Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Accelerating particle-in-cell simulations using multilevel Monte Carlo LEE RICKETSON, New York Univ NYU — Particle-in-cell (PIC) simulations have been an important tool in understanding plasmas since the dawn of the digital computer. Much more recently, the multilevel Monte Carlo (MLMC) method has accelerated particle-based simulations of a variety of systems described by stochastic differential equations (SDEs), from financial portfolios to porous media flow. The fundamental idea of MLMC is to perform correlated particle simulations using a hierarchy of different time steps, and to use these correlations for variance reduction on the fine-step result. This framework is directly applicable to the Langevin formulation of Coulomb collisions, as demonstrated in previous work, but in order to apply to PIC simulations of realistic scenarios, MLMC must be generalized to incorporate self-consistent evolution of the electromagnetic fields. We present such a generalization, with rigorous results concerning its accuracy and efficiency. We present examples of the method in the collisionless, electrostatic context, and discuss applications and extensions for the future.

Lee Ricketson
New York Univ NYU

Date submitted: 23 Jul 2015 Electronic form version 1.4