PARTICLE-FLUID HYBRID SIMULATION OF ACCELERATION AND PINCH DYNAMICS IN DENSE PLASMA FOCUS

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Dense Plasma Focus (DPF) is a kind of high-efficiency plasma device with high energy density, which has important application potential in the fields of fusion energy, radiation source and material science. However, due to the coupling effects of complex multi-scale physical processes in DPF, it is difficult to achieve high-precision simulation of its entire physical process with a traditional single numerical model. In this paper, a particle-fluid hybrid model is established to study the dynamic process of dense plasma focus. In the hybrid simulation, the particle method is used to simulate kinetic ions, the fluid method is used to simulate electrons, and the Maxwell equation and FDTD (finite difference time domain) method are used to solve the electromagnetic field. Aiming at the time step advancement of hybrid simulation, the self-consistent explicit iteration of hybrid simulation is realized by using the prediction-correction method. Plasma acceleration, pinch and final focus formation are covered in the simulation, and the interaction of various physical effects such as electromagnetic field, fluid mechanics and particle dynamics is considered. On this basis, we compare the simulation results with the experimental data. The simulation results are in good agreement with the experimental data in terms of the spatial-temporal evolution of the plasma and the physical characteristics of the plasma focus region, which verifies the effectiveness and reliability of the hybrid simulation method.