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Fully Kinetic Simulations of Asymmetric Magnetic Reconnection at the Magnetopause with Different Configurations

Emanuele Cazzola and Giovanni Lapenta
Centre for mathematical Plasma-Astrophysics, Departement Wiskunde, KULeuven

This work aim at presenting fully kinetic simulations of magnetic reconnection with the current sheet acrossed by asymmetric profiles in density and magnetic. Unlike traditional single layer o double mirrored layers, we here wanted to study the different behavior between a typical current sheet with continous profiles and a layer with a steep gradient profile.
The former clearly represents those conditions standing at the nose of the magnetopause, where shocked solar wind encounters the magnetospheric plasma, which is currently widely studied given the imminent launch of the NASA MMS satellite's cluster completely devoted to the reconnection occurring in this area. The second layer, however, resembles the typical Riemann's problem conventionally used for studying formation and propagation of waves in aforementioned magnetospheric region. Additionally, steep gradient may also recall those conditions during the inflowing northward IMF, when a pure tangential discontinuity is present.

We here mainly focus on this second configuration, where interesting features are observed from simulation. In fact, a very steep profile gradient seems to give origin to explosive multiple reconnection events all over the layer, which in turn lead to a rapid island merging and relevant energy release.
Manifold analysis turns out to be addressed. First step concerns to better study the glaring and quick island merging, where presence of anti-reconnections may lead to the generation of vertical outflow jets and further particles heating. This latter point is intimately linked to the energetics of the process. Either ions and electrons normally increase energy thanks to the stored magnetic energy released by the reconnection event. However, it soon appears that separatrixes seem to play a more fundamental and spatially extensive role in increasing either ions or electrons thermal and bulk energy with respect to the reconnection region, which is the ultimate scale where magnetic reconnection is tought to begin.

Finally, further analysis focus on studying whether any relevant interaction between the two layers may occur, given the overall compression generated by the asymmetric plasmoid swelling towards the low magnetic field region in between, as well as on the eventual presence of electron holes signatures in one or both reconnecting layers.

All simulations were perfomed by using the Fully Kinetic Implicit Particle-in-Cell Code iPIC3D (Markidis et al. 2010), whose implicitness allows us to no longer consider costraints between temporal scales and spatial resolutions.

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