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# Implementation of a sub-grid cosmic rays diffusion coefficient and resonant Alfvén waves drift velocity term in the RAMSES code

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## Abstract

Cosmic Rays (CRs) transport is linked to the turbulent dynamics of the interstellar medium (ISM). An implicit scheme for solving the anisotropic diffusion of CRs in the RAMSES code have been developed by Dubois & Commerçon (2015). The CRs diffusion coefficient they use is initially constant throughout the simulation volume and evolves according to the turbulent properties of the gas (Lazarian 2016) throughout the simulation.

A lot of studies showed that the turbulence generated by CRs has a non-negligible role on their dynamics and that of the ISM (Nava et al. 2016, Lucek & Bell 1999). It results in a spatial CRs diffusion coefficient which depends on the CRs and plasma properties. To answer this problem, we implemented a routine correcting the CRs diffusion coefficient value by considering the sub-resolution turbulent motions.

In addition, the Alfvén waves velocity is different from the sound velocity of the gas which means that the energy transfer rates between CRs and waves is roughly evaluated. To correct it, we need to consider a streaming velocity term which takes in account the real resonant Alfvén waves velocity and their propagation direction along the magnetic field (Pfrommer et al. 2016). Implicit and explicit implementations are discussed.

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