PIC simulations of relativistic magnetic reconnection in ion-electron plasmas

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Magnetic field reconnection in relativistic ion-electron plasmas is a prime candidate to account for various high-energy events: for example flares in AGN jets, particle acceleration and transient jet production in microquasars, or high-energy emission in GRBs. With the help of two-dimensional particle-in-cell simulations, we present preliminary investigations of magnetic reconnection in a Harris current sheet where the magnetic field energy and the plasma thermal energy reach or exceed the particles rest mass energy.

We find fast reconnection, with a classical two-scale dissipation region where ions decouple from the magnetic field at an ion skin depth from the X-point, and the electrons at an electron skin-depth. These two zones are bounded by shocks, and the high resolution employed exhibits sharp transitions at various other locations.

We explicit the balance of terms in Ohm's law, and explain how to evaluate them in PIC simulations with relativistic particle distributions. We show that just as in non-relativistic simulations, the finite reconnection-induced electric field is allowed by bulk inertia in the ion region, and bulk plus thermal inertia in the electron region.

We also discuss particle acceleration, and find particles mainly accelerated by the reconnection-induced electric field.