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Plasma simulations with a domain-hybridized model[1] I. A. M. DATTA, A. HO, U. SHUMLAK, University of Washington — High-fidelity simulations of plasma dynamics are facilitated by an approach incorporating multiple mathematical descriptions that represent varying degrees of physical completeness. These include a single fluid magnetohydrodynamic (MHD) model, a multi-species (electrons, ions, and neutrals) 5-moment fluid model, and a continuum kinetic plasma model. The WARPXM high-order finite element framework developed at the University of Washington implements these models using a discontinuous Galerkin spatial discretization on unstructured meshes with Runge-Kutta time integration. These models are also being synthesized in a domain-decomposed hybrid model, in which different models are applied in different regions of the simulation, based on local plasma properties including the degree of magnetization, charge separation, and collisionality. Various plasma problems are studied using this model, including that of magnetic reconnection and plasma sheaths. The goal of this work is to determine the parameter regimes most appropriate for each model to maintain sufficient physical fidelity over the whole domain while minimizing computational expense.

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