Cosmic ray streaming instability in the ISM: analytic predictions vs numerical simulations

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Abstract

We study the evolution of the Cosmic ray streaming instability (CRSI) using MHD-PIC simulations, where cosmic rays are treated as macro-particles and the background gas as fluid. This approach retains the gyro-resonant nature of the interaction and allows to decrease the density fraction of cosmic rays to low values and evolve the system for very long timescales, as compared to the full-PIC approach.
The output of these simulations is expected to give a valuable input for sub-grid prescriptions in global MHD models where cosmic rays are treated as fluid.
Results of the simulations with various initial drift velocities between CRs and the gas and for different density fractions will be presented and compared to the linear theory of the CRSI. Some aspects of the non-linear evolution such as saturation level of the magnetic field amplitude, particle scattering, and decrease of the relative velocity to the Alfven speed will be discussed.

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