Modelling of LHCD at various densities in Tore Supra tokamak

J. Decker\textsuperscript{1}, E. Nilsson\textsuperscript{1,2}, Y. Peysson\textsuperscript{1}, J.-F. Artaud\textsuperscript{1}, A. Ekedahl\textsuperscript{1}, J. Hillairet\textsuperscript{1}, M. Goniche\textsuperscript{1}, T. Hoang\textsuperscript{1}, F. Imbeaux\textsuperscript{1}, D. Mazon\textsuperscript{1}, and P. Sharma\textsuperscript{3}

\textsuperscript{1} CEA, IRFM, F-13108, Saint-Paul-lez-Durance, France.
\textsuperscript{2} Applied Physics, Chalmers University of Technology, S-41296 Göteborg, Sweden
\textsuperscript{3} Institute for Plasma Research, Bhat, Gandhinagar - 382428, India

In the Tore Supra tokamak, lower hybrid (LH) waves are used to heat electrons and drive a toroidal current in a variety of plasma conditions, including fully non-inductive scenarios. The LH wave is coupled to the plasma using a fully active multijunction (FAM) launcher and/or a ITER-relevant passive active multijunction (PAM) launcher \cite{1}. Hard X-ray measurements during high density LHCD experiments show a photon count decreasing with density at a much faster rate than anticipated \cite{2}.

In this work, LHCD modelling using a new modelling suite is presented. Tore Supra discharges are simulated using the METIS transport code for plasma equilibrium and kinetic profiles. Using LH spectra from the coupling code ALOHA, the wave propagation is calculated using the ray-tracing code C3PO. It is found that 36 rays, corresponding to the six waveguide rows and the six main lobes in the LH spectrum, are sufficient to correctly describe the LH wave propagation. The electron distribution function is calculated by the 3D Fokker-Planck code LUKE. Full convergence is obtained in the self-consistent calculation of the distribution function and the power absorption along all rays.

The driven current calculated by LUKE and a synthetic diagnostic of the bremsstrahlung emission (R5X2) provide a comparison of LHCD modelling results with experimental measurements. LHCD simulations are found to agree well with experimental observations for relatively low density plasmas ($\bar{n} < 2 \times 10^{19}$ m\textsuperscript{-3}). At higher density, the LH wave propagation enters a new regime for which the validity of ray tracing modelling becomes questionable. Not surprisingly, the comparison between modelling and experiments is not satisfactory in these conditions. Possible mechanisms explaining the strong decrease in hard X-ray signal at higher density are discussed.

References
