Multi group cosmic rays in RAMSES

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Abstract

Cosmic rays are high-energy particles that interact with plasma through magnetic fields. As a substantial component of a galaxy's energy budget, they can play a major role in regulating galactic dynamics, acting as an important source of feedback, as shown by numerical simulations. However, this impact is strongly dependent on how cosmic rays propagate—an aspect that is not well constrained. Accurate modeling of their energy distribution is needed to better constrain theoretical models with direct observations.

To this end, we have developed a new cosmic ray module, now integrated into the RAMSES simulation code, which incorporates their full spectral energy distribution. In this presentation, I will outline the numerical framework of this implementation and share test results illustrating cosmic ray evolution across various physical processes.