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Current and Vortex Singularities: Drivers of Impulsive Reconnection in Plasmas and Fluids[1] A. BHATTACHARJEE, K. GERMASCHEWSKI, C.S. NG, Space Science Center, University of New Hampshire — Reconnection in nature is often impulsive or bursty, characterized not only by a fast growth rate but a rapid change in the time-derivative of the growth rate. We present analytical and numerical results, obtained by asymptotic analyses and high-resolution numerical simulations (using AMR) of the Hall MHD and Euler equations. Within the framework of Hall MHD, we consider a two-dimensional collisionless reconnection model in which electron inertia provides the mechanism for breaking field lines, and the electron pressure gradient plays a crucial role in controlling magnetic island dynamics. Current singularities tend to form in finite time and drive fast and impulsive reconnection. By a combination of analysis and simulations, we determine the scaling of the reconnection rate in the nonlinear regime, and demonstrate its dependence on the electron and the ion skin depth, plasma beta, and system size. We also present new results on the analogous problem of finite-time vortex singularity in a high-symmetry Kida flow containing null points of the flow. It is found that while the system tends to a self-similar vortex collapse solution in the early nonlinear stage, in the late nonlinear stage the self-similarity is broken and the solution becomes exponential in time. Eventually viscosity intervenes, producing fast vortex reconnection.

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Amitava Bhattacharjee
Space Science Center, University of New Hampshire

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