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EX/P6-24: Recent Progress on Lower Hybrid Current Drive and Implications for ITER

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The demonstration that a sustainable production of energy is achievable from nuclear fusion in a tokamak requires controlling non-inductive current drive plasmas in steady state conditions. Following the ITER Science and Technology Advisory Committee recommendation, LHCD is now considered for a future upgrade of its heating and current drive (H&CD) capability. Preparing the ITER steady state operations not only requires the development of ITER operating scenarios or burning plasma physics, but also to master the LHCD auxiliaries. The achievement of stationary plasmas sustained by LHCD, i.e. zero loop voltage discharges over durations much longer than the resistive time scale and the total thermalisation time scale of the tokamak components, obliges to address a number of technological and physical challenges: development of high power Continuous Wave (CW) radiofrequency (RF) sources, actively cooled transmission lines with low RF power loss, antennas with high coupling efficiency, real time control systems and diagnostics and LH current deposition modeling. In order to minimize the operational risks for ITER, all of these items - from the RF sources to the current deposition calculations - must have a high reliability and efficiency.
In order to address these steady-state operational issues, eighteen klystrons have been validated routinely at ~ 620 kW/CW in relevant Tore Supra plasma conditions. The Passive-Active Mulitjunction (PAM) is an ITER-relevant concept whose capabilities to address long pulse operation issues has been demonstrated in Tore Supra. A general framework for modeling the current drive by coupling the ray tracing calculations and Fokker-Planck solver has been developed. This scheme reproduces efficiently the HXR signal of Tore Supra steady state discharges and can be used as a predictive tool for the design of next-generation LH launchers.
Based on the latest LHCD results obtained in the Tore Supra tokamak, a re-design of the 20 MW LH system for ITER has been conducted through an international collaborative task, coordinated by CEA/IRFM under the EFDA organization. In 2011, a 5 GHz mode converter has been successfully tested at low power, Furthermore, a 5 GHz window will be tested at high power in collaboration with the National Fusion Research Institute (NFRI) in South Korea in 2012.

Country or International Organization of Primary Author

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Collaboration (if applicable, e.g., International Tokamak Physics Activities)

International Design and Physics Activities

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