeT/ARCA detector to trace TeVs neutrinos from star-forming environments, encompassing both diffuse and point-like signals. For the diffuse analysis,
we compute the 90% C.L. quasi-differential sensitivity for 10 years of the full detector operation, considering the whole energy range observable by KM3NeT/ARCA (100 GeV-100 PeV) and selecting upgoing track-like as well as all-sky cascade-like events. For the
point-like analysis, we compute the sensitivity for several declinations, focusing also on some particular Starburst Galaxies sources, such as NGC 1068, the Small Magellanic Cloud
(SMC) and Circinus Galaxy. The present contribution shows that KM3NeT/ARCA will be fundamental in strengthening the observations of the IceCube experiment and also in connecting the star formation processes with the high-energy neutrino production, within
a few years of operation in full configuration.

Primary authors: AMBROSONE, Antonio (Istituto Nazionale di Fisica Nucleare); IDRISSI IBN-SALIH, Walid (Istituto Nazionale di Fisica Nucleare)

Co-authors: MARINELLI, Antonio (Istituto Nazionale di Fisica Nucleare); MIELE, Gennaro; Ms MUSONE, Maria Rosaria (Università degli studi della Campania Luigi Vanvitelli); MIGLIOZZI, Pasquale (Istituto Nazionale di Fisica Nucleare)

Presenter: AMBROSONE, Antonio (Istituto Nazionale di Fisica Nucleare)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **285** Type: **not specified**

The GECCO Mission: Technology and Science with GECCO

Thursday, September 14, 2023 5:45 PM (15 minutes)

The Galactic Explorer with a Coded Aperture Mask Compton Telescope (GECCO) is a novel concept for a next-generation telescope covering the MeV band. We will present the potential and importance of this approach that bridges the observational gap between the keV and GeV energy range. With the unprecedented angular resolution of the coded-mask telescope combined with the sensitive Compton telescope, a mission such as GECCO can disentangle the discrete sources from the truly diffuse emission. This also allows to understand the gamma-ray Galactic center excess and the Fermi Bubbles, and to trace the low-energy cosmic rays, and their propagation in the Galaxy. Nuclear and annihilation lines are spatially and spectrally resolved from the continuum emission and from sources, addressing the role of low-energy cosmic rays in star formation and galaxy evolution, the origin of the 511 keV positron line, and fundamental physics. Such an instrument also detects explosive transient gamma-ray sources, which enable identifying and studying the astrophysical objects in a multi-messenger context. In this talk we will present the technology used for GECCO and the science that can be addressed.

Primary author: BOTTACINI, Eugenio

Presenter: BOTTACINI, Eugenio

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **286** Type: **not specified**

LeHaMoC: A novel radiation code for high-energy astrophysics

Wednesday, September 13, 2023 4:55 PM (15 minutes)

Recent associations of high-energy neutrinos with active galactic nuclei (AGN) have revived the interest in leptohadronic models of radiation from astrophysical sources. The rapid increase in multi-messenger observations requires fast numerical models that may be applied to large source samples. In this contribution, we introduce LeHaMoC, a newly developed code for solving (using an implicit difference scheme) the Fokker-Planck equations of photons and relativistic particles (e.g., electrons, positrons, protons, neutrinos) produced in a homogeneous magnetized source that may also be expanding. Our code offers several notable benefits compared to other existing codes, such as flexibility, speed, and precision. We demonstrate the capabilities of LeHaMoC by presenting astrophysical applications. All applications showcase the versatility of our code and its ability to accurately predict the observed high-energy photon and neutrino emission from high-energy astrophysical sources. Additionally, it can be easily customized to model a variety of high-energy astrophysical sources and has the potential to become a widely utilized tool in multi-messenger astrophysics.

Primary author: Mr STATHOPOULOS, Stamatios Ilias (National and Kapodistrian University of Athens)

Co-author: PETROPOULOU, Maria (National and Kapodistrian University of Athens)

Presenter: Mr STATHOPOULOS, Stamatios Ilias (National and Kapodistrian University of Athens)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **290** Type: **not specified**

Study of the region in the vicinity of SNR G312.4-0.4 with H.E.S.S. and Fermi-LAT

Tuesday, September 12, 2023 2:30 PM (15 minutes)

The region corresponding to the Centaurus Galactic spiral arm tangent of our galaxy, within 1 deg radius around Galactic longitude 312°, harbours a rich environment with candidate sources for gamma-ray astronomy. In particular, it contains five pulsars, with spin-down powers ranging between 10^35 and 10^37 erg.s−1, and characteristic ages between 13.6 and 62.8 kyr. The possible presence of associated pulsar wind nebulae (PWNe), could provide insights into the transition between the evolutionary stages of a PWN to a pulsar halo. In addition, this field contains SNR G312.4-0.4, a shell-type supernova remnant (SNR) detected at radio wavelengths. It is spatially coincident with the positions of PSR J1413-6141 and PSR J1412-6145, and the inferred characteristics of this SNR indicate that it is in the Sedov-Taylor phase.
In this contribution, we present a detailed spectro-morphological analysis of this region using more than 100 hours of H.E.S.S. observations and 14 years of Fermi-LAT data. We focus on the detection of high-energy gamma-ray emission spatially coincident with the SNR G312.4-0.4 seen by Fermi-LAT, and the detection of two extended sources of very-high-energy gamma-rays around the intermediate-aged pulsars PSR J1413-6205 and PSR J1406-6121 observed by H.E.S.S.. Finally, we discuss the origin of the detected gamma-ray emission in the context of those astrophysical sources and their evolution stages.

Primary author: CHAMBERY, Pauline (LP2i Bordeaux)

Co-authors: JARDIN-BLICQ, Armelle (LP2i Bordeaux); Dr SINHA, Atreyee (UCM Madrid); Dr LEMOINE-GOUMARD, Marianne (LP2i Bordeaux); Dr TSIROU, Michelle (DESY); Dr MARANDON, Vincent (CEA); Dr GALLANT, Yves (LUPM)

Presenter: JARDIN-BLICQ, Armelle (LP2i Bordeaux)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **291** Type: **not specified**

Exploring Dark QCD Dark Matter Models with Heavy Quarks

Thursday, September 14, 2023 2:40 PM (20 minutes)

We investigate different classes of models, in which the dark matter candidate arises as a hadronic state of dark constituent quarks, which are charged under both the new confining dark gauge group and the standard model. Specifically, we focus on the case of quarks in the fundamental representation of SU(N), which are heavier than the dark QCD confinement scale. Recent literature has demonstrated that this class of models can lead to a first order phase transition of the dark sector, which effectively results in a significant depletion of the dark matter relic abundance, due to a second annihilation stage after the usual freeze-out. In this study, we assess the distinctive thermal history associated with these type of models and perform a comprehensive study of the relevant parameter space - spanned by the dark QCD scale and the dark matter mass - beyond what was considered so far. We combine the experimental bounds from direct and indirect searches as well as specific collider signals and confront it with the predicted relic abundance to constrain the viable parameter space for these models.

Primary authors: NAPETSCHNIG, Martin (Technische Universität München); Dr BECKER, Mathias (University of Mainz); Prof. HARZ, Julia (University of Mainz)

Presenter: NAPETSCHNIG, Martin (Technische Universität München)

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **292** Type: **not specified**

TAMBO: Searching for Tau Neutrinos in the Peruvian Andes

Monday, September 11, 2023 6:00 PM (15 minutes)

The detection of high-energy astrophysical neutrinos by IceCube has opened a new window on our Universe. While IceCube has measured the flux of these neutrinos at energies up to several PeV, much remains to be discovered regarding their origin and nature. Currently, measurements are limited by the small sample size of astrophysical neutrinos and by the difficulty of discriminating between electron and tau neutrinos.

TAMBO is a next-generation neutrino observatory specifically designed to detect tau neutrinos in the 1-100 PeV energy range, enabling tests of neutrino physics at high energies and the characterization of astrophysical neutrino sources. The observatory will comprise an array of water Cherenkov and plastic scintillator detectors deployed on the face of the Colca canyon in the Peruvian Andes. This unique geometry will facilitate a high-purity measurement of astrophysical tau neutrino properties. In this talk, I will present the prospects of TAMBO in the context of next-generation neutrino observatories and provide an overview of its current status.

