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A first-principles analytical theory for 2D magnetic reconnection in electron and Hall MHD. A. ZOCCO, A.N. SIMAKOV, L. CHACON, LANL — While the relevance of two-fluid effects in fast magnetic reconnection is well-known,[1] a first-principles theory –akin to Sweet and Parker's in resistive MHD– has been elusive. Here, we present such a first principles steady-state theory for electron MHD,[2] and its extension to Hall.[3] The theory discretizes the extended MHD equations at the reconnection site, leading to a set of time-dependent ODEs. Their steady-state analysis provides predictions for the scaling of relevant quantities with the dissipation coefficients (e.g, resistivity and hyper-resistivity) and other relevant parameters. In particular, we will show that EMHD admits both elongated and open-X point configurations of the reconnection region, and that the reconnection rate E_z can be shown not to scale explicitly with the dissipation parameters. This analytic result confirms earlier computational work on the possibility of fast (dissipation-independent) magnetic reconnection in EMHD. We have extended the EMHD results to Hall MHD, and have found a general scaling law for the reconnection rate (and associated length scales) that bridges the gap between resistive and EMHD.

[1]J. Birn et al., *J. Geophys. Res.*, **106** (A3), pp. 3715–3719 (2001)
[2]L. Chacón, A. N. Simakov, A. Zocco, *Phys. Rev. Lett.*, submitted
[3]A. N. Simakov, L. Chacón, in preparation

Luis Chacon
Los Alamos National Laboratory

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