HK 17: Astroparticle Physics

Time: Monday 16:30–19:00 Location: H-ZO 70

Invited Group Report HK 17.1 Mo 16:30 H-ZO 70
Measuring the highest-energy particles in the universe — •Heino Falcke — Dept. Astronomy, Radboud University, Nijmegen, NL — ASTRON, Dwingeloo, NL

Since almost 100 hundred years we know that the earth is exposed to cosmic rays, which cause the ionisation of the atmosphere and also genetic mutations. Cosmic rays are actually mainly composed of energetic particles, mostly protons and atomic nuclei. The energy of these particles can reach up to 10^{20} eV, an energy which surpasses what can be achieved in even the largest particle accelerators on earth by many orders of magnitude. For this reason, ultra-high energy cosmic rays are equally interesting to particle physicists as well as astronomers. A big mystery is the origin of these particles. Where do they come from? Which processes can accelerate to such high energies? Candidate sources of cosmic rays are supernova explosions and supermassive black holes. However, also more exotic theories, like the decay of primordial strings have been proposed. A suite of major experiments will be trying to answer these questions in the near future. Among them are the Pierre Auger Observatory, a huge particle detector array in Argentina, KM3NET and IceCube, which are huge neutrino telescopes, and the LOFAR radio telescope, which not only will study the sources of cosmic rays but also is used to constrain some of the highest energy particles one can ever expect to detect. The talk will address the scientific issues surrounding ultra-high energy cosmic rays and neutrinos as well as the related experimental efforts.

Group Report HK 17.2 Mo 17:00 H-ZO 70
Untersuchung der Eigenschaften galaktischer kosmischer Strahlung mit dem KASCADE-Grande Experiment — •Jörg R. Hörandel und KASCADE-Grande Kollaboration — Radboud University Nijmegen, Department of Astrophysics, Nijmegen, The Netherlands

Ausgedehnte Luftschauer entstehen durch Wechselwirkungen hochenergetischer Teilchen der kosmischen Strahlung in der Erdatmosphäre. Mit dem KASCADE-Grande Experiment werden Luftschauer vermessen und daraus die Eigenschaften galaktischer kosmischer Strahlung im Energiebereich von 10^{14} bis 10^{18} eV abgeleitet. Die Interpretation der gemessenen Luftschauerdaten erfordert eine detaillierte Kenntnis der Eigenschaften hochenergetischer hadronischer Wechselwirkungen. Mit KASCADE-Grande werden daher die Eigenschaften der Wechselwirkungen untersucht, in Energie- und kinematischen Bereichen komplementär zu Beschleunigerexperimenten. Die beobachteten Eigenschaften der kosmischen Strahlung, wie ihr Energiespektrum und ihre Elementzusammensetzung geben Aufschlüsse über den Ursprung der galaktischen kosmischen Strahlung. Besonders interessant ist hierbei der Energiebereich von 10^{17} bis 10^{18} eV, in dem ein Übergang von galaktischer kosmischer Strahlung zu einer extragalaktischen Komponente erwartet wird. Neueste Ergebnisse werden vorgestellt.

HK 17.3 Mo 17:30 H-ZO 70
Modelling Geo-magnetic radiation from Extensive Air Showers — •Krijn de Vries[1], Olaf Scholten[1], and Klaus Werner[2] — [1]KVI, University of Groningen, The Netherlands — [2]Subatech, Universaty of Nantes, France

An incoming ultra high energy cosmic ray (UHECR) entering our atmosphere will create a so called extensive air shower (EAS). A cascade of particles flying toward the Earth's surface with extremely high velocities. As a result of this they are concentrated in a thin shower front, which can be visualized by a pancake of particles flying toward the Earth. The deflection of electrons and positrons due to the Earth magnetic field in combination with retardation effectis is responsible for an electromagnetic pulse to be emitted within the radio frequency range.

Concentrating on a macroscopic description, focussing on the net current created due to the deflection of the electrons and positrons in the Earth magnetic field, a model has been made to simulate the radio signal for a realistic air shower. Several different contributions to the electric pulse have been included to obtain more realistic simulations and have a better comparison with measured data.

