T 63: Kosmische Strahlung III

Zeit: Dienstag 16:45–19:05 Raum: VMP9 SR 29

Gruppenbericht T 63.1 Di 16:45 VMP9 SR 29

The rise in the positron fraction: Distance limits on positron point sources from cosmic ray arrival directions and diffuse gamma-rays — •Iris Gebauer and Rosemarie Bentele — Karlsruhe Institute of Technologie, Karlsruhe, Germany

The rise in the positron fraction as observed by AMS and previously by PAMELA, cannot be explained by the standard paradigm of cosmic ray transport in which positrons are produced by cosmic-ray-gas interactions in the interstellar medium. Possible explanations are pulsars, which produce energetic electron-positron pairs in their rotating magnetic fields, or the annihilation of dark matter.

Here we assume that these positrons originate from a single close-by point source, producing equal amounts of electrons and positrons. The propagation and energy losses of these electrons and positrons are calculated numerically using the DRAGON code, the source properties are optimized to best describe the AMS data. Using the FERMI-LAT limits on a possible dipole anisotropy in electron and positron arrival directions, we put a limit on the minimum distance of such a point source. The energy losses that these energetic electrons and positrons suffer on their way through the galaxy create gamma ray photons through bremsstrahlung an Inverse Compton scattering. Using the measurement of diffuse gamma rays from Fermi-LAT we put a limit on the maximum distance of such a point source. We find that a single electron positron point source powerful enough to explain the locally observed positron fraction must reside between 225 pc and 3.7 kpc distance from the sun and compare to known pulsars.

T 63.2 Di 17:05 VMP9 SR 29

Cosmic ray anisotropy searches with AMS-02 — •Stefan Zeissler, Iris Gebauer, and Ricarda Trumpf — Karlsruher Institut für Technologie (KIT)

The Alpha Magnetic Spectrometer (AMS-02) is a state-of-the-art particle detector designed to operate as an external module on the International Space Station (ISS). In this unique space environment cosmic particles can be measured with high precision over an energy range from GeV up to TeV. The AMS collaboration provided precise measurements of the electron and positron fluxes, which indicate an additional source of positrons among the various cosmic particles. Possible candidates for this source are local pulsars, a local source of positrons produced in proton-gas interactions or dark matter annihilation. In the first two cases a possible anisotropy in the electrons and positrons incoming direction at Earth might be detectable. To determine the level of isotropy the measured data is compared to reference maps, which simulate the measurement of an isotropic sky. A common choice of reference maps are proton count maps or shuffled maps, which redistribute measured incoming directions over the whole measuring time. Both choices lead to difficulties in the reconstruction of a marginal signal with a big expansion over the galactic sky as it would be the case for charged cosmic particles. We developed a method to construct reference maps based on fundamental detector characteristics such as the livetime and the geometric acceptance. Using this we are able to reconstruct the isotropic sky as it would be seen by the detector. We demonstrate the performance of the method using AMS-02 data.

T 63.3 Di 17:20 VMP9 SR 29

Towards an antiproton measurement with AMS-02 — •Andreas Bachlechner — RWTH Aachen University

AMS-02 is a high-precision multi-purpose particle detector. It has been onboard the International Space Station since May 2011.

The antiproton measurement is an important part of the AMS-02 physics program. An excess above the expected spectrum due to interactions of cosmic rays with the interstellar matter can hint at exotic sources like dark matter annihilation. The antiproton-to-proton ratio and the antiproton flux itself may also improve the understanding of the origin and propagation of cosmic rays.

Due to the very small abundance of antiprotons in the cosmic radiation of about 10^{-5} compared to protons a very precise particle identification is crucial. The main backgrounds are other singly charged particles like protons, electrons, and pions produced within the detector material itself. At lower energies the time-of-flight system and the ring-imaging Cherenkov detector seperate light particles from protons. The electromagnetic calorimeter and the transition radiation detector redundantly suppress the electron background. The reconstruction of the charge sign by the magnetic spectrometer is limited by its resolution and has to be taken into account carefully.

The methods to identify antiprotons in the cosmic-ray measurement of AMS-02 in different energy regions will be presented. The ways to handle the uncertainties to the antiproton-to-proton ratio considering the various challenges will be discussed.

T 63.4 Di 17:35 VMP9 SR 29

Search for Positron Anisotropies in Cosmic Rays with AMS — •Fabian Machate — 1. Physikalisches Institut B, RWTH Aachen University

The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station has observed a significant excess of cosmic ray positrons over the background expected from secondary production at energies above 10 GeV. Nearby pulsars and annihilating dark matter particles as a primary source of electrons and positrons have been discussed as an explanation. A possible way of distinguishing between pulsar and dark matter origin is the measurement of dipole anisotropies in the positron flux or the positron to electron ratio. Any anisotropy will be reduced by diffusion in galactic magnetic fields to below the percent level.

