Contribution ID: **137** Type: **particle astrophysics (including cosmic rays, neutrinos, nuclear astrophysics)**

The micro-physics of CR transport in galactic environments

We discuss the micro-physics of cosmic-ray (CR) diffusion as resulting from particle scattering onto the three modes in which the *Magneto-Hydro-Dynamics* (MHD) cascades are decomposed. Assuming that Alfvén modes are subdominant in confining CRs, due to their anisotropic cascading, we debate over the key points that need to be understood while considering fast-magnetosonic modes as the main responsible for CR diffusion. In particular, we show that the possible damping of these modes is crucial in shaping the diffusion coefficient that particles experience throughout the Galaxy. Based on this physics, we implement the resulting diffusion coefficients in a two-zone model in the DRAGON2 code, separating the *Halo* from the *Warm Ionized Medium*, and solve the transport equation. Remarkably, we obtain the correct propagated slope and normalization for the charged species taken into account, without any *ad-hoc* tuning of the transport coefficients. As expected, Alfvén modes are only relevant when their anisotropy is not developed yet, showing up as a feature in the diffusion coefficient that might be observed in the sub-PeV local CR spectra. Also, this framework cannot be responsible for CR confinement below $\sim 200\,\mathrm{GeV}$, implying that the Kraichnan-like scaling of the B/C might not be an imprint of the underlying turbulence.

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