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Measurements of all-particle energy spectrum and mean logarithmic mass of cosmic ray with LHAASO

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The all-particle energy spectrum and mean logarithmic mass of cosmic rays are measured in the energy range of 0.3-30 PeV using data collected from LHAASO-KM2A with unprecedented accuracy. Our analysis reveals the position of the knee at 3.72 PeV, with a sharpness measurement of 4.1. Below the knee, the spectral index is found to be 2.743, while above the knee, it is 3.131. The mean logarithmic mass of cosmic rays is heavier than Helium in the whole measured energy range. It decreases from 1.6 at 0.3 PeV to 1.4 at 3 PeV, representing a 14% decline following a power law with an index of 0.0777. This is equivalent to an increase in abundance of light components. Above the knee, the mean logarithmic mass exhibits a power law trend towards heavier components. The mean logarithmic mass exhibits a variation with energy, which is reversal to the behavior observed in the all-particle energy spectrum. Additionally, the knee position and the change in power-law index are approximately same. These findings suggest that the knee observed in the all-particle spectrum corresponds to the knee of the light component, rather than the medium-heavy components.

Collaboration (if any)

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