RICAP-13 Roma International Conference on AstroParticle Physics

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Physics Department, University ”La Sapienza”, Roma, Italy

Book of Abstracts

Contents

III Plenary Session / 23

AMS: status and first results

Exactly two years ago, the AMS-02 spectrometer was installed on the ISS to start its long mission to perform highly accurate measurements of Cosmic Rays up the TeV region. We discuss the status of the experiment after two years in space and the first results, in particular the measurement of positron/electron ratio up to 350 GeV.

Parallel Session D / 18

An exploration of hadronic interactions in blazars using IceCube

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The relativistic electrons responsible for the observed broad band synchrotron / inverse Compton emission from blazars can be either directly accelerated at the source (primary electrons) or produced in result of interactions of high energy protons with surrounding medium (secondary electrons). If the observed electromagnetic emission from blazars is produced by secondary electrons, neutrino emission is also expected. Using the measurements of electromagnetic luminosity of blazars with the Fermi/LAT telescope in the GeV band, we estimate expected neutrino flux from brightest blazars. We compare this estimate to the neutrino flux upper limits imposed by IceCube (in the IC-40 configuration) to set constraints on the parameters of the spectrum of accelerated protons: the spectral index(gamma) and the high-energy cutoff(Emax). We find that if the assumption of hadronic origin of electromagnetic emission is correct, blazars should accelerate protons to very-high energy (Emax>1e18 eV) with a hard spectrum (gamma<2).

Parallel Session B / 47

Analysis on H and He production during the 2012 March 7 flare with the PAMELA experiment

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The satellite-borne PAMELA experiment has been continuously collecting data since 2006. This apparatus is designed to study charged particles in the cosmic radiation. The combination of permanent magnet, silicon strip spectrometer and silicon-tungsten imaging calorimeter, with the redundancy of instrumentation allows very precise studies on the physics of cosmic rays in a wide energy range and with high statistics. This makes PAMELA a very suitable instrument for Solar Energetic Particle (SEP) observations. Not only does it span the energy range between the ground-based neutron

monitor data and the observations of SEPs from space, but also PAMELA carries out the first direct measurements of the composition for the highest energy SEP events, including those causing Ground Level Enhancements (GLEs). PAMELA has registered many SEP events in solar cycle 24 including the 2012 March 7 flare, offering unique opportunities to address the question of high-energy SEP origin. A preliminary analysis on proton and helium behaviour during this event is presented in this work.

Parallel Session F / 33

Anisotropy in Cosmic rays from internal transitions in neutron stars

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We discuss the possibility that some recently measured anisotropic cosmic ray components in the TeV-PeV range may be an indication of the ejection of a peculiar type of matter formed in a neutron star internal transition caused by the critical accretion of dark matter from the galactic halo.Current parallel accelerator experiments on earth or on the ISS may shed light on this exotic form of matter.

Poster Session / 15

CVD diamond as UV photosensor for two-phase LAr and LXe detectors

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Recent progress in growth of single crystal Chemical Vapour Deposition (CVD) diamonds of very high purity and high homogeneity has opened new perspectives to UV photosensors dedicated to work optically coupled to next generation two-phase liquid-Ar (LAr) and/or liquid-Xe (LXe) detectors for future neutrino and dark matter experiments. These physical investigations require detectors that combine large volume with low energy threshold (down to keV region) and provide efficient background rejection. Useful interactions are followed by UV photons emissions, but only few hundred photons are produced for each interactions and they needs to be collected with high efficiency. CVD diamond shows excellent performances in UV and X-ray detection, its chemical inertness and mechanical robustness make them most suitable to operate in hash environment. Diamond detectors are blind to visible light and this property greatly help reducing one of the most disturbing source of background. Investigations done by SEM-EDS in order to measure the quantity and kind of impurities inside diamond lattice are presented and discussed, showing how persistent photoconductivity and undesirable pumping effects can be significantly reduced smashing down the impurity and point defects concentration in the lattice. The response time, the photosensivity and the signal to noise ratio results greatly improved, I-V, visible blindness and dark current measurements are reported. CVD diamond spectral response was characterized in the 190-400 nm range, the highest current sensitivity is achieved at 225 nm, the photopeak response at 225 nm is higher than four order of magnitude with respect to photocurrent measured at wavelength just before 400 nm and a very

sharp photocurrent drop is observe just after 245 nm. The response of CVD diamonds as UV sensors suggests that they could be considered as suitable candidates for neutrino and/or dark matter applications.

VII Plenary Session and Conference Summary / 115

Conference concluding remarks

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Parallel Session A / 58

Constraints on the Galactic Halo Dark Matter from Fermi-LAT Diffuse Measurements

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I will discuss constraints on dark matter annihilating or decaying in the Milky Way Halo from observations of the diffuse gamma-ray emission with the Fermi Large Area Telescope.
A novel approach is developed to take into account the astrophysical foregrounds, with the use of the GALPROP code to model the foreground astrophysical diffuse emission and a profile likelihood formalism to marginalize over the model uncertainties.
We find that the resulting limits impact the range of particle masses over which dark matter thermal production in the early Universe is possible, and challenge the interpretation of the PAMELA/Fermi-LAT cosmic ray anomalies as annihilation of dark matter.

Poster Session / 14

Contribution from individual nearby sources to the spectrum of high-energy cosmic-ray electrons

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In the last few years, very important data on high-energy cosmic-ray electrons and positrons from high-precision space-borne and ground-based experiments have attracted a great deal of interest.These particles represent a unique probe for studying local comic-ray accelerators because they lose energy very efficiently and rapidly by two dominant processes: inverse Compton scattering and synchrotron radiation. These energy losses reduce the lifetime so drastically that high-energy cosmic-ray electrons can attain the Earth only from rather local astrophysical sources. This work aims at calculating by means of Monte Carlo simulation the contribution from some known nearby sources to the cosmic-ray electron/positron spectra at high energy (above 10 GeV). The background to the electron energy spectrum from distant sources is determined with the help of GALPROP code. The obtained numerical results are compared with a set of experimental data.

I Plenary Session / **37**

Cosmic Ray Composition with the Pierre Auger Observatory

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The Pierre Auger Observatory in Argentina is the largest cosmic ray detector array ever built. Although the construction was completed in 2008, the Observatory has been taking data continuously since January 2004.
Its main goal is to measure ultra high energy cosmic rays (UHECRs, energy above 10^{18} eV) with unprecedented statistics and precision.
Measurements of the energy spectrum, chemical composition (including neutrinos and photons) and arrival directions of UHECRs can provide hints for understanding their origin, propagation and interactions.
The Fluorescence Detector of the Pierre Auger Observatory measures the atmospheric depth, X_{max}, where the longitudinal profile of the high energy air showers reaches its maximum. This is sensitive to the nuclear mass composition of the cosmic rays and to the characteristics of the hadronic interactions at very high energy. Due to its hybrid design, the Pierre Auger Observatory also provides independent experimental observables obtained from the Surface Detector for the study of the nuclear mass composition.
A selection of the Pierre Auger Observatory results on the study of the UHECRs will be presented, focusing on the composition results.
In particular, the measurements and the different roles of the observables with respect to mass composition will be discussed.

I Plenary Session / **12**

Cosmic Ray Physics with ARGO-YBJ

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Cosmic ray physics in the 10^12-10^15eV primary energy range is among the main scientific goals of the ARGO-YBJ experiment. The detector, located in the Cosmic Ray Observatory of Yangbajing (Tibet, China) at 4300m a.s.l., is a full coverage Extensive Air Shower array consisting of a carpet of Resistive Plate Chambers (RPC) of about 7000m2. The apparatus layout, performance and location offer a unique opportunity for a detailed study of several characteristics of the hadronic component of the cosmic ray flux in an energy window marked by the transition from direct to indirect measurements. Moreover the analog readout of the RPC signals indeed provides a powerful tool to study, with unprecedented resolution and without saturation, the extensive air shower space-time structure down to few meters from its axis.

Results concerning the study of cosmic ray energy spectrum, mass composition and arrival directions will be given together with the search for an antiproton signal and the study of the interplanetary magnetic field. Furthermore, measurements of the proton air cross section and of the particle distributions close to the shower axis will be shown, thus giving new inputs, in the very forward region,

to the hadronic interaction models currently used for understanding particle physics and cosmic rays up to the highest energies.

II Plenary Session / 31

Cosmic-ray Spectrum, Composition, and Anisotropy Measured with IceCube/IceTop

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Analysis of cosmic-ray surface data collected with the IceTop array of Cherenkov detectors at the South Pole gives an accurate measurement
of the cosmic-ray spectrum and its features in the “knee” region and at higher energies up to about 1 EeV. IceTop is part of the IceCube Observatory, a cubic kilometer Cherenkov detector deployed under IceTop in the polar ice sheet, which reconstructs tracks of deeply penetrating muons. The surface and in-ice signals detected in coincidence provide clear insights into the nuclear composition of cosmic rays. IceCube/IceTop already measured an average heavier composition after the knee. We present preliminary results on both the IceTop only analysis and the coincident event analysis. Furthermore, we discuss the implications of the recent measurement of the cosmic-ray anisotropy with IceTop.

