T 29: Cosmic rays I

Time: Tuesday 17:00–18:30 Location: H-HS XII

T 29.1 Tue 17:00 H-HS XII

Towards joint analysis of KASCADE and Tunka-133 data — •Victoria Tokareva[1], Andreas Haungs[1], and Dmitriy Kostunin[2] — [1]Institute for Nuclear Physics, Karlsruhe Institute of Technology, DE-76021, Karlsruhe, Germany — [2]Deutsches Elektronen-Synchrotron, DE-15738, Zeuthen, Germany

Ultra-high-energy cosmic rays ($10^{14}-10^{18}$ eV) that are produced in extreme astrophysical processes can provide us with possible hints about the physical nature of these processes. In particular, one could be highly interested in studying neutral particles like primary gamma rays, which are not deflected by galactic magnetic fields and thus can be associated with the particular source that produced them.

The flux of ultra-high-energy gamma events registered by modern experiments (HAWC, Tibet, Carpet-2, etc.) is quite low, so the challenge of increasing the statistics of the events in question, as well as multicomponent air-showers investigation, are highly relevant.

The talk is going to consider a possible joint analysis of data from two observatories, KASCADE (Germany) and Tunka-133 (Russia). The data mapping for two observatories is going to be discussed as well as the current status of the data processing.

T 29.2 Tue 17:15 H-HS XII

Interstellar electron and positron spectra from MeV to TeV energies — •Andrea Vittino[1], Philipp Mertsch[1], Henning Gast[2], and Stefan Schael[2] — [1]Institute for Theoretical Particle Physics and Cosmology (TTK), RWTH Aachen University, Germany — [2]I. Physics Institute and JARA-FAME, RWTH Aachen University, Germany

Electrons and positrons play a special role among cosmic ray (CR) species. Most strikingly, their strong energy losses in the Galactic magnetic and radiation fields severely limit their propagation distances. Therefore electrons and positrons offer invaluable insights into the local properties of CR acceleration and propagation. In this talk we present our model for their interstellar spectra over a wide energy range extending from the MeV to the TeV domain. We illustrate how the underlying parameters can be efficiently constrained by exploiting different experimental observations, including both direct observations of the spectra (at Earth and at the heliopause) and measurements of the diffuse synchrotron emission generated by CR leptons as they propagate through the magnetic field of the Galaxy. We then consider recent time-dependent observations at GeV energies by AMS and estimate heliospheric modulation in an extension of the force-field model. What emerges is a complex picture of the interstellar electron and positron spectra that must be shaped by a number of transport processes beyond the simplest models.

T 29.3 Tue 17:30 H-HS XII

Comparing the Cosmic-Ray Sun Shadow in Seven Years of IceCube Data with the Solar Cycle and Solar Magnetic Field Models — Frederik Tenholt, Julia Becker Tjus, and •Johan Wulff for the IceCube-Collaboration — Theoretische Physik IV, Ruhr-Universität Bochum, 44780 Bochum

Measuring the temporal variation of the cosmic-ray Sun shadow has been shown to be a useful tool for assessing different solar magnetic field models.

In this talk, seven years of IceCube data are compared to solar activity and solar magnetic field models. For the first time, such models have been compared quantitatively to IceCube data on the event rate level. Moreover, the energy-dependence of the Sun shadow in IceCube has been studied for the first time and is compared to recent predictions.

Using the sunspot number as an indicator of solar activity, an anticorrelation between Sun shadow strength and solar activity is found to be likely. By modeling cosmic-ray propagation in the solar magnetic field and comparing the predicted Sun shadow to the measured one, two different models of the coronal magnetic field are tested. In agreement with the data, both models predict a weakening of the shadow in times of high solar activity. Assuming only statistical uncertainties, however, tensions on the order of $3\,\sigma$ remain. In times of high solar activity, there is a small indication that the shadowing effect increases with increasing cosmic-ray energy, which is in agreement with a recent prediction.

T 29.4 Tue 17:45 H-HS XII

The cosmic-ray shadow of the Sun and its temporal variation - lessons learned from simulations — •Julia Becker Tjus[1], Paolo Desiati[2], Niklas Döpper[1], Horst Fichtner[1], Jens Kleimann[1], and Frederik Tenholt[1] — [1]Theoretische Physik IV, Ruhr-Universität Bochum, 44780 Bochum — [2]UW Madison, Wisconsin, USA

While cosmic rays show a high level of isotropy when they arrive at Earth, two sinks have been identified by different observatories: the Moon and the Sun. Moon shadow measurements, on the one hand, are typically used for pointing calibrations and angular resolution estimates of the instruments. The Sun shadow, on the other hand, has been shown to change with time, revealing a correlation with the 22-year cycle of the solar magnetic activity and, in turn, the solar magnetic field.

In this contribution, we present simulations of the cosmic-ray Sun shadow for which we apply a back-tracking approach for the particle propagation around the Sun. We show how the shadow projected at Earth changes with time. In addition, we investigate the energy dependence of the depth of the shadow. We show that it changes significantly when comparing years of low solar activity to those of high solar activity. We discuss the implications for future measurements with cosmic-ray detectors and the physics to be learned from such measurements.

T 29.5 Tue 18:00 H-HS XII

High Energy Antiproton Analysis with the AMS-02 Experiment — •Sichen Li — RWTH I. Physikalisches Institut B

The Alpha Magnetic Spectrometer (AMS-02) is a high precision cosmic rays detector installed on the International Space Station in May 2011. It has collected more than 145 billion events until now. Surprisingly, the ratio of antiprotons to protons appears to be energy independent above 60 GeV.

The most important background in the high energy range consists in protons with mis-reconstructed charge sign. In this analysis, we train a deep neural network based on Monte Carlo simulation, using the Keras framework, to separate antiprotons from charge-confused protons. With this method, we have a good potential to extend the energy range for the antiproton to proton flux ratio, which will help us clarify the origin of antiprotons.

T 29.6 Tue 18:15 H-HS XII

Large Acceptance Analysis of Time-Dependent Electron Fluxes with AMS-02 — •Fabian Machate — 1. Physikalisches Institut B, RWTH Aachen

The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station performs precision measurements of cosmic rays in the GeV to TeV energy range. The published analyses of the electron and positron fluxes rely on the electromagnetic calorimeter (ECAL) for energy measurements and background rejection. The geometrical acceptance for the conventional analyses is restricted by the weight limitations for the calorimeter.

A new analysis method based on the Transition Radiation Detector (TRD) and Tracker will be presented. This analysis has a significantly larger geometrical acceptance and can increase the statistics by a factor of up to ~ 4 at the cost of larger systematic uncertainties. These improvements are of particular importance for the time-dependent electron fluxes, which are dominated by statistical uncertainties.