Particle-in-cell Simulations of Relativistic Asymmetric Magnetic Reconnection

E. Figueiredo[1], B. Cerutti[1]

[1] *Université Grenoble Alpes, CNRS, IPAG, Grenoble, France*

Accretion of magnetized matter around supermassive black holes is expected to produce relativistic pair plasma jets. A clear discrepancy in the plasma properties between the accretion disk and the jet is then expected, especially in terms of density, magnetization and composition. General relativistic magnetohydrodynamics simulations of black hole accretion disk provide hints of plasma heating via magnetic reconnection events at the boundary between these two regions, which could explain the observed limb brightening of nearby jets as in M87* or Centaurus A. In this work, we present a kinetic study of an asymmetric reconnection layer in the relativistic regime through 2D particle-in-cell numerical simulations. In a first setup, the current layer separates a strongly magnetized pair plasma and a weakly magnetized electron-ion plasma. In a second part, we study how a symmetric shear of a current layer affects the dynamics and behavior of magnetic reconnection. We find that in the case of a composition asymmetry, the reconnection rate is dictated by the most weakly magnetized side, with ions receiving the majority of the reconnection energy. Furthermore, we observe that relativistic shearing of a current layer reduces the reconnection rate, although the asymptotic particle's spectra remain unaffected. Our results show that such a mechanism is a relevant candidate for accretion disk heating at black hole jet boundary.