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Simulation of Unsteady Wakes in Magnetized Plasmas[1] CHRISTIAN BERNT HAAKONSEN, IAN H. HUTCHINSON, CHUTENG ZHOU, MIT PSFC — Wakes occur in plasmas moving past obstacles such as probes or the moon, and can take a variety of forms for different plasma parameters. The present work addresses relative motion perpendicular to a magnetic field, where the plasma Debye length and typical ion gyroradius are smaller than the obstacle. We have discovered such wakes to be unsteady, using Particle-In-Cell simulations, both for subsonic and supersonic relative motion. The underlying drive for the unsteadiness is provided by counterstreaming ions in the wake, and for supersonic motion kinetic electron effects lead to unsteadiness closer to the obstacle than what is seen in simulations with a Boltzmann electron response. It is thus sometimes necessary to resolve the electron time-scale in simulations, requiring parallel simulations using significant computational resources. The subsonic simulations are for a regime applicable to (among other things) Mach probes in the scrape-off layers of tokamaks, where unsteady wake effects could potentially be detected. The supersonic simulations are for instance relevant to the solar wind flowing past the moon, where the present work dramatically improves the resolution and understanding of plasma phenomena in the wake.

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