Parallel Session A / 72

Cosmological and astrophysical constraints on majoron dark matter

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In my talk I will explore the possibility that the dark matter is related to the origin of neutrino masses. In fact, neutrino masses could arise from spontaneous breaking of ungauged lepton number and the resulting Goldstone boson, the majoron, may pick up a mass due to gravity and play the role of dark matter. I will first examine the cosmological constraints on the majoron density and lifetime. Then I will show the X- and gamma-ray constraints on the (subdominant) majoron decay to photons. Finally, I will compare these observational constraints to the predictions of different realizations of a general majoron see-saw model.

Parallel Session G / 71

Cross section measurements of fusion reactions at astrophysically relevant energies: the LUNA experiment

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Accurate knowledge of thermonuclear reaction rates is important in understanding the generation of energy, the luminosity of neutrinos, and the synthesis of elements in stars.
The LUNA Collaboration has shown that, by going underground and by using the typical techniques of low background physics, it is possible to measure nuclear cross sections down to the energy of the nucleosynthesis inside stars.
This talk will give an overview of the experimental techniques adopted in underground nuclear astrophysics and will present a summary of the main recent results and achievements.
The future developments of the LUNA experiment will also be shown .

Parallel Session C / 93

DAMA/LIBRA results and perspectives

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The DAMA/LIBRA set-up (about 250 kg highly radiopure NaI(Tl)) is running at the Gran Sasso National Laboratory of INFN. The positive results obtained by exploiting the model independent annual modulation signature for the presence of Dark Matter particles in the galactic halo will be discussed. The data satisfy all the many requirements of the Dark Matter annual modulation signature at high confidence level. Presently DAMA/LIBRA is in data taking in the new configuration with higher quantum efficiency PMTs. Results, implications and experimental perspectives will be addressed.

Parallel Session A / 69

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

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The detailed origin of the diffuse gamma-ray background is still unknown. However, the contribution of unresolved sources is expected to induce small-scale anisotropies in this emission, which may provide a way to identify and constrain the properties of its contributors. Recent studies have predicted the contributions to the angular power spectrum (APS) from extragalactic and galactic dark matter (DM) annihilation or decay. The Fermi-LAT collaboration reported detection of angular power with a significance larger than 3σ in the energy range from 1 GeV to 10 GeV on 22 months of data [Ackermann et al. 2012]. In this talk I will present preliminary results using the already published Fermi-LAT APS measurements [Ackermann et al. 2012] compared to the accurate predictions for DM anisotropies from state-of-the-art cosmological simulations as presented in [Fornasa et al. 2013] to derive constraints on different DM candidates.

VII Plenary Session and Conference Summary / 112

Deep Undergroud/Under-Water/Uder-Ice experiments results and prospects.

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Parallel Session A / 55

Diffuse gamma-rays from Misaligned AGN and constraints on galactic Dark Matter

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We calculate the diffuse gamma-ray emission due to the population of misaligned AGN (MAGN) unresolved by the Large Area Telescope (LAT) on the Fermi Gamma-ray Space Telescope. We demonstrate that the MAGN can contribute from 10% up to nearly the entire measured Isotropic Gamma-Ray Background (IGRB), with a theoretical uncertainty on the flux of almost an order of magnitude. We also evaluate the room left to galactic dark matter at high latitudes, by taking into account the new result on the MAGN contribution to the IGRB, together with the other significant galactic and extragalactic components.

Parallel Session B / 62

Efficient turbulent amplification of magnetic field driven by dynamo effect at supernova remnant shocks

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Supernova Remnant (SNR) shocks are considered the main source of galactic cosmic-rays at least up to the knee of the cosmic-ray spectrum, and possibly further. From recent high-energy observations of SNRs a magnetic field at the shock far exceeding the theoretically predicted shock-compressed field has been inferred. Theoretical work in the last decade has linked particles accelerated at the shock to such an amplification. We show that density inhomogeneities in the interstellar medium might strongly enhance the magnetic field, regardless any cosmic-rays influence. The growth of the turbulent component of the downstream magnetic field is driven by the vortical eddies motion. We determine the time-evolution and saturation of the amplified field. The explicit expression of growth rate and non-linear field back-reaction in terms of the parameters of shock and interstellar density fluctuations is derived from jump conditions. Field saturation up to the order of milligauss and a short-time variability in the X-ray observations of SNRs can be obtained by using reasonable parameters for the interstellar turbulence.

Parallel Session F / 41

Energy spectrum of Cosmic ray Protons and Helium nuclei measured by the ARGO-YBJ experiment

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The ARGO-YBJ experiment is a full-coverage air shower detector operating at the Yangbajing International Cosmic Ray Observatory (Tibet, P.R China, 4300 m a.s.l.). The detector was in stable data taking in its full configuration from Nov. 2007 to Dec 2012. More than 10^11 events have been collected and reconstructed. Due to its characteristics (full-coverage, high segmentation,high altitude operation) the ARGO-YBJ experiment is able to investigate the cosmic ray energy spectrum in a wide energy range. In this work we present the measurement of the Proton and Helium spectra in the energy range 1-300 TeV by using a large data sample collected between Jan. 2008 and Dec. 2011.

Parallel Session C / 0

Enter the DarkSide

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A wide range of astrophysical measuments evidence that the stars and gas in all galaxies are immersed in a much larger cloud of non-luminous and non-baryonic "dark matter". The nature of the dark matter is still totally unknown, and the resolution of the "dark matter puzzle" is of fundamental importance to cosmology, astrophysics, and elementary particle physics.
One of the major lines of researches directing their efforts at detection of dark matter
are direct searches of Weakly Interacting Massive Particles (WIMPs) with detectors operated in deep underground laboratories. The new generation of direct searches of WIMPs promises to probe the most interesting region of parameters for the dark matter candidates.
I will review and describe the DarkSide-50 underground argon detector at Laboratori Nazionali del Gran Sasso (LNGS).

Parallel Session B / 101

Fermi LAT recent results on AGNs

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During the last years our knowledge of Active Galactic Nuclei (AGNs) in the gamma-ray band has received a huge boost mainly due to the advent of a new generation of satellite instruments, such as the Fermi Large Area Telescope (LAT) and AGILE. Besides incrementing tremendously the number of gamma-ray detected objects and opening the window to the discovery of unexpected source classes, the new facilities allowed the detailed study of the Spectral Energy Distributions of AGNs, especially in the still less explored MeV-GeV energy range.
In this talk I will review some of the most interesting and recent Fermi LAT results on AGNs, some of which have strongly put into question theoretical assumptions and predictions on the jet physics and emission mechanisms of these objects. Moreover I will illustrate progresses on other astrophysical grounds related to AGNs that have directly benefit from such science return, among all the study of

Extragalactic Background Light, Extragalactic Gamma-ray Background and Intergalactic Magnetic Field.

III Plenary Session / **81**

Fermi Large Area Telescope highlights after five years of operations

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The Fermi Large Area Telescope (LAT) has been collecting high-energy gamma rays from 20 MeV to more than 300 GeV for 5 years, and is still performing nearly flawlessly.
With about 800 million gamma rays to date, and a uniform coverage of the whole sky, LAT data allowed for the first time high statistics observations of gamma-ray sources of known and diverse classes, like active galaxies, pulsars, supernova remnants and gamma-ray bursts, as well as discovery of new emitters, like Novae, radio-quiet millisecond pulsars and terrestrial gamma-ray flashes, that in most cases evolved into actual catalogs or population studies.
The study of diffuse gamma-ray emission not associated to sources, which constitutes roughly 90% of the LAT photon events, constrains cosmic-ray production and propagation in our own Galaxy and models of gamma-ray propagation through the Universe, and allows accurate modeling of the bright and structured foreground for searches of gamma rays originating from Dark Matter.
The LAT also detected and identified millions of cosmic-ray electrons and positrons, enabling access to Dark Matter signatures complementary to those in gamma rays.
In this talk I will review some of the most important LAT discoveries, and discuss future prospects for astro-particle physics with Fermi in the next years.

Parallel Session D / **107**

From NEMO to KM3NeT-Italy

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The KM3NeT-Italy Collaboration has entered the production stage of an 8 tower apparatus that will be deployed at about 100 km away from the Sicily coast. The architecture of the system is based on the NEMO Phase-2 prototype tower that is taking data since the deployment in March 2013. In order to optimize production costs, power consumpion, and usability some components have been re-engineered by taking advantage of the previously gained experience and technological progress. The aim of this contribution is to give an overview of the main features that characterize the new apparatus.

V Plenary Session / **86**

Fundamental physics with present and future Cherenkov telescopes

Cherenkov telescopes can open a new light on several aspects of fundamental physics, providing information complementary to accelerators. In this talk I concentrate on the implications of the characteristics of photon propagation on the existence of light particles coupling to photons, and to possible new physics beyond relativity.

