

Energy dependence of the knee in the cosmic-ray spectrum across the Milky Way

The all-particle spectrum of cosmic rays measured at Earth has a knee-like feature around 4 PeV. A priori, it is not clear if this is a local feature specific to the Solar neighbourhood in the Milky Way, or if it is a generic property of the Galactic cosmic-ray spectrum. We argue that combining gamma-ray and cosmic-ray data of LHAASO indicates that the knee is a local feature. In order to demonstrate this, we derive a model for the local cosmic-ray spectrum and composition, consistent with the recent LHAASO measurements of the all-particle spectrum and the mean logarithmic mass in the knee region. We calculate the spectrum of diffuse gamma-ray emission based on this model and find that the expected spectral shape of the diffuse gamma-ray flux disagrees with the LHAASO measurements of the diffuse gamma-ray emission in the 10-100 TeV energy range in the inner and outer Galaxy. We determine the break energy in the CR spectrum expected from these gamma-ray data and find it an energy ten times lower than obtained from local measurements.

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