# Roma International Conference on Astroparticle Physics

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# Book of Abstracts

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**Parallel session 2: Dark Matter Search / 0**

## Anomalous U(1)'s and dark matter

**Author:** Andrea Mammarella[1]

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String theory and GUTs theories suggest that anomalous extra U(1)'s symmetries can arise from many high energy scenarios. At low energy scale these extra symmetry groups and the interactions that they mediate can have many phenomenological consequences.
One of the most important is the presence of extra neutralinos with respect to the four of the MSSM. These particles make more viable the scenario of coannihilations, in which there are one or more particles almost degenerate in mass with the LSP that can contribute to its relic density and thus to the theoretical dark matter estimates. We have build an explicit model in which this construction is realized and we have extensively studied the coannihilation possibilities in the most general case also with the use of a modified version of the DarkSUSY package, finding zone of the parameter space in which WMAP data are satisfied.

**Welcome and Review on Experimental Results and Theories / 1**

## Welcome

**High Energy Cosmic Rays and Gammas / 9**

## The Dawn of AMS-02

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**Co-author:** AMS Collaboration

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The AMS02 experiment is designed to perform precision spectroscopy of many different cosmic-ray species. AMS-02 will search for anomalous peaks or structures in the energy spectra of positron, anti-proton, or gamma ray that could signal the existence of dark matter candidates. The AMS-02 spectrometer will also try to provide an answer to the question if nuclear antimatter still exists in the universe.
On May 19 the experiment was installed on the International Space Station and became operative on the same day.
The objectives and the experimental apparatus of AMS-02 will be presented and a first collection of events will be shown.

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## NEMO (t. b. c.)

**26**

## New Methods and Results in Astroparticle Physics

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New Methods and Results in Astroparticle Physics
New method of research, the self-developing logical analysis and the suggested mathematical description, has enabled us to discover new features of space and its objects.

**Summary**:

This theoretical research is based on a radically new method that enabled us to discover new properties and features of space, particles and atoms.

**High Energy Neutrinos / 28**

## Status of BAIKAL-GVD Project

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Since 2006, the development of a km3-scale neutrino telescope - the Gigaton Volume Detector (GVD) in Lake Baikal - is the central goal of the Baikal collaboration. We present selected results obtained in the course of developing and testing key elements and systems of GVD. We furthermore describe configuration and technical design of GVD and discuss the expected physics sensitivity.

**Parallel session: High Energy Neutrinos / 29**

## Search for neutrinos from transient sources with the ANTARES telescope and optical follow-up observations

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The ANTARES telescope is well suited to detect neutrinos produced in astrophysical transient sources as it can observe a full hemisphere of the sky at all the times with a duty cycle close to unity. Potential sources include Gamma-Ray Bursts (GRBs), Core Collapse Supernovae (CCSNe), and flaring

Active Galactic Nuclei (AGNs).
To enhance the sensitivity of ANTARES to such sources, a new detection method based on coincident observations of neutrinos and optical signals has been developed. A fast online muon track reconstruction is used to trigger a network of small automatic optical telescopes. Such alerts are generated one to two times per month for special events such as two or more neutrinos coincident in time and direction, or single neutrinos of very high energy.
Since February 2009, ANTARES has sent 29 alert triggers to the TAROT and ROTSE telescope networks, 19 of which have led to follow-up observations. First results on the optical image analysis to search for GRB and core collapse SNe will be presented.

**Parallel session: High Energy Gamma and Neutrino** / **30**

## ”Measurement of the CR light component primary spectrum”

**Authors:** Beatrice Panico[1]; Giuseppe Di Sciascio[2]

[1] *Universita' Roma Tor Vergata - INFN Roma Tor Vergata*

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The ARGO-YBJ experiment, located at Yangbajing Cosmic Ray Laboratory (Tibet, 4300 m a.s.l., 606 g/cm^2 ) has an high segmentation that allows the detection of air showers with greater granularity and lower energy threshold than other EAS-arrays. The spectrum of the primary Cosmic Rays light (p+He) component in the energy range ~10 - 100 TeV is measured selecting vertical showers with the reconstructed core position located in a 40×40 m^2 fiducial area. The results are compared with other measurements carried out with direct methods.

**Poster Session** / **31**

## ”Observation of Horizontal Extensive Air Showers with the ARGO-YBJ experiment”

**Authors:** Beatrice Panico[1]; Giuseppe Di Sciascio[2]

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The observation of Extensive Air Showers with zenith angle greater than 80 deg with the ARGO-YBJ experiment is described. The measurement of the size spectrum, angular (zenithal and azimuthal) and time distributions of horizontal events is reported.
A description of their space-time topological phenomenology is also provided.

**Parallel session 1: Dark Matter Search** / **32**

## Dark matter searches with the ANTARES neutrino telescope

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The ANTARES neutrino telescope was completed in May 2008 with the installation of its twelfth line. Its scientific scope is very broad, but the two main goals are the observation of astrophysical sources and the indirect detection of dark matter. The latter is possible through neutrinos produced after the annihilation of WIMPs, which would accumulate in sources like the Sun, the Earth or the Galactic Centre. The neutralino, which arises in Supersymmetry models, is one of the most popular WIMP candidates. KK particles, which appear in Universal Extra Dimension models, are another one. Though in most models these annihilations would not directly produce neutrinos, they are expected from the decay of secondary particles. An important advantage of neutrino telescopes with respect to other indirect searches (like gamma rays) is that a potential signal (for instance from the Sun) would be very clean, since no other astrophysical explanations could mimic it (like pulsars). Moreover, the Galactic Centre is accessible for ANTARES, being in the Northern Hemisphere. In this talk I will present the results of the ANTARES telescope for dark matter searches, which include neutralino and KK particles.

**Parallel session: High Energy Gamma and Neutrino / 35**

## Cosmic-ray anisotropies observed by the ARGO-YBJ experiment

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The ARGO-YBJ experiment, located at the Yangbajing Cosmic Ray Laboratory (Tibet, 4300 m asl, 606 g/cm2), is an EAS-array exploiting the full coverage approach at high altitude. We analyzed the data taken since November 2007 looking for anisotropies in the arrival directions of cosmic rays on different angular scales. The results of the analysis is reported and compared with other experiments.

**Parallel session: High Energy Gamma and Neutrino / 36**

## A needlet-based approach to the data analysis in the ARGO-YBJ experiment

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The ARGO-YBJ experiment, located at the Yangbajing Cosmic Ray Laboratory (Tibet, 4300 m asl, 606 g/cm2), is an EAS-array exploiting the full coverage approach at high altitude. The large field of view (~ 2 sr) and the low energy threshold (few hundreds of GeV) result in a trigger rate of ~ 3.6 kHz and ~ 10^{11} EAS collected per year. Such a dataset contains signals laying on different angular scales: point-like and extended gamma-ray sources, as well as large and intermediate scale cosmic-ray anisotropies. The separation of all these contributions is crucial, mostly when they overlap with each other.
Needlets are a new form of spherical wavelets that have recently drawn a lot of attention in the cosmological literature, especially in connection with the analysis of CMB data. Needlets enjoy a number of important statistical and numerical properties which suggest that they can be very

effective in handling cosmic-ray and gamma-ray data analysis. An unprecedented application to astroparticle physics is shown here. In particular, we focus on their use for background estimation, which is expected to be optimal or nearly-optimal in a well-defined mathematical sense, and for point-source detection. This technique is applied here to the whole ARGO-YBJ dataset, stressing its advantages with respect to standard methods.

**High Energy Cosmic Rays and Gammas: future experiments** / **37**

## The Cherenkov Telescope Array (CTA) Project

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The Cherenkov Telescope Array (CTA) will be the world's next generation high energy gamma ray observatory, aiming to provide an order of magnitude improvement in sensitivity over present instruments, together with a broader energy coverage (below 50 GeV to over 100 TeV) as well as significantly improved resolution (0.2 deg). To achieve these goals will require two distributed arrays, one in the Southern hemisphere and one in the North, of multiple sizes of air Cherenkov telescopes. The project is recently funded by EU for a Preparatory Phase that should lead to the construction of CTA. Ongoing work packages include mechanics and optics, the focal plane instrumentation, the observatory management and the data center. In this talk, I will describe the CTA project and its present status.

