Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Reconnection in Hall-MHD[1] ANDREY BERESNYAK, US NAVAL RESEARSCH LABORATORY — Large-scale reconnection, like the one causing solar flares, involves multiple scales. The size of the system is many orders of magnitude larger than electron skin depth or electron Larmor radius. Do micro-scales fundamentally affect large-scale reconnection rate? If yes, our methodologies to describe plasma using reduced descriptions, such as MHD, will have to change and MHD will have to be replaced with special treatment near current layers. If no, we can get away with using MHD in many large-scale physical systems, such as the Sun and solar corona. Resolving this question directly with numerical simulations is very challenging and may involve boxes up to ten times bigger than we can currently afford. We use simplistic planar current layers in a periodic box, unstable to oblique tearing and developing turbulent current layer. We look at the current layer evolution and change the box size with respect to the ion skin depth. Independently we change the mass ratio. Looking at this two-parameter space allows us to elucidate general trends in multi-scale turbulent reconnection. As the current layer thickness increases, the mixing rate of ion fluid approaches that of an electron fluid. The mixing surface for electron fluid is bi-fractal, on small scales it corresponds to a more vigorous Hall reconnection, dominated more by 2D X-points, while on large scales it looks more like 3D MHD type. Our best guess is that on large scales we may eventually recover MHD behavior.

[1]Supported by NASA Astrophysics Theory Program

Andrey Beresnyak
US NAVAL RESEARSCH LABORATORY

Date submitted: 02 Jul 2020 Electronic form version 1.4