

Galactic gamma-ray and neutrino emission from interacting cosmic-ray nuclei

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Abstract

We present a study of the expectations for very/ultra high energy (VHE/UHE) gamma-ray and neutrino emission from interacting cosmic rays in our Galaxy and comparison to the latest results for the Galactic UHE diffuse emission. We demonstrate the importance of properly accounting for the mixed cosmic-ray composition as well as gamma-ray absorption. We adopt the wounded-nucleon model of nuclei interaction and provide parameterisations of the resulting gamma-ray and neutrino production. Nucleon shielding due to clustering inside nuclei is shown to have a measurable effect on the production of gamma-rays and is particularly evident close to breaks and cut-offs in mixed composition particle spectra. The change in composition around the ‘knee’ in the cosmic ray spectrum has a noticeable impact on the diffuse neutrino and gamma-ray emission spectra. We show that current and near future detectors can probe these differences in the key energy range from 10 TeV to 1 PeV, testing the paradigm of the universality of the cosmic ray spectrum and composition throughout the Galaxy.