**Poster Session** / **38**

## Atmospheric muon Neutrino backgroung suppressions at 20 GeV opening to a new Astronomy

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At twenty GeV upward atmospheric neutrino are suppressed (above a factor ten) offering a quite energy windows to look for upward galactic and extragalactic neutrino sources.
We did estimated the present Deep Core and possibly future Pingu neutrino detectors spectra for atmospheric background in the tens GeV range taking care of known flavor (muon-tau) mixing signature and eventual additional CPT violation inprint. We also considered an exciting tuned experiment beaming twenty GeV neutrinos across the Earth Opera-like toward Deep Core for a similar sharper test.
A comparision with other ongoing competitive experiments will be also shown.

**Summary**:

Atmospheric muon neutrino in Deep Core (whose rate and spectra might be soon available) should exhibit a suppression (due to tens GeV up-going muon neutrino converted into tau flavor) that must be imprinted in out-coming rate spectra. We estimate here our independent muon neutrino spectra based on SK and its projected record on Deep Core Channels. Our estimate (based on cosmic rays, muon records and tested Super-Kamiokande (SK) data) differs both in shape and in rate from other previous published spectra. At the flux minimum around channel 6-8, (a flux suppressed respect the non oscillated case at least by an order of magnitude) the atmospheric neutrino paucity offers a better windows

to a twenty GeV Neutrino Astronomy. Therefore by doubling the string array we may foresee a richer rate and a more complete (zenith and azimuth) atmospheric neutrino distribution and an exciting first twenty GeV Astronomy pointing to North pole sky.
Moreover a new MINOS result hint a different anti-neutrino mass splitting and different mixing angle with respect to the neutrino. We propose a future long baseline experiment with a beam of neutrinos through the Earth in the direction of DeepCore at the South Pole, to test their anti-muon disappearance or (for CPT violation) appearance at the longest distances, compatible with present sources and tuned to DeepCore minimal detectable energies.We suggest also anti-muon beaming that may sharply confirm or disfavor the CPT violation, by one an anti-tau a day (in CPT conserved scenario) versus nearly five anti-muon a week in CPT violated case, even beaming at 1% of an Opera-like experiment.

**Parallel session: High Energy Gamma and Neutrino** / **39**

## UHECR light nuclei and upward Tau airshower

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At tens EeV UHECR in AUGER show a composition linked to nuclei. At same energy UHECR showers in Hires seem to point to nucleon (or light nuclei). We found that lightest nuclei as He UHECR may solve at once both experiment composition signals as well as the spread around Cen-A of more than a dozen of events and the absence of Virgo cluster traces. The consequences maybe a diluted and unobservable GZK neutrino signal at EeV and an ineteresting signal at a tenth of WB flux of PeV neutrinos. Such a signals maybe observed by nearby upward tau airshowers seen in fluorescence telescopes in AUGER and TA.

**Summary**:

Ultra High Cosmic Rays (UHECR) should be tracing their sources, making a new astronomy. Their events counting are finally growing, by Auger experiment, into cosmic sky. Their map should follow the mass distribution in a narrow cosmic volume (the GZK cut off region, correlated with Super Galactic Plane (SPG) or Local Group) if they were protons, as most expected. Indeed at first UHECR did seem to follow the GZK cut off and to correlate with SGP, (even if a few of us disagreed ). Recently the last 69 UHECR did not longer follow the SGP map, opening the way to very different correlations , and extreme bending connection; we reconfirm here our Lightest Nuclei interpretation while showing here the last event over different radio,X,Gamma and tens TeV CR maps. The Virgo Cluster absence, the persistence of UHECR clustering along Cen A, the first triplet along Vela seem to confirm light nuclei UHECR understanding, implying a very narrow Universe view, even partially of galactic origin. UHECR fragments might follow (at half, fourth of the energy) the same UHECR map with a tail or a crown clustering around main UHECR group. Also secondary gamma and UHE neutrino might trace partially those maps. Tau neutrinos at EeV or PeVs may play a role in correlating UHECR map and disentangling nucleon from nuclei nature, possibly in Auger Fluorescence Telescopes, by night horizontal up-going tau airshowers.

**Ultra High Energy Cosmic Rays** / **40**

## The Tunka-133 EAS Cherenkov light array: status, all particle energy spectrum and future plans.

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The new EAS Cherenkov light array Tunka-133 with ~1 km2 geometric area has been installed in the Tunka Valley (50 km from the Lake Baikal) in 2009. We describe the array construction, the DAQ and methods of the array calibration. The method of energy reconstruction, providing high energy resolution, and the absolute energy calibration are discussed. The all particle energy spectrum, based on the data of the first winter season 2009/2010, is presented. The spectrum is compared with that obtained by the Tunka-25 array as well as the results of other experiments, a possible interpretation is discussed. Plans for future upgrade are presented: deployment of remote clusters, installation of a radio antennas, muon detectors and low energy optical stations.

**Parallel Session: Cherenkov Imaging Detectors / 41**

## From MAGIC to MAGIC-stereo: filling the gap with HE satellite experiments.

**Author:** Michele Doro[1]

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The MAGIC telescope experiment was designed primarily to reach the lowest possible energy threshold with the ground-based gamma-ray Cherenkov technique, in order to fill the gap between MeV-GeV gamma-ray satellite experiments and TeV ground-based installations. The construction of a second MAGIC telescope, and the subsequent use of the stereoscopic operation mode, has already proven the achievement of that goal. Astrophysical spectra of some active galactic nuclei and pulsar wind nebulae are for example now completely sampled in the high energy peak from MeV to TeV, and often synchronized with very fruitful multi-wavelength campaigns, thus allowing a deeper insight onto the target physics. In addition, the sensitivity at low energies allows us to perform studies at pulsars, gamma-ray burst and other fundamental physics topics.
In this review, the improvement due to the stereoscopic upgrade will be briefly presented and discussed. The importance of low energy studies in astrophysics and fundamental physics searches will be exposed together with a selection of the most recent and conspicuous results obtained with the new MAGIC-stereo experiment.

**Parallel Session: Experimental techniques / 43**

## Astroparticle and Particle Physics with HiSCORE

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We propose to explore the cosmic ray and gamma-ray sky (accelerator sky) in the so far poorly covered energy range from 10 TeV to 1 EeV.
The main motivation for observations in this energy regime is to solve the origin of Galactic cosmic

rays. Further different questions of astroparticle and particle physics could be addressed in this energy regime.
Furthermore, new physics questions might arise by opening the last remaining observation window of gamma-ray astronomy (TeV/PeV).
The proposed large-area (100 square-km) wide-angle (0.9 sr) air Cherenkov detector HiSCORE (Hundred Square-km Cosmic ORigin Explorer) is based on non-imaging Cherenkov light-front sampling with sensitive large-area detector modules of the order of 0.5 square-m. Sampling the lateral photon density and arrival-time distribution allows the reconstruction of the direction,
the energy and the particle type (mainly shower depth) of the primary particle.
The physics motivations, the detector concept, the expected performance and the current status of the experiment will be presented.

**High Energy Neutrinos** / **44**

## Status and recent results of the Antares Deep-sea Neutrino Telescope

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ANTARES is currently the largest operating neutrino telescope located in the northern hemisphere. Its main goal is to detect high energy neutrinos that are expected from cosmic ray acceleration sites. The construction of ANTARES was completed in 2008. It consists of 12 identical lines deployed at 2500 m depth offshore from Toulon. Data are continuously taken by 885 photomultipliers that detect the Cherenkov light induced by relativistic charge particles reaching the detector. The status of the experiment will be discussed, together with the latest results including searches for a diffuse high-energy cosmic neutrino flux and for neutrinos from point-like sources.

**Parallel Session: Low energy astroparticle physics** / **45**

## The axion challenge in gamma-rays: a blueprint of the best search strategy

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Axion Like Particles (ALPs) are predicted to couple with photons in the presence of magnetic fields. This may lead to a significant change in the observed spectra of gamma-ray sources such as AGNs. Here we simultaneously consider both the photon/ALP mixing that takes place in the gamma-ray source itself and the one expected to occur in the intergalactic magnetic fields. We show that photon/ALP mixing might explain recent puzzles regarding the observed spectra of distant gamma-ray sources (e.g. the pile-up problem at the highest energies). We summarize the different ALP signatures expected in VHE spectra and discuss the best search strategy to be followed by the Fermi satellite and current Imaging Atmospheric Cherenkov telescopes (IACTs). We finally test this scenario making use of recent measurements of blazars spectra obtained by IACTs above 100 GeV.