Parallel Session G / 46

GERDA: Recent Results and Future Plans

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The GERmanium Detector Array (GERDA) is an experiment designed to investigate the neutrinoless double beta decay (0nubb) in 76Ge. An array of high purity germanium detectors enriched to 86% of 76Ge is operated inside 65m^3 of liquid argon (LAr) inside the Laboratori Nazionali del Gran Sasso. The experiment aims to explore the 0nubb half-life up to 1.4e26 yr with a collected exposure of 100 kg yr separated into two physics phases. The data taking of Phase I started in November 2011 and is planed to finish in June 2013 with more than 20 kg yr of exposure and a background index of 2e-2 cts / (keV kg yr) around the Q-value of 2039 keV. Phase II of the experiment is being prepared with 30 additional Broad Energy Germanium (BEGe) detectors and an additional instrumentation of the LAr, aiming at a background index reduction of a factor 10 w.r. to Phase I.
This talk will present the latest results of the GERDA collaboration including a new measurement of the 2nubb spectrum of Ge76 and the decomposition of the background. Furthermore, the preparations for the blinded 0nubb analysis of Phase I data will be presented along with the roadmap and improvements planed for Phase II.

95

GRBs by FERMI

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In its almost 5 years mission, the Large Area Telescope
(LAT) onboard the Fermi Gamma-Ray Space Telescope has detected around
40 Gamma-Ray Bursts above 100 MeV. The high energy observations of
Gamma-ray Bursts by Fermi-LAT gave rise to many recent theoretical
challenges. The talk will present an overview of the general
properties of GRBs in the high energy band and their theoretical
implications.

Poster Session / 67

GVD data acquisition system

Parallel Session E / 80

Gamma rays from Fermi bubbles as due to diffusive injection of Galactic cosmic rays

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Recent detailed analysis of the Fermi-LAT data has discovered two giant gamma-ray emission regions, the so-called Fermi bubbles, extending up to ~ 50 degree in Galactic latitude above and below the Galactic center with a width of ~ 40 degree in longitude. The origin of the gamma-ray emission is not clearly understood. Suggested explanations include injection of cosmic-ray nuclei from the Galactic center by high-speed Galactic winds, electron acceleration by multiple shocks in the Galactic halo and stochastic electron acceleration inside the bubbles. Here, it is proposed that the gamma-rays can be the result of diffusive injection of Galactic cosmic rays during their propagation through the Galaxy. If the plasma inside the bubbles is extremely turbulent, the injected cosmic rays can undergo much slower diffusion inside the bubbles than in the averaged Galaxy, and at the same time, also suffer from inelastic collisions with the bubble plasma producing pion-decay gamma rays. It will be shown that this minimal model can explain many of the observed properties of the Fermi bubbles such as the measured intensity profile, the energy spectrum and the measured luminosity without invoking any additional particle production processes or sources other than those responsible for the production of bulk of the Galactic cosmic rays.

Parallel Session B / **91**

Gamma-ray emission from the SNR W44: confirmations and challenges for cosmic-ray acceleration.

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The SNRW44 plays a crucial role in our understanding of the Cosmic Ray origin.
Recently, AGILE and Fermi-LAT data have determined, for the first time in a supernova remnant, that the gamma-ray emission from W44 can be attributed to accelerated proton/ions.
We present new W44 AGILE data and compare them with the recent Fermi data, in the light of new NANTEN2 telescope CO results. Our analysis provides strong constraints for the SNR complex environment: high density (n>200 cm^-3), high magnetic field on large scales (B~10^2 microG) and a proton spectral index steeper than in other middle-aged SNRs (p=3.2).
The W44 characteristics are challenging for all theoretical models.

Parallel Session G / **98**

Gamma-ray observations of Cygnus X-1 in the hard and soft states

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Gamma-ray observations by the AGILE satellite during the period mid-2007-2010 of the black hole binary system Cygnus X-1 will be presented. The source was observed both in the most common hard state and during a remarkably prolonged 'soft state' phase (June 2010 – May 2011). Previous 1–10 MeV observations of Cyg X-1 in this state hinted at a possible existence of a non-thermal particle component with substantial modifications of the Comptonized emission from the inner accretion disk. Our AGILE data provide a significant upper limit for the gamma-ray emission above 100 MeV, excluding the existence of prominent non-thermal emission above 100 MeV during the soft state of Cygnus X-1. We will discuss theoretical implications of our findings in the context of high-energy emission models of black hole accretion. We also discuss possible gamma-ray flares detected by AGILE. In particular, we report a weak but important candidate for enhanced emission which occurred at the end of June 2010 (2010-06-30 10:00 - 2010-07-02 10:00 UT) exactly in coincidence with a hard-to-soft state transition and before an anomalous radio flare.

VII Plenary Session and Conference Summary / **114**

Groud experiments results and prospects.

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Poster Session / **110**

Hard and long life GRB130427A by a thin persistent gamma blazing jets

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GRBs have been found within a wide range of power and photon energy spectra. Their understanding was usually seen as the largest explosion, fireball, billion times a SN one. Fireball, by definition were isotropic. Last decades have been an evolution of fire-ball hitting shells in some fountain of tens degree size. I advocated since 1998 a much thinner jet whose solid angle is a part of a billion: it is blazing at SN output while in axis appear as a GRB output. Its spread precessing, bending and blazing leads to high variability, gamma photons at high energy and long life. As in GRB130427A event.

Poster Session / **42**

Hardware and first results of Tunka-HiSCORE

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As a non-imaging wide-angle Cherenkov air shower detector array with an area of up to 100 km2, HiSCORE (Hundred Square km Cosmic ORigin

Explorer) is built to measure gamma rays and cosmic rays in an energy range of 10 TeV up to 1EeV. Three stations consisting of light collector Winston cones equipped with photomultiplier tubes have already been deployed to Tunka Valley, Russia. The first results and the most important hardware components are presented on this poster.

II Plenary Session / **76**

High Energy Cosmic Rays: Sources and Fluxes

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We discuss the energy spectrum of the cosmic rays above 100 GeV that have been derived from measurements of balloon and satelite experiments and from air shower detection. If one uses Peters cycle to describe the spectrum it is difficult to describe with two single power laws before and after the knee. A much better fit is obtained by using more complicated shape.

Parallel Session A / **40**

High and low energy puzzles in the AMS-02 positron fraction results

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AMS-02 recently measured the cosmic ray positron fraction (PF) with unprecedented accuracy in a wider energy range (0.5 - 350 GeV) than PAMELA and Fermi-LAT did. Above few hundred GeV the electron and positron spectra are expected to be significantly affected by the spatial distribution of sources. For this reason we model, for the first time, their propagation by means of a 3-dimensional numerical diffusion code (DRAGON.v3) accounting for a realistic spiral arm distribution of astrophysical sources in the Galaxy. We will show under which conditions the AMS-02 PF can consistently be reproduced together with the electron, and electron + positron, spectra measured by PAMELA and Fermi-LAT and shortly discuss possible interpretations.
Our analysis also address the GeV scale discrepancy between the PF measured by AMS-02, PAMELA, as well as previous experiments, by means of a new code simulating CR propagation in the Heliosphere and accounting for independent radio and gamma-ray data.

III Plenary Session / **6**

INTEGRAL Observatory highlights

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ABSTRACT

ESAs INTEGRAL Space Observatory has just spent his first decade in orbit, producing an unprecedented harvest of results in the soft gamma-ray range, ranging from the inventory of the high energy sources, to the discovery of hundreds of variable soft gamma-ray sources to the mapping of the Aluminum and 511 keV annihilation line in the Galaxy and the evidence of polarized gamma ray emission from the Crab Nebula, strong Gamma-ray burst and more recently Cyg X-1.

INTEGRAL observing strategy has recently supplemented the deep
observations of the Galactic Centre and Plane and the regular monitoring of the Galaxy Plane (GPS) with deep observations of
extragalactic regions demonstrating soft (15 keV to 10 MeV) and high
energy gamma FERMI and AGILE sky are barely overlapped.

The talk will review the latest INTEGRAL discoveries in the framework ofthe high energy sky and the future prospects.

VI Plenary Session / **38**

Identifying Neutrino Flavors in Radio Neutrino Telescope Experiments

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We propose a new method to identify flavors of ultra high energy cosmic neutrinos. Energy loss of leptons in matter provides important informations for the detection of neutrinos originated from high energy astrophysical sources. 50 years ago, Askaryan proposed to detect Cherenkov signals by radio wave from the negative charge excess of particle showers. The theory of Cherenkov pulses with Fraunhofer approximation was widely studied in the past two decades. However, at high energies or for high density materials, electromagnetic shower should be elongated due to the Landau-Pomeranchuck-Migdal (LPM) effect. As the standard Fraunhofer approximation ceases to be valid, we perform Monte Carlo simulations recently to investigate this regime based on the finite-difference time-domain (FDTD) method, and modified time domain integration method. Adopting the deduced relationship between the radio signal and the cascade development profile, we investigate its implication to lepton signatures. Our method provides a straightforward technique to identify the neutrino flavor through the detected Cherenkov signals.

