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Scenario development for DT operation at JET

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The JET exploitation plan foresees D-T operations in 2019-20. With respect to the first D-T campaign in 1998, when JET was equipped with a C wall, the experiments will be conducted in presence of a Be-W ITER-like wall and will benefit from an extended and improved set of diagnostics and higher available additional power. Among the challenges presented by operations with the new wall there are a general deterioration of the pedestal confinement, the risk of heavy impurity accumulation in the core, and the requirement to protect the W divertor from excessive heat loads. Therefore, an intense activity of scenario development has been undertaken at JET during the last three years to overcome these difficulties and to achieve a stationary scenario of the duration of 5 seconds featuring H_{98}>0.9, W_{th}≈10-12 MJ towards the lowest values of $\rho and\ \nu$ achievable on JET.

Two complementary scenarios are being developed to approach the problem of developing a scenario suitable for high-performance D-T operation. The baseline scenario (β_N~1.8 and H_{98}~1.0) concentrates mainly on pushing the operation towards the high current and field limits with a relaxed current profile, whereas the hybrid scenario (β_N~2-3 and H_{98}>1.0) exploits the advantages of operating at high normalised beta with a shaped current profile above unity. Encouraging results were achieved for the baseline scenario at 3MA/2.8T and for the hybrid scenario at reduced plasma current (2.2-2.5MA/2.8-2.9T). High-performance plasmas with H_{98}~0.9 producing ~3 10^{16} neutrons/s were obtained for >5 energy confinement times (~1.5s).

A third scenario, has also been developed for alpha particle studies. This scenario aims at maintaining high plasma performance for 1-2s to generate a significant population of α-particle for the α-particle studies and deliberately omits ICRH heating to avoid creating RF driven fast particles, which could mask the effect of the fusion-generated α-particles. In these pulses ICRH induced TAEs were observed after the NBI switch-off compatibly with the beam fast ion slowing-down time.

The results of all scenarios have been the object of an extensive activity of code validation and modelling and extrapolated to the target D-T scenarios.

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