**Parallel session 1: Dark Matter Search / 46**

## Dark Matter implications of the Fermi-LAT measurement of anisotropies in the diffuse gamma-ray background

**Author:** Mattia Fornasa[1]

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For the first time, the Fermi-LAT measured the angular power spectrum (APS) of anisotropies in the diffuse gamma-ray background. The data is found to be broadly compatible with a model with contributions from the point sources in the 1-year catalog, the Galactic diffuse background, and the extragalactic isotropic emission; however deviations are present at both large and small angular scales.
In this study we complement the model with a contribution from Dark Matter (DM) whose distribution is modeled exploiting the results of the most recent N-body simulations, considering both the contribution of extragalactic halos and subhalos (from Millenium-II) and of Galactic substructures (from Aquarius). With the use of the Fermi Science Tools, these simulations serve as templates to produce mock gamma-ray count maps for DM gamma-ray emission, both in the case of an annihilating and a decaying DM candidate. The APS will then be computed and compared with the Fermi-LAT results to derive constraints on the DM particle physics properties. The possible systematic due to an imperfect model of the Galactic foreground will also be studied and take into account properly.

**Parallel Session: Low energy astroparticle physics / 47**

## New Solar 7Be rate and day night effect measurements in Borexino

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Two new experimental data about solar 7Be neutrinos have been released in the middle April 2011 by the Borexino collaboration: the new high precision interaction rate and the absence of the day night effect. The two results will be discussed together with their physical consequences about low energy neutrino oscillations.

**Summary**:

A direct measurement of the 0.862 MeV 7Be solar neutrino interaction rate performed with the Borexino detector at the Laboratori Nazionali del Gran Sasso yields 46.0 +-1.5stat +1.6-1.5 syst counts/(day100 ton). This result is the first direct measurement of a sub-MeV solar neutrino rate with an accuracy better than 5%. The hypothesis of no oscillation for 7Be solar neutrinos is rejected at 4.9 % C.L. Using the latest Standard Solar Model (SSM) flux predictions, the
result leads directly to a precise determination of the survival probability for solar neutrino in vacuum, and permits to probe with unprecedented sensitivity the transition between the matter-enhanced and vacuum-dominated neutrino

I will in addition report on a search for the day-night asymmetry of the 7Be solar neutrino rate measured by Borexino at the Laboratori Nazionali del Gran Sasso (LNGS), Italy. The measured value, Adn = 0.001 +- 0.012 (stat) +- 0.007 (syst), shows the absence of a significant asymmetry. This result alone rejects the so-called LOW solution at more than 8.5 sigma. Combined with the other solar neutrino data, it isolates the Large Mixing Angle LMA-MSW solution at chi2 > 190 without relying on the assumption of CPT symmetry in the neutrino sector. We also show that including the day-night asymmetry, data from Borexino alone restricts the MSW neutrino oscillations to the LMA solution at 90% CL.

**Parallel session: High Energy Neutrinos / 48**

## Performance Studies for the KM3NeT Neutrino Telescope

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KM3NeT is a future deep-sea neutrino telescope in the Mediterranean Sea with an instrumented volume of a few km3. Its goal is to detect cosmic neutrinos from sources such as supernova remnants, active galactic nuclei and gamma ray bursts by recording the Cherenkov light generated by secondary particles produced during interactions of those neutrinos. To optimize its sensitivity, detailed Monte Carlo simulations with varying detector parameters have been performed. In particular, the focus was on a new detector design using many small photomultiplier tubes per light detection unit instead of a single large one.
Results of these studies will be presented and the sensitivity of KM3NeT to expected neutrino fluxes will be discussed.

**Parallel session 2: Dark Matter Search / 49**

## CLUES on Fermi-LAT prospects for munuSSM gravitino dark matter extragalactic detection

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The munuSSM is a supersymmetric model that has been proposed to solve the problems of other supersymmetric extensions of the standard model. The gravitino is a natural candidate for dark matter in the munuSSM and could be detectable through the emission of a monochromatic gamma ray in a two-body decay.
We study the prospects of the Fermi-LAT telescope to detect such monochromatic lines in 5 years of observations of the most massive extragalactic objects.
The dark matter halo around the Virgo galaxy cluster is selected as a reference case, since it is associated to a particularly high signal-to-noise ratio and is located in a region scarcely affected by the presence of astrophysical point sources.
The simulation of both signal and background gamma-ray events is carried out with the Fermi Science Tools, and the dark matter distribution around Virgo is taken from a $N$-body simulation with constrained initial conditions provided by the CLUES project.
We find that a gravitino with a mass range of 0.5–10 GeV approximately, and with a lifetime of about 5e27 s (1e28 s) would be detectable by the Fermi-LAT with a signal-to-noise of 5 (3).

**Parallel Session: Cherenkov Imaging Detectors / 52**

## The Galactic Center Region Imaged by VERITAS

**Author:** Matthias Beilicke[1]

**Co-author:** VERITAS Collaboration

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The galactic center (GC) has long been a region of interest for high-energy and very-high-energy (VHE) observations. Many potential sources of GeV/TeV gamma-ray emission have been suggested for the GC
region, e.g., the accretion of matter onto the black hole, cosmic rays from a nearby shell-type supernova remnant, or the annihilation of dark matter. The GC has been detected at MeV/GeV energies by EGRET and recently by Fermi/LAT. At TeV energies, the GC was detected at the level of 4 standard deviations with the Whipple 10 m telescope, by CANGAROO, and by H.E.S.S. with a significantly better sensitivity. We present the results from 15 hrs of VERITAS GC observations conducted at large zenith angles, resulting in a >10 standard deviation detection. The sky map is shown, and the combined Fermi/H.E.S.S. and VERITAS results are compared to dark matter and astrophysical models.

**Ultra High Energy Cosmic Rays / 53**

## Measuring the spectrum of UHECR with the Pierre Auger Observatory

**Author:** Roberto Pesce[1]

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The Pierre Auger Observatory is an experiment aimed at the detection of the Extensive Air Showers (EAS) produced by the Ultra-High Energy Cosmic Rays (UHECR). It consists of a surface array,
that measures the secondary particles at ground level, and a fluorescence detector, that observes the development
of EAS above the array.
We report a measurement of the “hybrid” spectrum of UHECR above 10^18 eV using fluorescence observations in coincidence with at least one water Cherenkov detector of the array. In particular, we discuss the calculation of the hybrid exposure, that is the main ingredient
necessary to derive the hybrid spectrum, starting from a detailed knowledge of the time dependence of the detector configurations.
The we describe the spectrum based only on the surface array data and its combination with the hybrid spectrum, addressing the systematic uncertainties.

**High Energy Cosmic Rays and Gammas / 54**

## Main results from the PAMELA space experiment after 5 years in flight

**Author:** Roberta Sparvoli[1]

[1] *ROMA2*

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After five years of data taking in space, the experiment PAMELA is showing very interesting features in cosmic rays, namely in the fluxes of protons, heliums, electrons, that might change our basic vision of the mechanisms of production, acceleration and propagation of cosmic rays in the galaxy.

In addition, PAMELA measurements of cosmic antiproton and positron fluxes are setting strong constraints to the nature of Dark Matter.
PAMELA is also measuring the radiation environment around the Earth, and has recently discovered an antiproton radiation belt. The analysis of particles coming from the Solar activity is part of the scientific program of PAMELA too, and important improvements in the comprehension of the solar modulation mechanisms are achievable.
In this talk PAMELA main results will be reviewed.

