TOPLHA: an accurate and efficient numerical tool for analysis and design of LH antennas

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Auxiliary ICRF heating systems in tokamaks often involve large complex antennas, made up of several conducting straps hosted in distinct cavities that open towards the plasma. The same holds especially true in the LH regime, wherein the antennas are comprised of arrays of many phased waveguides. Upon observing that the various cavities or waveguides couple to each other only through the EM fields existing over the plasma-facing apertures, we self-consistently formulated the EM problem by a convenient set of multiple coupled integral equations. Subsequent application of the Method of Moments yields a highly sparse algebraic system; therefore formal inversion of the system matrix happens to be not so memory demanding, despite the number of unknowns may be quite large (typically 10^5 or so).

The overall strategy has been implemented in an enhanced version of TOPICA (Torino Polytechnic Ion Cyclotron Antenna) and in a newly developed code named TOPLHA (Torino Polytechnic Lower Hybrid Antenna). Both are simulation and prediction tools for plasma facing antennas that incorporate commercial-grade 3D graphic interfaces along with an accurate description of the plasma.

In this work we present the new proposed formulation along with examples of application to real life large LH antenna systems.