

Relativistic reconnection with effective resistivity: a comparison between fluid and kinetic models

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Abstract

Magnetic reconnection is one of the most important physical processes capable of powering many high-energy transient phenomena (such as flares from black hole magnetospheres, blazar jets, and fast radio bursts), as the dissipation of magnetic fields can efficiently accelerate charged particles and thus lead to the production of the observed non-thermal emission. Numerical models adopting a fully-kinetic approach (as in PIC simulations) can self-consistently capture the properties of magnetic dissipation during a reconnection event, but their high computational cost makes the study of the large-scale dynamics of compact objects magnetospheres extremely challenging. On the other hand, fluid models (e.g. relativistic MHD) are instead widely used to describe the accretion/ejection of matter and magnetosphere dynamics on temporal and spatial scales set by a black hole, but they generally can't reproduce a self-consistent dissipation mechanism, being limited by either numerical dissipation or an explicit resistivity parameter not constrained by the microphysics.

We present a study that compares, for the first time, results from a typical PIC model of relativistic reconnection with those obtained in the resistive RMHD regime with a non-constant effective resistivity, which can capture the local enhancement of magnetic dissipation within the reconnecting current sheet. The dynamical change of the resistivity leads to significant deviations from the standard case of a constant dissipation parameter and a significant agreement with fully-kinetic models. I will show the impact of effective resistivity on the reconnection rate and the non-ideal electric field that ultimately can accelerate charged particles, demonstrating how the introduction of kinetic effects can bridge the gap between the PIC and resistive RMHD frameworks.