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Observation of a knee in the cosmic ray p+He energy spectrum below 1 PeV with the ARGO-YBJ experiment

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The CR spectrum has been studied by the ARGO-YBJ experiment in a wide energy range (TeV → PeV). This study is particularly interesting since it allows a better understanding of the so called "knee" of the energy spectrum and its origin, and also provides a powerful cross-check among very different experimental techniques. The unique detector features (full coverage, time resolution, large dynamic range) and location (4300 m above sea level) allowed both lowering the energy threshold down to the region covered by direct measurements and reaching the all-particle spectrum knee. In addition, the possibility of a detailed study of the particle distribution in the first few meters from the shower core provided a new and efficient way of selecting events initiated by light mass primaries (p and He nuclei) and could give new inputs, in the very forward region, to the hadronic interaction models currently used for the highest energies CR studies.
The all-particle spectrum (measured in the range 100 TeV - 10 PeV) is in good agreement with theoretical models and previous measurements, thus validating the selection and reconstruction procedures. The light-component (p + He) spectrum, measured in the range 30 TeV - 5 PeV, while being consistent with highest energy direct measurements, shows a clear indication of a bending below 1 PeV. This is in agreement with other independent analysis of ARGO-YBJ data and provides new important inputs to acceleration models for galactic cosmic rays.

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