AMS-02 is the leading space-based experiment for cosmic ray detection and well suited for this search. A new analysis procedure for anisotropies using an event sample with large acceptance will be presented. It relies on the ability of the Transition Radiation Detector (TRD) to separate positrons from the proton background.

T 63.5 Di 17:50 VMP9 SR 29

The Pierre Auger Fluorescence Detector: Cross-Checking the Absolute Calibration Using a Drone — •Lenka Tomankova for the Pierre-Auger-Collaboration — Institute for Nuclear Physics (IKP), Karlsruhe Institute of Technology (KIT), 76021 Karlsruhe, Germany

The Pierre Auger Observatory combines the air shower fluorescence and surface array methods to study ultra-high energy cosmic rays. As the energy scale of the experiment is derived from calorimetric measurements by the fluorescence telescopes, their accurate calibration is of primary importance to all Auger data. We discuss a novel calibration method based on a remotely flown drone equipped with a specially designed light source that mimics a snapshot of an air shower traversing the atmosphere. Several drone measurement campaigns have been performed to study the properties of the Auger fluorescence telescopes and to derive an end-to-end calibration. We give an overview of the measurements and present the basic analysis chain as well as the first results of an independent cross-check of the Auger energy scale.

T 63.6 Di 18:05 VMP9 SR 29

Simulation and analysis of surface scintillator signals at the Pierre Auger Observatory — •David Schmidt, Darko Veberic, and Markus Roth for the Pierre-Auger-Collaboration — Karlsruhe Institute of Technology, Karlsruhe, Germany

To improve reconstruction of cosmic ray primary mass, the Pierre Auger Observatory is upgrading its surface detectors by installing a scintillator on top of each existing water Cherenkov tank. The different responses of the coupled detectors to the components of extensive air showers facilitates estimation of the number of muons reaching Earth's surface, which is correlated with primary mass. Geant4 and the Offline framework are used to simulate the detectors' responses, construct signal traces for individual particle components, and calculate total expected signals. This enables assessment of proposed reconstruction algorithms. An overview of the simulations and selected algorithms is presented here.

T 63.7 Di 18:20 VMP9 SR 29

Reconstruction of charge number of heavy cosmic rays using Cherenkov Light — •Robert Stein, Attila Abramowski, and Dieter Horns — Universität Hamburg, Hamburg, Germany

Between impact with the upper atmosphere and decay into a charged particle shower, heavy cosmic ray elements such as Iron emit Cherenkov Light at an angle determined by the Refractive Index of the air and the energy per nucleon. This direct Cherenkov Light forms a characteristic circular light distribution on the Earth's surface with an intensity proportional to the square of the cosmic ray charge. A new method has been developed to reconstruct this charge number. The expected performance for various existing and planned installations will be presented.

T 63.8 Di 18:35 VMP9 SR 29

Charakterisierung von 64 Channel SiPM Arrays für das SiECA Projekt — •Max Renschler[2], Jörg Bayer[3], Francesca Bisconti[1], Andreas Ebersold[4], Andreas Haungs[1], Thomas Huber[2], Tobias Jammer[3], Michael Karus[1], Matthias Kleifges[4], William Painter[1], Andrea Santangelo[3], Harald Schieler[1] und Andreas Weindl[1] für die JEM-EUSO-Kollaboration — [1]Institut für Kernphysik (IKP) , KIT — [2]Institut für experimentelle Kernphysik (IEKP), KIT — [3]Institut für Astronomie und Astrophysik, Universität Tübingen — [4]Institut für Prozessdatenverarbeitung und Elektronik (IPE), KIT

Um an Stelle von herkömmlichen Multianoden-Photomultipliern eine alternative Detektionsmethode von ultrahochenergetischer kosmischer Strahlung (UHECR) mit Silicon Photomultipliern (SiPMs) zu testen, wird derzeit das 'Silicon Elementary Cell Add-on' (SiECA) entwickelt, das die Detektion von UHECR mit SiPMs im Rahmen des 'Extreme Universe Space Observatory' (EUSO) Pathfinder Experiments 'EUSO-Super Pressure Ballon' untersuchen soll. In diesem Zusammenhang werden 64 Channel SiPM Arrays der neusten Generation von Hamamatsu untersucht und charakterisiert. Die Motivation und die Idee sowie der aktuelle Stand von SiECA werden vorgestellt und die Ergebnisse der Charakterisierung der neusten 64 Channel SiPM Arrays von Hamamatsu diskutiert.

T 63.9 Di 18:50 VMP9 SR 29

Silicon PM readout in SiECA — •Tobias Jammer for the JEM-EUSO-Collaboration — Physikalisches Institut, Universit Tübingen

The goal of SiECA, the SiPM Elementary Cell Addon to the EUSO Super Pressure Balloon pathfinder experiment, is to evaluate the feasibility of a Silicon PM camera in an EUSO-like setting. Therefore an additional standalone Elementary Cell will be mounted next to the MAPMT camera to test the UHECR camera prototype in a live environment. This talk will focus on the readout of the Silicon PMs for SiECA and the integration of the addon with the main apparatus.