V Plenary Session / **77**

Indirect Search for Dark Matter with Cherenkov Telescopes

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In the general WIMP scenario, dark matter (DM) can be seen in gamma-rays because photons can found in various DM annihilation or decay processes, either as broad-band or line emission or because of secondary processes of charged particles in the final stages of annihilations or decays. The energy range of the former processes is accessible by current ground-based Imaging Atmospheric Cherenkov telescopes (IACTs, like HESS, MAGIC and Veritas). The strengths of this technique are: a) the DM gamma-ray spectra show peculiar features like bumps and cutoff that make them clearly distinguishable from the smoother astrophysical spectra, b) the DM spectrum is universal and therefore by observing two or more DM targets with the same spectrum, a clear identification (besides detection) of DM would be allowed. The role of IACTs may gain more importance in the future as the results at LHC may hint to a DM at the TeV or above, where the IACTs sensitivity is unbeaten by other experiments. In this talk, a review of the search for DM with the current generation of IACTs is presented.
All the above mentioned experiments are now converging into one single large project with tens of Cherenkov telescopes located in both hemispheres, called Cherenkov Telescope Array (CTA), with great expectations for DM searches. An outlook on the performance will be also given.

Parallel Session C / 73

Indirect and direct detection prospects of RH-sneutrino dark matter in the NMSSM

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Nowadays the situation regarding the detection of Dark Matter (DM) is extremely exciting and promising. On the one hand, indirect detection experiments, such as Femi-LAT, are collecting data from the whole sky and beginning to constrain vanilla DM models, specially for light DM masses. On the other hand, direct detection experiments have reached an unprecedented sensitivity, starting to explore important regions of the parameter space in some DM models. In this talk, I will show for the right-handed sneutrino DM in the NMSSM, indirect and direct detection prospects, with special emphasis in the region of the parameter space in which the sneutrinos have a mass lower than 50 GeV.

VI Plenary Session / 4

Investigation of extensive air shower properties with the CODALEMA experiment : tackling the challenges of the next generation cosmic ray observatory.

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Our knowledge on ultra-high energy cosmic rays and their underlying sources and acceleration mechanisms is steadily improving thanks to the large observatories nowadays in operation. However the need for a next generation instrument is emerging from their experimental limitations and the scientific questions currently out of reach within a reasonable time line. Within these scope, the

main features of the radio detection of extensive air showers will be investigated and confronted to these challenging requirements. CODALEMA is the last experiment currently running in Europe dedicated to the cosmic ray detection using the observation of its induced radio electric field. The latest experimental upgrade will be presented and the main results of CODALEMA will be summarized. A special emphasis will be put on the detailed and precise access to the air shower features and the cosmic ray properties given by the radio detection technique and its unique capabilities with respect to the usual cosmic ray detection methods. The opportunities provided by the Nançay observatory for efficient R&D activities and for fast prototyping of new emerging detection methods will be also presented. Examples of such experimental developments will be given.

I Plenary Session / **29**

Latest results from the KASCADE-Grande experiment

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The KASCADE-Grande experiment operated in KIT from January 2004 to November 2012, measuring EAS generated by primary cosmic rays in the 10^16-10^18 eV energy range. The experiment detected, for each single event and with a high resolution, the total number of charged particles (Nch) and of muons (Nm).
In this talk I will present the updated results about:
- the measurement of the all particle energy spectrum, discussing the influence of the hadronic interaction model used in the event simulation.
- The energy spectra derived separating the events according to the Nmu/Nch ratio. This technique allowed us to enhance the features of the heavy primary spectrum, measuring a change of slope at E~8x10^16 eV.
- The elemental spectra (for five mass groups) obtained applying an unfolding analysis.

I Plenary Session / **43**

Latest results from the Telescope Array

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The Telescope Array ultra-high energy cosmic ray detector, situated in Utah, USA, is taking data since March 2008. We will present the latest results of the spectrum, composition and anisotropy studies based on the 4 years of the Telescope Array data.

Parallel Session B / **2**

Lorentz Invariance Violation: the latest Fermi results and the GRB/AGN complementarity

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Because they are bright and distant, Gamma-ray Bursts (GRBs) have been used for more than a decade to test propagation of photons and to constrain relevant Quantum Gravity (QG) models in which the velocity of photons in vacuum can depend on their energy. With its unprecedented sensitivity and energy coverage, the Fermi satellite has provided the most constraining results on the QG energy scale so far. In this talk, the latest results obtained from the analysis of four bright GRBs observed by the LAT will be reviewed. These robust results, cross-checked using three different analysis techniques set the limit on Quantum Gravity energy scale at EQG,1 > 7.6 times the Planck energy for the linear dispersion and EQG,2 > 1.3x10^11 GeV for the quadratic dispersion (95% CL). After describing the data and the analysis techniques in use, results will be discussed and confronted to latest constraints obtained with Active Galactic Nuclei.

5

Low energy cosmic rays and balloon-borne experiments.

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During the last decade, balloon-borne experiments dedicated to more and more detailed measurements of low energy cosmic rays have achieved important progress : new challenge in solar physics and dosimetry, search for signals of dark matter in cosmic rays and diffuse ɣ-rays at higher energy, search for antimatter or consistency of the “leaky box” model, etc. New candidates enlarging the multiplicity of cosmic ray sources have motivated an important effort on sophisticated instruments. Important data of high quality have been recorded by the balloon-borne missions such as BESS and BESS-polar, ATIC, CREAM, CAPRICE or RUNJOB, under small ranges of atmospheric thickness between 2g/cm2 up to 20 g/cm2 in the case of important zenith angles and various float altitudes. Therefore, we have started new calculations implying different options of CORSIKA. Considering the convergence of several measurements of particles energy spectra with large statistics under 100 GeV/c, we have used this energy band to testify the predictions for the models of p-air and A-air interactions implemented in CORSIKA. For projectile hadrons of energies lower than 100 GeV, the cascades of secondaries are completely reproduced by the hadronic interaction generators GEISHA, UrQMD, FLUKA. For secondary particles with energy exceeding 5 GeV, the comparison becomes more complicated by the combination with different high energy collision Monte Carlo generators (operating above 80 GeV), QGSSJet, SYBILL, DPMJet, EPOS and we have extended hybrid simulations up to 10 TeV. The fluxes obtained for positive and negative electrons and muons, photons, p, p-bar, n, n-bar are produced according to suitable inputs of primary spectra, i.e. local interstellar spectrum (LIS) modulated by the force field model when the solar modulation cannot be neglected.

II Plenary Session / 106

MAGIC latest results

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The MAGIC telescopes for gamma-ray astronomy in the very-high energy range are located on the Canary island of La Palma. They are two imaging atmospheric Cherenkov telescopes with 17m diameter composite mirror dishes and ultra-fast electronics. Reaching an energy threshold as low as 50 GeV for observations at low zenith angles, they can close the energy gap between satellite-bourne and ground-based observations. A major upgrade program to improve and to unify the stereoscopic system finished in fall 2012. This talk will provide a review of the most important results recently obtained by the MAGIC collaboration with the upgraded system.

Poster Session / **32**

Mapping UHECR deflections through the random Galactic magnetic field

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We study the influence of the random part of the Galactic magnetic field on the propagation of ultra high-energy cosmic rays. We can derive an approximated but clear and direct relation to cosmic ray deflections, bypassing the detailed knowledge of the magnetic properties of the turbulent plasma. Thanks to the observational data on rotational measures, we then build a direction-dependent map of such deflections.

Poster Session / **59**

Measurement of Hydrogen and helium isotopes flux in galactic cosmic rays with the PAMELA experiment

Valerio Formato[1]

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PAMELA is a satellite borne experiment designed to study with great accuracy cosmic rays of galactic, solar, and trapped nature, with particular focus on the antimatter component.
The detector consists of a permanent magnet spectrometer core to provide rigidity and charge sign information, a Time-of-Flight system for velocity and charge information, a Silicon-Tungsten calorimeter and a Neutron detector for lepton/hadron identification.
The velocity and rigidity information allow the identification of different isotopes for Z=1 and Z=2 particles in the energy range 100MeV/n to 1 GeV/n. In this work we will present the PAMELA results on the H and He isotope fluxes based on the data collected during the 23rd solar minimum from 2006 to 2007.
Such fluxes carry relevant information helpful in constraining parameters in galactic cosmic rays propagation models complementary to those obtained from other secondary to primary measurements such as the boron-to-carbon ratio.

