Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Conditions for collisionless shocks formation in magnetized plasma interaction with kinetic-scale obstacles[1] F. CRUZ, E.P. ALVES, R.A. FONSECA, L.O. SILVA, GoLP/IPFN, Instituto Superior Tecnico, Lisbon, Portugal, R.A. BAMFORD, R. BINGHAM, RAL Space, STFC, UK — The interaction between plasmas and kinetic-scale magnetic obstacles is a problem of interest in space and laboratory plasmas. In general, this interaction is purely three dimensional, highly nonlinear and happens over a wide range of plasma/obstacle parameters. The complexity of the problem limits the development of analytical models and requires the use of computer simulations. In this work, we model the interaction between a magnetized plasma colliding with a small-scale dipolar magnetic obstacle from first principles using multidimensional PIC simulations, with the aim of determining under which conditions a shock can be formed. We identify that the global system behavior can be determined by the flow Alfvènic Mach number M_A and the ratio between the effective obstacle size and the ion gyroradius measured in the upstream plasma conditions, L/ρ_i. We determine that a shock is critically formed for $L/\rho_i>1$ and show that this is a very restrictive condition on the maximum possible shock M_A for small obstacle sizes. We describe the magnetopause and shock dynamics of different 2D planes and compare the results with full 3D simulations. We also identify the optimal parameter regimes to explore this physics in the laboratory.

[1]Work supported by the European Research Council (Accelerates ERC-2010-AdG 267841).

F. Cruz
GoLP/IPFN, Instituto Superior Tecnico, Lisbon, Portugal

Date submitted: 24 Jul 2015 Electronic form version 1.4