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Modeling plasma fluid-to-kinetic transitions with speed-limited PIC methods in VSim[1] THOMAS JENKINS, Tech-X Corporation, G. R. WERNER, University of Colorado, J. R. CARY, A. M. CHAP, P. H. STOLTZ, D. N. SMITHE, Tech-X Corporation — Speed-limited particle-in-cell (SLPIC) modeling [G. R. Werner et al., Phys. Plasmas 25, 123512 (2018)], has been shown to model plasmas characterized by low-velocity kinetic processes significantly faster than conventional PIC methods. SLPIC, like PIC, retains a fully kinetic description of the plasma, but also imposes an artificial speed limit on fast particles whose kinetics do not play a meaningful role in the system dynamics. Larger simulation timesteps, which enable faster simulations of such discharges, are thus permitted. SLPIC has been implemented in the VSim code [C. Nieter and J. R. Cary, J. Comp. Phys. 196, 448 (2004)]. In this poster we'll show how SLPIC can be used to rapidly model the evolution of a plasma discharge through transient or fluid-like phases, and can then continuously transition to a conventional PIC model with smaller timesteps as kinetic processes in the discharge become important. Applications include plasma opening switches (fluid-like in the conduction phase, but kinetic in the opening phase) and magnetron sputtering configurations (wherein convergence to steady-state is slow due to collisional effects between species with large mass ratios). VSim simulations of these and other SLPIC-relevant discharges will be presented.

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