

Abstract Submitted
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Warping Simulation Time: Multi-Dimensional Asynchronous Hybrid Simulations¹ YURI OMELCHENKO, HOMA KARIMABADI, SciberQuest, Inc — Fusion and space plasmas are often characterized by the strong presence of ion kinetic effects and multiple temporal scales associated with plasma and magnetic field inhomogeneities. Traditional hybrid (electron fluid/particle ion) simulations of such systems face severe restrictions on the global timestep and sometimes even fail to resolve fine spatial structures. Recently we introduced a new approach to multi-scale modeling [1]: Discrete-Event Simulation (DES). Our new multi-dimensional code, HYPERS (HYbrid-Particle Event-Resolved Simulation) proceeds by adaptively selecting physically appropriate time increments for individual particles and local electromagnetic fields. As a result, numerical updates are always carried out when needed only. This enables fast, reliable and accurate simulations of energetic plasmas immersed in highly inhomogeneous magnetic fields. We report preliminary results from simulations of the interaction of streaming plasmas with dipole magnetic obstacles and discuss the applicability of this technique to other plasma configurations (magnetic confinement schemes) and theoretical approximations (MHD, two-fluid, Vlasov).

[1] Y.A. Omelchenko, and H. Karimabadi, J. Comp. Phys. 216, 153 (2006).

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