Hamiltonian description of low frequency waves propagation and absorption in magnetically confined plasmas

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Magnetically confined fusion plasmas feature low frequency waves: unstable modes in the Alfvén range of frequency are observed in ongoing experiments and are expected to play a crucial role in future devices, whereas waves in the Ion Cyclotron Range of Frequency (ICRF) are routinely used for plasma heating and non-inductive current drive. In experiments featuring both Alfvén and ICRF waves, a strong interplay between them is observed and explained by cross influences on the dynamics of the fast particles distribution functions.

A Hamiltonian description of the particles is well adapted to accurately describe their interaction with ICRF and Alfvén waves. It provides a convenient framework for self-consistent calculations of the wave propagation and the kinetics of absorbing plasma species. In the wave-field calculation, this formulation allows to account for non-local effects caused by large fast particles orbits (fast ions and alphas).

We present here the progress made in the development of the two dimensional full-wave code EVE, based on the same principles as ALCYON[1,2], i.e. a Hamiltonian description of the particles dynamics in terms of action-angle variables. We discuss the formalism of EVE, the numerical aspects, as well as the results obtained with the code. Short-term prospects will also be outlined.

[1] D.J. Gambier and A. Samain, Nucl. Fusion **25**, 283 (1985).

[2] A. Bécoulet, D. J. Gambier, and A. Samain, Phys. Fluids B **3**, 137 (1991).