Contribution ID: **23** Type: **not specified**

Introduction to High-Energy Cosmic Ray Physics

Monday, 10 July 2006 09:15 (1 hour)

Energetic particles, traditionally called Cosmic Rays, were discovered nearly a hundred years ago, and their origin is still uncertain. Their main constituents are normal nuclei as in the standard cosmic abundances of matter; there are also electrons, positrons and anti-protons, but no anti-nuclei. Today we also have information on isotopic abundances, which show some anomalies, as compared with the interstellar medium. The cosmic ray all-particle spectrum extends over energies from a few hundred MeV to 3x1020 eV and shows few clear spectral signatures: There is a small spectral break near 5x1015 eV, the “knee”, where the spectrum turns down; there is another spectral break near 3x1018 eV, the “ankle”, where the spectrum turns up again. Up to the ankle the cosmic rays are usually interpreted as originating from Galactic sources; however, we do not know what the origin of the knee is. The particles beyond the ankle have to be extragalactic, but due to interaction with the cosmic microwave background there is a strong cut-off expected near 5x1019 eV, which is, however, not seen; The measured high energy cosmic rays beyond this “GZK-cutoff” (after its discoverers Greisen, Zatsepin and Kuzmin) are the challenge to interpret.
High-energy primary cosmic rays above energies of about 1x1014 eV are investigated by observations of extensive air showers (EAS) using large area ground based detector installations for registering various components of the EAS cascade development. In the present lecture different experimental approaches deducing mass and energy sensitive information from the most sophisticated EAS experiments and their results are presented. In particular the KASCADE-Grande experiment for measurements around the knee and the Pierre Auger Observatory for detecting highest energy cosmic rays will be discussed in detail. These experiments involve measurements of secondary particle distributions, as well as measurements of air Fluorescence light and radio waves emitted during the EAS development. The physical and astrophysical implications of the current findings in various energy regions are briefly discussed and prospects of the KASCADE-Grande and Pierre-Auger experiments are presented.

Primary author: Dr HAUNGS, Andreas (Forschungszentrum Karlsruhe)

Session Classification: Monday at the Forschungszentrum in Karlsruhe