
Cosmic ray physics in Ramses

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Abstract

Cosmic rays (CRs) are now expected to play an important role for shaping the interstellar medium dynamics and chemistry, producing galactic wide outflows and providing non-thermal pressure support in large-scale structures. CRs can be treated as a pressure term in the equations of hydrodynamics with an extra equation evolving their energy. One important aspect of CR physics is that they diffuse anisotropically along magnetic field lines, and I will review the implementation from Dubois & Commerçon 16. Additionally, CRs can stream down their own gradient along magnetic field lines and generate an instability heating the gas (the so-called "streaming instability") and are accelerated at shock interfaces. I will introduce these recent implementations in the Ramses code with the streaming instability modeled as a diffusion plus heating term, and how our shock finder algorithm can produce shock-accelerated CRs.

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