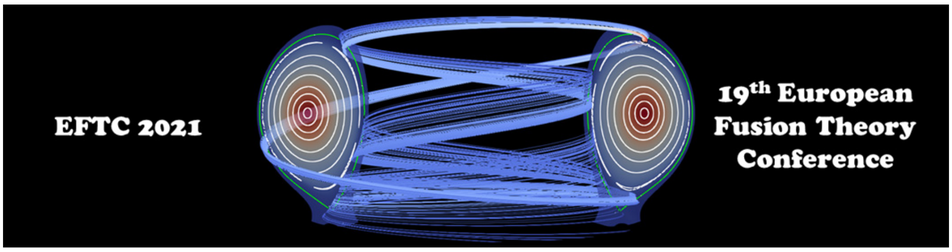

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ANTITER IV modeling of excitation by an ICRH antenna of near fields and of their propagation along the plasma edge in view of a future fusion reactor.

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Understanding the field excitation and power losses in the plasma edge from an ICRH antenna is of paramount importance to avoid impurity release from the edge in reactor conditions. The semi-analytical code ANTITER IV provides a complete description in plane geometry (z along the total B0 field in front of the antenna, x the radial component) in the cold plasma approximation and with appropriate boundary conditions of the excitation of Fast (F) and Slow (S) waves in the inhomogeneous plasma in front of the antenna. For usual non-inverted heating scenarios (i.e. ω>ωci of majority ions) the Lower Hybrid (LH) resonance is present in the SOL region of the plasma density profiles considered in this study, representative for large machines like ITER or DEMO. The system of 4 first order differential equations describing the waves is singular at the position of the LH and integration through the LH layer is performed by analytical continuation. The S waves are excited by their confluence with the F waves or directly by the Ez component radiated by the antenna. The case of the 24 straps antenna array of ITER is modeled using reference profiles for low and high coupling conditions. An antenna based on this design is presently considered for DEMO. The analysis is made for an antenna and Faraday screen that are non field-aligned with respect to B0 and compared to the field-aligned cases. The results show that, for the considered density profile in front of the antenna: (i) A surface is wave excited along the LH layer together with TEM/z coaxial modes propagating between the wall and the LH region. These are decaying waves at both sides of the antenna but are of significant amplitude far from the antenna. (ii) The radial electric field component Ex is dominant in front of the antenna and along the wall for all antenna phasing cases. The Ez component is much smaller even if the Faraday screen is not aligned with B0. (iii) Ex is resonant at the LH resonance and is the only RF electric field component entering into the power loss expression at the LH. (iv) The minimization of the low |kz| components in the antenna excitation spectrum, mainly in the region |kz|=k0, leads to a reduction in the Ex amplitude in front and on the edges of the antenna, the amplitude of the coaxial and surface waves and the edge power loss. It leads also to a reduction of the z component of the surface current density Jz=-Hy at both sides of the antenna array. (v) The large Ex component extending outside the antenna region and diverging at the lower hybrid layer could be a main cause for the impurity production by an ICRH antenna. (vi) When the density profile is amputated to avoid the LH density the edge wave behavior is strongly modified, the edge power losses cancelled and the coupling results to the plasma center can be perturbed. Such a modeling simplification can lead to wrong conclusions.

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