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Computational Algorithm for the Multi-Fluid Plasma Model - WARPX[1] N. REDDELL, R. LILLY, U. SHUMLAK, E. SOUSA, B. SRINIVASAN, Aerospace and Energetics Research Program, University of Washington — An algorithm is developed for the multi-fluid plasma model derived from moments of the Boltzmann equation, which only assumes local thermodynamic equilibrium within each fluid, e.g. ion and electron fluids for the two-fluid plasma model. Physical parameters determine the importance of the two-fluid effects: electron to ion mass ratio m_e/m_i, ion skin depth δ_i, and ion Larmor radius r_L. Asymptotic approximations of the two-fluid plasma model, Hall-MHD, lead to an unbounded Whistler wave that requires artificial dissipation. No unbounded waves exist in the two-fluid plasma model. Adding additional fluids, e.g. neutrals, is a simple extension of the model. The computational algorithm simulates plasma dynamics with a finite element (discontinuous Galerkin) method that uses an approximate Riemann solver to compute the fluxes of the fluids and electromagnetic fields at the computational cell interfaces. The algorithm is validated with several test problems including the GEM challenge magnetic reconnection problem and the generation of dispersive plasma waves which are compared to analytical dispersion diagrams. Solutions of Z-pinch and FRC configurations are presented.

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