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Finite Ion Orbit Effects on Magnetic Islands in Toroidal Plasmas

XINZHENG LIU, CHRIS HEGNA, University of Wisconsin — A kinetic theory for the interaction of an ion population with an isolated magnetic island in a high aspect ratio tokamak plasma is presented. We examine islands whose characteristic widths are larger than the ion gyro radius but comparable to the ion banana width. In this regime, the trapped ions do not respond to the island electrostatic potential and helical magnetic geometry 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. A two-fluid model is used to determine the electrons response. Quasineutrality leads to a self-consistent calculation for the electrostatic potential. An iteration procedure is introduced to calculate the potential, which is shown to be a combination of functions of the helical flux surfaces and the topologically toroidal flux surfaces. These results are contrasted with the results of small ion orbit case. The contribution to the perturbed current is composed of the helical flux surface-averaged bootstrap current and the perpendicular ion polarization current. Using this current in the Rutherford equation, the island width evolution equation is determined. A pair of self-consistent equations for the island width, w, and its rotation frequency, ω, is to be derived. *Research supported by US DoE under grant No. DE-FG02-86ER53218.

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