**Power balance analysis of JET-ILW L-H transition in Deuterium plasmas**

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The understanding of the physics governing the transition from low (L) to high (H) -mode confinement and of the existence of a plasma density, \(n_{\text{e,min}}\), at which the power to access H-mode is minimum, has strong implications for ITER operation and DEMO design. Studies in the last decades on different tokamaks have sometimes shown a flattening or even a minimum of the L-H power (\(P_{\text{L-H}}\)) threshold as a function of density. On JET C-wall, the rollover of the power threshold at low density was not observed in all divertor geometries, it reappeared only with the installation of the JET-ILW (ITER-like wall) [1]. In JET, both the power threshold and the value of \(n_{\text{e,min}}\) (when observed) depend on toroidal field and plasma shape. Results from ASDEX-Upgrade ( AUG) and Alcator C-mod (C-mod) experiments suggested that the variation of the ion heat flux with density, dominated by equipartition in electron heated plasmas, can explain the non-monotonic density dependence of the L-H threshold power [2], [3].

Based on data from dedicated L-H transition experiments in JET-ILW with Deuterium plasmas heated by Neutral Beam Injection (NBI), interpretative numerical simulations have been run with JINTRAC suite of codes [4] to carry out a power balance analysis, estimating in particular the power coupled to ions at the L-H transition. The NBI power deposition is estimated with ASCOT Monte Carlo code [5]. For pulses where core ion temperature (T\(_i\)) measurements were not available, the quasilinear gyrokinetic transport model QuaLiKiz-JETTO [6] is used to predict core T\(_i\). Since the position of the divertor strike points strongly influences \(P_{\text{L-H}}\), each plasma shape has been considered as a separate dataset. For the JET discharges analyzed (\(B_{\text{tor}}=3\ T, I_{\text{p}}=2.5\ \text{MA}\)), ion heating is dominated by direct NBI heating, and the electron-ion equipartition power term is generally lower in magnitude than NBI power to ions. This result is exemplified in fig. 1, referring to 3 discharges, at different average densities, of high-triangularity “Horizontal Target” (HT) plasmas, having the outer strike point located in a tilted, almost horizontal, divertor tile. Similar results are found for the other sets analyzed, namely a low-triangularity HT dataset, and a “Vertical Target” dataset, with plasmas having both inner and outer strike points on vertical target tiles. For these L-H transitions in JET, the existence of a minimum ion heat flux, at given plasma density, seems to be in agreement with results from NBI-heated AUG discharges, while it appears different from radio-frequency heated plasmas, where such a minimum was not observed. Similarities and differences with other devices are discussed, in particular with respect to AUG and C-mod results. Modelling of the L-mode edge prior to the transition is also presented, focusing on the micro-turbulence analysis performed at various densities with the gyrokinetic code GENE [7].

![Fig. 1: Power balance terms for high-triangularity JET D-plasmas at different volume-averaged densities in the divertor configuration named “Horizontal Target” (shown in the right-bottom corner).](image-url)

**References**