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On the continuous confinement transition between "baseline" and "hybrid" plasmas in JET with an ITER-Like Be/W Wall

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Experiments with the JET ITER-like wall have shown that confinement is often lower than the IPB98(y,2) scaling in low beta plasmas, typical of the "baseline" domain foreseen for ITER Q=10 operation, while high beta "hybrid" plasmas have achieved improved confinement compared with the scaling. JET "baseline" and "hybrid" plasmas differ in terms of beta, q95 and initial q-profile, as well as operational aspects such as gas injection rate. These results motivated an investigation to determine if there is a bifurcation or a smooth transition between the two domains and to identify the key plasma parameters explaining the departure from the scaling. Plasmas with initial q-profiles typical of the "baseline" and "hybrid" domains were compared at same beta and q95. Additionally, the heating power was varied to produce plasmas with a range of beta, keeping the same initial q-profiles. The results show confinement to be insensitive to the initial q-profile, but to increase with respect to the IPB98(y,2) scaling as power increases, such that H98 increases from 0.85 to 1.2 as normalized beta rises from 1.4 to 2.5. The detailed scan in heating power shows that the power degradation of confinement is weaker than that of the IPB98(y,2) scaling, with a smooth, continuous transition between the two domains. The weak power dependence of confinement is thought to be due to the interplay between many factors affecting core transport (ExB flow shear; fast ion pressure; electromagnetic effects; collisionality) and H-mode pedestal height (which is consistent with peeling-ballooning stability modelling in shots with low gas rate injection rates). Operational factors also play a role: e.g. high gas injection is needed to avoid high W concentration, however, this reduces the energy confinement. These results show the importance of including all key core and edge physics processes to predict the confinement behavior in future devices.