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EX/6-1: The Effect of ELM Mitigation Methods on the Access to High H-mode Confinement (H_98˜1) on JET

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Since ITER is expected to operate at powers close to the H-mode threshold power scaling, it is important for ITER predictions to investigate the confinement and plasma dynamics in H-modes for heating powers marginally above the H-mode threshold power (P_{L-H}). The JET experience is that such operation leads to a transient behavior of the H-mode, with transitions from Type I ELMs to Type III or L-mode. One question relevant to the extrapolation to ITER is to which extent this transient behavior is related to the ELM dynamics (loss power in between ELMs, ELM crash) and therefore if it can be changed, and how, with ELM amelioration methods.
This paper describes experiments carried out in JET before the installation of the ITER-like wall to investigate the influence of ELM amelioration on the power requirements to obtain and maintain target H-mode confinement (H_{98y}˜1) in stationary conditions. Two ELM mitigation methods were used in these experiments: edge magnetic perturbations (static, n=2) produced by Error Field Correction coils (EFCCs) and ELM pacing by fast vertical movements of the plasma column ('vertical kicks').
Experiments have shown that the power needed to access the stationary type I ELMy H-mode regime was reduced by ˜40% (in high triangularity plasmas) with the use of vertical kicks without loss of confinement. On the other hand, applying edge magnetic perturbations in H-modes with P_loss close to P_{L-H} leads to a behavior of the H-mode normally associated with even lower P_loss (i.e. a Type I ELMy H-mode reverts to low ELM frequency regime). A set of experiments using slow NBI ramps during the application of EFCCs showed that while the P_{L-H} decreases in pulses with I_EFCC=2-3kA, the power required to achieve stationary conditions with regular type I ELMs in the same pulses increases, suggesting that different mechanisms are at play. The results obtained with both mitigation methods suggest that the power threshold for the type I ELM regime (with H_{98y}˜1 in stationary conditions) is not simply proportional to the power above PL-H and other mechanism such as the ELM dynamics also plays a role. Analysis of the local plasma edge conditions leading to the H-mode and the plasma evolution after the L-H mode transition, will be presented and directions for future work discussed.

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