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Plasma and diagnostics preparation for alpha-particle studies in JET DT

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A deuterium-tritium (D-T) experimental campaign DTE2 on JET scheduled for 2019-2020,will be done in the Be/W vessel and will address essential operational, technical, diagnostic and scientific issues in support of ITER [1]. In preparation for the campaign, developments were performed on JET aiming at studies of alpha-particles. For studying AEs driven entirely by alpha-particles, a scenario similar to the TFTR beam "afterglow" [2] was developed for JET. In DT plasmas, after NBI is switched off, alpha-particles will be the only energetic ions during time interval between slowing-down times for NBI-produced ions and alpha-particles. Detection of alpha-driven AEs in this time window may help in diagnosing the temporal evolution of the pressure profile and slowing-down time of alpha-particles. JET advanced tokamak scenarios with q ≈ 1.5-2.5 were chosen and discharges have been successfully developed. The transport modelling extrapolated to DT predicted that alpha-particle beta of ≈ 0.1% could be achieved comparable to that in successful TFTR experiments.
In "hybrid"scenario plasmas with q0 ≥ 1, fast ion losses in the MeV energy range were observed during n=1 fishbones driven by a resonant interaction with D beam ions in the energy range ≤ 120 keV [3]. The losses are identified as an expulsion of D-D fusion products, 1 MeV tritons and 3 MeV protons. A mode analysis with the MISHKA code combined with the study of nonlinear wave-particle interaction with HAGIS show that the loss of toroidal symmetry strongly affects the confinement of high energy tritons and protons by perturbing their orbits and expelling them in a good agreement with experiment. The extrapolation to the case of alpha-particles in DTE2 hybrid scenarios with similar fishbones has shown an additional alpha-particle loss of ~ 1% [3]. References: [1] Weisen H et al., Fus. React. Diag., AIP Conf. Proc. 1612, 77-86 (2014); [2] Nazikian R et al., PRL 78, 2976 (1997); [3] Fitzgerald M et al, submitted to Nucl. Fusion (2018).

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