HK 17.4 Mo 17:45 H-ZO 70
Probing light dark matter by e^-p scattering — •Tobias Beranek, Achim Denig, and Marc Vanderhaeghen — Institut für Kernphysik, Johannes-Gutenberg Universität, 55099 Mainz

Gamma radiation from the galactic center around 511 keV has been observed for more than thirty years. These data imply that the 511 keV emission line is caused by annihilating low-energy positrons. Recent measurements of SPI spectrometer at the INTEGRAL probe confirm this hypothesis. The number of positrons in the galactic center is not large enough to explain the γ ray intensity in a simple way. A possible explanantion of this observation assumes a new gauge boson U and scalar dark matter particles ϕ with mass of $10 - 100$ MeV. The U boson couples to the Standard model particles as well as to the light dark matter particles ϕ.
We analyse the process $e^-p \rightarrow e^-pU$ as a background process to elastic scattering $e^-p \rightarrow e^-p$ and make a feasibility study for an experimental realization at the MAMI accelerator facility at Mainz. Simulations for the parameter space resulting from various theoretical approaches to light dark matter will be shown.

HK 17.5 Mo 18:00 H-ZO 70
Status and results from the EDELWEISS-2 Dark Matter Search — •Valentin Kozlov for the EDELWEISS-Collaboration — Forschungszentrum Karlsruhe, Institut für Kernphysik

EDELWEISS uses cryogenic Germanium bolometers to search for Dark Matter in form of weakly interacting massive particles, WIMPs. The experiment is situated in the French-Italian Fréjus tunnel, in the Modane underground laboratory LSM with a shielding of 4800 m.w.e against cosmic rays. Since the end of 2007, EDELWEISS is taking data, with a successive increase of target mass and further developments of detector technology.

We will present the status and the latest results of the current data taking with emphasis on the performance of new detectors. These detectors show a significantly improved β/γ-rejection and provide a promising base for a dark matter experiment of the next generation. In addition, the identification of muon-induced background events and special measurements of muon-induced neutrons will be discussed.

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Group Report HK 17.6 Mo 18:15 H-ZO 70
Messung von Radioemission in ausgedehnten Luftschauern mit dem LOPES Experiment — •Jörg R. Hörandel und LOPES Kollaboration — Radboud University Nijmegen, Department of Astrophysics, Nijmegen, The Netherlands

Luftschauer entstehen durch die Wechselwirkung hochenergetischer Teilchen der kosmischen Strahlung in der Atmosphäre. Sekundäre Elektronen (und Positronen) werden im Erdmagnetfeld abgelenkt und emittieren Synchrotronstrahlung. Diese wird mit dem LOPES (LOfar PrototypE Station) Experiment im Frequenzbereich von 40 bis 80 MHz in zwei Polarisationsrichtungen (Nord-Süd und Ost-West) mit einem Dipolantennenfeld registriert. Gleichzeitig werden die Eigenschaften der Luftschauer mit dem KASCADE-Grande Experiment vermessen. Die Intensität der registrierten Radiostrahlung wird als Funktion verschiedener Schauerparameter untersucht, dies sind u.a. Schauerenergie, Abstand zur Schauerachse und Winkel zwischen Erdmagnetfeld und Schauerachse. Neueste Ergebnisse werden präsentiert. Diese zeigen, daß die Messung von Radiostrahlung in Luftschauern auf dem Wege ist, sich als neue Methode zur Messung der Eigenschaften hochenergetischer ($> 10^{16}$ eV) kosmischer Strahlung zu etablieren.

HK 17.7 Mo 18:45 H-ZO 70
The GSI Anomaly — •Hendrik Kienert — Max Planck Institut für Kernphysik, Heidelberg

Recently, an interesting experiment at the ESR facility of GSI Darmstadt has observed a non-exponential decay law for electron capture decays of certain heavy nuclei. Several controversial attempts have been made to explain this effect in terms of neutrino mixing. We briefly describe the experimental results, give an overview of the literature, and show that the effect cannot be due to neutrino mixing. We also briefly discuss alternative explanation attempts and their problems.