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Energy spectra of light and heavy primary cosmic rays in the energy range from 10 TeV to 100 PeV

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A new paradigm of multisensory observations joined multiband measurements of the radiation coming from celestial objects to develop and confirm models of the origin of high-energy cosmic rays. The integral parameters of the cosmic ray flux, such as energy spectra and mass composition, mostly measured in the last century also bring useful information on the CR origination. Especially useful was an approach to disentangle the cosmic ray flux and obtain separately energy spectra of different mass groups by applying AI methods, first introduced in [1], and then realized for the MAKET-Ani [2] and KASCADE experiments [3].
The MAKET-ANI surface array operated on Aragats Mt. in Armenia in from 1997 to 2004 turned out to be very well suited for the energy and composition measurements at the "knee" of the cosmic ray spectrum. The problem of event-by-event classification of EAS has been solved by using Bayesian and neural network techniques [4]. The evidence from MAKET-ANI data can be summarized as follows:
The estimated energy spectrum of the light mass group of nuclei shows a sharp knee: Δγ ˜0.9, compared to ˜0.3 for the all-particle energy spectra.
The energy spectrum of the heavy mass group of cosmic rays shows no break in the energy interval of 1015 2x1016 eV. In the new era of EAS studies by HAWK and LHAASO experiments aimed to detect point sources of gamma radiation and energy spectra of species of primary cosmic rays, it is interesting to present and analyze the full pattern of available energy spectra in the energy range from 1013 1017 eV, from already finished and just starting EAS experiments.

References

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