RF-sheath assessment of ICRF Faraday Screens.

L. COLAS, S. HEURAUX[+],
Association Euratom-CEA, CEA/DSM/DRFC, Centre de Cadarache, 13108 Saint-Paul lez Durance, France ;
[+]*LPMIA, Unité du CNRS 7040, Université Henri Poincaré, Nancy 1, BP 239, 54506 Vandœuvre Cedex, France*

Although tolerable on present short RF pulses, RF-sheaths are suspected to hinder proper operation of future steady-state ICRF antennas. Within the simplest models, RF-sheaths are driven by the line-integrated parallel RF electric field ΔV_{RF}. A Faraday Screen (FS) is meant to mitigate RF-sheaths: it acts as a polarizing mirror reflecting the RF field parallel to FS rods. However FS alignment on tilted magnetic field lines is never perfect. Moreover the plasma itself acts as a natural polarizing mirror. Finally it is questionable whether the FS produces any mitigation of ΔV_{RF} near antenna box corners, i.e. outside the radiating surface closed by FS rods. The present paper addresses these issues on "long field lines", extending toroidally far away on both sides of the antenna. Several geometries of progressive complexity are successively considered. An analytical theory is derived for phased toroidal arrays of infinitely long straps in front of Ideal FS and ideal plasma. ΔV_{RF} is quantified as a function of FS misalignment, pitch angle, strap phasing and skin depth for the Slow Wave. Horizontal FS rods are shown to produce no screening of ΔV_{RF}. Using the ICANT antenna code, the theory is then validated numerically with a long strap in front of a real plasma and realistic FS. Two smaller straps housed in individual boxes are finally simulated, suggesting poor efficiency of the FS for reducing ΔV_{RF} near antenna box corners. A brief outlook at measurements and future antenna designs is given.
Email : laurent.colas@cea.fr ; phone number : (+33) 4-42-25-65-32