Plans and progress on JET for the full D-T campaign in 2021

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JET’s currently unique capabilities to prepare for a full D-T campaing are Tritium handling and ITER-like wall (ILW: Be wall and W divertor). It is the culmination of years of concerted scientific and engineering work, with the ITER like wall, improved diagnostic capabilities, now fully available, a major Neutral Beam Injection (NBI) upgrade providing record power of up to 32MW, and the technical & procedural preparation for safe operation with tritium. Integrated scenarios preparation for high fusion power sustained for 5s progressed significantly for the two routes investigated: ‘Baseline’ (q95~3, Ip≥3MA, βN<2) and ‘Hybrid’ (tailored q-profile, q95~4.5, Ip≤2.7MA, βN ≥ 2.4). Peak neutron rateσ of 4.2x1016n/s are obtained simultaneously with tolerable divertor temperatures and controlled high/medium Z impurity for the full pulse duration in Baseline plasmas at 3.3T/3.5MA, with PTOT=34MW (NBI and Ion Cyclotron Resonance Heating (ICRH)). Pellets help controlling the ELM frequency (fELM) needed for impurity flushing, with low total D2 throughput for high confinement. Hybrid plasmas developed to 3.4T/2.3MA reached 4.8x1016n/s but MHD avoidance and fELMs control must be optimised for improved, steady performance. The equivalent PD-T for these pulses is consistent with past predictions at same BT, IP, PTOT giving confidence in the theory-based modelling. Further gains are likely with 40MW auxiliary power now reachable and higher IP, with divertor heat loads controlled by strike-point sweeping, thus prospects for reaching the target (5x1016n/s) are good. In these conditions PD-T=11-16MW is predicted by theory-based physics models, where the uncertainty in the auxiliary power is due to uncertainties in the pedestal predictions and isotope effects.

EUROfusion is planning DT experimental campaigns in 2020 on JET with the ITER-Like Wall (DTE2) to address key physics and technological issues for the DT experiments in ITER. The paper will review the key elements developed for DTE2 preparation, which includes DT operation scenario and the fusion power predicted with first-principle modelling, isotope effect studies, and technological hardware improvements for DT plasma operation. To achieve the scientific objectives in DTE2, JET operation should demonstrate 15MW of fusion power for 5 seconds stationary state, a performance never attempted before in fusion-research history. For optimized operation in DTE2, the isotope effects and DT scenarios will be further exploited in the DD and TT campaigns during 2020. This paper will also introduce the tests for the Shattered Pellet Injector, which is ITER’s main strategy to mitigate disruption and runaway electrons.