A fully implicit, conservative, hybrid kinetic-ion fluid-electron algorithm ADAM STANIER, LUIS CHACON, GUANGYE CHEN, Los Alamos Natl Lab — The hybrid model with full-orbit kinetic ions and fluid electrons is a promising approach to describe a wide range of space and laboratory plasmas [e.g. 1]. Explicit hybrid algorithms typically use a predictor-corrector method with sub-cycling or a semi-implicit field solve to deal with the strict Whistler-wave CFL condition. However, these do not conserve momentum or energy, and are susceptible to numerical instability. While fully implicit methods have been recently explored [2,3] to step over such timescales in a stable manner, these studies have not considered conservation properties. Here, we present a novel particle-based non-linear hybrid algorithm that features discrete conservation of mass, momentum, energy and the solenoidal condition of the magnetic field. The scheme combines fully implicit time advance with orbit-averaging of the ion particles and the flexibility of conservative smoothing to reduce numerical noise. We verify the algorithm for a number of test problems and demonstrate the unique conservation properties.


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