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Geometric Gyrokinetic Particle Algorithm for RF Physics[1] ZHI YU, Dept. of Modern Physics, Univ. of Science and Technology of China, HONG QIN, Princeton Plasma Physics Laboratory — A new geometric gyrokinetic PIC algorithm was developed to simulate RF physics in magnetized plasma. The new algorithm is based on the gyrocenter gauge kinetic theory and PIC discretization of the pullback transformation. The moment integral is calculated with Monte Carlo sampling, and the δ function in the gyrocenter coordinate is approximated by an analytical shape function. According to the gyrocenter gauge kinetic theory, the gyrocenter distribution function $f(X, u, \mu)$ is gyrophase independent, and the gyrophase dynamics are represented by the gauge function $S(X, u, \mu, \theta)$. In the new algorithm, the distribution function $f(X, u, \mu)$ and gauge function $S(X, u, \mu, \theta)$ are sampled in Lagrangian gyrocenter coordinates, grouped by the gyrocenters (X, u, μ). The pullback transformation in the momentum integral is numerically implemented through integration by parts. The new algorithm is fully electromagnetic and fully nonlinear. Compared with the conventional PIC method for simulating RF physics, it offers improved numerical efficiency and long term accuracy. Bernstein mode and high frequency electromagnetic cold wave have been successfully simulated using the new algorithm.

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