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Wave-particle interactions in toroidally confined fusion plasmas[1]
A. PAPADOPOULOS, Y. KOMINIS, K. HIZANDIS, NTUA, Greece, A.K. RAM, PSFC, MIT — Radio frequency (RF) waves are routinely used for heating and controlling the current profile in fusion plasmas. RF waves modify the particle distribution functions away from an equilibrium distribution through wave?particle interactions, while collisions try to restore the distribution function to its equilibrium state. In high temperature plasmas, RF waves modify the particle distribution function over times much shorter than collisional times. In this long mean free path limit, particles do not undergo Brownian/Markovian diffusion. There persist long time correlations which require special attention. We have developed a kinetic theory for RF wave-particle interactions in the long mean-free path limit [1]. In order to be fully consistent, the distribution function has to be evolved concurrently with the particle motion. The ensuing diffusion tensor depends on time and the action variables describing particle motion in tokamaks. This leads to results that are different from the usual quasilinear theories of wave-particle interactions. The consequences of our diffusion tensor will be illustrated through the evaluation of averaged quantities, like current and temperature, for ITER and DEMO plasmas.

[1] Y. Kominis, A.K. Ram, and K. Hizanidis, Phys. Rev. Lett. 104, 235001 (2010).

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