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Particle-in-cell simulations of laser-driven, ion-scale magnetospheres in laboratory plasmas[1] F. D. CRUZ, F. CRUZ, L.O. SILVA, GoLP/Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal, D. B. SCHAEFFER, A. BHATTACHARJEE, Department of Astrophysical Sciences, Princeton University, Princeton, NJ 08540, USA, R. S. DORST, P. HEUER, C. G. CONSTANTIN, P. PRIBYL, C. NIEMANN, Department of Physics and Astronomy, University of California – Los Angeles, Los Angeles, CA 90095, USA — Ion-scale magnetospheres have been observed around comets, weakly-magnetized asteroids, and localized regions on the Moon. These mini-magnetospheres provide a unique environment to study kinetic-scale plasma physics, in particular in the collisionless regime. In this work, we present collisionless particle-in-cell (PIC) simulations of ion-scale magnetospheres that reproduce recent laboratory experiments performed on the Large Plasma Device (LAPD) at UCLA. Utilizing high-repetition rate lasers to drive super-Alfvénic plasma flows into a dipole magnetic field embedded in a uniform background magnetic field, these experiments examine the evolution of local and global magnetosphere structure for a range of dipole and upstream parameters. PIC simulations are employed to interpret highly-resolved, volumetric experimental datasets, and used to determine the magnetospheric structure, magnetopause location and kinetic-scale structures of the plasma current distribution. Single and multiple ion species simulations are compared to investigate the role of heavy ion debris from the laser target in the interaction.

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