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Effects of the Galactic magnetic field on the spectrum, composition and arrival direction of cosmic rays

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The energy spectrum of cosmic rays is one of the central measurements in cosmic ray physics. Mostly following a power law relation, it contains small breaks at the higher end of the energy range. Of particular importance are the so-called "knee" at around 5 PeV, where the spectrum softens, the "ankle" at around 5 EeV, where it hardens again, and a high-energy cut-off at around 50 EeV. The energy range between the knee and the ankle is where the transition from Galactic cosmic rays (GCRs) to extragalactic cosmic rays (EGCRs) is expected to occur; the knee is considered to be the point where the maximum rigidity of known GCR accelerators is reached for protons, whereas the ankle is thought to represent the point where the extragalactic component begins to dominate, as all Galactic accelerators are exhausted past this point. However, fits to the spectrum using current Galactic and extragalactic acceleration and propagation models, fail to describe the measured flux in this region, leaving the details of the transition poorly understood.
I wish to present results from simulations with the Monte Carlo-based cosmic ray propagation software CRPropa3 of the effects of the Galactic magnetic field (GMF) on cosmic rays that are expected from the rigidity-dependence of the degree of deflection in a magnetic field. They include the shielding of EGCRs from the Galaxy for low rigidities and a concentration effect in the Galactic plane for intermediate rigidities
as well as the gradual escape of GCRs from the Galaxy with increasing rigidity, due to the increasing strength of the GMF increases towards lower Galactic latitudes. These effects all occur at ridigites within the transition region and beyond the ankle, so this study may provide a better understanding of the transition from GCRs to EGCRs by potentially reproducing observed features in the spectrum, composition and the arrival direction distribution, such as the spectral hardening, the "lightening" of the composition and anisotropies.

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