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The rigidity dependence of galactic cosmic-ray fluxes and its connection with the diffusion coefficient

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Thanks to tremendous experimental efforts, galactic cosmic-ray fluxes are being measured up to the unprecedented percent precision level. The logarithmic slope of these fluxes is a crucial quantity that promises us information on the diffusion properties and the primary or secondary nature of the different species. However, these measured slopes are sometimes interpreted in the pure diffusive regime, guiding to misleading conclusions. In this paper, we have studied the propagation of galactic cosmic rays by computing the fluxes of species between H and Fe using the USINE code and considering all the relevant physical processes and an updated set of cross-section data. We show that the slope of the well-studied secondary-to-primary B/C ratio is distinctly different from the diffusion coefficient slope, by an offset of ~ 0.2 in the rigidity range in which the AMS-02 data reach their best precision (several tens of GV).
Furthermore, we have demonstrated that none of the species from H to Fe follows the expectations of the pure-diffusive regime. We argue that these differences arise from propagation processes such as fragmentation, convection, and reacceleration, which cannot be neglected. On this basis, we also provide predictions for the spectral slope of elemental fluxes not yet analysed by the AMS collaboration.

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