Modelings of rectified potentials induced by RF sheaths and transverse RF currents in front of ICRH antennas

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RF heating is fully dependent on edge plasma conditions and particularly on convection of accelerated particles which can damage ICRH antennas (hot spots). These deleterious particle flux born in DC potential structures are induced by sheaths which rectify RF potentials. The potential map in front of antenna is not homogeneous so that transverse (to magnetic field) RF currents occur and can significantly modify the final DC potential map and thus convective fluxes. The behavior of rectified potentials is investigated here for $f=f_{ci}$ and $f>f_{ci}$, which was not yet achieved in our last works [1]. Therefore, we have built a 2D fluid modeling including RF sheaths physics (parallel current) coupled with transverse RF currents. The full description of the currents exhibits a maximum for frequencies around F_{ci}, which can be explained by the fact that RF oscillation is capacitive at low frequency and inductive at high frequency. Both effects are present at frequencies around f_{ci} and the DC peak potential appears for $f=f_{ci}/2$. This is due to the rectification of the sinusoidal signal, which doubles the effective RF frequency radiated by the antenna. The theoretical DC peak value is 0.5 time the RF amplitude of the applied potential instead of $1/\pi$ without transverse currents. For typical potential structures in front of ICRH antennas (centimetric wide and 1000 Volts peak potential), a factor between 0.4 and 0.45 can be expected according to 2D fluid code results.

[1] E. Faudot et al., Phys. Plasmas **13**, 042512 (2006).