

TOPICA/TOPLHA: a 3D/1D Predictive Tool for ICRF and LH Antennas

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TOPICA is an innovative tool for the simulation of the ICRF and LH antenna systems that incorporates commercial-grade graphic interfaces into a fully 3D self-consistent description of the antenna geometry and an accurate description of the plasma; it can be considered a predictive tool to assist the detailed design phase of the antenna systems.

Theoretical and computational advances of the TOPICA code has allowed to incorporate a CAD drawing capability of the antenna geometry, with fully 3D geometrical modeling, and to combine it with a 1D accurate plasma description that can take into account any desired effect; the plasma profiles are inserted directly from measured data (when available), or specified analytically by the user. The coaxial or waveguide feeding is modeled as such; computation and visualization of relevant parameters (input scattering parameters, current and field distributions, etc.) complete the suite.

The approach to the problem is based on an integral-equation formulation for the self-consistent evaluation of the current distribution on the conductors. The environment has been subdivided in two coupled region: the plasma region and the vacuum region. The two problems are linked self-consistently by representing the field continuity in terms of equivalent (unknown) sources. In the vacuum region all the calculations are executed in the spatial (configuration) domain, and this allows triangular-facet description of the arbitrarily shaped conductors and associated currents; in the plasma region a spectral representation of the fields is used, which allows to enter the plasma effect via a surface impedance matrix; for this reason any plasma model can be used, and at present the FELICE code has been adopted; special techniques have been adopted to parallelize the code and to increase the numerical efficiency.

The TOPICA suite has been tested against assessed codes and against measurements of mock-ups and existing operating antennas. The comparisons have demonstrated a very good agreement, leading to a validation of TOPICA as a predictive tool.