Parallel Session H / 82

Measurement of the energy spectrum of cosmic rays at the highest energies using data from Pierre Auger Observatory

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We report a measurement of the cosmic ray energy spectrum based on the high statistics collected by the surface detector of the Pierre Auger Observatory. Based on the combination of fluorescence detector (FD) and surface detector (SD) and do not rely on detailed numerical simulation or any assumption about the chemical composition. The energy calibration of the observables, which exploits the correlation of surface detector data with fluorescence measurements in hybrid events, is presented in detail. Besides presenting statistical uncertainties, we address the impact of systematic uncertainties. We also summarize the combined energy spectrum obtained using the showers detected with zenith angles between 60 and 80 degrees, and the hybrid data which extends the spectrum towards lowers energies.

Parallel Session H / 83

Multi-TeV Gamma astronomy: The Tunka-HiSCORE project

. Tunka-HiSCORE collaboration[1] ; Ralf Wischnewski[2]

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The new HiSCORE detector concept is based on Cerenkov air-shower detection, using the non-imaging technique. HiSCORE is build for gamma-ray astronomy from 10 TeV to several PeV, and cosmic rays studies from 100 TeV to 1 EeV. It will search for “pevatrons” (ultra-high energy gamma-ray sources), and measure cosmic ray composition and spectrum in the transition range from a supposed Galactic to extragalactic origin of cosmic rays.

The detector is made of wide-angle optical stations (0.6 sr) placed at distances of 150-200m, and will cover an area of 1 km2 - 100 km2, to be deployed in various stages.

We report on plans and status for the Tunka-HiSCORE installation, in the Tunka valley near Lake Baikal, from first prototypes operating now to the 1km2 and 10km2 arrays envisaged for the near future.

VI Plenary Session / 96

Multi-messenger search for gravitational waves and high energy neutrinos.

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With the recent development of experimental techniques that have opened new windows of observation of the cosmic radiation in all its components, multi-messenger astronomy is entering an exciting era. Many astrophysical sources and cataclysmic cosmic events with burst activity can be plausible sources of concomitant gravitational waves (GWs) and high-energy neutrinos (HENs). Such messengers could reveal hidden and new sources that are not observed by conventional photon astronomy, in particular at high energy. Requiring consistency between GW and HEN detection channels enables new searches and a detection would yield significant additional information about the common source. We present the results of the first search for gravitational wave bursts associated with high energy neutrino triggers, detected by the underwater neutrino telescope ANTARES in its 5 lines configuration, during the fifth LIGO science run and first Virgo science run. No evidence for coincident events was found. We place a lower limit on the distance to GW sources associated with every HEN trigger. We are able to rule out the existence of coalescing binary neutron star systems and black hole-neutron star systems up to distances that are typically 5 Mpc and 10 Mpc, respectively.

Parallel Session B / 48

Multiparticle Analysis of Forbush Decrease of the 13th December 2006 Solar Event with the PAMELA Experiment

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PAMELA (Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics) is a spaceborne experiment launched on 15 June 2006 and continuously collecting data since then.
The apparatus measures electrons, positrons, protons, anti-protons and heavier nuclei from about 100 MeV to several hundreds of GeV. On-board instrumentation is built around a permanent magnet with a silicon microstrip tracker, providing charge and track deflection information.
The PAMELA detectors allow a deep insight into the Forbush Decrease dynamics not possible with ground based experiments limited by atmosphere and geomagnetic field.
The analysis focused on charge and mass dependence of the effect on main components of the cosmic rays.
The detector allowed for the first time the observation of the effect on positrons.
The recovery time rigidity dependence has been measured with unprecedented precision.
Furthermore proton and helium differential flux spectral index hardening has been measured.

Parallel Session F / 16

Muon puzzle in cosmic ray experiments and its possible solution

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The term “muon puzzle” was finally formulated at International Symposium on Future Directions in UHECR Physics in CERN 13-16 February 2012. In this talk various aspects of muon puzzle and brief history of their appearance are considered. It is possible to separate two types of experimental results: an excess of muon bundles which is increasing with energy of primary particles, and excess

of very high energy muons in muon energy spectrum. One of the possible (and realistic) solutions is the hypothesis about generation of blobs of quark-gluon matter with large orbital momentum in nucleus-nucleus interactions at energies above the knee. Propositions how to check this hypothesis are discussed.

Poster Session / 17

Muons and neutrinos colimation in extensive air shower cores

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Detailed simulations of EAS have been carried out with CORSIKA program in order to evaluate the energy brought by different shower components at ground level and transmitted underground. A special attention is given to the angular distributions and to the collimation of beams penetrating deep underground or underwater. The natural collimation of high energy particles in EAS cores results mainly from the ratio between the transverse and the longitudinal momenta of secondary particles generated in the earliest interactions. This collimation is partly conserved by high energy muons and neutrinos. It is comparable to magnetic focusing of charged pions and kaons decaying in tunnels of suitable length after production in accelerators. Such is the case for neutrino beams of KEK J-PARC/T2K (300 km to Kamiokande), OPERA (730 km to Gran Sasso) and MINOS (735km to Irvine Mine).
Near three decades ago, De Rujula, Glashow, Wilson and Charpak advocated in CERN the employment of a new generation of proton synchrotron to explore the Earth with neutrino beams and we shall examine if the core of giant air showers can give any preliminary information for such purpose. We also consider another aspect of high energy physics, the asymmetry observed recently in p-A and A-A collisions at $\sqrt{s}$=7 TeV which could be reflected in families of very high energy muons in very inclined EAS.

IV Plenary Session / 56

Neutrino Astrophysics with IceCube

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IceCube is a neutrino observatory in operation at the geographical South Pole. The main objective of IceCube is to conduct high-energy neutrino astronomy, including the search for the sources of cosmic rays. Neutrinos are detected by observing blue Cherenkov light from charged particles product of neutrino-matter interaction at or near the
detector. An array of 86 strings, each consisting of 60 digital optical modules (DOMs), monitors 1 gigaton of highly transparent ice at depths between 1450 m and 2450 m. IceCube has a nominal neutrino threshold of 1 TeV. A small group of strings have been installed with denser vertical and horizontal DOM density in the center and bottom part of the detector. This subarray, known as

DeepCore, has a lower nominal threshold of 10 GeV. In this talk I will present an overview of the latest results from IceCube.

Parallel Session E / 92

OBSERVATION OF TEV GAMMA-RAY EXTENDED SOURCES WITH ARGO-YBJ

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A large fraction of unidentified TeV gamma-ray sources observed in the Galaxy are spatially extended, raising the question of why there are so few point-like VHE sources. The study of these objects is important because the extended emission could be the result of cosmic ray interactions with the ambient medium which provides the target to produce TeV gamma-rays.
Since the instrument sensitivity decreases for extended sources, the shower detectors, with their limited angular resolution, are less affected with respect to Cerenkov telescopes.
The ARGO-YBJ experiment (Yangbajing Cosmic Ray Laboratory, Tibet, China, 4300 m asl) is an air shower detector able to observe VHE gamma rays with an integrated sensitivity of 0.29 Crab units at energies above a few hundred GeV. In this paper the observation of galactic extended sources with ARGO-YBJ during 5 years is reviewed.

VI Plenary Session / 105

Perspectives for UHE acoustic neutrino detection

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In recent years the astro-particle community is involved in the realization of experimental apparatuses for the detection of high energy neutrinos originated in cosmic sources or produced in the interaction of Cosmic Rays with the Cosmic Microwave Background. For neutrino energies in the TeV-PeV range, the underwater optical Cherenkov technique is considered optimal. For higher energies, three experimental techniques are under study: the detection of radio pulses produced by showers following a neutrino interaction, the detection of air showers initiated by neutrinos interacting with rocks or deep Earth's atmosphere and the detection of acoustic waves produced by deposition of energy in the interaction of neutrinos in acoustically transparent mediums. Different groups are conducting studies to characterize acoustic properties of different mediums and developing the technologies required for future large-scale acoustic arrays. Test experiments were carried out using military arrays of hydrophones or available scientific infrastructures and first searches for neutrino signals were performed. Though the studies on this technique are still in an early stage, its potential use to build very large neutrino detectors is appealing, thanks to the optimal properties of mediums such as water, ice or salt as sound propagator. The status of simulation work, medium studies, sensor developments and first results from test experimental setups will be discussed.

Parallel Session A / 39

Perspectives of dark matter searches with antideuterons

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The search for an excess of antideuterons in the cosmic rays flux has been proposed as a very promising channel for dark matter indirect detection, especially for WIMPs with a low or intermediate mass. With the development of the AMS experiment and the proposal of a future dedicated experiment, i.e. the General Antiparticle Spectrometer (GAPS), there are exciting possibilities for a dark matter detection in the near future.
In this talk, I'll give an overview on the principal issues related both to the antideuterons production in dark matter annihilation
reactions and to their propagation through the interstellar medium and the heliosphere, with a particular focus on the impact of various solar modulation models on the flux at Earth. Lastly, I'll provide an updated calculation of the reaching capabilities for current and future experiments compatible with the constraints on the dark matter annihilation cross section imposed by the antiproton measurements of PAMELA and BESS POLAR II.

