NONPARAMETRIC DETERMINATION OF ENERGY SPECTRA AND MASS COMPOSITION OF PRIMARY COSMIC RAYS AND THEIR ANGULAR DEPENDENCE

Markus Roth and the KASCADE Collaboration
Institut für Kernphysik, Forschungszentrum Karlsruhe, 76021 Karlsruhe, Germany.
roth@ik3.fzk.de/Fax: +49/7247/82-4075

The data measured by the KASCADE (KArlsruhe Shower Core and Array DEtector) experiment are the basis for a multi-component analysis with the aim to determine the mass composition of the primary cosmic rays in the knee region. We discuss the methods used for estimating mass and energy of primary particles by utilising neural network and nonparametric classification methods. By applying such techniques, measured data have been analysed in an event-by-event mode and the mass and energy of individual EAS inducing particles are reconstructed. Recent results of all-particle energy spectra, relative abundances and spectra for different groups of primary particles on basis of the electron and muon size data measured for different slant depths are presented. The analyses of measured data indicate a transition to a heavier composition at a knee energy of ca. 5 PeV.

Alas it turns out that the mass composition depends on the particular set of observables (e.g. electron size N_e, truncated muon size N_μ^{tr}, hadron size N_h, most energetic hadron $E_h^{\max}$,...) being considered simultaneously in the analysis. Though different sets of observables result in a qualitatively similar mass composition, quantitatively this leads to conspicuous differences. In this way the limitations of a particular interaction model is revealed and the necessity of detailed studies of correlations of EAS observables as test of the hadronic interaction model is shown.