Primary authors: GARCIA SOTO, Alfonso (Harvard University); THOMPSON, Will (Harvard University)

Presenter: GARCIA SOTO, Alfonso (Harvard University)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **293** Type: **not specified**

Unraveling the mystery of Galactic PeVatrons: VERITAS and multi-wavelength study of the unidentified LHAASO sources

Tuesday, September 12, 2023 3:30 PM (15 minutes)

The detection of 14 ultra-high-energy (UHE, photon energy above 100 TeV) gamma-ray sources by LHAASO has opened up new avenues for investigating Galactic PeVatrons. We present the status of a VERITAS study of three intriguing LHAASO sources: J2108+5157, J0341+5158, and J0621+3755. J2108+5157 and J0341+5158 are "dark PeVatrons" without any source association. J0621+3755 is a TeV halo candidate associated with PSR J0622+3749, possibly the third detection of this new source class. VERITAS has an angular resolution of 0.1 deg and sensitivity to an energy range complementary to LHAASO. Therefore VERITAS provides a unique opportunity to study the emission sites of the VHE counterpart of the LHAASO sources and allows us to place constraints on the particle acceleration mechanism. In this study, we will give an update on the VERITAS and available multi-wavenlength observations of the three unidentified LHAASO sources.

Primary author: Ms WOO, Jooyun (Columbia University)

Co-author: ., VERITAS collaboration (Fred Lawrence Whipple Observatory)

Presenter: Ms WOO, Jooyun (Columbia University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **294** Type: **not specified**

The GAPS Antarctic Balloon Mission: A Dark Matter Search with Cosmic-ray Antinuclei

Monday, September 11, 2023 5:15 PM (15 minutes)

The General Antiparticle Spectrometer (GAPS) is an upcoming Antarctic balloon mission to search for dark matter by measuring low-energy cosmic-ray antinuclei using a novel detection technique. GAPS is the first experiment optimized to detect cosmic-ray antideuterons below 0.25 GeV/n. Antideuteron production in this energy range is kinematically suppressed in standard astrophysical processes but expected from a wide range of well-motivated dark matter models. Thus, detection of antideuterons by GAPS would be a smoking-gun signature of new physics. In addition to antideuterons, GAPS will also provide a precision cosmic-ray antiproton spectrum in a previously unprobed energy range, as well as leading sensitivity to low-energy antihelium-3. The GAPS sensitivity to antinuclei is enabled by a novel particle identification method based on exotic atom formation, de-excitation, and decay. Exotic atom-based particle identification provides a unique event topology for negatively-charged antinuclei and, because it does not require a magnet, enables a large sensitive area for detecting rare events within the constraints of a balloon payload. The instrument contains two sensitive detector systems. A ~2.5 m^3 tracker volume instrumented with 1060 silicon sensors and cooled by an oscillating heat pipe thermal system serves as the target, X-ray spectrometer, and particle tracker. Completely enclosing the tracker with ~40 m^2 of scintillator panels, the time-of-flight system provides the instrument trigger and the velocity measurement. Calibration and testing of the payload is underway, in preparation for the first of several Antarctic flights expected in 2024. This contribution will briefly review the dark matter motivation for a low-energy cosmic-ray antinucleus detector. It will then introduce the GAPS instrument and its sensitivity to antinuclei before finally reporting the calibration of the detector systems and the performance of the integrated payload.

Primary author: Dr ROGERS, Field (University of California, Berkeley / Space Sciences Laboratory)

Presenter: Dr ROGERS, Field (University of California, Berkeley / Space Sciences Laboratory)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **295** Type: **not specified**

Multicomponent Dark Matter signatures in supersymmetric models

Thursday, September 14, 2023 12:03 PM (13 minutes)

An intriguing possibility is that multiple dark matter (DM) candidates can coexist and contribute significantly to its measured relic abundance. In R-parity conserving supersymmetric models, the MSSM and the next-to-MSSM extended with RH neutrino superfields, we study a two-component scenario with right-handed sneutrino NLSP and gravitino LSP as DM candidates. Interestingly, the right-handed sneutrino decay is dominated by two-body processes to the LSP plus neutrinos, producing a potentially detectable signal in the ballpark of current and planned neutrino telescopes, in addition to the usual WIMP signatures. Since the interaction is suppressed by the Planck mass, and if the LH-RH sneutrino mixing parameter is small, $\ll O(10^{-2})$, a long-lived RH sneutrino NLSP is possible. On the other hand, in R-parity breaking models we consider axino and gravitino as DM candidates. Both can decay into a neutrino-photon pair with a lifetime much longer than the age of the Universe yielding a potentially detectable signal by gamma-ray telescopes. Moreover, if one is the NLSP and the other the LSP, the former can live enough as to contribute to the relic density in important regions of the parameter space. We study this multicomponent scenario in the context of the $\mu\nu$SSM in which a double-line signal can arise as a smoking gun.

Primary author: PEREZ, Andres Daniel (UAM-IFT)

Presenter: PEREZ, Andres Daniel (UAM-IFT)

Session Classification: Plenary

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **296** Type: **not specified**

Diffuse Emission from the Milky Way with Picard

Thursday, September 14, 2023 4:30 PM (15 minutes)

We will given an overview of recent developments in numerical modelling of cosmic-ray transport and ensuing gamma-ray emission within our Galaxy using the Picard code. Picard is a cosmic-ray propagation code allowing for efficient solution of spatially three-dimensional models. We will discuss challenges at arriving at the necessary three-dimensional models of our Galaxy that determine the transport of cosmic rays. In particular, we will focus on the distribution of cosmic-ray sources and of Galactic gas in our Galaxy and their impact on cosmic-ray transport and gamma-ray emission. Especially the latter impacts cosmic-ray transport via multiple transport processes and, additionally, acts as the target for the cosmic-rays to produce gamma-rays. We will show results of corresponding models and related gamma-ray emission especially in the TeV regime.

Primary author: KISSMANN, Ralf (Universität Innsbruck)

Co-authors: Mr RAMIREZ TAPIAS, Andrés (Universität Innsbruck); THALER, Julia (Universität Innsbruck); REIMER, Olaf (Universität Innsbruck)

Presenter: KISSMANN, Ralf (Universität Innsbruck)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **297** Type: **not specified**

The High Energy X-ray Probe (HEX-P): locations, spectra, and acceleration mechanisms for the highest-energy electrons in supernova remnants and pulsar-wind nebulae

Thursday, September 14, 2023 2:00 PM (15 minutes)

HEX-P is a probe-class mission concept that will combine high spatial resolution X-ray imaging (<10 arcsec FWHM) and broad spectral coverage (0.1-150 keV) with an effective area far superior to current facilities (including XMM-Newton and NuSTAR) to enable revolutionary new insights into a variety of important astrophysical problems. HEX-P is ideally suited to address important problems in the physics and astrophysics of supernova remnants (SNRs) and pulsar-wind nebulae (PWNe). For shell SNRs, HEX-P can greatly improve our understanding in several areas, including detections of, or limits on, 44Ti in the youngest supernova remnants and better spectral characterization and localization of nonthermal X-ray emission from both nonthermal-dominated SNRs and those containing both thermal and nonthermal components. For PWNe, HEX-P will provide spatially-resolved, broadband X-ray spectral data separately from their pulsar emissions, allowing us to study how particle acceleration, cooling and propagation operate in different evolution stages of PWNe. For Galactic PeVatrons and TeV gamma-ray sources in general, HEX-P will fill in a large gap in the spectral-energy distributions (SEDs) of many objects observed in radio, soft X-rays, and gamma rays, constraining the maximum energies to which electrons can be accelerated, with implications for the nature of the Galactic Pevatrons required by the spectrum of Galactic cosmic rays. We will also discuss HEX-P's unique and complementary roles to the future TeV gamma-ray and neutrino observatories in the 2030s.

Primary author: Ms WOO, Jooyun (Columbia University)

Co-author: ., HEX-P SNW/PWN Science Working Group (Various affiliations)

Presenter: Ms WOO, Jooyun (Columbia University)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **298** Type: **not specified**

A multi-zone scenario for the non-thermal emission of NGC1068

Tuesday, September 12, 2023 3:30 PM (15 minutes)

The IceCube telescope found an excess of 79 neutrinos
at Tera-electron-volt energies correlated with the galaxy NCG1068 (the corresponding significance is 4.2 sigmas), making this Seyfert galaxy spatially coincident with the
hottest spot in the northern high-energy neutrino sky.
Considering that NGC1068 presents a core with a high star-formation rate and hosts an active galactic nucleus, these observations can be the result of different astrophysical components.
In a recent work the ALMA collaboration highlights the emission from a kiloparsec jet associated to this AGN identifying 4 major knots.
In this contribution we explore a multi-messenger scenario, modeling the different astrophysical components through the available electromagnetic observations. The total expected neutrino emission is then compared with the IceCube observations and interesting perspectives for the future Global Neutrino Network are shown.

