A comparison of Vlasov with drift kinetic and gyrokinetic theories

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Abstract

A kinetic consideration of an axisymmetric equilibrium with vanishing electric field near the magnetic axis shows that $\nabla f$ should not vanish on axis within the framework of Vlasov theory while it can either vanish or not in the framework of both a drift kinetic and a gyrokinetic theories ($f$ is either the pertinent particle or the guiding center distribution function). This different behavior, relating to the reduction of phase space which leads to the loss of a Vlasov constant of motion, may result in the construction of different currents in the reduced phase space than the Vlasov ones. This conclusion is indicative of some limitation on the implications of reduced kinetic theories in particular as concerns the physics of energetic particles in the central region of magnetically confined plasmas.

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