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Lensing effects of ultra-high-energy cosmic rays propagating in Galactic magnetic fields

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Most ultra-high-energy cosmic rays (UHECRs) are charged particles. As a result, they are deflected by magnetic fields, which can act as lenses, altering their trajectories and (de)magnifying their apparent sources. In this study, we investigate the influence of Galactic magnetic fields on the propagation of UHECRs. The deflections of UHECR trajectories can lead to phenomena such as the appearance of multiple images of a source and modifications in its observed energy spectrum. Using realistic models of Galactic magnetic fields, such as the `JF12` (Jansson and Farrar) and `KST24` (Korochkin, Semikoz, and Tinyakov) models, we analyze the (de)magnification effects over a rigidity range from $1\,\mathrm{EV}$ ($\equiv 10^{18}$ V) to $100\,\mathrm{EV}$, and study their dependence on the chosen model. Since the deflections induced by the magnetic fields depend on the particle's rigidity, their effect varies among different nuclear species. Consequently, our findings can have implications for interpreting mass-composition and anisotropy observations, as the rigidity-dependent deflections directly alter the observed UHECR arrival direction distribution.

Collaboration(s)

Authors: Dr DE OLIVEIRA FRANCO, Danelise (II. Institute for Theoretical Physics, Universität Hamburg); SIGL, Guenter (II. Institute for Theoretical Physics, Universität Hamburg)

Presenter: Dr DE OLIVEIRA FRANCO, Danelise (II. Institute for Theoretical Physics, Universität Hamburg)

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