Primary authors: MARINELLI, Antonio (Dipartimento di Fisica, Università Federico II, Napoli); Mr RAUDALES, David (Universidád Nacionál Autonoma de Honduras, Instituto de Fisica)

Co-authors: AMBROSONE, Antonio (Dipartimento di Fisica, Università Federico II, Napoli); FIORILLO, Damiano (Niels Bohr Institute, Copenhagen); TORRESI, Eleonora (INAF/OAS); Dr CHIANESE, Marco (Università degli Studi di Napoli Federico II); GRANDI, Paola (INAF/OAS); SACAHUI, Rodrigo (Universidad de San Carlos de Guatemala)

Presenters: MARINELLI, Antonio (Dipartimento di Fisica, Università Federico II, Napoli); Mr RAUDALES, David (Universidád Nacionál Autonoma de Honduras, Instituto de Fisica)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **300** Type: **not specified**

Kinetic Simulations of Collisionless Shock Formation in the Dark Sector

Thursday, September 14, 2023 5:30 PM (15 minutes)

Historically, dark matter searches have primarily focused on hunting for effects from two-to-two scattering. However, given that the visible universe is primarily composed of plasmas governed by collective effects, there is great potential to explore similar effects in the dark sector. Recent semi-analytic work has shown that new areas of parameter space for dark U(1) and millicharged models can be probed through the observation of collisionless shock formation in astrophysical dark plasmas, a nonlinear process that requires simulation. Here, I will show results from simulating such warm, non-relativistic pair plasmas within the EPOCH framework, a fully-kinetic particle-in-cell plasma physics simulation suite.

Primary author: GIFFIN, Pierce (University of California, Santa Cruz)

Co-author: DEROCCO, William (Stanford Institute for Theoretical Physics)

Presenter: GIFFIN, Pierce (University of California, Santa Cruz)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **301** Type: **not specified**

An Improved Dark Halo Analysis with MADHAT v2.0

Monday, September 11, 2023 5:00 PM (15 minutes)

A key strategy for constraining the properties of particle dark matter is the search for the gamma-rays produced by its annihilation or decay in dwarf spheroidal galaxies. The Model-Agnostic Dark Halo Analysis Tool (MADHAT) is a publicly-available computational tool that uses data from the Fermi-LAT to constrain gamma ray emission from dwarf satellite galaxies and dwarf galaxy candidates due to dark matter annihilation, dark matter decay, or other nonstandard or unknown astrophysics. This tool efficiently provides statistical upper bounds on the number of observed photons in excess of the number expected, based on empirical determinations of foregrounds and backgrounds, using a stacked analysis of any selected set of dwarf targets. Here, I discuss the most current limits from MADHAT v2.0, which can produce optimized constraints for any model of dark matter particle physics or astrophysics.

Primary author: SANDICK, Pearl (University of Utah)

Presenter: SANDICK, Pearl (University of Utah)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **302** Type: **not specified**

Dark Matter in the light of no signals

Wednesday, September 13, 2023 5:30 PM (15 minutes)

The evidence for the existence of non-baryonic dark matter is overwhelming, coming from many different scales. However, there are still no positive signals. Indeed, the upper limits from direct detection have improved by several orders of magnitude in the last decades. In this talk, we will discuss several novel directions in WIMP model-building. We will analyse different scenarios (complex dark sectors, pseudo-Nambu Goldstone bosons, sterile neutrinos…) which obey current direct detection limits and may yield distinctive signals in the future.

Primary author: Dr HERRERO GARCÍA, Juan (IFIC, University of Valencia - CSIC)

Presenter: Dr HERRERO GARCÍA, Juan (IFIC, University of Valencia - CSIC)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **303** Type: **not specified**

HERD: A Key for Progressing in Our Understanding of Cosmic Rays

Wednesday, September 13, 2023 6:00 PM (15 minutes)

The High Energy cosmic-Radiation Detection (HERD) facility is a calorimetric space-borne experiment for the direct detection of cosmic rays. It will be launched and installed onboard the China Space Station in 2027. The ambitious aim of HERD is the direct detection of cosmic rays in the "knee" region (~ 1 PeV), with a detector able to measure electrons, photons and nuclei with an excellent energy resolution, an acceptance 10 times larger than that of current missions, and long lifetime (> 10 years). The primary objectives of HERD are the indirect search for dark matter particles and the precise measurement of energy distribution and composition of cosmic rays from 30 GeV up to few PeV. Furthermore, HERD will monitor the high energy gamma-ray sky from 100 MeV, observing gamma-ray bursts, active galactic nuclei, galactic microquasars, etc. HERD will be composed of a 3D, homogeneous, isotropic, deep (55 X_0) and finely segmented calorimeter, surrounded by a scintillating-fiber tracker, a plastic scintillator detector and a silicon charge detector. The HERD design, prospects and expected performance, as well as its contribution to the multimessenger astronomy will be presented in this contribution.

Primary author: PERRINA, Chiara (EPFL)

Presenter: PERRINA, Chiara (EPFL)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **304** Type: **not specified**

Developing a theoretical model for the gamma-ray emission from the Sun

Thursday, September 14, 2023 3:15 PM (15 minutes)

Despite its very close proximity to Earth, there are still many unsolved puzzles about the Sun. One such example of significant recent interest relates to the gamma-ray emission (in the GeV-TeV range) from the solar disk. A major contribution to the solar emission in this energy range is believed to be caused by the interaction of galactic cosmic rays (GCRs) with the solar atmosphere: the interaction of a GCR proton with a solar atmosphere proton produces a neutral pion that decays in outgoing gamma-rays. Indeed, the only existing theoretical model, dating back to 1991, is in tension with the Fermi-LAT observed spectrum (at energy > 0.1 GeV) which is about 30 times brighter and harder than predicted. The main goal of our work is to develop a theoretical model that explains the mechanism behind gamma-ray emission. Here we investigate the transport of GeV-TeV GCRs through the static magnetic arcade of an active region within 0.3 solar radii from the top of the photosphere; a magnetic turbulent component is overlapped to the arcade magnetic field. We performed test-particle (protons) simulations with the PLUTO code by injecting GCRs at different heights from the top of the photosphere and comparing the time of the interaction GCR/atmosphere proton with the characteristic time of the trapping that results from the combination of magnetic field arcade geometry and turbulence. We find that the effect of the magnetic turbulence in the solar atmosphere cannot be neglected.

Primary author: PUZZONI, Eleonora (University of Arizona)

Co-authors: FRASCHETTI, Federico (University of Arizona and Center for Astrophysics Harvard & Smithsonian); KOTA, Jozsef (University of Arizona); GIACALONE, Joe (University of Arizona)

Presenter: PUZZONI, Eleonora (University of Arizona)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **305** Type: **not specified**

Gamma-ray detection of the newly discovered SNR G288.8−6.3

Tuesday, September 12, 2023 2:15 PM (15 minutes)

A new supernova remnant (SNR) was recently detected at radio frequencies with ASKAP at (l, b) = (288.8, -6.3) by Filipovic et al. 2023 (submitted), partly coincident with a Fermi-LAT extended source that was provisionally associated with a molecular cloud. We reanalysed the region around the SNR using Fermipy, taking 14.5 years of data in a ROI of 12°.
Extended emission from the region was detected with a significance of $\sim 11.4\,\sigma$ spatially consistent with the recently detected faint radio shell (radius $\sim 0.7°$) at the same position. In this study we looked at gamma-ray energies between 100 MeV and 1 TeV. All considered models favour the presence of the SNR as an additional component over a model with just the known Fermi source. We find the source to be best described by a radial Gaussian with an extension comparable to the radio size of the remnant, and a power-law spectral model with an energy flux of $(1.16\pm0.12)\times10^{-5} MeV cm^{-2} s^{-1}$, and an index of $\Gamma = 2.22\pm0.04$. The spectrum is extending up to around 5 GeV. Morphologically, hotspots seen above 1 GeV are coinciding well with the bright western part of the radio shell. Given a source position well above the Galactic plane, the low ambient density and the age of more than 10 kyrs, we conclude the emission to be likely of leptonic origin. SNRs at high Galactic latitudes are valuable targets for detailed investigations at high energies due to lower Galactic diffuse emission and lower risk of source confusion.