**Parallel Session: Low energy astroparticle physics / 55**

## Fermi LAT observation of quiet gamma-ray emission from the Sun

**Author:** Monica Brigida[1]

**Co-authors:** Elena Orlando [2]; Igor Moskalenko [2]; Nicola Giglietto [3]

[1] *Bari University*

[2] *SLAC - Stanford*

[3] *Dip. di Fisica "M.Merlin" e Politecnico di Bari*

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We show the latest results of Fermi-LAT observations of the quiescent Sun during the first 18 months of the mission.
During this period the solar activity was at its minimum, hence the solar emission induced by cosmic rays was at its maximum. Two emission components are clearly distinguished: the point-like emission from the solar disk due to the cosmic-ray cascades in the solar atmosphere, and the extended emission due to inverse Compton scattering of cosmic ray electrons on solar photons in the heliosphere.
We present the entire analysis, showing spectra and angular profiles of both components and discuss the comparison with models and future plans.

**Parallel session: High Energy Neutrinos / 58**

## Towards the acoustic U. H. E. neutrino detection in the Mediterranean Sea

**Author:** Giorgio Riccobene[1]

[1] *LNS*

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A promising detection technique for EHE neutrinos is based on the identification of the acoustic signature of neutrino induced showers in water. in recent, years the possibility of using hydrophones installed on the infrastructures of new Cherenkov telescopes, allowed start-up of R&D activities on acoustic detection. In the frame- work of the activities of the ANTARES, NEMO and KM3NeT, several small size experiments were run in order to measure acoustic noise in deep sea and test "neutrino-like" acoustic event detection. These activities have set milestones both for future HE neutrino detectors, for innovative deep sea technology and for Earth-Sea science.

**High Energy Neutrinos / 59**

## KM3NeT: an underwater multi-km3 neutrino detector

**Author:** Maurizio Spurio[1]

[1] *University of Bologna and INFN*

The KM3NeT consortium has been carrying on R&D activities towards the construction of a multi-km^3 scale deep sea neutrino telescope to detect high-energy astrophysical neutrinos. It will have the Galactic Centre and most of the Galactic plane in its field of view, and it will complement the IceCube detector at the South Pole. Recently the Technical Design Report has been published. It contains the general description of the KM3NeT deep sea research infrastructure. The KM3NeT research facility will represent also a multidisciplinary marine and Earth science observatory, hosting a network of nodes for long term continuous monitoring of the deep sea environment. The objectives, status and plans of the KM3NeT project will be presented.

**Review on Experimental Results and Theories / 60**

## High Energy Gamma Rays Astronomy

**Author:** Felix Aharonian[1]

[1] *DIAS, Dublin*

**Corresponding Author:** felix.aharonian@dias.ie

I will describe the status of the field and discuss the recent exciting results obtained in the GeV and TeV energy bands with an emphasis on topics related to the Origin of Cosmic Rays and to the Physics and Astrophysics of Relativistic Outflows.

**Ultra High Energy Cosmic Rays / 62**

## AERA, the Auger Engineering Radio Array

**Author:** Benjamin Fuchs[1]

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The Auger Engineering Radio Array (AERA) is being deployed at the Pierre Auger Observatory in Argentina. AERA is designed as a 20 $km^2$ radio array with 160 autonomous radio detection stations to measure the radio emission from ultra-high energetic cosmic ray air showers above $10^{17}$ eV. AERA is based on experiences made with various prototype radio stations at the Pierre Auger Observatory during recent years. In the current stage one, AERA consists of 21 radio antennas operating since November 2010. Because AERA is positioned inside the surface detector array of the Pierre Auger Observatory, coincident measurements with the fluorescence telescopes and surrounding surface detectors are possible. In addition AERA overlaps with the AMIGA and HEAT low energy extensions of the Observatory.
The expected precise measurements will provide insights on the radio emission mechanism and the lateral distribution of radio signals from air showers.These measurements may lead to a better understanding of the emission mechanisms and the intrinsic capabilities of the radio detection technique enabling detailed analyses on the properties of high energetic cosmic rays, like the composition of the primary particles, its energy and the incident direction. In addition, AERA will serve as a prototype for even larger future antenna arrays. AERA acts as the pathfinder for radio antenna arrays on scales of some 1000 $km^2$.

We will present the current status, the hardware setup and the first data taken during the commissioning phase of AERA as well as the features of the analysis software developed for AERA. In addition, an outlook on the future of AERA and the foreseen enlargements will be presented.

**Parallel session 1: Dark Matter Search / 63**

## Particle Dark Matter signal in DAMA/LIBRA

**Author:** Riccardo Cerulli[1]

[1] *LNGS*

The DAMA/LIBRA set-up (about 250 kg highly radiopure NaI(Tl)) is running at the Gran Sasso National Laboratory of the I.N.F.N..
It has already released the results obtained in 6 annual cycles; the cumulative exposure with the one released by the former DAMA/NaI is 1.17 ton × yr, corresponding to 13 annual cycles. The data further confirm the model independent evidence for the presence of Dark Matter particles in the galactic halo on the basis of the Dark Matter annual modulation signature (8.9 sigma C.L.). The data of a further annual cycle have already been collected before the new important upgrading performed at the end of 2010. The set-up has now started the data taking in this new configuration. Results, comparisons and perspectives will be summarized.

**High Energy Cosmic Rays and Gammas: future experiments / 64**

## Toward the autonomous radiodetection of ultra high energy cosmic rays with CODALEMA

**Author:** Pascal Lautridou[1]

**Co-author:** 1,2,3,4,5,6,7 THE CODALEMA COLLABORATION [2]

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CODALEMA is one of the experiments devoted to the detection of ultra high energy cosmic rays by the radio method.
So far, the device, installed at the radio-observatory of Nançay (France), has used in coincidence a ground particle detector array and an antenna array, connected by cable to a central acquisition room, for sampling a surface of 0.25 km2.
Since the early 2011, the experience is the subject of a major evolution with the addition, all around the original radio setup, of a new radio network made of 60 autonomous radiodetection stations, spread over an area of 1.5 km2.
This new configuration should allow both to deepen the interpretation of results and serve as a testbed for the mastery of this technology in the context of possible large-scale deployments.
The main characteristics of this new mode of operation will be presented in the light of recent results obtained by the conventional network CODALEMA.

**Parallel session: High Energy Neutrinos / 65**

## The South Pole Acoustic Test Setup SPATS.

**Author:** Karim Laihem[1]

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New detection techniques for Ultra-Hight Energy (UHE) neutrinos are required for instrumenting a large detector volume needed to observe the expected low neutrino fluxes at energies of EeV or above. To measure these low fluxes, studies on a larger IceCube neutrino observatory at the south pole have been intensively investigated in the last decade. These studies have introduced a hybrid detection concept including radio and acoustic detection techniques combined with the existing optical array. This hybrid configuration would allow for a larger sensitive volume at reasonable cost with high sensitivity and low background.
The feasibility of an acoustic neutrino detection array at the South pole depend upon the acoustic properties of the ice such as the attenuation length, sound speed, background noise level and transient rate. The South Pole Acoustic Test Setup (SPATS) has been developed and deployed to evaluate in-situ the acoustic properties of the South Pole ice in the 10 to 100 kHz frequency range. The SPATS array consists of four vertical acoustic strings deployed in the upper 500 meters of the Antarctic ice cap. Each string has seven stages and each stage is equipped with one transmitter and one sensor module. A retrievable transmitter was used in 10 drill holes to collect data at a range of distances up to approximately 1 kilometer. The latest SPATS results are presented.

**Parallel Session: HECR and results from accelerators / 66**

## Results of NEVOD-DECOR experiment and evidences of quark-gluon plasma in cosmic rays

**Author:** Anatoly Petrukhin[1]

**Co-author:** DECOR Collaboration [2]

[1] *NRNU MEPhI*

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**Corresponding Author:** aapetrukhin@mephi.ru

A distinctive feature of the NEVOD-DECOR experiment is the investigation of muon component in inclined EAS. A rapid growth of the distance between the observation point and muon generation region, and as a consequence a large lateral spread of EAS muons at large zenith angles allow us to detect showers in a wide energy interval from 1015 up to about 1019 eV by means of relatively small-size experimental setup. Measurements of local muon density spectra (LMDS) were conducted during about 20 thousand hours. The main features of UHE cosmic ray spectrum – the knee, the second knee and the increase of the spectrum slope – were observed. The comparison of the experimental data with results of CORSIKA-based simulations showed that the muon density in inclined EAS increases with the energy of primary particles more rapidly than it can be expected even for pure iron composition of cosmic rays. Further experimental plans are connected with measurements of the energy deposit of muon component in Cherenkov water detector. These measurements will give a possibility to check some ideas about changes of hadron interaction characteristics at energies above the knee.

