Non perturbative guiding centre theory: Hamiltonian structure and exact solutions of motion.

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Abstract

Guiding Centre theory has been developed to describe the dynamics of chargedparticles subject to the Lorentz force. In the context of fusion theory, it is used in numerical simulations to find approximate trajectories of particles in an external field which can be locally approximated by a straight uniform one, but also the collective effect of an ensemble of such particles as a part of a magnetized plasma. Recently, a new, exact, approach to guiding centre theory has been proposed [Di Troia, 2015 & 2018]. In this new approach the guiding centre is defined geometrically as the reference frame in which a particle moves in a closed orbit. Then exact equations of motion are derived. In this work we propose a Hamiltonian formulation of these equations, even in the relativistic regime. We also show the solutions for toroidally symmetric magnetic fields with spherical boundary conditions.

Keywords: Guiding Centre, Hamiltonian systems

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