87

Perspesctives for UHE acoustic neutrino detection

Parallel Session C / 60

Preliminary results of ANAIS-25

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The ANAIS (Annual Modulation with NaI(Tl) Scintillators) experiment aims at the confirmation of the DAMA/LIBRA signal using the same target and technique at the Canfranc Underground Laboratory. 250 kg of ultrapure NaI(Tl) crystals will be used as a target, divided into 20 modules, each coupled to two photomultipliers. Two NaI(Tl) crystals of 12.5 kg each, grown by Alpha Spectra from a powder having a potassium level under the limit of the analytical techniques, form the ANAIS-25 set-up. Preliminary results of the ANAIS-25 set-up will be presented. The background measured by these two modules has been carefully studied: their natural potassium content in the bulk has been quantified, as well as the uranium and thorium radioactive chains presence in the bulk through the discrimination of the corresponding alpha events by PSA, and due to the fast commissioning, the contribution from cosmogenic activated isotopes is clearly identified and their decay observed along the first months of data taking. Background results are supported by the background model carried out with a Geant4 simulation. Following the procedures established with ANAIS-0 and previous prototypes, bulk NaI(Tl) scintillation events selection and light collection efficiency have been studied.

Parallel Session H / 51

Proof of feasibility of the Vacuum Silicon PhotoMultiplier Tube (VSiPMT)

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VSiPMT (Vacuum Silicon PhotoMultiplier Tube) is an innovative hybrid photon detector combining the performances and the potential of SiPM technology with a hemispherical glass PMT standard envelope. Our purpose is to combine the key features of a SiPM (high quantum efficiency, low operation voltages, insensitivity to magnetic fields and robustness) with the large sensitive area of a photocathode. In such a device, the SiPM replaces the standard dynode chain of a PMT, thus acting as an electron multiplier. In order to get a proof of the feasibility of the VSiPMT, we tested the performances of a special non-windowed Hamamatsu MPPC with an electron source. In this work we provide a detailed description of the experimental setup and of our measurements.

III Plenary Session / 111

Propagation of Cosmic Rays in the Heliosphere and in the Milky Way

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This talk will discuss two questions about the propagation of cosmic rays: the charge dependent modulation in the heliosphere and the confinement of particles in the Milky Way.
In both cases the global structure of the magnetic field plays a crucial role.

Parallel Session F / 61

Propagation of UHECRs in the Universe

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The origin, propagation, and mechanisms of acceleration of the ultra-high energy cosmic rays (UHECRs) are not yet well understood. Aiming for a better interpretation of the available experimental data, it is important to develop computational tools to propagate these cosmic rays from their source to Earth, and confront theoretical models with the current data. A realistic simulation of the propagation of UHECRs in the universe should take into account all the relevant energy loss processes due to the interaction with astrophysical backgrounds, as well as the intervening cosmic magnetic fields. Cosmological effects, such as the redshift dependence of the photon backgrounds, and the adiabatic expansion of the universe, can play an important role in the forementioned processes. Here we present for the first time the results of simulations of the propagation of UHECR through the large scale structure of the universe considering cosmological and magnetic field effects simultaneously.

Poster Session / 57

Prospects for the detection of Gamma Ray Bursts with HAWC

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Gamma Ray Bursts (GRBs) are among the most powerful events in the Universe. They have been observed from radio to GeV energies. In the past few years Fermi LAT has shown that GRBs are able to produce photons up to 30 GeV (approx. 90 GeV corrected for redshift for GRB 090902B). It is unknown up to what energy the spectrum extends. Studying the spectrum beyond 10 GeV, is of interest in understanding GRBs themselves, it allows us to probe the extragalactic background light (EBL) and it may be used to constrain Lorentz invariance violation. In this presentation I will show that the GRB detection rate by the extended air shower array detector HAWC, may be as high as 2 GRBs per year, assuming that the spectrum is only cutoff by EBL attenuation.

IV Plenary Session / 78

Prototyping Phase of the BAIKAL-GVD Project

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The construction of a km3-scale neutrino telescope – the Gigaton Volume Detector (GVD) in Lake Baikal – is the central goal of the Baikal collaboration. During the R&D phase of the GVD project in 2008–2010 years the basic elements of GVD – new optical modules, FADC readout units, underwater communications and trigger systems – have been developed, produced and tested in situ by long-term operating prototype strings in Lake Baikal. The Prototyping Phase of the GVD project has been started in April 2011 with the deployment of a three string engineering array which comprises all basic elements and systems of the GVD-telescope in Lake Baikal. This array has been continuously upgraded in 2012 and 2013. We review the results obtained during the Prototyping Phase of the BAIKAL-GVD project realization.

Parallel Session C / 34

Radio constraints on Galactic WIMP dark matter

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Synchrotron emission from electron cosmic ray populations can be used to study both cosmic rays physics and WIMP dark matter imprints on radio skymaps. We used available radio data - from MHz to GHz - to analyze the contribution from galactic WIMP annihilations and impose constraints on WIMP observables: annihilation cross section, channel and mass. Depending on the annihilation channel we obtain as competitive bounds as those obtained in FERMI-LAT gamma ray analyses.

Parallel Session F / 30

Radio detection of air shower with AERA on behalf the Pierre Auger Collaboration

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Deployed at the end of 2010 at the Pierre Auger observatory, the first stage of the Auger Engineering Radio Array, AERA24, consists of 24 radio stations covering an area of 0.5 km². AERA measures the radio emission from cosmic-ray induced air showers. This electric field is used to constrain the characteristics of the primary particle: arrival direction, energy and nature.These studies are possible thanks to an instrumentation development allowing self-triggered measurements in the MHz domain and an improved understanding of radio emission processes.
In 2013, 136 new stations will be installed to cover an area of 20 km², for a total of 160 stations. AERA160 will provide a higher statistics and will enhance both the estimation of the nature of the primary cosmic ray and the energy resolution using additional detectors such as the Auger fluorescence telescopes and particle detectors, above 10^17 eV.
After a brief description of the radio detection experiments deployed at the Pierre Auger observatory, we will present the main results obtained with AERA24 and discuss the next stage deployment status.

Parallel Session F / 7

Radioactive Heavy nuclei UHECR as the source of TeVs anisotropy?

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UHECR may keep memory of their source because their rigidity do not suffer much of magnetic bending. Therefore we are waiting for the birth of an UHECR astronomy. We do observe by AUGER a little UHECR clustering. On the other side at TeVs-PeVs energy scale cosmic rays at medium scale show anisotropy in the sky, without any plausible source or reasonable explanation. We suggest that UHECR radioactivity may be , as observed at non relativistic stage, a main source of Luminosity around Supernovae, while if beamed to us it may shine as an ultrarelativistic gamma- and or alfa source correlated to the UHECR sources.

VI Plenary Session / 108

Recent results from cosmic-ray measurements with LOFAR

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LOFAR (the LOw Frequency ARray) is a new kind of radio telescope built in the Netherlands and its neighboring countries for astronomical observations in the low frequency range of ~ 10-240 MHz. Unlike traditional radio telescopes which consist of steerable big parabolic dishes, LOFAR uses simple dipole antennas which remain static on the ground. Using digital signal processing, LOFAR can point towards different directions in the sky at the same time. This unique property makes LOFAR suitable for the measurement of cosmic rays whose arrival directions are random in nature.
LOFAR can measure cosmic rays with energies above ~ 10^16 eV. High-energy cosmic rays impinging onto the Earth's atmosphere produce cascades of secondary particles referred to as extensive air showers. A large fraction of the particles in the cascade are electrons and positrons. In the presence of the Earth's magnetic field, these particles produce coherent radio emission which peaks in the frequency range sensitive to LOFAR. In order to assist the LOFAR cosmic-ray measurements, a small air shower array LORA (the LOfar Radboud air shower Array) has been built in the LOFAR core. Its main objective is to trigger LOFAR with cosmic-ray events and to provide basic air shower parameters such as the position of the shower axis, the arrival direction and the energy. In addition, LOFAR is also expected to measure the highest-energy cosmic rays and neutrinos with energies above ~ 10^20 eV. This will be carried out by detecting coherent radio Cherenkov emission from particle cascades on the Moon induced by these particles. Recent results and the ongoing efforts on the LOFAR cosmic-ray measurements are presented.

IV Plenary Session / 50

Recent results from the ANTARES neutrino telescope

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The ANTARES neutrino telescope is currently the largest operating water Cherenkov detector and the largest neutrino detector in the Northern Hemisphere. It comprises 885 optical modules distributed on 12 detection lines anchored at a depth of about 2,5 km in the Mediterranean Sea near Toulon (France). Its main scientific target is the detection of high-energy (TeV and beyond) neutrinos from cosmic accelerators, as predicted by hadronic interaction models, and the measurement of the diffuse neutrino flux. Its location allows for surveying a large part of the Galactic Plane, including the Galactic Centre.