**Parallel Session: HECR and results from accelerators / 67**

## Forward photon energy spectrum at LHC 7TeV p-p collisions measured by LHCf

**Author:** Hiroaki MENJO[1]

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[1] *Nagoya University*

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The LHCf experiment is one of the LHC forward experiments. The aim of the LHCf is to measure energy and transverse momentum spectra of neutral particles, gamma-rays, neutrons and neutral pions, due to calibrate the hadron interaction models which are used in air shower simulations. The LHCf detectors are composed of sampling and imaging calorimeters and had been installed 140m from a LHC interaction point to cover the very forward region of collisions (psudorapidity range eta >8.4). The LHCf has completed operations at p-p collisions of sqrt(s)=900GeV and 7TeV in 2010 successfully. The first physics paper with photon energy spectra measured at sqrt(s)=7TeV pp collisions has been submitted recently. In this talk, I will present the results.

**Parallel Session: Low energy astroparticle physics / 68**

## Long duration gamma-ray solar emission during march, 7-8th, 2011 observed by Fermi

**Author:** Nicola Giglietto[1]

**Co-author:** on behalf of the Fermi-LAT Collaboration . Allafort, N.Giglietto, N.Omodei, H. Takahashi, Y. Tanaka on behalf of the Fermi-LAT Collaboration [2]

[1] *BA*

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We report on Fermi Large Area Telescope (LAT) detection of long-lived gamma-ray emission from the Sun during 2011 March 7 to 8.
At 19:43 UT on 7 March 2011, GOES X-ray monitor observed the onset of M3.7 solar flare. Following the flare, gamma-rays above 100 MeV was detected by Fermi/LAT with high significance. The flux was at least higher than the Vela pulsar, which is the brightest steady source in the gamma-ray band. The gamma-ray emission lasted at least 9 hours, and the spectrum (E>100 MeV) accumulated during the flare duration was relatively soft. Rhessi and Fermi/GBM did not detect such a long-lasting hard X-ray emission during the LAT detection.
Considering the lack of hard X-ray emission, decay of pions produced by accelerated protons would be responsible for the LAT emission.
We discuss these possible emission mechanisms.

**Summary**:

We report on Fermi Large Area Telescope (LAT) detection of long-lived gamma-ray emission from the Sun during 2011 March 7 to 8.
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We discuss these possible emission mechanisms.

**Parallel session 2: Dark Matter Search / 69**

## Searches for dark matter candidates with the CMS experiment at the LHC

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A number of searches for signals of physics beyond the Standard Model have been performed with the data acquired by the CMS experiment in 2010 and at the beginning of 2011 in p-p collisions at 7 TeV center-of-mass energy. The predictions of many models of new physics that provide candidates for dark matter have been tested against experimental observations.

**Welcome and Review on Experimental Results and Theories / 70**

## Review on High Energy Cosmic Rays

**Author:** Giorgio Matthiae[1]

[1] *University "Tor Vergata" of Roma and INFN*

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Recent results on very high energy cosmic rays will be presented. The observation of the GZK suppression at the end of the energy spectrum and the measurements of the mass composition will be discussed in detail together with the search for extragalactic sources.

**Ultra High Energy Cosmic Rays / 71**

## Telescope Array: the latest results

**Author:** Petr Tinyakov[1]

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The Telescope Array ultra-high energy cosmic ray detector, situated in Utah, USA, is taking data since March 2008. I will present the latest results of the spectrum, composition and anisotropy studies by the Telescope Array.

**Parallel Session: HECR and results from accelerators / 72**

## Measurement of the muon charge ratio in cosmic ray events with the CMS experiment at the LHC

**Author:** Stefano Marcellini[1]

[1] *BO*

**Corresponding Author:** stefano.marcellini@bo.infn.it

We present a measurement of the ratio of positive to negative muon fluxes from cosmic ray interactions in the atmosphere, using data collected by the CMS detector both at ground level and in the underground experimental cavern at the CERN LHC. Muons were detected in the momentum range from 5 GeV/c to 1 TeV/c. The surface flux ratio is measured to be 1.2766±0.0032 (stat.)±0.0032 (syst.), independent of the muon momentum, below 100 GeV/c. This is the most precise measurement to date. At higher momenta the data are consistent with an increase of the charge ratio, in agreement with cosmic ray shower models and compatible with previous measurements by deep-underground experiments.

**Poster Session / 73**

## Quark-gluon plasma in cosmic ray experiments

**Author:** Anatoly Petrukhin[1]

[1] *NRNU MEPhI*

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Possibilities of observation of new particles or states of matter in cosmic ray experiments at very high energies (above 1015 eV) always gave rise to doubts, especially among accelerator physicists. Nevertheless, attempts of explanation of various unusual phenomena detected in cosmic rays periodically appear. The first of them was an explanation of the knee appearance due to hadron interaction model changes, which was done in the first paper about the knee observation. Then various theoretical models and ideas with explanations of unusual phenomena observed in very high energy cosmic ray experiments were discussed in many papers. Recent LHC results, especially those obtained in nucleus-nucleus interactions, allow one to hope that some of these ideas were not so erroneous. In this paper, a simple model of quark-gluon plasma production is considered. It allows explain practically all unusual events detected in cosmic ray experiments, and the appearance of the knee and the observed mass composition changes above the knee.

**Parallel Session: Low energy astroparticle physics / 74**

## Fermi gamma-ray 'bubbles' from stochastic acceleration of electrons

**Author:** Philipp Mertsch[1]

**Co-author:** Subir Sarkar [2]

[1] *Rudolf Peierls Centre for Theoretical Physics*

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Gamma-ray data from Fermi-LAT reveal a bi-lobular structure extending up to 50 degrees above and below the galactic centre, which presumably originated in some form of energy release there less than a few million years ago. It has been argued that the gamma-rays arise from hadronic interactions of high energy cosmic rays which are advected out by a strong wind, or from inverse-Compton scattering of relativistic electrons accelerated at plasma shocks present in the bubbles. We explore the alternative possibility that the relativistic electrons are undergoing stochastic 2nd-order Fermi acceleration by plasma wave turbulence through the entire volume of the bubbles. The observed gamma-ray spectral shape is then explained naturally by the resulting hard electron spectrum and inverse Compton losses. Rather than a constant volume emissivity as in other models, we predict a nearly constant surface brightness, and reproduce the observed sharp edges of the bubbles.

**Parallel Session: Experimental techniques / 75**

## SiPM thermoregulated fast front end electronics for Time Of Flight detectors in space

**Author:** Cristina Sbarra[1]

**Co-authors:** Cristina Guandalini [2]; Foschi Evelyn [2]; Giuseppe Levi [3]; Ignazio D'Antone [2]; Ignazio Lax [2]; Lucio Quadrani [2]; Mirco Zuffa [2]

[1] *INFN-PD & Bologna University*

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[3] *Bologna University*

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Silicon Photomultiplier (SiPM) are considered very promising in many applications where high timing performance, low cost, hardness to radiation damage and single photon counting are requested. Such applications go from astrophysics, high energy accelerator physics and medical physics. A group of SiPM from FBK-Irst has been tested with a low noise fast amplifier, based on a heterojunction FET, mounted on a proper front end board. A first cosmic ray telescope prototype has been used to test the electronics and results are shown.
The SiPM gain depends critically on temperature and the use of a thermoelectric module to control the circuit was also studied in order to use the system for space detectors.

**High Energy Neutrinos / 76**

## Acoustic detection of ultra-high energetic neutrinos - a snap-shot

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**Author:** Rolf Nahnhauer[1]

[1] *scientific associate*

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After a brief introduction of early ideas and activities in the field, signal expectations for different target materials and Thermo-acoustic Model approaches are discussed in relation to available data. Acoustic sensors and transmitters available from industry or developed in dedicated R&D programs are shortly characterized together with calibration methods for their applications.
Recent results of experimental tests in several target materials are reviewed and possible future applications of the acoustic particle detection technique are discussed.