Primary author: BURGER-SCHEIDLIN, Christopher (Dublin Institute for Advanced Studies DIAS)

Co-authors: BROSE, Robert (Dublin Institute for Advanced Studies); MACKEY, Jonathan; DE ONA WILHELMI, Emma (DESY-Zeuthen); SUSHCH, Iurii (North-West University, South Africa); GOSWAMI, Pranjupriya (TezpurUniversity); MESTRE, Enrique; FILIPOVIĆ, Miroslav

Presenter: BURGER-SCHEIDLIN, Christopher (Dublin Institute for Advanced Studies DIAS)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **306** Type: **not specified**

Application of Deep Learning to early detection of compact binaries by ground-based detectors

Wednesday, September 13, 2023 2:25 PM (15 minutes)

Multimessenger astronomy is a new way of exploring the Universe by combining data from different cosmic messengers such as gravitational waves and electromagnetic radiation. One of the best astrophysical targets for performing multimessenger analysis is Binary Neutron Star (BNS) coalescences, which produce both gravitational waves and detectable multiwavelength electromagnetic emissions. The success of this kind of analysis is based on the capability to rapidly detect and calculate the source's localization via the gravitational signal to be ready to catch the prompt counterpart with telescopes around the world.
This project aims at building a novel early warning pipeline for BNS signals based on deep neural networks. Deep learning is a promising tool for fast processing of significant amounts of data, such as those produced by Advanced gravitational wave interferometers. The architecture I implemented is a one-dimensional Convolutional Neural Network to perform predictions on interferometers' strain time series. I have trained it on a simulated LIGO and Virgo dataset I produced using custom simulations of GW signals embedded in a realistic, colored noise. The network is trained to distinguish between glitch transient noises and a BNS inspiral signal chunks.
The results show that deep learning is a viable approach to tackle the problem of early warning, opening the possibility of successful multimessenger analysis in future observing runs.

Primary authors: PAPALINI, Lucia (University of Pisa and Istituto Nazionale di Fisica Nucleare); RAZZANO, Massimiliano (University of Pisa and INFN-Pisa)

Presenter: RAZZANO, Massimiliano (University of Pisa and INFN-Pisa)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **307** Type: **not specified**

Tension in Currently Measured Values of H0

Tuesday, September 12, 2023 12:05 PM (25 minutes)

The question of whether there is new physics beyond our current standard model, Lambda Cold Dark Matter (LCDM), is a crucial unresolved issue in cosmology today. Recent measurements of the Hubble constant (Ho) using Cepheids and Type Ia supernovae (SNe) appear to differ significantly (5-sigma) from values inferred from the cosmic microwave background (CMB) fluctuations. This discrepancy, if real, could indicate new physics beyond the standard model. In this talk, I will review results using data from the Hubble Space Telescope using Cepheids as well as the Tip of the Red Giant Branch (TRGB). A comparison of these results indicates that there remain systematic uncertainties in the local calibration of Ho. I will describe a new program using the James Webb Space Telescope (JWST) aimed at reducing uncertainties in extragalactic distances and the measurement of Ho, and present some new, preliminary results. JWST has four times the resolution and ten times the sensitivity of HST in the near infrared, and will be critical for ascertaining whether new physics is required beyond the standard model of cosmology.

Primary author: FREEDMAN, Wendy (University of Chicago)

Presenter: FREEDMAN, Wendy (University of Chicago)

Session Classification: Plenary

Track Classification: Cosmology

Contribution ID: **308** Type: **not specified**

Particle escape from evolved pulsar wind nebulae

Friday, September 15, 2023 11:00 AM (25 minutes)

Pulsars and their associated pulsar wind nebulae are known to be efficient particle accelerators and antimatter factories in our Galaxy; the Crab nebula is the only leptonic accelerator firmly identified to date.
Observations at high and very high energies have shown in recent years that pulsar wind nebulae efficiently inject particles into the ambient medium, especially in their evolved phases.
In X-rays, we have detected a number of elongated, thin, almost monochromatic features apparently emanating from the heads of bow shock nebulae produced by fast-moving pulsars, injecting newly accelerated particles into the medium and tracking the ambient magnetic field.
Largely thanks to LHAASO, we now also know that the number of extended sources emitting in the TeVs (and up to PeVs) is much larger than originally predicted, and many of these sources have a possible pulsar nature. Two of the best-studied TeV halos are actually associated with evolved pulsars (Geminga and Monogem).
Understanding how particles can escape from the pulsar/pulsar wind nebula region of influence and how they then interact with the environment is a key point in unraveling the nature of these structures. Here I will discuss what we have learned in recent years.

Primary author: OLMI, Barbara (INAF -OAPa/OAA)

Presenter: OLMI, Barbara (INAF -OAPa/OAA)

Session Classification: Plenary

Track Classification: Gamma Ray Astronomy

Contribution ID: **309** Type: **not specified**

The Search for Physics Beyond the Standard Model: a Theorist Perspective

Thursday, September 14, 2023 11:00 AM (25 minutes)

In this talk I will give a theorist point of view of the status of our quest for physics beyond the standard model of particle physics. One decade after the discovery of the Higgs boson many of the theoretical questions remain the same. I will review how our view of these questions has been impacted by experimental data. I will give some examples of what I consider to be interesting ideas to experimentally test in the future, whether they are those related to the origin of the Higgs sector or some other questions such as the nature of dark matter or the origin of flavor.

Primary author: BURDMAN, Gustavo (Univ. São Paulo (USP))

Presenter: BURDMAN, Gustavo (Univ. São Paulo (USP))

Session Classification: Plenary

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **310** Type: **not specified**

Cosmology in the era of Multimessenger Astronomy

Tuesday, September 12, 2023 11:00 AM (25 minutes)

Multimessenger observations leverage the unique roles of each messenger to provide new insight into our universe. With successive upgrades to current facilities and the launch of new instruments, and hence a growing number of detections, we are prepared to address a number of fundamental questions in cosmology. In this talk, I will give an overview of the exciting opportunities that multimessenger observations will provide in cosmology, and discuss the path toward the main science targets.

Primary author: CHEN, Hsin-yu (University of Texas at Austin)

Presenter: CHEN, Hsin-yu (University of Texas at Austin)

Session Classification: Plenary

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **312** Type: **not specified**

Particle acceleration and high-energy emission from star-forming galaxies

Monday, September 11, 2023 11:15 AM (25 minutes)

The intense star-forming activity typical of star-forming galaxies results in unique conditions for the acceleration of high-energy particles.
The enhanced supernova rate associated with such star formation can in fact transfer a large amount of power to non-thermal particles which,
in turn, can lose most of their energy in the dense and perturbed star-forming environment before being able to escape it.
I will discuss the transport conditions in these galaxies and their multi-messenger implications in terms of gamma rays and high-energy neutrinos.
The star-forming activity can also launch and sustain powerful galactic wind bubbles extending for several kiloparsecs.
I will illustrate how particles can be accelerated up to hundreds of PeV at shocks produced in such winds and I will highlight the associated high-energy radiation and its possible detectability with current and upcoming observatories.
Finally, by taking into account the star formation history of the Universe, I will assess the potential contribution of star-forming galaxies to the observed diffuse flux of gamma rays, high-energy neutrinos and cosmic rays at energies beyond the Knee.

Primary author: PERETTI, Enrico (Niels Bohr Institute)

Presenter: PERETTI, Enrico (Niels Bohr Institute)

Session Classification: Plenary

Track Classification: Gamma Ray Astronomy

Contribution ID: **313** Type: **not specified**

TeV Halos: A New Class of Gamma-Ray Sources Provide Insight into Galactic Diffusion

Monday, September 11, 2023 4:45 PM (15 minutes)

Observations by the HAWC and HESS telescopes have found extended TeV emission consistent with a handful of young and middle-aged pulsars. In this talk, I will show that these detections have significant implications for our understanding of both pulsar emission and TeV astrophysics. Most importantly, the high-luminosity and spatial extension of TeV halos indicate that cosmic-ray diffusion on 20-50 pc scales surrounding energetic sources is atypical of the standard interstellar medium. Four models have been proposed, including those where locally anisotropic diffusion creates an appearance of a concentrated source from certain viewing angles, models which invoke rectilinear transport to produce a compact spatial profile in an otherwise standard diffusion environment, models where some pulsars fortuitously pockets of low-diffusion, and finally models where the pulsar (or associated supernova remnant) actively inhibit diffusion on moderate spatial scales. I will review each model, and argue that current observations prefer models where energetic sources actively inhibit diffusion in their surrounding environment.

Primary author: LINDEN, Tim (Stockholm University)

Presenter: LINDEN, Tim (Stockholm University)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **314** Type: **not specified**

Multi-class classification of Fermi-LAT sources with machine learning

Thursday, September 14, 2023 4:45 PM (15 minutes)

About one third of the Fermi-LAT sources have no high probability associations. Some of the sources may have no observable counterparts at other frequencies, such as pulsars with misaligned radio jets. For these sources probabilistic classification, e.g., with machine learning (ML), may be the only possibility to understand their nature. One of the main problems in using ML for classification of unassociated sources is that there are 23 classes in the latest 4FGL-DR3 catalog, where about 10 classes have less than 10 associated sources, which makes it impractical to use all physical classes for the probabilistic classification. We develop an hierarchical procedure for the definition of classes by dividing all physical classes into two groups at the first step and then subdividing the groups at further steps. As a result, one has control on the number of sources in a group of classes which, on the one hand, ensures reasonable classification performance and, on the other hand, gives more information about the classes of unassociated sources compared to, e.g., two-class classification. I will discuss application of the multi-class classification of the Fermi-LAT sources for the population studies of the sources that include both associated and unassociated sources.