In addition to the standalone searches for point-like and diffuse high-energy excesses, ANTARES has developed a range of multi-messenger strategies to exploit the close connection between neutrinos and other cosmic messengers such as gamma-rays, charged cosmic rays and gravitational waves. This contribution will provide an overview of the recently conducted analyses, including e.g. a search for neutrinos from the Fermi bubbles region, searches for optical counterparts with the TAToO program, and searches for neutrinos in correlation with blazars, microquasars and gravitational lenses. Further topics of investigation, covering e.g. the search for neutrinos from dark matter annihilation, searches for exotic particles and the measurement of neutrino oscillations, will also be reviewed.

Parallel Session G / 11

Recent results from the Borexino experiment and future perspectives

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The Borexino experiment has recently completed the Phase I and has already started the Phase II, with even lower radioactive background.
The talk will summarize the result of the Phase I on solar and geophysical neutrinos. Besides, it will cover the contents of the letter of intent of Phase II, recently published on ArXiV. The Phase II aims at the completion of the study of the low energy solar neutrino spectrum (pp, pep and possibly CNO neutrinos) and at the search of new physics by means of solar neutrinos and, particularly, by means of artificial neutrino and anti-neutrino sources.

Parallel Session C / 90

Results and prospects of dark matter searches with ANTARES

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Dark matter is one of the most important scientific goals for neutrino telescopes. These instruments have particular advantages with respect to other experimental approaches. Compared to direct searches, the sensitivity of neutrino telescopes to probe the spin-dependent cross section of WIMP-proton is unsurpassed. On the other hand, neutrino telescopes can look for dark matter in the Sun, so a potential signal would be a strong indication of dark matter, contrary to the case of other indirect searches like gammas or cosmic rays, where more conventional astrophysical interpretations are very hard to rule out. Moreover, ANTARES, although smaller, has a better visibility of the Galactic Center than IceCube.

Parallel Session E / 54

SCIENTIFIC VERIFICATION OF THE HIGH ALTITUDE WATER CHERENKOV OBSERVATORY

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The High Altitude Water Cherenkov (HAWC) observatory is a TeV gamma-ray and cosmic-ray detector currently under construction at an altitude of 4100 m close to volcano Sierra Negra in the state of Puebla, Mexico. The HAWC observatory is an extensive air-shower array comprised of 300 optically-isolated water Cherenkov detectors (WCDs). Each WCD contains ~200,000 liters of filtered water and four upward-facing photomultiplier tubes. In Fall 2014, when the HAWC observatory will reach an area of 22,000 m^2, the sensitivity will be 15 times higher than its predecessor Milagro. Since September 2012, more than 30 WCDs have been instrumented and taking data. This first commissioning phase has been crucial for the verification of the data acquisition and event reconstruction algorithms. Moreover, with the increasing number of instrumented WCDs, it is important to improve the scientific verification. In this work we present a comparison between Monte

Carlo simulation and data for different detector configurations and results of muon discrimination algorithms.

Parallel Session D / 35

Search for neutrino emission of gamma-ray flaring blazars with the ANTARES telescope

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The ANTARES telescope, with a duty cycle close to unity and a full hemisphere of the sky at all the times visible, is well suited to detect neutrinos produced in astrophysical transient sources. Assuming a known neutrino production period, the background and point-source sensitivity can be drastically improved by selecting a narrow time window around it. Blazars are radio-loud active galactic nuclei with their jets pointing almost directly towards the observer. They are particularly attractive potential neutrino point sources, since neutrinos and gamma-rays may be produced in hadronic interactions with the surrounding medium as they are the most likely sources of the observed ultra high energy cosmic rays. A strong correlation between the gamma-ray and the neutrino fluxes is expected in this scenario.

ANTARES data collected between 2008 and 2011 is analyzed by an unbinned method based on the minimization of a likelihood ratio. The sensitivity of a standard time-integrated point source search in such period has been improved by a factor 2-3 by looking for neutrinos detected during the high state periods of the the gamma-ray light curves of the AGN candidates. The typical width for a flare ranges from 1 to 20 days depending on the source. The results of this analysis will be presented.

Parallel Session H / 36

SiPM application for a detector for UHE neutrinos tested at Sphinx Station

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We present the preliminary test results of the prototype detector, working at Sphinx Observatory Center, Jungfraujoch (∼3800 m a.s.l.) HFSJG - Switzerland. This prototype detector is designed to measure a large angle cosmic rays flux emerging from the Earth crust. This station provides us an opportunity to understand if the prototype detector works safely under harsh environmental

conditions (the air temperature changes between -25 ^{o}C and -5 ^{o}C). This detector prototype is using silicon photomultiplier (SiPM) produced by SensL and DRS4 board as read-out part. Measurements at different temperature at fixed bias voltage ($\sim$ 29.5 V) were performed to reconstruct tracks by time of flight. Several array Tests deployed for 18 months at KIT to study the shower reconstruction and background are also presented.

VII Plenary Session and Conference Summary / **113**

Space experiments results and prospects.

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V Plenary Session / **75**

Status of LHAASO and Updates on the ARGO-YBJ Observations

In this presentation, the status of the LHAASO is updated mainly about the site preparation and proposing of the project, together with some results using the prototype detectors. As the phase-0, the LAWCA project is going to be covered by the report, including its proposing status. Some progress on ARGO-YBJ analysis is updated as well.

Parallel Session D / **79**

Study of TeV-PeV cosmic-ray anisotropy with the IceCube, IceTop and AMANDA detectors

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The study of the cosmic ray anisotropy in the TeV-PeV energy range could provide clues about the origin and propagation of cosmic rays in our galaxy. The measurement of this per-mille-anisotropy requires data sets with several billion cosmic-ray events. A sample of this size has been collected over the last six years by the IceCube neutrino telescope at the south pole, which detects cosmic-ray muons at a rate of about 2 kHz. In the IceCube data, we observe a significant anisotropy in the southern sky for primary energies between 20 and 400 TeV.

The anisotropy has a large-scale component of per-mille strength, accompanied by localized excess and deficit regions with smaller amplitudes and typical angular sizes between 10 degrees and 20 degrees. A study of the time variability of the anisotropy is performed by combining data from IceCube and its predecessor experiment, AMANDA, which operated between 2000 and 2007. Finally, A change in the shape and an increase in the amplitude of this anisotropy is observed at PeV energies by including events of IceTop, the air shower array above IceCube.

V Plenary Session / **68**

TeV Astrophysics with the HAWC Gamma-Ray Observatory

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The High Altitude Water Cherenkov (HAWC) Observatory is a wide-field gamma-ray detector sensitive to gamma rays with energies between 100 GeV and 100 TeV. Located on the volcán Sierra Negra in Puebla, Mexico at an elevation of 4100 meters above sea level, HAWC will observe ~6 sr of the sky each day. The large field-of-view and continuous operation make HAWC an ideal instrument to search the high-energy sky for transient phenomena such as gamma-ray bursts and flaring from active galaxies. In addition, the long integration times available for all sources in our field-of-view (~1200 hours/year/source), give HAWC excellent sensitivity to the highest energy photons, where one is often limited by photon statistics. With more than an order-of-magnitude greater sensitivity than the Milagro experiment HAWC will be capable of surveying ~5 sr of the sky with a sensitivity of better than 25 mCrab after five years of operation. In this talk I will discuss the design and physics potential of HAWC and give an update on recent results obtained with a small section of the complete detector known as HAWC-30.

Parallel Session E / **52**

TeV gamma-ray variability and duty cycle of Mrk 421 as determined by 3 Years of Milagro monitoring

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The blazar Mrk 421 is one of the brightest extragalactic TeV gamma-ray sources. Like the other TeV blazars, it presents flaring episodes in both X-rays and TeV gamma-rays. A correlation has been observed between the emissions in these two energy bands, although not all X-ray flares have been associated with a simultaneous increase in the TeV flux.
Milagro was a TeV gamma-ray detector located near Los Alamos, New Mexico. It used the water Cherenkov technique to detect extensive air-showers produced by very high energy (VHE, > 100 GeV) gamma rays as they interact with the Earth's atmosphere.
Here we report on the long term TeV gamma-ray monitoring of Mrk 421 with Milagro. The source was detected with a statistical significance of 7.1 standard deviations over the period from September 2005 to March 2008. We present the study of the variability of Mrk 421 and provide upper limits on the flux; furthermore, we estimate the gamma-ray duty cycle of the source and compare it with the X-ray duty cycle.