**Parallel Session: Experimental techniques / 77**

## CALET: a calorimeter based orbital observatory for High Energy Astroparticle Physics

**Author:** Pier Simone Marrocchesi[1]

[1] *SI*

**Corresponding Author:** piersimone.marrocchesi@pi.infn.it

CALET is a complex experiment that will be installed on the Exposure Facility of the Japanese Experiment Module (JEM-EF) on the International Space Station (ISS) with a launch window in the late 2013. The instrument consists of three modules: a charge module using plastic scintillator to identify the charge of the particle, a thin imaging calorimeter (3 r.l.) with tungsten plates interleaving scintillating fiber planes, and a thick calorimeter (27 r.l.) composed of lead tungstate logs. It has sufficient depth, imaging capabilities and adequate energy resolution to allow for an excellent separation between hadrons and electrons and between charged particles and gamma rays. The charge module will be able to identify cosmic nuclei up to Fe and to detect trans-Fe elements.
With extended observations, over a period of 5 years, CALET will be able to unveil the presence of possible nearby sources of high energy electrons, study the details of particle propagation in the galaxy and search for signatures of dark matter.
In this paper, we will review the main features of the CALET instrument and the present status of the mission.

**Ultra High Energy Cosmic Rays / 78**

## Large scale anisotropy studies with the Pierre Auger Observatory

**Author:** Raffaella Bonino[1]

[1] *IFSI-INAF, INFN Torino*

**Corresponding Author:** rbonino@to.infn.it

Completed at the end of 2008, the Pierre Auger Observatory has been continuously operating for more than seven years, collecting a statistics of cosmic rays that already allows one to be sensitive to intrinsic anisotropies in their sky distributions at the 1% level at EeV energies.
We present here the most recent results about the search for large scale anisotropies, reporting both the phase and the amplitude measurements of the first harmonic modulation in right ascension in different energy ranges above 2.5·10^17 eV. No significant anisotropies have been observed, upper limits on the amplitudes have thus been obtained and are here compared with the results of previous experiments and with some theoretical expectations.

**Review on Experimental Results and Theories / 80**

## Expectations for High-Energy Neutrinos From Galactic Sources

**Author:** Francesco Vissani[1]

[1] *LNGS*

**Corresponding Author:** francesco.vissani@lngs.infn.it

I discuss the expectations for the high-energy neutrino emission from astrophysical galactic sources, focussing in particular on supernova remnants, and emphasizing the synergy between neutrino- and gamma-ray astronomy.

**Parallel Session: Experimental techniques / 81**

## Stand-alone low energy measurements of light nuclei from PAMELA Time-of-Flight system.

**Author:** Rita Carbone[1]

[1] *NA*

The PAMELA experiment, built to detect charged particles in cosmic rays, is in orbit since June 2006. The Time-of-Flight system, composed by 24 scintillation counters arranged in 3 double view planes, is a key element of the apparatus: it generates the general trigger, provides measurements of the velocity of the particles entering the detector and allows rejection of albedo particles. It operates also identification of light nuclei up to Oxygen by means of measurements of the ionizing energy loss of the particles inside the scintillation counters. The procedure applied to obtain the atomic number and the kinetic energy per nucleon of a traversing nucleus starting from measurements of, respectively, energy loss and velocity of the nucleus itself will be described in this work. As an application, a completely stand-alone measurement from ToF of the B/C ratio below few GeV will be shown.

**Poster Session** / **82**

## Laboratory Tests of the Hard X-ray Polarimeter X-Calibur

**Author:** Matthias Beilicke[1]

[1] *Washington University in St.Louis*

**Corresponding Author:** beilicke@physics.wustl.edu

X-ray polarimetry promises to give qualitatively new information about high-energy sources, such as binary black hole systems, rotation and accretion powered neutron stars, Microquasars, Active Galactic Nuclei and Gamma-Ray Bursts. Furthermore, hard X-ray polarimetric observations of galactic sources can place uniquely sensitive constrains on Lorentz Invariance violations. We designed, built and tested a hard X-ray polarimeter X-Calibur to be used in the focal plane of the InFOCuS grazing incidence hard X-ray telescope. The polarimeter combines a low-Z Compton scatterer with a high-Z Cadmium Zinc Telluride (CZT) detector assembly to measure the polarization of 10-80 keV X-rays. X-Calibur makes use of the fact that polarized photons Compton scatter preferentially perpendicular to the electric field orientation. In contrast to competing designs, which use only a small fraction of the incoming X-rays, X-Calibur achieves a high detection efficiency of order unity. We report on the technical design of X-Calibur, the X-Calibur and InFOCuS sensitivity on short and long duration balloon flights, and present detailed laboratory calibration measurements.

**Summary**:

X-ray polarimetry promises to give qualitatively new information about high-energy sources, such as binary black-hole-systems, Microquasars, AGN, GRBs, etc. We designed, built and tested a hard X-ray polarimeter X-Calibur to be used in the focal plane of the InFOCuS grazing incidence hard X-ray telescope. The polarimeter combines a low-Z Compton scatterer with a high-Z CZT detector assembly to measure the polarization of 10-80 keV X-rays, making use of the fact that polarized photons Compton scatter preferentially perpendicular to the electric field orientation. X-Calibur achieves a high detection efficiency of order unity. We report on the technical design, sensitivity, and laboratory calibration measurements.

**Parallel Session: HECR and results from accelerators** / **83**

## Results from KASCADE-Grande

**Author:** Mario Edoardo Bertaina[1]

**Co-author:** KASCADE-Grande Collaboration

[1] *University of Torino*

The KASCADE-Grande experiment, located at Karlsruhe Institute for Technology (Germany) is a multi-component extensive air-shower experiment devoted to the study of cosmic rays and their interactions at primary energies 10^14 - 10^18 eV. One of the main goals of the experiment is the measurement of the all particle energy spectrum in the 10^16 - 10^18 eV range by sampling charged (Nch) and muon (Nmu) components of the air shower. The methods to derive the energy spectrum and its uncertainties, as well as the implications of the obtained result, will be discussed in detail. An overview of the other analyses performed by KASCADE-Grande will also be presented.

**Parallel Session: Low energy astroparticle physics / 84**

## Fermi's view of the Galactic Center region

**Author:** Beatriz CANADAS DEL RIO[1]

[1] *ROMA2*

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The inner region of the Milky Way Galaxy is one of the most interesting and complicated regions of the gamma ray sky because of the many point sources and potential confusion, the uncertainties associated with the diffuse gamma-ray emission, together with the potential for dark matter detection. In this talk, we report on the Fermi LAT team analysis of a 10 degree region around the direction of the galactic center using over 2 years of data.

**High Energy Cosmic Rays and Gammas: future experiments / 85**

## The HAWC Observatory

**Author:** Tyce DeYoung[1]

[1] *Pennsylvania State University*

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The High Altitude Water Cherenkov (HAWC) Observatory is a new very high energy water Cherenkov gamma ray telescope, now under construction at 4100 m altitude at Sierra Negra, Mexico. Due to its increased altitude, larger surface area and improved design, HAWC will be about 15 times more sensitive than its predecessor, Milagro. With its wide field of view and high duty factor, HAWC will be an excellent instrument for studies of diffuse gamma ray emission, the high energy spectra of Galactic gamma ray sources, and transient emission from extragalactic objects such as GRBs and AGN, as well as surveying a large fraction of the VHE sky. The status of the HAWC project and its scientific prospects will be discussed.

**Parallel session 1: Dark Matter Search / 86**

## Anisotropies in the diffuse gamma-ray background measured by the Fermi-LAT

**Author:** Vincenzo Vitale[1]

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The contribution of unresolved sources to the diffuse gamma-ray background could produce anisotropies in this emission on small angular scales. Recent studies have considered the angular power spectrum and other anisotropy metrics as tools for identifying contributions to diffuse emission from unresolved source classes, such as extragalactic and Galactic dark matter as well as various astrophysical gamma-ray source populations. We present recent preliminary results of an anisotropy analysis of the diffuse emission measured by the Fermi-LAT.