Primary author: MALYSHEV, Dmitry (ECAP)

Co-author: BHAT, Aakash (Potsdam University)

Presenter: MALYSHEV, Dmitry (ECAP)

Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy

Contribution ID: **315** Type: **not specified**

Unique Properties of Primary Cosmic Rays: Results from the Alpha Magnetic spectrometer

Monday, September 11, 2023 2:00 PM (10 minutes)

In this contribution, we report the latest results of primary cosmic ray proton, helium, carbon, oxygen, neon, magnesium, silicon, sulfur, and iron fluxes based on the data collected by the Alpha Magnetic Spectrometer experiment on the International Space Station during 11 years of operation. We discuss the properties and composition of their spectra and present a novel model-independent determination of their abundance ratios at the source. The systematic comparison with the latest GALPROP cosmic ray model is presented.

Primary author: FORMATO, Valerio (RM2)

Presenter: FORMATO, Valerio (RM2)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **316** Type: **not specified**

High-energy Neutrino Emission from Interaction-powered Supernovae

Monday, September 11, 2023 2:45 PM (15 minutes)

Over the past decade, a significant number of supernovae exhibiting luminosities that exceed $10^{43}\,\mathrm{erg\,s^{-1}}$ and characterized by narrow hydrogen lines in their spectra have been discovered. These supernovae are believed to be powered by the collision of ejected material with a dense circumstellar medium (CSM). The interaction of the SNe ejecta with the CSM results in a shock wave propagating in the dense circumstellar environment, which can efficiently generate thermal UV/optical emission and accelerate protons up to PeV energies. Such protons can undergo hadronic interactions and produce neutrinos in the $1 - 10^3$ TeV energy range. I will present the connection between the neutrino signal detectable at the IceCube Neutrino Observatory and the photometric properties of the electromagnetic signals observable by optical surveys. Finally, I will discuss how detecting high-energy neutrinos can help constrain the large space of parameters characterizing interacting SNe and will outline the best follow-up strategy for upcoming multi-messenger searches from this class of objects.

Based on T.Pitik, I.Tamborra, M.Lincetto, A.Franckowiak (arXiv:2306.01833)

Primary author: Ms PITIK, Tetyana (Niels Bohr Institute Academy)

Co-authors: FRANCKOWIAK, Anna (Astronomical Institute, Ruhr University Bochum, Germany); TAMBORRA, Irene (Niels Bohr Institute); LINCETTO, Massimiliano (Ruhr-Universität Bochum)

Presenter: Ms PITIK, Tetyana (Niels Bohr Institute Academy)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **317** Type: **not specified**

Neutrino spin flavor oscillations in intergalactic medium

Monday, September 11, 2023 3:00 PM (15 minutes)

The ultra-high energy cosmic neutrinos, which usually perambulate gargantuan scales in the extragalactic universe, are expected to play a crucial role in determining the origin of cosmic rays as well as probing new physics extending even up to the Planck scale. This epitomizes the selling point of several currently running or planned neutrino telescopes. If neutrinos have magnetic moment owing to new physics contributions, the phenomenon of spin flavor oscillations may get induced. Using the current limit on neutrino magnetic moment, we show that the flux of cosmic neutrinos will get reduced by half if they traverse a few Mpcs through the intergalactic magnetic field in the range of microG to nanoG. Finally, we show that the reduction of cosmic neutrino flux is not possible if the current upper limit of magnetic moment is improved by a few orders of magnitude even if the neutrinos travel through the entire length of the visible universe.

Primary author: CHUNDAWAT, Neetu Raj Singh

Co-authors: Mr ALOK, Ashutosh Kumar (Indian Institute of Technology, Jodhpur, India); Mr MANDAL, Arindam (Indian Institute of Technology, Jodhpur, India)

Presenter: CHUNDAWAT, Neetu Raj Singh

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **319** Type: **not specified**

Axion and FIMP Dark Matter in a U(1) extension of the Standard Model

Tuesday, September 12, 2023 2:20 PM (20 minutes)

In the Standard Model a Dark Matter candidate is missing, but it is relatively simple to enlarge the model including one or more suitable particles. We consider in this paper one such extension, inspired by simplicity and by the goal to solve more than just the Dark Matter issue. Indeed we consider a local U(1) extension of the SM providing an axion particle to solve the strong CP problem and including RH neutrinos with appropriate mass terms. One of the latter is decoupled from the SM leptons and can constitute stable sterile neutrino DM. In this setting, the PQ symmetry arises only as an accidental symmetry but its breaking by higher order operators is sufficiently suppressed to avoid introducing a large θ contribution. The axion decay constant and the RH neutrino masses are related to the same v.e.v.s and the PQ scale and both DM densities are determined by the parameters of the axion and scalar sector. The model predicts in general a mixed Dark Matter scenario with both axion and sterile neutrino DM and is characterised by a reduced density and observational signals from each single component.

Primary authors: COVI, Laura (Institute for theoretical physics); KHAN, Sarif (ITP, University of Goettingen)

Presenter: KHAN, Sarif (ITP, University of Goettingen)

Session Classification: COS: Cosmology

Track Classification: Cosmology

Contribution ID: **320** Type: **not specified**

Analysis of the cosmic proton and helium fluxes towards PeV energies with DAMPE

Monday, September 11, 2023 3:35 PM (15 minutes)

The DArk Matter Particle Explorer (DAMPE) is a satellite-borne experiment, in operation since 2015, aimed at studying high-energy gamma rays and cosmic rays. Proton and helium are the first- and second-most abundant components in cosmic rays. Given their smaller interaction cross-sections with the interstellar medium, compared to heavier nuclei, they can travel larger distances, thereby becoming important probes to cosmic-ray sources as well as acceleration and propagation mechanisms. Recently, in the DAMPE collaboration, machine learning (ML) techniques were developed and deployed with the aim of improving particle tracking and identification as well as compensating for the energy lost in the calorimeter at high energies due to saturation of the electronics. This work presents a direct measurement of the energy spectra of cosmic-ray proton and helium nuclei, using 7 years of data recorded by DAMPE. Application of the above-mentioned ML techniques helps in extending the spectra to higher kinetic energies than those previously reported by DAMPE.

Primary authors: KOTENKO, Andrii (University of Geneva); Dr COPPIN, Paul (University of Geneva); Dr RUINA, Arshia (University of Geneva); Dr STOLPOVSKIY, Mikhail (University of Geneva); Prof. TYKHONOV, Andrii (University of Geneva); Dr YUE, Chuan (Purple Mountain Observatory)

Presenter: KOTENKO, Andrii (University of Geneva)

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **323** Type: **not specified**

The Square Kilometre Array: a unique high-precision cosmic-ray observatory

Wednesday, September 13, 2023 5:45 PM (15 minutes)

The PeV-EeV range of the cosmic ray energy spectrum is a complex region that probably harbours the transition from Galactic to extragalactic origins. It is unclear where this transition occurs and whether a secondary Galactic component is required to explain the observations. Measuring the mass composition of cosmic rays is essential to disentangle the fluxes and gain better understanding of the sources and their acceleration mechanisms. We propose to use the Square Kilometre Array (SKA) to perform ultra-high precision air shower measurements and make a unique contribution to mass composition analysis between the knee and the ankle.

The low-frequency part of the SKA, to be built in Australia, will have an extremely high antenna density of roughly 60.000 antennas within one square kilometer, and is the perfect site for high-resolution studies of air showers. Individual showers will be observed with thousands of antennas simultaneously. The depth of shower maximum Xmax can be reconstructed with a resolution of 10 g/cm^2 using methods currently used by LOFAR and the Pierre Auger Observatory. However, the high-resolution SKA data allows the development of new methods that can reconstruct more features of the longitudinal development of air showers. In particular, we have shown that SKA can measure the shower length, which contains further information on the primary mass and can be used to validate hadronic interaction models.

In this contribution, we present our plans to prepare the SKA for cosmic-ray observation by deploying a particle detector array. Furthermore, we show simulation studies that demonstrate the unique capabilities of SKA and discuss how it contributes to solving the cosmic-ray origin puzzle.

