
Energy conversion and firehose instability during non-linear phase of tearing-driven reconnection: Hybrid simulation using Mobius boundary conditions

Olga Alexandrova^{*1}, Etienne Berriot^{1,2}, Petr Hellinger^{3,4}, and Alexandra Alexandrova⁵

¹Laboratoire d'Instrumentation et de Recherche en Astrophysique – Institut National des Sciences de l'Univers, Observatoire de Paris, Centre National de la Recherche Scientifique, Sorbonne Université,

Université Paris Cité, CY Cergy Paris Université – France

²Università della Calabria, dipartimento di Fisica – Italie

³Astronomical Institute of the Czech Academy of Sciences, Prague, Czechia – République tchèque

⁴Institute of Atmospheric Physics of the Czech Academy of Sciences, Prague, Czechia – République tchèque

⁵ReConnection Institute for Humanity's Unified Development – Suisse

Résumé

Magnetic reconnection is a ubiquitous process in astrophysical plasmas, being at the origin of many eruptive phenomena, and typically inducing an important localized transfer of magnetic energy toward the acceleration of particles. The tearing instability can trigger several reconnection events along a same elongated current sheet, bringing even more complexity to the process.

Here, we study the tearing instability in a 2.5D hybrid-PIC simulation using the Hybride code, and with boundary conditions similar to the topology of a Mobius strip. We show that the energy conversion predominantly takes place during the non-linear stage of the instability, by evaluating the ion electric work rate and pressure-strain interaction terms. We show that at the X-points, the magnetic energy gets converted in similar amounts to heating and plasma jetting, and that overall, there is more heating within the magnetic islands than around the X-points. Moreover, the reconnection outflows present an important ion temperature anisotropy with $T_{\parallel} \rightarrow T_{\perp}$, which is sustained by the contraction of the magnetic islands. The firehose instability then eventually regulates the temperature anisotropy within the islands and participates to the energy conversion.

*Intervenant