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Speed-Limited Particle-in-Cell Modeling of Plasma Discharges[1]
THOMAS G. JENKINS, ANDREW M. CHAP, JOHN R. CARY, Tech-X Corp, GREGORY R. WERNER, University of Colorado-Boulder — Speed-limited particle-in-cell (SLPIC) modeling is a new simulation technique [G. R. Werner J. R. Cary, arXiv:1511.08225 (2015)] for efficiently modeling plasmas characterized by low-velocity kinetic processes. Numerical constraints (e.g. timestep limitations associated with particle cell-crossing times) often place challenging restrictions on PIC models of these systems, since even though the physics of interest is predominantly driven by slower particles, it is the fastest particles which dictate the timestep constraint. In SLPIC, artificial speed-limiting behavior is imposed on fast particles whose kinetics do not play a meaningful role in the system dynamics. Larger simulation timesteps, and more rapid modeling of such discharges, are thus enabled. In this poster we'll demonstrate the use of SLPIC methods in a number of plasma discharge simulations using the VSim code [C. Nieter J. R. Cary, JCP 196, 448 (2004)], including collisionless and collisional sheath formation (for which SLPIC has achieved up to 7x overall speedup and comparable accuracy) and the free expansion of plasma into vacuum (2.5x speedup/comparable accuracy). In addition, we'll discuss a potential application of SLPIC in modeling plasma opening switches, and the challenges associated with such modeling.

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