T 54: Cosmic Rays III

Time: Wednesday 16:00–18:30 Location: Td

T 54.1 Wed 16:00 Td

Follow-Up Search for UHE Photons after Gravitational Wave Events with the Pierre Auger Observatory — •Philip Ruehl, Marcus Niechciol, and Markus Risse — Center for Particle Physics Siegen, Experimentelle Teilchenphysik, Universität Siegen

With the first detection of a gravitational wave (GW) event by the Advanced LIGO detectors in September 2015 a new window to multimessenger astronomy has been opened. The origin of this event has later been identified as the merger of a binary black hole system. Since then, multiple gravitational wave events have been observed from different sources. Possibly, these transient objects could be sources of ultra-high-energy (UHE) cosmic rays. This can be tested by multimessenger observations. Unlike charged particles, neutral messengers like neutrinos and photons carry information about the direction and the time of their production site making them ideal tools for multimessenger astronomy. While in classical scenarios photons can interact with the cosmic microwave background such that a measurable UHE photon fraction would only be expected from nearby sources, a UHE photon detection from a distant source could point towards new physics.
To extend the search window of the Pierre Auger Observatory, in addition to the established follow-up neutrino search now also a follow-up photon search is being developed. In this contribution, the first approach towards a search for UHE photons from GW sources using the surface detector of the Pierre Auger Observatory will be presented.
Gefördert durch BMBF-Verbundforschung.

T 54.2 Wed 16:15 Td

Follow-up of the ANITA observation of up-going high energy showers with the Fluorescence Detector of the Pierre Auger Observatory* — •Ioana Alexandra Caracas for the Pierre Auger-Collaboration — Bergische University Wuppertal, Gaußstraße 20, Wuppertal, Germany

The ANITA observations of two upgoing cosmic ray like showers with energies of $\simeq$ 0.6 EeV remain unexplained. Because the Pierre Auger Observatory also has sensitivity to these phenomena, a follow up search of these events is performed. With 14 years of Fluorescence Detector(FD) data available, the post-selection exposure of the FD to upgoing showers exceeds that of ANITA by at least a factor of 10 as indicated by Monte Carlo studies. Therefore a search with the FD should be able to either confirm or significantly constrain ANITA's observations.

Simulations of up-going extensive air showers with elevation angles of more than 20 degrees above the horizon with primary energies between $10^{16.5}$ - $10^{18.5}$ eV have been performed using CONEX. The detector response to these events is further simulated using the Auger software framework. Additionally, a large isotropic sample of downgoing and horizontal cosmic ray showers was simulated as background. Preliminary results of the detector response and sensitivity to both cosmic ray and tau leptons induced air showers scenario will be presented and discussed.

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T 54.3 Wed 16:30 Td

The 320 EeV Fly*s Eye event: a key messenger or a statistical oddity? — •Thomas Fitoussi[1,2], Gustavo Medina-Tanco[2], and Juan-Carlos D'Olivo[2] — [1]Karlsruhe Institute of Technology, Institut für Kernphysik, Karlsruhe, Germany — [2]Instituto de Ciencas Nucleares, Universidad Nacional Autónoma de México, México, D.F., México

Almost three decades ago, the Fly's Eye experiment recorded the most energetic cosmic-ray ever observed. With an energy of 320 EeV, this event is well beyond the suppression region of the ultra-high energy cosmic rays (UHECR) spectrum. Modern and larger observatories, with an exposure up to 60 times larger, have never observed an event with even remotely comparable energy. Thus, if the energy of the Fly's Eye event was indeed well measured, as strongly suggested by the data, then it remains a great mystery. At such high energies, the Universe is very opaque to electromagnetic interacting particles and therefore its source must be relatively close. Using numerical simulations for the propagation of protons and nuclei, we reexamine the problem by testing different possibilities for the nature of the primary, the injection spectrum and the location of the source. Based on these calculations, we show that the most feasible scenario corresponds to a nearby ($\sim 2-3$ Mpc) bursting source of heavy nuclei in the northern sky, which injected a hard spectrum ($\gamma \leq 1.5$) with an energy cut-off between 300 and 1000 EeV. Such scheme generates a significant probability for the observation of one event by Fly's Eye combined with a null result of Telescope Array at the same energy.

T 54.4 Wed 16:45 Td

Muon deficit in air shower simulations estimated from AGASA muon measurements — •Flavia Gesualdi[1,2], Alberto Daniel Supanitsky[1], and Alberto Etchegoyen[1] — [1]Instituto de Tecnologías en Detección y Astropartículas (CNEA, CONICET, UNSAM), Centro Atómico Constituyentes, B1650KNA San Martín, Buenos Aires, Argentina — [2]Karlsruhe Institute of Technology, Institute for Astroparticle Physics (IAP), 76021 Karlsruhe, Germany

