24th IAEA Fusion Energy Conference - IAEA CN-197

Contribution ID: **235** Type: **Poster**

TH/P6-11: Integrated Plasma Simulation of Lower Hybrid Current Profile Control in Tokamaks

Thursday, 11 October 2012 14:00 (4h 45m)

Lower hybrid (LH) waves have the attractive property that they damp efficiently via Landau resonance at relatively low electron temperature on "tail electrons" at parallel phase speeds that are approximately 2.5 - 3.0 times the electron thermal speed. As a consequence they can be used to drive current in the outer half of tokamak plasmas in order to broaden the current profile and access and optimize improved energy confinement regimes. In order to assess the use of lower hybrid (LH) current profile control in present day devices and in future reactor designs we have developed a time dependent simulation capability for this type of plasma control and tested it using sawtooth modification experiments via LHCD that were performed in the Alcator C-Mod device. These experiments were initially simulated using the TSC transport code to evolve the background plasma and the Porcelli model to predict sawtooth behavior. The LHCD was calculated using the LSC code and the predicted LH current was 200-250 kA with a total plasma current of 450 kA.

In order to improve the physics fidelity of the LHCD calculation we have taken advantage of a parallel framework, the Integrated Plasma Simulator (IPS), where the driven LH current density profiles are computed using a ray tracing component (the GENRAY code) and a Fokker Planck component (the CQL3D code), that are iterated in a coupled time advance with TSC. The GENRAY code affords a more detailed description of the LH launcher including its poloidal extent and the CQL3D code allows for an accurate description of the 2-D velocity space effects in the wave damping; both effects of which are known to be very important for LH wave propagation and absorption.

We shall present time dependent comparisons of predicted profiles of LH current drive obtained from both coupled TSC-LSC and TSC-GENRAY-CQL3D simulations over an entire discharge simulation. The IPS framework also includes an ion cyclotron range of frequency (ICRF) component, the massively parallel TORIC solver. We will also show predictive simulations for C-Mod where LHRF power is injected into discharges that have been pre-heated using the ICRF mode conversion heating scheme in order to raise the background electron temperature and thus increase the single pass damping of the LH waves into the target plasma.

Country or International Organization of Primary Author

USA

Primary author: Mr BONOLI, Paul T. (USA)

Co-authors: Dr HUBBARD, A. E. (Massachusetts Institute of Technology); Dr KESSEL, C. E. (Princeton Plasma Physics Laboratory); Dr BATCHELOR, D. B. (Oak Ridge National Laboratory); Dr WRIGHT, J. C. (Massachusetts Institute of Technology); Dr CHEN, J. (Princeton Plasma Physics Laboratory); Prof. PARKER, R. R. (Massachuetts Institue of Technology); Dr HARVEY, R. W. (Compx Corporation); Dr JARDIN, S. C. (Princeton Plasma Physics Laboratory); Dr SHIRAIWA, S. (Massachuetts Institute of Technology)

Presenter: Mr BONOLI, Paul T. (USA)

Session Classification: Poster: P6

Track Classification: THW - Magnetic Confinement Theory and Modelling: Wave–plasma interactions; current drive; heating; energetic particles