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Data-driven discovery of reduced plasma physics models from high-fidelity simulations[1] E. PAULO ALVES, FREDERICO FIUZA, SLAC National Accelerator Lab — Computationally efficient reduced plasma models that accurately capture the essential physics of Inertial Confinement Fusion (ICF) and High-Energy-Density (HED) plasmas are highly desirable to bridge the range of spatial and temporal scales of many of the problems of interest, from laser-plasma interactions to hydrodynamic instabilities. In this work, we explore the use of modern sparse-learning techniques to uncover reduced plasma physics models directly from the data of high-fidelity fully kinetic particle-in-cell (PIC) simulations. We demonstrate the methodology through the robust recovery of the fundamental hierarchy of plasma physics equations, from the kinetic Vlasov equation to magnetohydrodynamics, based solely on spatial and temporal data of plasma dynamics from first-principles PIC simulations. We discuss how such data-driven reduced models can overcome the limitations of traditional analytically derived reduced models, and contribute to the discovery of improved kinetic-fluid closure models for ICF and HED simulations.

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