Understanding the origin of ultra-high energy cosmic rays is still a challenge. The composition profile as a function of primary energy is a key information to elucidate the origin of these very energetic particles. The most sensitive observables to the mass composition are the atmospheric depth of the shower maximum and the muon content of the showers. In this work, direct measurements of the muon density at 1000 m from the shower axis observed by the Akeno Giant Air Shower Array (AGASA) are analysed. The selected events have zenith angles $\theta \leq 36°$ and energies in the range $18.83 \leq \log_{10}(E_R/\text{eV}) \leq 19.46$. These are compared to the predictions corresponding to proton, iron, and mixed composition scenarios obtained by using the high energy hadronic interaction models EPOS-LHC, Sibyll2.3c, and QGSJetII-04. A muon deficit in air shower simulations is observed: The muon density obtained from AGASA data is greater than the one obtained in the mixed composition scenario by a factor of $1.49 \pm 0.11\,(\text{stat}) \pm 0.17\,(\text{syst})$, $1.54 \pm 0.12\,(\text{stat}) \pm 0.18\,(\text{syst})$, and $1.66 \pm 0.13\,(\text{stat}) \pm 0.20\,(\text{syst})$ for EPOS-LHC, Sibyll2.3c, and QGSJetII-04, respectively.

T 54.5 Wed 17:00 Td

Time-dependent antiproton to proton ratio with the AMS-02 experiment — •Sichen Li — I. Physikalisches Institut B, RWTH, Aachen, Germany

The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station has been performing precision measurements of cosmic rays in the GeV to TeV energy range since 2011. The study of the time dependence of the antiproton-to-proton ratio ($\frac{\overline{p}}{p}$), and its comparison to the electron-to-positron ratio, allows important insights into the physics of the heliospheric modulation of cosmic rays. I will present the analysis method developed to derive the $\frac{\overline{p}}{p}$ ratio with a time resolution of six months.

T 54.6 Wed 17:15 Td

Analysis of the isotopic composition of cosmic-ray Lithium with AMS-02 — •Manbing Li — I. Physikalisches Institut B RWTH Aachen, Sommerfeldstraße 14

AMS-02 is a multi-purpose magnetic spectrometer designed for precise measurements of cosmic-ray fluxes above Earths atmosphere. The isotopic composition of cosmic-ray nuclei is of great interest since it directly reflects processes related to cosmic-ray propagation through the Galaxy. In more than nine years of data taking, AMS-02 has collected the largest available dataset on the fluxes of cosmic-ray nuclei. The Ring Imaging Cherenkov detector of AMS-02 provides particle velocity measurements with a resolution better than 0.1%. Together with the rigidity measurement provided by the silicon tracker, the mass of a particle can be derived. I will present an analysis method based on template fits to determine the lithium isotope ratio.

T 54.7 Wed 17:30 Td

Search for heavy antimatter with AMS — •Robin Sonnabend — 1. Physikalisches Institut B, RWTH Aachen, Aachen

The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station has been performing precision measurements of cosmic rays in the GeV to TeV energy range since 2011. The search for heavy antimatter (Z>=2) requires advanced methods for the suppression of instrumental background which arises from the mis-reconstruction of the charge sign. I will present a multivariate analysis designed to

achieve this goal.

T 54.8 Wed 17:45 Td

Daily Electron Fluxes with AMS-02 — •Fabian Machate — 1. Physikalisches Institut B, RWTH Aachen University

The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station has been performing precision measurements of cosmic rays in the GeV to TeV energy range since 2011. The time variation in the fluxes of electrons and positrons, caused by heliospheric modulation that varies with solar activity, has so far only been observed with monthly time resolution.

Now, an analysis to derive a daily flux of electrons with AMS-02 has been developed. It increases the acceptance by a factor of five, by including events outside the electromagnetic calorimeter. The new method allows the study of short-term variations in the electron flux, such as Forbush decreases.

T 54.9 Wed 18:00 Td

Measurement of the cosmic ray spectrum with the HAWC's Eye hybrid detector at the HAWC observatory. — •Frank Maslowski for the HAWC's Eye-Collaboration — Physics Institue III A, RWTH Aachen, Germany

HAWC's Eye is a compact imaging air Cherenkov telescope, which aims to improve energy and angular resolution of the High Altitude Water Cherenkov (HAWC) observatory. The HAWC observatory is a ground based air-shower array located in the Mexican state of Puebla, dedicated to the messurement of TeV gamma rays. When primary cosmic ray particles interact with the atmosphere they create extensive air showers, which in turn create Cherenkov light. These two components are messured by the two detectors. The good reconstruction of the core position by HAWC combined with the imaging capabilities of the telescope enables triangulation of the shower. From the data taken during one of the first hybrid observation campaigns, a cosmic ray spectrum above a few TeV has been derived.

T 54.10 Wed 18:15 Td

Proton Energy Reconstruction with the MAGIC Experiment — •Alicia Fattorini and Lena Linhoff for the MAGIC-Collaboration — TU Dortmund, Germany

MAGIC is a stereoscopic telescope system located on Roque de los Muchachos (2200 m a.s.l.) on La Palma, Canary Islands. The two Imaging Air Cherenkov Telescopes (IACTs) were built for the detection of gamma-ray sources at energies between 20 GeV and 100 TeV. The background of measurements with IACTs consists mainly of protons and heavier nuclei such as helium and iron. The signal-to-background ratio is typically 1:10000, leading to large statistics of hadrons. In this work, the energies of the primary protons are estimated. The proton energies are reconstructed with a random forest trained and tested on Monte Carlo simulations of protons. The performance of the energy reconstruction of protons and the instrument response of the telescopes are shown.