Primary author: BUITINK, Stijn (Vrije Universiteit Brussel (VUB))

Presenter: BUITINK, Stijn (Vrije Universiteit Brussel (VUB))

Session Classification: CCR: Charged Cosmic Ray

Track Classification: Charged Cosmic Rays

Contribution ID: **324** Type: **not specified**

Neutrino and Gamma-ray Signatures from Inelastic Dark Matter Annihilation around Neutron Stars

Tuesday, September 12, 2023 3:00 PM (15 minutes)

Heavy inelastic dark matter can substantially annihilate outside neutron stars for inelastic inter-state mass splittings ∼MeV and produce standard model particles. Such inelastic dark matter annihilations can happen during the long timescale of the dark matter thermalization, i.e. losing enough kinetic energy to enter an orbit fully contained inside the neutron star. In this talk, I will present a study on this effect along with the constraints and detection prospects with current and future high-energy neutrino and gamma-ray experiments.

Primary authors: ACEVEDO, Javier (SLAC); BRAMANTE, Joseph (Queen's University); LIU, Qinrui (Queen's University); TYAGI, Narayani (Queen's University)

Presenter: LIU, Qinrui (Queen's University)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **325** Type: **not specified**

Studies of Supernova Remnants and Pulsar Wind Nebulae with VERITAS

Friday, September 15, 2023 11:25 AM (20 minutes)

Supernova remnants (SNRs) and pulsar wind nebulae (PWNe) are key classes of Galactic particle accelerators and are generally thought to be responsible for providing the bulk of cosmic rays in the Galaxy up to the knee. VERITAS observations of SNRs and PWNe in the very high energy (VHE; E > 100 GeV) range provide critical information to help us understand the nature of these accelerators, including the types of particles (leptons, hadrons, or a mix?) responsible for their VHE emission, as well as the maximum energies which they can reach. VERITAS, as an array of four imaging atmospheric Cherenkov telescopes, also provides sufficient angular resolution to correlate VHE emission with gamma-ray emission at higher (HAWC, LHAASO) and lower (Fermi-LAT) energies, as well as potential counterparts - whether compact objects, molecular clouds, or other structures - observed at other wavelengths. In this talk, we will summarize recent results from VERITAS, focusing on updated gamma-ray maps and spectra for IC 443, a resolved gamma-ray SNR interacting with molecular and atomic clouds in its vicinity.

Primary author: HUMENSKY, Brian (NASA Goddard Space Flight Center)

Presenter: HUMENSKY, Brian (NASA Goddard Space Flight Center)

Session Classification: Plenary

Track Classification: Gamma Ray Astronomy

Contribution ID: **326** Type: **not specified**

BSM Searches with Wide-field of View TeV Observatories

Monday, September 11, 2023 3:00 PM (15 minutes)

Observations of very high-energy (>1 TeV) cosmic gamma rays are a powerful, unique tool to explore new physics beyond the Standard Model. The Southern Wide-field Gamma-Ray Observatory (SWGO), a next-generation experiment looking for cosmic gamma rays, will be situated in the Southern hemisphere with gamma-ray sensitivity up to the PeV range. This observatory will have an order of magnitude better sensitivity than the current-generation High Altitude Water Cherenkov (HAWC) observatory. Because of its increased sensitivity and location in the Southern hemisphere, SWGO will be ideally situated to look for dark matter signals from the Milky Way. Specifically, SWGO will be able to search for dark matter with annihilation cross-sections a thousand times smaller than those observable with HAWC. SWGO will also be well-situated to search for other phenomena Beyond-the-Standard-Model, including Primordial Black Holes, Axion-like Particles, and Violations of Lorentz Invariance and to complement other next-generation observatories in these searches. In this presentation, I will discuss the prospects for SWGO as a leading observatory in next-generation searches for physics beyond the Standard Model.

Primary author: ALBERT, Andrea (Los Alamos National Laboratory)

Presenter: ALBERT, Andrea (Los Alamos National Laboratory)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **327** Type: **not specified**

Searches for new physics in the Higgs sector

Thursday, September 14, 2023 10:15 AM (15 minutes)

The discovery of the Higgs boson with a mass of 125 GeV completed the particle content predicted by the Standard Model (SM). Even though this model is well established and consistent with many measurements, it is not capable to solely explain some observations. Many extensions of the SM addressing such shortcomings have additional (neutral or charged) Higgs bosons. In some models, the Higgs boson can also serve as a portal to a dark sector, through e.g. invisible decays. Finally, new physics could also appear through modifications of the cross-section and kinematics of the elusive Higgs boson pair (HH) production process. The current status of searches for additional low- and high-mass Higgs bosons, for invisible Higgs boson decays and for HH production, based on the full LHC Run 2 dataset of the ATLAS experiment at 13 TeV, are presented.

Primary authors: Prof. DALLAPICCOLA, Carlo (Univ. of Massachusetts); OTERO Y GARZÓN, Gustavo

Presenter: OTERO Y GARZÓN, Gustavo

Session Classification: Plenary

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **328** Type: **not specified**

Searches for Dark Matter with the ATLAS Experiment at the LHC

Thursday, September 14, 2023 4:50 PM (20 minutes)

The presence of a non-baryonic Dark Matter (DM) component in the Universe is inferred from the observation of its gravitational interaction. If Dark Matter interacts weakly with the Standard Model (SM) it could be produced at the LHC. The ATLAS Collaboration has developed a broad search program for DM candidates in final states with large missing transverse momentum produced in association with other SM particles (light and heavy quarks, photons, Z and H bosons, as well as additional heavy scalar particles) and searches where the Higgs boson provides a portal to Dark Matter, leading to invisible Higgs decays. The results of recent searches on 13 TeV pp data from the LHC, their interplay and interpretation will be presented.

Primary authors: Prof. DALLAPICCOLA, Carlo (Univ. of Massachusetts); CIROTTO, Francesco (Istituto Nazionale di Fisica Nucleare)

Presenter: CIROTTO, Francesco (Istituto Nazionale di Fisica Nucleare)

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **329** Type: **not specified**

Non-WIMP dark matter searches with the ATLAS detector

Thursday, September 14, 2023 5:10 PM (20 minutes)

Collider searches for dark matter (DM) so far have mostly focussed on scenarios where DM particles are produced in association with heavy standard model (SM) particles or jets. However, no deviations from SM predictions have been observed. Several recent phenomenology papers have proposed models that explore the possibility of accessing the strongly coupled dark sector, giving rise to unusual and unexplored collider topologies. The results of recent searches on dark QCD, semi-visible jets, dark sector, dark photon, LLP, and ALPs on 13 TeV pp data from the LHC, their interplay and interpretation will be presented.

Primary authors: Prof. DELLAPICCOLA, Carlo (Univ. of Massachusetts); VUJINOVIC, Olivera

Presenter: VUJINOVIC, Olivera

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **330** Type: **not specified**

Recent searches for new phenomena with the ATLAS detector

Thursday, September 14, 2023 10:00 AM (15 minutes)

Many theories beyond the Standard Model (BSM) have been proposed to address several of the Standard Model shortcomings, such as the origin of dark matter and neutrino masses, the fine-tuning of the Higgs Boson mass, or the observed pattern of masses and mixing angles in the quark and lepton sectors. Many of these BSM extensions predict new particles or interactions directly accessible at the LHC. This talk will present some highlights on recent searches based on the the full Run 2 data collected by the ATLAS detector at the LHC with a centre-of-mass energy of 13 TeV. These include searches for leptoquarks and vector-like quarks, new high mass resonances and lepton flavour violating decays, as well as searches using unconventional and long-lived particle signatures.

Primary authors: Prof. DELLAPICCOLA, Carlo (Univ. of Massachusetts); FELIGIONI, Lorenzo

Presenter: FELIGIONI, Lorenzo

Session Classification: Plenary

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **331** Type: **not specified**

Search for Dark Matter and hidden sectors in CMS

Thursday, September 14, 2023 9:40 AM (20 minutes)

CMS searches for dark matter including those with dark portal interactions are presented. Various topologies and kinematic variables are explored. In this talk, we focus on the recent results obtained using the full Run-II dataset collected at the LHC.

Primary author: Prof. YUAN, Li (Beihang University)

Presenter: DARWISH, Mohamed

Session Classification: Plenary

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **332** Type: **not specified**

Search for Dark Matter with mono-X Signatures in CMS

Thursday, September 14, 2023 4:30 PM (20 minutes)

Searches in CMS for dark matter in final states with invisible particles recoiling against visible states are presented. Various topologies and kinematic variables are explored, including jet substructure as a means of tagging heavy bosons. In this talk, we focus on the recent results obtained using the full Run-II dataset collected at the LHC.

