Deuterium-tritium experiments in JET with the ITER-like wall

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In 2021, high fusion power deuterium-tritium experiments (DTE2) were performed in JET for the first time since the 1997 D-T campaigns in TFTR and JET (DTE1). This represents the culmination of a plan in support of ITER that started with the conception of the ITER-like wall (ILW: W divertor and Be main chamber) in 2006, and included several enhancements (diagnostics, heating power & new operational scenarios), as well as dedicated experimental campaigns to expand the operational space in JET-ILW and prepare the plasmas required to exploit JET's currently unique tritium handling capabilities.

DTE2 delivered fusion energies exceeding the previous record (59MJ compared to 22MJ in DTE1) and demonstrated the compatibility of sustained high performance D-T plasmas with the ILW. The fusion power in the different operational scenarios performed is consistent with predictions made before DTE2. Experiments designed to address specific physics questions provide a unique set of data, with several notable preliminary results. Compared to their deuterium counterparts, D-T plasmas require lower input power to reach the high confinement mode (H-mode) relied on in ITER and show better energy confinement. The plasma edge (H-mode pedestal) pressure increases with the ratio of T to D, with improved measurements allowing better understanding of its contribution to global confinement. The total W source is higher for T ions than D, but the concentration in the high power D-T plasmas remains tolerable, at least in part due to strong core heating and screening. Unambiguous observations of alpha particles and of alpha-driven instabilities were obtained, providing a unique dataset for testing predictions. Efficient core heating and impurity control was observed with the Ion Cyclotron Radio Frequency schemes considered for ITER D-T operations: ^{3}He minority heating, and a D-^{9}Be-T three-ion scheme with the Be that is naturally present in the ILW. Plasmas with neon seeding, as planned in ITER to reduce the divertor power loads, were performed, with indications that the neon can also lead to improved confinement.

This plenary talk will summarise the motivation for, and the journey towards, DTE2, but will focus on the execution of the DTE2 experiments and main results, describing some of the challenges encountered, and highlighting how the unprecedented observations inform the preparation for ITER and other future fusion devices D-T operations.