**Parallel session: High Energy Neutrinos** / **87**

## Particle physics in ice with IceCube DeepCore

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The IceCube Neutrino Observatory is the world's largest high energy neutrino telescope, using the Antarctic ice cap as a Cherenkov detector medium. DeepCore, the low energy extension to IceCube, is an infill array with a fiducial volume of around 30 MTon in the deepest, clearest ice, aiming for an energy threshold as low as 10 GeV and extending IceCube's sensitivity to indirect dark matter searches and atmospheric neutrino oscillation physics, as well as astrophysical neutrino sources in the southern sky. We will discuss the analysis of the first year of DeepCore data, as well as ideas for a further extension of the particle physics program in the ice with a future PINGU detector.

**High Energy Cosmic Rays and Gammas** / **88**

## Gamma ray sources observation with ARGO-YBJ.

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The ARGO-YBJ experiment is a full coverage Extensive Air Shower array operating at the Cosmic Ray Observatory of Yangbajing (Tibet, China, 4300 m a.s.l.).
One of the scientific goals of ARGO-YBJ is the observation of gamma ray sources at energies E > 0.3 TeV.
The large field of view ( > 2 sr) and the high duty cycle (> 90%) of the detector allows the continuous monitoring of the sky in the declination band from -10 to +70 degrees.
In this work we present the results of our observations of galactic and extragalactic sources during more than three years, focusing our attention on the Crab Nebula, the blazar Mrk421 and the galactic extended source MGRO J1908+06, associated to the Fermi pulsar PSR J1907+0602.

**Parallel Session: HECR and results from accelerators** / **89**

## Status of the RICE and preparations for next generation radio neutrino experiments in Antarctica

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The RICE experiment on detection of UHE neutrinos has been running over a decade. The experiment comprises an array of radio antennas buried in ice to the depth of up to 300 meters near the geographic South Pole, and is designed to observe neutrino interactions in ice employing the radio Cherenkov technique. We discuss RICE limits on the diffuse UHE neutrino flux. We also present studies of ice properties performed by the radio group of Icecube as well as first technical results from the recently funded ARA experiment.

**Poster Session** / **90**

## Observation of Markarian 180 at the Fermi LAT energies

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We present the results of the analysis of Markarian 180 (1ES 1133+704), a BL Lac object embedded in a giant elliptical galaxy, obtained for a period of 45 days, during which multiwavelenght observations were on going. The Mrk 180 is associated to a quasar- like object whose distance can be determined unambiguously, thanks to the well done measurement of absorption line that gives the redshift (z=0.046; Ulrich 1978).
The source Mrk 180 was observed for 45 days, during which it was possible to discovery a change of emissivity, at the energies 100 MeV – 300 GeV. Results of the analysis are shown.

**Welcome and Review on Experimental Results and Theories** / **91**

## Review of Astrophysical Neutrino Results

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I will review current limits on astrophysical neutrinos with emphasis on the implications for models of cosmic-ray origin. IceCube results are presented in a separate talk.

**High Energy Cosmic Rays and Gammas: future experiments** / **92**

## Radio Detection of High Energy Cosmic Rays

**Author:** Andreas Haungs[1]

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Since the renaissance of this detection technique in 2003 enormous achievements could be reached. This concerns both, improvements of the experimental sensitivities and a better theoretical understanding of the emission process. This led to an increase of interest in the field worldwide with a bulk of new experimental efforts as well as a couple of new approaches for the Monte Carlo description of the radio emission in air-showers. This contribution will review the recent advances, the present status, and the perspectives of the radio detection technique of high-energy cosmic rays.

**High Energy Neutrinos** / **93**

## Status and Recent Results from the IceCube km^3 Neutrino Detector

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The IceCube neutrino detector has recently completed construction with the deployment of the full IceTop air shower array and 5160 optical sensors instrumenting 1 km^3 of deep ice at the Antarctic South Pole station. IceCube is the world's largest neutrino detector and has achieved a sensitivity that represents a new era in the search for neutrinos of astrophysical origin. In addition to searches for astrophysical neutrinos and the source of cosmic rays, IceCube has a broad physics program in neutrino oscillations, dark matter searches, cosmic-ray measurements and the search for exotic new physics. This talk will summarize the operational status, performance and results from the IceCube Collaboration using data taken during the construction phase, including the 2008-2009 and 2009-2010 detector configurations.

**Poster Session** / **94**

## Young SNRs: a new class of GeV Emitters

**Author:** Francesco Giordano[1]

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Fermi-LAT has recently detected a new class of of GeV emitters: Young SNRs. A review of Tycho, VelaJr, RXJ1713 and CasA will be given hilighlithing possible interpretation of the observed spectrum as emitted by hadrons accelereted in the SNR sites. Differences with older SNR mostly interacting with Molecular Clouds will be also discussed.

**High Energy Cosmic Rays and Gammas** / **95**

## Status of VERITAS

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The VERITAS observatory is composed of four 12-m imaging atmospheric Cherenkov telescopes located in southern Arizona and dedicated to the study of gamma rays at very high energies (VHE, E > 100 GeV). It has been in full operation since 2007 and has detected more than 30 VHE sources to date. The VERITAS collaboration pursues a broad scientific program including the study of galactic and extragalactic sources, the search for dark matter, and gamma-ray burst follow-up observations. This talk will review some of our recent results and briefly discuss the status of the detector upgrade currently underway.

**High Energy Cosmic Rays and Gammas: future experiments / 96**

## The Pierre Auger Observatory Enhancements

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The Pierre Auger Observatory was designed to study the extensive air showers generated by Ultra High Energy Cosmic Rays (UHECRs). It consists of 1600 water Cherenkov detectors spread over 3000 km2 viewed by 24 fluorescence telescopes. The implementation of these two complementary techniques together is known as the hybrid detection and makes Auger unique. The combination of a large ground array and fluorescence detectors allows the reconstruction of the shower axis geometry with greater accuracy than the achieved with either detector system on its own. The Southern site of the Observatory is acquiring data since 2004 and its construction was completed in mid 2008.

Enhancements to this baseline configuration are currently being made to decrease the minimum energy to an order of magnitude below its original design.This includes three additional telescopes with elevated field of view (HEAT, High Elevation Auger Telescopes) and a nested surface array with 750 m and 433 m spacing respectively and additional muon detection capabilities (AMIGA, Auger Muons and Infill for the Ground Array). HEAT is fully commissioned and is taking data continuously since September 2009. The status and prospects of HEAT are discussed. AMIGA is in a very advanced stage with most of the infill detectors installed and taking data since August 2008 and with the first muon detector prototype installed. We present the status of AMIGA and the performance of the surface infill array.

The Southern Auger Observatory provides an excellent test bed to study alternative ways for detection of extensive air showers. In particular several efforts are being done in radio detection in the VHF band as well as through a novel detection technique using the microwave emission from the electromagnetic cascade induced in the atmosphere by the UHECRs.

**High Energy Cosmic Rays and Gammas: future experiments / 97**

## Status of LHAASO Project

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Aiming at wide field of view survey for sources of gamma rays at energies above 100 GeV, search for cosmic ray origins among those gamma ray sources at energies above 30 TeV and energy spectrum measurements for individual cosmic ray species from 30 TeV to 10 PeV, a Large High Altitude Air Shower Observatory (LHAASO) project with a complex array of many types of detectors is proposed. Progresses on R/D of all the detectors, construction and operation of an engineer array at the Tibet site at 4300 m a.s.l. are presented in this talk.

**Parallel Session: Experimental techniques / 98**

## The data acquisition and transport design for NEMO phase 2

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The NEMO collaboration has planned to deploy a prototype tower composed by 8 floor by the end of the year. The aim of this contribution is to give an overview of the NEMO electronic system: the underwater electronics sample
signals from photomultipliers and acquire slow-control data both from
oceanographic instruments and dedicated sensors, allowing to monitor the operational conditions of the apparatus. The whole data are sent to the laboratory through a fully bi-directional fiber optic link. On-shore the data are
received by dedicated boards that distribute them to first-level trigger and to the slow-control system. The architecture described here provides a real-time data transport layer, synchronous and phased with the GPS clock, between the onshore laboratory and the underwater detector. A description of the different stages of data acquisition and transport will be given.

