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ECRH and its Effects on Neoclassical Transport in a Stellarator[1]

JAECHUN SEOL, National Fusion Research Institute, C.C. HEGNA, J.D. CALLEN, University of Wisconsin-Madison — A direct loss flux can be generated from energetic electron population in a stellarator. Thus energetic electron populations can substantially modify the neoclassical transport properties in stellarators. A model accounting for this change in transport is developed assuming the presence of electron cyclotron resonance heating (ECRH). The quasilinear diffusion coefficient for second harmonic X- mode ECRH is developed for a bumpy stellarator. Care is taken in accounting for the pitch-angle dependence of the quasilinear diffusion coefficient since application to experiments with narrow resonance zones is of interest. For trapped particles in a three dimensional configuration, collisionless loss zones exist in velocity space. Radio-frequency (rf) waves accelerate trapped electrons into the direct loss zone in bumpy stellarators and produce a direct loss flux. An analytic expression for this loss flux is derived; it is proportional to the rf field strength and the value of the zeroth order distribution function at the minimum speed for collisionless loss. The direct loss flux of electrons is another source of a non-ambipolar particle flux in bumpy stellarators. This additional non-ambipolar flux modifies the ambipolarity equation which generally has multiple roots for the radial electric field. An electron root (large positive E_r) is easily obtained if the electrons are in the $1/\nu$ regime and the ions are in the ν regime.

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