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On the role of galactic wind termination shocks in accelerating cosmic rays

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The origin of cosmic rays above the \textit{knee} at PeV energies is an unsolved problem. We examine whether the re-acceleration of Galactic cosmic rays at the termination shock developed by the Galactic wind can contribute to the observed spectrum beyond the knee. In particular, in the context of a cosmic-ray-driven galactic wind we study the transport of cosmic rays up to the Galactic wind termination shock, where the re-acceleration occurs through diffusive shock acceleration. We find that the re-accelerated particles can achieve rigidities up to several tens of PV/c and can propagate back to the Galactic disk, potentially contributing to the measured spectrum. We show that the re-accelerated component can contribute to $\sim$ 10% of the observed all-particle spectrum under standard parametric assumption and up to $\sim$ 40–50\% when optimistic configurations are considered. We finally compute the escaping flux of re-accelerated particles seeding the intergalactic medium with protons of energies up to $\sim$ 100 PeV, and heavier nuclei with energies up to $\sim$ 1 EeV. Finally we explore the associated multimessenger flux in terms of gamma rays and neutrinos resulting from the hadronic interactions of re-accelerated cosmic rays in the whole Galactic wind volume.

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