Parallel Session B / **45**

The AGILE gamma-ray sky and the AGILE data center at ASDC

Carlotta Pittori[1]

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AGILE is a Scientific Mission of the Italian Space Agency (ASI) with INFN, INAF e CIFS participation devoted to gamma-ray astrophysics.
The satellite is in orbit since April 23rd, 2007. Thanks to its sky monitoring capability and fast ground segment alert system, AGILE is producing several important scientific results, among which the unexpected discovery of strong and rapid gamma-ray flares from the Crab Nebula over daily timescales. This discovery won to the AGILE PI and the AGILE Team the Bruno Rossi Prize for 2012.
The AGILE Data Center, part of the ASI Science Data Center (ASDC), is in charge of all the scientific oriented activities related to the analysis, archiving and distribution of AGILE data.
I will give an overview of the AGILE scientific highlights after 6 years of operations, and I will present the AGILE data center main activities, with particular focus on ASDC Community and User Support.

Parallel Session F / 13

The CR anisotropy below the knee: experiments and models of the last decade

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In the last decade important results were obtained about CR anisotropy at energy below the knee, i.e. for galactic CRs. Experiments like Tibet ASg, Milagro, ARGO-YBJ and Icecube reached unprecedented accuracy in measuring the arrival direction distribution of CRs and collected more than 10^12 showers both in the northern and the southern hemisphere. There have been important findings, like the discovery of structures as narrow as ~10° with spectra significantly different from each other, or the absence of the Compton-Getting effect due to the motion of the Solar System in the Galaxy. The impact of the experimental outcome has been such that important steps in understanding the origin of the anisotropy were taken, mostly as far as the local interstellar medium is concerned. An attempt to overview the most relevant results and the ideas they prompted in recent years is made.

Parallel Session E / 99

The Crab Nabula: observations and simulations

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The Crab Nebula, one of the most studied objects in high energy astrophysics, was discovered to produce strong and short gamma-ray flares by the AGILE satellite. More recently a slower and less intense component of enhanced emission was deteceted in gamma rays. This transient gamma-ray emission leads to substantially revise current models of particle acceleration in Pulsar Wind Nebulae. The South-East jet of the Crab Nebula is thought to be one of the region where the particle acceleration might take place. I will discuss the implications of the gamma-ray enhanced emission and our results on the 3D relativistic MHD simulations of the South-East jet.

Parallel Session B / 109

The Fermi view on GRBs

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In its almost 5 years mission, the Large Area Telescope (LAT) onboard the Fermi Gamma-Ray Space Telescope has detected around 40 Gamma-Ray Bursts above 100 MeV. The high energy observations of Gamma-ray Bursts by Fermi-LAT gave rise to many recent theoretical challenges. The talk will present an overview of the general properties of GRBs in the high energy band and their theoretical implications.

IV Plenary Session / 100

The KM3NeT Neutrino Telescope: Status and Prospects

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The KM3NeT Collaboration aims to build, deploy and operate in the Mediterranean Sea a neutrino telescope with a volume of several cube kilometres. Using the experienced gained by the precursor projects, this telescope will complement IceCube, ensuring full coverage of the sky. Due to its location, it will have a privileged access to the Galactic centre and to a large fraction of the Galactic plane. With such a large detection volume, there are good prospects for the discovery of several neutrino sources, for instance, neutrinos from the supernova remnant RX J1713-3946 should be detectable with 5 within five years if the gamma emission from this object is of purely hadronic origin. After the design and preparatory phases funded by the EU, the project is entering into its first construction phase. In this contribution, we will describe the technical and scientific aspects of KM3NeT and report on a few milestones recently achieved.

III Plenary Session / 19

The Pamela cosmic ray observatory: a platform for high precision measurements at 1 AU

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In this presentation we will review and discuss the main scientific results of the PAMELA mission. Since 2006, the space spectrometer PAMELA has been providing high-precision data for cosmic rays of galactic, solar, trapped and terrestrial origin in the energy range 100MeV 1.2 TeV, often challenging the current understanding of production and propagation of particles in the galaxy and in the solar system. We will also provide an update on the mission and its perspectives.

I Plenary Session / 49

The Pierre Auger Observatory: results and open issues

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We will present the status and the main results of the Pierre Auger Observatory. These include the measurement of the energy spectrum above 10^18 eV, where we observe a suppression for energies larger than 5.5X10^19eV, the analyses of the arrival directions and the chemical composition. The implications on the origin and on the acceleration mechanisms of the most energetic Cosmic Rays will be
discussed with a particular emphasis to the still open issues.

II Plenary Session / 21

Theoretical aspects of Dark Matter search

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Direct and indirect dark matter searches will be reviewed. Several interesting theoretical models of annihilating and decaying dark matter will be discussed. For annihilating dark matter, the possibility of obtaining stringent model-independent constraints from Fermi-LAT inner Galaxy measurements, will also be analyzed.

IV Plenary Session / 63

Theoretical implications of LHC results

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We present a concise overview of the status of particle physics after the important recent experimental developments.

Poster Session / 70

Total Cross Section growth at Cosmic Ray Energies

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Total cross section measurements at cosmic ray energies can reveal information about the shape of hadronic matter. Recent measurements at cosmic ray energies and at TOTEM/LHC confirm the growth of the total cross section. Based on theoretical investigations it is found that Geometrical picture helps us in having a glimpse of hadronic radii indicating the growth of hadrons at ultrahigh energies.

Parallel Session G / 97

Transient gamma-ray emission from Cygnus X-3: AGILE observations and spectral constraints

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The AGILE satellite detected several episodes of transient gamma-ray emission from Cygnus X-3. Cross-correlating the AGILE light curve with both X-ray and radio monitoring data, we found that the main events of gamma-ray activity were detected while the system was in soft spectral X-ray states, that coincide with local and often sharp minima of the hard X-ray flux, a few days before intense radio outbursts. This repetitive temporal coincidence between the gamma-ray transient emission and spectral state changes of the source turns out to be the spectral signature of high-energy activity from this microquasar.
Finally, both leptonic and hadronic emission models for the gamma-ray activity have been tested. In particular, in the leptonic model - based on inverse Compton scatterings of mildly relativistic electrons on soft photons from both the Wolf-Rayet companion star and the accretion disk - the emitting particles may also contribute to the overall hard X-ray spectrum, possibly explaining the hard non-thermal power-law tail seen during special soft X-ray states in Cygnus X-3.

V Plenary Session / 8

Tunka-133: Results of 3 Year Operation.

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The improved methods of EAS parameters reconstruction in Tunka-133 suitable both for the internal and external shower core position are described. The methods are used for the analysis of data collected during three winter seasons from 2009 till 2012. The primary CR energy spectrum in the range 10^15 – 10^18 eV is presented. The variation of X_max distribution parameters with energy and corresponding variation of the primary mass composition are discussed.

V Plenary Session / 44

Tunka-Rex: Status and Results of the First Measurements

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Tunka-Rex is the new radio extension to Tunka-133 located in Siberia close to lake Baikal. The latter is a photomultiplier array registering air-Cherenkov light from air showers induced by cosmic-ray particles with initial energies of $10^16 - 10^18$ eV. Tunka-Rex extends this detector with 20 antennas spread over an area of 1 km2 . It is triggered externally by Tunka-133, and detects the radio emission of the same air showers. The combination of an air-Cherenkov and a radio detector provides a great facility for hybrid measurements and cross-calibration between the two techniques. The main goal of Tunka-Rex is to determine the precision of the reconstruction of air-shower parameters using the radio detection technique. It started operation in autumn 2012. We present the overall concept of Tunka-Rex , the current status of the array and first analysis results.

III Plenary Session / 10

UHECR observation by JEM-EUSO space mission: status and perspectives

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The JEM-EUSO experiment, Extreme Universe Space Observatory at the Japanese Module of the International Space Station, is the first space mission devoted to the scientific research of cosmic rays of highest energies. JEM-EUSO will address basic problems of fundamental physics and high-energy astrophysics studying the nature and origin of the Ultra High Energy Cosmic Rays (E > 3×10^19 eV). The JEM-EUSO instrument basically consists of an UHECR telescope assisted by an atmosphere monitoring device and controlled by a calibration system. Its super-wide-field telescope looks down from the International Space Station onto the night sky to detect UV photons emitted from air showers generated by UHECRs in the atmosphere. The optic system, the focal surface electronics and the infrared camera are in advanced stage of development and they will be tested and calibrated on ground (EUSO-TA) in the next months at (and with) the Telescope Array experiment in Utah, and next year on board of a stratospheric Balloon (EUSO-Balloon) in collaboration with the French Space Agency CNES.
13 Countries, 77 Institutes and about 280 researchers are collaborating in JEM-EUSO, with the support of the most important International and National Space Agencies and research funding institutions.

Parallel Session E / 53

VERITAS Recent Results

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VERITAS is an array of four imaging atmospheric Cherenkov telescopes near Tucson, Arizona and is one of the world's most sensitive detectors of very high energy (VHE: >100 GeV) gamma rays and cosmic rays. The scientific reach of VERITAS covers the study of both Extragalactic and Galactic objects and the search for astrophysical Dark Matter. In this talk I will discuss the status of VERITAS operations and detector upgrades and present a selection of recent results.

I Plenary Session / **9**

Welcome by local authorities.

Prof. Egidio Longo, Director of the Physics Department