Self-consistent non-linear radio-frequency wave propagation and peripheral plasma biasing

J. Jacquot,[1] L. Colas,[1*] S. Heuraux,[2] M. Kubič,[1] J.P. Gunn,[1] E. Faudot,[2] , J. Hillairet[1], M. Goniche,[1] *presenting author.

[1]*CEA, IRFM, F-13108 Saint-Paul-lez-Durance, France.*

[2]*IJL-P2M UMR 7198 CNRS, F-54506 Vandoeuvre les Nancy.*

Compared to the excitation of radiofrequency (RF) waves by complex antennae, or their propagation and damping in the core of magnetized plasmas, the simulation of anomalous RF power losses in the plasma edge is less advanced. Peripheral Ion Cyclotron (IC) wave damping is attributed to a DC biasing of the edge plasma by RF-sheath rectification. This paper treats self-consistently the interplay between slow magnetosonic RF wave penetration and edge plasma DC biasing using a two-field fluid approach. RF and DC parts are coupled by non-linear RF and DC sheath boundary conditions at lateral boundaries of the simulation domain. The code is implemented with COMSOL, presently in 2D (radial/toroidal).

The model is first applied in support of Langmuir probe measurements during IC heating. Two mechanisms of RF-induced DC current flows are outlined, depending on the toroidal symmetry of the RF drive. Asymmetric maps of $E_{//\mathrm{RF}}$ break the left/right symmetry of open flux tubes, driving DC currents between opposite sheaths along $\mathbf{B_0}$. With symmetric drive DC current loops can still arise from the differential biasing of adjacent flux tubes connected electrically *via* a finite DC transverse conductivity. In each case analytic criteria are presented for the toroidal homogeneity of the DC potential V_{DC}, depending on the plasma parameters, the intensity of the RF drive and the connection length. V_{DC} variations under a density scan are also investigated.

*mailto:laurent.colas@cea.fr