Primary author: Prof. YUAN, Li (Beihang University)

Presenter: LEE, Jeongeun

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **333** Type: **not specified**

New Results for eV-scale Sterile Neutrino Searches with IceCube

Thursday, September 14, 2023 9:00 AM (20 minutes)

Various short-baseline neutrino oscillation experiments have yielded unexpected results, which hint at the existence of light sterile neutrinos. IceCube has performed a unique search for sterile neutrinos by exploiting matter-enhanced resonant oscillations, which can be probed using atmospheric and astrophysical neutrinos in the TeV energy regime. The analysis uses the world's largest sample of Earth-crossing muon neutrino events from ten years of IceCube data with a purity above 99.9%. We present new results on this analysis using both new event selection and energy reconstruction based on machine learning techniques.

Primary author: GARCIA SOTO, Alfonso Andres

Presenter: GARCIA SOTO, Alfonso Andres

Session Classification: Plenary

Track Classification: Neutrinos

Contribution ID: **334** Type: **not specified**

CMB and Lyman-α constraints on dark matter decays to photons

Tuesday, September 12, 2023 5:45 PM (15 minutes)

Dark matter energy injection in the early universe modifies both the ionization history and the temperature of the intergalactic medium. In this work, we improve the CMB bounds on sub-keV dark matter and extend previous bounds from Lyman-α observations to the same mass range, resulting in new and competitive constraints on axion-like particles (ALPs) decaying into two photons. The limits depend on the underlying reionization history, here accounted self-consistently by our modified version of the publicly available DarkHistory and CLASS codes. Future measurements such as the ones from the CMB-S4 experiment may play a crucial, leading role in the search for this type of light dark matter candidates

Primary author: CAPOZZI, Francesco (Università degli Studi dell'Aquila)

Presenter: CAPOZZI, Francesco (Università degli Studi dell'Aquila)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **335** Type: **not specified**

Neutrino signal from Seyfert galaxies

Monday, September 11, 2023 12:05 PM (25 minutes)

IceCube collaboration has previously reported an evidence for neutrino signal from a Seyfert galaxy NGC 1068. This may suggest that all Seyfert galaxies emit neutrinos. To test this hypothesis, we identify the best candidate neutrino sources among nearby Seyfert galaxies, based on their hard X-ray properties. Only two other sources, NGC 4151 and NGC 3079 are expected to be detectable in 10 years of IceCube data. We find an evidence for neutrino signal from both sources in publicly available ten-year IceCube dataset. The chance coincidence probability to find the observed neutrino count excesses in the directions of the two out of two expected sources, in addition to the previously reported brightest source, is p<2.6e-7. This corresponds to the detection of Seyfert galaxies as a neutrino source class.

Primary authors: NERONOV, Andrii (University of Paris City and EPFL); Dr SAVCHENKO, Denys (APC Paris); SEMIKOZ, Dmitri (APC Paris)

Presenter: SEMIKOZ, Dmitri (APC Paris)

Session Classification: Plenary

Track Classification: Neutrinos

Contribution ID: **336** Type: **not specified**

Performance studies of Micromegas detectors in ATLAS with Run3 data

Thursday, September 14, 2023 5:30 PM (20 minutes)

The Micromegas detectors are part of the New Small Wheel (NSW) system of the ATLAS experiment, the largest upgrade project of Phase-1. Together with sTGC detectors they provide trigger and tracking capability in the innermost station of the end-cap part of the Muon spectrometer.
The Micromegas detector of ATLAS cover an active area of about 1280 m^2, has 1024 HV channels and 2.1 M readout channels, representing the largest Micro-Pattern Gaseous Detector system ever built.
The two NSW have been installed in ATLAS in time for the start of Run3, went through a detailed commissioning phase during 2022 and are now contributing to the ATLAS data taking.
In this presentation, after an introduction of the NSW, a series of latest results regarding simulations, reconstruction, performance and first data
obtained with Run 3 will be reported.

Primary author: Dr IENGO, Paolo (INFN/CERN)

Presenter: MANCINI, Giada (Istituto Nazionale di Fisica Nucleare)

Session Classification: PP: Particle Physics

Track Classification: Particle Physics [theory + colliders]

Contribution ID: **337** Type: **not specified**

Axion Star Explosions: A New Source for Axion Indirect Detection

Tuesday, September 12, 2023 5:30 PM (15 minutes)

If dark matter is composed of axions, then axion stars form in the cores of dark matter halos. These stars are unstable above a critical mass, decaying to radio photons that heat the intergalactic medium, offering a new channel for axion indirect detection. Axion star decays lead to efficient reionization of the intergalactic medium during the dark ages. By comparing this non-standard reionization with Planck legacy measurements of the Thompson optical width, we exclude new regions of axion parameter space.

Primary author: Prof. FAIRBAIRN, Malcolm (King's College London)

Presenter: Prof. FAIRBAIRN, Malcolm (King's College London)

Session Classification: IDM: Indirect DM searches

Track Classification: Indirect DM searches

Contribution ID: **338** Type: **not specified**

Implications of Dark Photon Dark Matter for Gravitational Waves

Thursday, September 14, 2023 3:30 PM (15 minutes)

The well-studied graviton-to-photon conversion process provides an intriguing method to observe early universe gravitational wave sources. However, these effects are suppressed when considering magnetic fields present in the early universe, due to the presence of the Standard Model plasma. In contrast, a dark magnetic field would induce a graviton-to-dark photon conversion process, but not be subjected to these suppression effects, greatly enhancing the probability of conversion. In the presence of a dark magnetic field, the Gravitational Waves generated in the early universe - such as from inflation, phase transitions, and topological defects - would be partially converted to dark photons, with possible polarisation dependent and/or anisotropic suppression of the Gravitational Waves depending on the properties of the dark magnetic field. Additionally, the dark photon can play the role of dark matter if it has a small mass, with the dark photons generated from the conversion process for different gravitational wave sources leaving imprints on the dark matter power spectrum. Thus, providing a unique array of correlated observational signatures.

Primary author: BARRIE, Neil (USyd)

Presenter: BARRIE, Neil (USyd)

Session Classification: GWMM: Gravitational Waves & MultiMessenger

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **340** Type: **not specified**

The SABRE South Experiment at the Stawell Underground Physics Laboratory

Wednesday, September 13, 2023 4:30 PM (15 minutes)

The SABRE (Sodium iodide with Active Background REjection) experiment aims to detect an annual rate modulation from dark matter interactions in ultra-high purity NaI(Tl) crystals in order to provide a model independent test of the signal observed by DAMA/LIBRA. It is made up of two separate detectors; SABRE South located at the Stawell Underground Physics Laboratory (SUPL), in regional Victoria, Australia, and SABRE North at the Laboratori Nazionali del Gran Sasso (LNGS). SABRE South is designed to disentangle seasonal or site-related effects from the dark matter-like modulated signal by using an active veto and muon detection system. Ultra-high purity NaI(Tl) crystals are immersed in a linear alkyl benzene (LAB) based liquid scintillator veto, further surrounded by passive steel and polyethylene shielding and a plastic scintillator muon veto. Significant work has been undertaken to understand and mitigate the background processes that take into account radiation from detector materials, from both intrinsic and cosmogenic activated processes, and to understand the performance of both the crystal and veto systems.
SUPL is a newly built facility located 1024 m underground (~2900m water equivalent) within the Stawell Gold Mine and its construction was completed in mid-2022. It will house rare event physics searches, including the SABRE dark matter experiment, as well as measurement facilities to support low background physics experiments and applications such as radiobiology and quantum computing. The SABRE South commissioning is expected to occur this year.
This talk will report on the design of SUPL and the construction and commissioning of SABRE South.

Primary author: BOLOGNINO, Irene (The University of Adelaide, Adelaide, SA 5005, Australia. ARC Centre of Excellence for Dark Matter Particle Physics, Australia.)

Presenter: BOLOGNINO, Irene (The University of Adelaide, Adelaide, SA 5005, Australia. ARC Centre of Excellence for Dark Matter Particle Physics, Australia.)

Session Classification: DDM: Direct DM searches

Track Classification: Direct DM searches

Contribution ID: **341** Type: **not specified**

Recent UHECR results and their interpretation

Monday, September 11, 2023 9:55 AM (25 minutes)

Recent experimental results probe that UHECRs have extragalactic origin, and that their nature evolves towards heavier nuclear species with increasing energy. Several uncertainties however affect the understanding of the characteristics of UHECRs at Earth, as well as the association of UHECRs with possible source classes. In this talk I will report about the most recent experimental achievements and the models used for interpreting them in terms of astrophysical scenarios. Multi-messenger approaches will be also discussed, as well as the benefit expected from ongoing or future experimental upgrades.

