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Structure of the Electron Diffusion Region in Vlasov-Darwin simulations of magnetic reconnection.

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Magnetic reconnection is the only process in a plasma able to rearrange the global magnetic field topology eventually leading to conversion of magnetic energy into acceleration of particles and heating. To allow for magnetic field reconfiguration, both ions and electrons must be demagnetized. The demagnetization process takes place in the ion and electron diffusion regions respectively, in both cases at kinetic scales. The Electron Diffusion Region (EDR), in particular, plays a critical role in regulating and mediating the reconnection process both in terms of magnetic field topology and energy conversion.
A key question is whether the EDR is characterised by laminar structure or it presents electron scale inhomogeneities and turbulence. In order to investigate this aspect, we use a novel numerical approach based on a Eulerian Vlasov-Darwin model to solve the protons and electrons Vlasov equation coupled to the Maxwell equations approximated using Darwin approximation. Within this approximation all wave modes are retained except for the vacuum modes. We present preliminary results of a simulation whose initial equilibrium is chosen to mimic the electron diffusion region encounter observed by Magnetospheric Multiscale spacecraft in the magnetotail (11/07/2017 around 22.34 UTC, as reported in [1]).

[1] Torbert, R. B. et al., "Electron-scale dynamics of the diffusion region during symmetric magnetic reconnection in space", (2018), Science, 362, 1391-1395.