Pedestal structure and stability of high-performance scenarios with I-mode-like pedestals in JET with the Be/W wall

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Recent experiments in JET with the Be and W wall have shown that operation at low density and high pedestal temperature opens a path for developing plasma regimes that allow simultaneous access to good energy confinement and small ELMs, while maintaining plasma density and radiation in stationary conditions. Improving our understanding of the mechanisms governing the access to small ELMs in those conditions is of interest due to the need in ITER to avoid the sizeable transient heat flux associated with type I ELMs. Two scenarios are included in the work presented here. A baseline scenario at low q_{95} (=3.2, 3 MA), with moderate NBI power (20-25 MW) and where the gas fuelling is completely removed (known as 'no-gas' Baseline Small ELMs (BSE) regime)[1,2]. These plasmas are characterized by achieving $T_i > T_e$ (starting from the pedestal region), strong rotation and ITER-relevant pedestal collisionality ($\upsilon^*_{e,ped}$~0.1). Conditions for small or fully suppressed ELMs were also found in high-performance scenarios at lower I_p=1.9-2.5 MA with dominant electron heating by ICRH (minority heating), explored in D and D-T plasmas[3], that exhibits core conditions closer to those expected in ITER, i.e. low torque and high electron heating. This highlights that the access to conditions with no or small ELMs at low density in JET does not depend on the heating mix or the isotope plasma composition. A common feature in both scenarios is the presence of an I-mode-like pedestal; whereas an H-mode-like pedestal is built up in the temperature profile, the density profile gradient resembles that found in L-mode. In contrast to observations of the I-mode in other devices, no edge coherent MHD activity (WCM) is detected. Experimental evidence indicates that the abovementioned regimes are likely linked to L-H transitions in the low-density branch[4]. Turbulence modelling has shown the intricate dynamics of plasma confinement and turbulence in these scenarios[1,3,5]. This contribution focuses on the pedestal structure and ELM dynamics obtained in those plasma regimes where the pedestal conditions are deeply stable for the peeling-ballooning and KBM modes, contrary to what usually happens with type I ELMs. Interestingly, operation at low pedestal collisionality in a high q_{95}(~8-9, 1.4 MA) hybrid scenario (with pedestal density values similar to those found in the BSE regime) results in large type I-ELMs[6], with edge profiles having steep gradients in both temperature and density, which shows that the lower density gradient is the key parameter determining the access to small ELMs in plasmas with I-mode-like pedestals. Investigating the similarities and differences between these different operating regimes provides valuable insight into the physics mechanisms involved in accessing good H-mode confinement at low density (and low $\upsilon^*_{e,ped}$) and the onset conditions for small ELMs in those conditions.

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