Primary author: BONCIOLI, Denise (INFN Laboratori Nazionali del Gran Sasso)

Presenter: BONCIOLI, Denise (INFN Laboratori Nazionali del Gran Sasso)

Session Classification: Plenary

Track Classification: Charged Cosmic Rays

Contribution ID: **342** Type: **not specified**

Multi-messenger emission from weak-jetted active galactic nuclei

Monday, September 11, 2023 11:40 AM (25 minutes)

The majority of active galactic nuclei (AGN; accreting supermassive black holes in the centers of galaxies) do not possess strong jets. A large part of the broadband emission of such weak-jetted active galactic nuclei (a.k.a. radio-quiet AGN) is understood to be thermal in nature, but there is increasing observational evidence for important nonthermal contributions, particularly at radio frequencies, and possibly also in gamma rays. Most remarkable is the recent detection of high-energy neutrinos from the Seyfert 2 galaxy NGC 1068 by IceCube. On the other hand, numerical simulations for such AGN of accretion disks, coronae, winds, small-scale jets, etc. are beginning to reveal the potential prevalence of various types of shock waves, magnetic dissipation events, turbulence, etc. that can be conducivet to particle acceleration and nonthermal emission. We review recent progress in this field and highlight future prospects for elucidating the nature of the sub-parsec regions of AGN, some aspects of feedback processes onto their environment, and multi-messenger implications.

Primary author: INOUE, Susumu

Presenter: INOUE, Susumu

Session Classification: Plenary

Track Classification: Neutrinos

Contribution ID: **343** Type: **not specified**

Perspectives and challenges of multi-messenger astronomy including gravitational-waves

Wednesday, September 13, 2023 11:00 AM (25 minutes)

On Aug. 17, 2017, the merger of a binary neutron-star system observed through gravitational waves and multi-wavelength emissions, from gamma rays, X-rays, ultraviolet-optical-near-infrared, and radio, marked the history of multi-messenger astronomy, showing its enormous potential in probing the physics of the most energetic events in the Universe. Multi-messenger observations are a unique tool to unveil the rich physics of neutron star mergers in association with gamma-ray bursts and kilonovae, to probe relativistic astrophysics, nuclear physics, nucleosynthesis, and cosmology. Starting with the current status of gravitational-wave observations, the talk will give an overview of challenges and perspectives of gravitational-astronomy expected with the next generation of gravitational-wave detectors, such as the Einstein Telescope, in the context of multi-messenger astrophysics.

Primary author: BRANCHESI, Marica (Istituto Nazionale di Fisica Nucleare)

Presenter: BRANCHESI, Marica (Istituto Nazionale di Fisica Nucleare)

Session Classification: Plenary

Track Classification: Gravitational Waves & MultiMessenger

Contribution ID: **345** Type: **not specified**

Recent results on gamma-ray astronomy from LHAASO

Monday, September 11, 2023 9:30 AM (25 minutes)

Over the past four years, since April 2019, LHAASO has been in operation, either partially or as a whole. Utilizing the data collected, detection on Gamma-ray emissions from the Northern sky have been made, and observation results on various targets such as pulsar wind nebulae, pulsar halos, supernova remnants, Gamma-ray bursts, active galactic nuclei, and galactic diffused gamma rays, have been achieved. The first catalogue of Gamma-ray sources has been released. This talk will primarily focus on recent results related to these topics, preceded by a brief introduction to the LHAASO performance. Finally, the near-future plans for LHAASO will be discussed.

Primary author: YAO, Zhiguo (Institute of High Energy Physics, Chinese Academy of Sciences)

Presenter: YAO, Zhiguo (Institute of High Energy Physics, Chinese Academy of Sciences)

Session Classification: Plenary

Track Classification: Gamma Ray Astronomy

Contribution ID: **346** Type: **not specified**

Galatic cosmic rays: state of the art

Monday, September 11, 2023 10:20 AM (25 minutes)

Over the past decade, AMS02 data have ushered us into a precision era for cosmic-ray physics. By unveiling features in the primary and secondary cosmic-ray spectra, these highly precise data challenge the current paradigms of galactic cosmic rays. In this talk, I will revisit the main results that have sparked interest within the cosmic-ray community, both about particles and antiparticles. I will show that these results call for refined theoretical predictions, which are primarily limited by uncertainties in fragmentation cross-sections. Additionally, efforts from the AMS02 collaboration are required to provide the energy correlations of the data systematic errors. I will conclude by giving outlooks about these limitations and the challenges that open up as we venture towards higher energies.

Primary author: GENOLINI, Yoann

Presenter: GENOLINI, Yoann

Session Classification: Plenary

Track Classification: Charged Cosmic Rays

Contribution ID: **347** Type: **not specified**

Overview of direct DM searches

Wednesday, September 13, 2023 9:00 AM (25 minutes)

This talk will give an overview of the field of Dark
Matter Direct Detection, present recent highlights, and give a perspective
on the exciting prospects for the future.

Presenter: MONROE, Jocelyn (Royal Holloway, University of London)

Session Classification: Plenary

Track Classification: Direct DM searches

Contribution ID: **350** Type: **not specified**

Improving the sensitivity of KM3NeT to MeV-GeV neutrinos from solar flares

Monday, September 11, 2023 5:15 PM (15 minutes)

The detection of MeV-GeV neutrinos from astronomical sources is a long-lasting challenge for neutrino experiments. The low flux predicted for transient sources, such as solar flares, would require a detector with both a large instrumented volume as well as a high density of photomultipliers (PMTs) to resolve the low-energy signature. We discuss how KM3NeT can play a key role in the search for these neutrinos.
KM3NeT is a Cherenkov neutrino telescope currently under deployment, located at the bottom of the Mediterranean Sea. It consists of two arrays of Digital Optical Modules (DOM): KM3NeT/ORCA and KM3NeT/ARCA, which are respectively optimised for the detection of GeV neutrinos for oscillation studies, and higher-energy astronomical neutrinos.
We present the predicted sensitivity of ORCA to the bright solar flare observed on September 10th, 2017.
We exploit the multi-PMT configuration of KM3NeT's DOMs to develop the techniques that allow disentangling of the MeV-GeV neutrino signature from the atmospheric and environmental background. Comparing data with neutrino simulations we identify the variables with discriminating power, and by applying hard cuts we are able to reject a large fraction of background.
We present a graph convolutional network approach to classify signal from background. To further improve the sensitivities compared to previous studies, we will make use of the Hierarchical Graph Pooling with Structure Learning algorithm and will use graph-structured data to reproduce the hit geometry on the DOM. This will allow for stronger constraints on the hits and reduce the fraction of background that survives the selection.

Primary author: MAURO, Jonathan (UCLouvain)

Co-author: DE WASSEIGE, Gwenhael (UCLouvain)

Presenter: MAURO, Jonathan (UCLouvain)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **351** Type: **not specified**

Application of Quantum Complexity in Neutrino Oscillations

Tuesday, September 12, 2023 5:00 PM (15 minutes)

Neutrino flavor oscillation is a widely studied physical phenomena with far reaching consequences in understanding the standard model of particle physics and to search for physics beyond it. Oscillation arises because of mixing of the mass states in flavor states, and their evolution over time. It is an inherent quantum system for which flavor transitions are traditionally studied with probabilistic measures. Quantum information theory in recent years have seen applications in neutrino oscillation physics. Here, we will present results from an investigation of neutrino oscillations using quantum spread complexities and consequences for high-energy neutrinos.

Primary author: RAZZAQUE, Soebur (University of Johannesburg Centre for Astro-Particle Physics)

Co-authors: DIXIT, Khushboo (University of Johannesburg Centre for Astro-Particle Physics); HAQUE, S. Shajidul (University of Johannesburg Centre for Astro-Particle Physics)

Presenter: RAZZAQUE, Soebur (University of Johannesburg Centre for Astro-Particle Physics)

Session Classification: NUS: Neutrinos

Track Classification: Neutrinos

Contribution ID: **353** Type: **not specified**

Welcome and logistics

Monday, September 11, 2023 9:00 AM (10 minutes)

Presenter: CHIANESE, Marco (Università degli Studi di Napoli Federico II)

Session Classification: Opening

Contribution ID: **354** Type: **not specified**

Physics Chair welcome

Monday, September 11, 2023 9:10 AM (10 minutes)

Presenter: MIELE, Gennaro (NA)

Session Classification: Opening

Contribution ID: **355** Type: **not specified**

Opening

Monday, September 11, 2023 9:20 AM (10 minutes)

Presenter: IOCCO, Fabio (Università di Napoli "Federico II")

Session Classification: Opening