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Finite Ion Orbit Effects on Magnetic Islands in Toroidal Plasmas
XINZHENG LIU, UW-Madison, CHRIS HEGNA — A kinetic theory for the interaction of ions with an isolated magnetic island in tokamak plasma is presented. We examine islands whose characteristic widths are larger than ion gyro radius but comparable to the ion banana width. In this regime, the ion response to the island has a non-local feature due to the banana drifts. When solving the drift kinetic equation for ions, a change in coordinates is used to account for this behavior. A bounce averaging procedure is developed to separate out and solve the lower order distribution function. Constraint relationships found from transport equations and collision operators are used to determine the distribution function, which is treated in different velocity regions. A self-consistent calculation for the electrostatic potential is proposed. The perturbed current is composed of the bootstrap current and the perpendicular neoclassical enhanced ion polarization current. The closure parallel current is calculated and compared with some recent numerical results. Using this current in Rutherford equation, the island width evolution equation is determined. A pair of self-consistent equations for the island width and rotation frequency is to be derived. The results are to be compared with calculations for large island width so as to yield a description of magnetic island width evolution from sub-banana width to macroscopic scale lengths.

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