**Parallel session: High Energy Gamma and Neutrino / 99**

## Observation of cosmic rays anisotropy above TeV energies in IceCube

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The IceCube neutrino detector, buried under the South Pole ice, has been completed in December 2010 with all 86 strings deployed. Between May 2009 and May 2010 the detector, operating in a smaller configuration with only 59 strings, has recorded 32 billion muons produced in cosmic ray-induced air showers, with energies above 10 TeV. With this large number of events we can, for the very first time, probe the southern sky for anisotropy in the arrival direction of cosmic rays in this energy range.
In this contribution we present the first observation of cosmic ray anisotropy at different angular scales in the southern sky. We study the energy dependence of the anisotropy and compare to observations made previously with detectors in the northern hemisphere.

**Poster Session / 100**

## Probing General Relativity and New Physics with Lunar Laser Ranging

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Over the past 40 years, Lunar Laser Ranging (LLR) to the Apollo Cube Corner Retroreflector (CCR) Arrays have supplied almost all the significant tests of General Relativity. LLR can evaluate the PPN (Post Newtonian Parameters), addressing this way both the possible changes in the gravitational constant and the self-energy properties of the gravitational field. In addition, the LLR has provided significant information on the composition and origin of the moon. This is the only Apollo experiment that is still in operation. Initially the Apollo LLR Arrays contributed a negligible fraction of the ranging error budget. Over the decades, the ranging capabilities of the ground stations have improved by more than two orders of magnitude. Now, because of the lunar librations, the existing Apollo retroreflector arrays contribute a significant fraction of the limiting errors in the range measurements.
We built a new experimental apparatus (the "Satellite/lunar laser ranging Characterization Facility", SCF) and created a new test procedure (the SCF-Test) to characterize and model the detailed thermal behavior and the optical performance of cube corner laser retroreflectors in space for industrial and scientific applications. Our key experimental innovation is the concurrent measurement and modeling of the optical Far Field Diffraction Pattern (FFDP) and the temperature distribution of the SLR retroreflector payload under thermal conditions produced with a close-match solar simulator. The apparatus includes infrared cameras for non-invasive thermometry, thermal control and real-time movement of the payload to experimentally simulate satellite orientation on orbit with respect to both solar illumination and laser interrogation beams. These unique capabilities provide experimental validation of the space segment for SLR and Lunar Laser Ranging (LLR).The primary goal of these innovative tools is to provide critical design and diagnostic capabilities for Satellites Laser Ranging (SLR) to Galileo and other GNSS (Global Navigation Satellite System) constellations. Implementation of new retroreflector designs being studied will help to improve GNSS orbits, which will then increase the accuracy, stability, and distribution of the International Terrestrial Reference Frame (ITRF), to provide better definition of the geocenter (origin) and the scale (length unit).
The SCF is also actively used to develop, validate and optimize 2nd generation LLR arrays for precision gravity and lunar science measurements to be performed with robotic missions of the International Lunar Network in which NASA and ASI participate (ILN). The capability will allow us to optimize the design of GNSS laser retroreflector payloads to maximize ranging efficiency, to improve signal-to-noise conditions in daylight and to provide pre-launch validation of retroreflector performance under laboratory-simulated space conditions.
For the MAGIA lunar orbiter Phase A study funded by ASI, we studied fundamental physics and absolute positioning metrology experiments, to improve test of the gravitational redshift in the Earth–Moon system predicted by General Relativity and a precursor test of our 2nd generation LLR payload, developed by the Univ. of Maryland (PI) and INFN-LNF (Co-PI).

**Parallel Session: Cherenkov Imaging Detectors / 101**

## Exploring Galactic TeV gamma-ray sources with H.E.S.S.

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The H.E.S.S. array of Imaging Atmospheric Cherenkov Telescopes continues to observe the southern sky with unprecedented sensitivity at very-high-energy (VHE, E>100 GeV) gamma-rays. This lead to a steady increase in the number of detected VHE gamma-ray sources as well as the discovery

of sources with fluxes of only a few percent of the flux of the Crab nebula. Up to now, well more than 100 VHE gamma-ray sources are known, which allows to study not only individual objects, but also whole populations of source classes, such as pulsar wind nebulae and shell-type supernova remnants. This talk focuses on Galactic sources, highlighting some aspects of the recent progress in this field.

**Review on Experimental Results and Theories** / **102**

## Dark Matter Searches and Models

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Theoretical models and particle candidates for dark matter will be discussed in the light of recent experimental results.

**Poster Session** / **103**

## On the extragalactic jet asymmetry and composition and the production of high energy cosmic rays

**Author:** Nectaria Gizani[1]

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We probe the role of the directional asymmetry between relativistic outflows to kilo-parsec scale jets, in the acceleration of cosmic rays. Our sample contains powerful AGN hosting dense cluster environments where the magnetic field decreases with the distance from the centre. We have mapped the internal magnetic field to the source and the cluster magnetic field in detail using radio and X-ray data.

We also use X-ray observations to constrain the jet composition. The presence of relativistic protons or mildly relativistic electrons contributes substantially to the energy budget of the jets enabling them to heat efficiently the intracluster gas.

**Poster Session** / **104**

## Radio extended regions in AGN and their connection with cosmic rays

**Author:** Nectaria Gizani[1]

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We study whether radio relics, halos and mini-halos contribute in the acceleration of cosmic rays. These extended structures are not associated with the AGN phenomenon.

AGN can produce particle bubbles of non-thermal emission, which can restrict cosmic rays. Radio relics and (mini) halos could be forming as a result of the confinement of cosmic rays by these bubbles. For our study we use radio, optical and X-ray data of a sample of 70 Abell clusters. We report on the work in progress and future plans.

**Welcome and Review on Experimental Results and Theories / 105**

## High-energy gamma-ray astronomy with ground-based observatories

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In recent years, ground-based very-high energy (E>30 GeV) gamma-ray astronomy has taken on a major role in high-energy astrophysics. The high sensitivity and performance parameters, still far from the limits of the observation technique though, have lead to the detection and enabled studies of more than 100 sources of various source populations, like pulsar wind nebulae, shell-type supernova remnants, giant molecular clouds, binary systems, active galactic nuclei and starburst galaxies, or yet unidentified "dark" gamma-ray sources. Also studies of galaxy clusters, fundamental physics issues, searches for dark matter annihilation or gamma-ray burst emission have been conducted, proving the versatility of very-high energy instruments. In the talk, the current status of the field is reviewed and selected recent scientific results are highlighted.

**Parallel session 2: Dark Matter Search / 106**

## Search for Dark Matter Candidate with the ATLAS detector

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Supersymmetry is one of the more appealing theory beyond the Standard Model, and provides a natural Dark matter candidate.
First ATLAS searches for signals of Supersymmetry in proton-proton collisions at the LHC will be reported.
These searches are performed in various channels containing different lepton and jet multiplicities in the final states;
the full data sample recorded in the 2010 LHC run, corresponding to an integrated luminosity of 35 pb-1, has been analysed.

**Review on Experimental Results and Theories / 107**

## Fermi Symposium Highlights

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The 2011 Fermi Symposium was dedicated to results and prospects for scientific exploration of the Universe with the Fermi Gamma-ray Space Telescope and related studies. Topics include: blazars and other active galactic nuclei, pulsars, gamma-ray bursts, supernova remnants, diffuse gamma radiation, unidentified gamma-ray sources, and searches for dark matter. A summary of the most interesting new results will be presented.

**Plenary Session and Summaries** / **108**

## RICAP-11 Summary talk

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**Poster Session** / **109**

## Electron muon identification in a new concept of an EAS detector

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We present results demonstrating the time resolution and muon-electron separation capabilities with a new concept of an EAS detector capable for measurements of cosmic rays arriving with large zenith angles. This kind of detector will be part of a large area (several square kilometer) surface array designed to measure Ultra High Energy (0.01-100 EeV) neutrinos using the Earth-skimming technique. Because of the very good time resolution and adjustable orientation of the detector elements, we can separate upward-moving tracks from downward tracks at any orientation with high efficiency.
The particle identification capability is tested by measurements in coincidence with the KASKADE-GRANDE experiment in Karlsruhe, Germany.
A method to identify muons and electron-gammas is presented and a validation from KASKADE-GRANDE is shown.

**Plenary Session and Summaries** / **110**

## ARAP prizes in Physics

**Plenary Session and Summaries / 111**

# Luciano Moscoso memorial