EFTC 2017

17th European Fusion Theory Conference

9 - 12 October 2017, Athens - Greece

Semi-Analytical inspection of the quasi-linear absorption of RF in presence of alpha-particles in tokamak reactor

A. Cardinali, C. Castaldo, and R. Ricci

ENEA, Fusion and Nuclear Safety Department, C. R. Frascati, Via E. Fermi 45, 00044 Frascati (Roma), Italy

In reactor plasma (like DEMO), which uses the RF heating or current drive [1], a large fraction of the ion population (the continuously born alpha-particle, and/or the NBI injected ions) is characterized by a non-thermal distribution function. The interaction (propagation and absorption) of the wave both in the ICRH and/or LH domain of frequencies must be reformulated by considering the quasilinear approach for each species separately. The collisional slowing down of such an ion population in a background plasma is balanced by a quasi-linear diffusion in velocity space due to the propagating electromagnetic wave. In this paper both the propagation (related to the hermitian part of the dielectric tensor) and the absorption (related to the anti-hermitian part) are reconsidered by including the ion distribution function solution of the Fokker-Planck equation, which describes the collisional dynamics of the particles, including the effects of frictional slowing down, energy diffusion, and pitch-angle scattering. Analytical solutions of the Fokker-Planck equation at the steady state are included in the calculation of the dielectric tensor and a novel dispersion relation is obtained. In the lower hybrid frequency domain, for example, the analytical ray tracing (including the quasi-linear damping), can be solved by iterating with the Fokker-Planck solution, and the interaction of the LH wave with alpha-particles and NBI ions can be accounted self-consistently and the lost of the CD efficiency can be evaluated.

References

[1] A. Cardinali et al., Plasma Physics and Controlled Nuclear Fusion Related 46, 5432 (2017)