The power threshold of H-mode access in tritium and deuterium-tritium plasmas at JET with ITER-like wall

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The H-mode is the envisaged plasma regime for a tokamak fusion reactor, and is achieved if the heating power deposited into the plasma exceeds the L-H power threshold, P_{LH}. While there are plenty of studies about the main ion isotope dependence of P_{LH} in hydrogen (H) and deuterium (D) tokamak plasmas, much less data is available for tritium (T) plasmas and the reactor relevant mixture of deuterium-tritium (D-T). For metallic wall conditions, as it will be the case for ITER plasmas and future fusion reactors, no data was available until now, since the only systematic study of P_{LH} in T containing plasmas was done 1997 in JET with a carbon wall.

The recent campaign at JET with ITER-like wall was the first opportunity to investigate the isotope dependence of P_{LH} in T and D-T plasmas in a metallic wall device. During this campaign, data in ICRF and NBI heated plasmas of pure T as well as in H-T and D-T mixtures were taken for different magnetic fields and densities in order to compare the measured P_{LH} with established isotope dependent scaling laws. The main result of this investigation is that the measured P_{LH} scales inversely proportional to the effective isotope mass, A_{eff}, *if* the radiated power is subtracted from the input power. Without the subtraction of radiation, the isotope dependence is blurred especially for data of ICRF heated plasmas. The radiation-subtracted P_{LH} is about 40% lower than the ITPA P_{LH} scaling corrected by a factor $2/A_{\mathrm{eff}}$ to account for isotope effects. This confirms earlier investigations, which also found a lower P_{LH} in metallic wall conditions. Minor deviations from the inverse mass dependence might be related to the comparably low ion heating fraction found in NBI and ICRF heated tritium plasmas. Further results like the isotope dependence of the density, for which the minimum of P_{LH} is achieved, $n_{\mathrm{e,min}}$, and details of the dynamics of T and D-T plasmas around the L-H transition will be presented. Based on measurements of Doppler backscattering and CXRS the role of radial electric field and edge ion heat transport will be discussed.

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