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A novel high-fidelity multi-fluid solver for plasma simulations.[1] XIAOWEN WANG, Univ of Alabama - Tuscaloosa — A particular challenge for plasma research is the diversity of parameter space and conditions. Fortunately, a continuum model used in fluid mechanics can explain as much as 80% of plasma phenomena observed in real experiments (Francis F. Chen, Introduction to Plasma Physics and Controlled Fusion, 2018). The main goal of this abstract is to develop a novel high-fidelity multi-fluid solver for plasma simulations based on self-consistent continuum models. The new solver is capable of simulating electrons, ions, and neutrals with complete transport phenomena and thermochemical non-equilibrium. It is a natural extension from a high-fidelity shock-fitting solver for hypersonic flow simulations where ionization is considered under the assumption of no charge separation. Code implementation is ongoing by coupling purely hyperbolic Maxwell's equations for electromagnetic field and adding the body force from electromagnetic field to the Navier-Stokes equation.

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