Revisiting H, D, T studies of L-H transition in JET

E. R. Solano[1], P. Carvalho[2], M. Chernyshova[3], E. Delabie[4], J.C. Hillesheim[5], C.F. Maggi[5], E. Righi[6], G. Verdoolaege[7,8], and JET contributors*

[1] *Laboratorio Nacional de Fusión, CIEMAT, Madrid, Spain;*
[2]*Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Lisbon, Portugal*
[3]*Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland;*
[4]*Oak Ridge National Laboratory, Oak Ridge, TN 37831-6169, USA;*
[5]*CCFE, Culham Science Centre, Abingdon, UK*
[6]*European Commission, Brussels, Belgium;*
[7]*Department of Applied Physics, Ghent University, Ghent, Belgium*
[8]*Laboratory for Plasma Physics, Royal Military Academy, Brussels, Belgium*

Much of the information on the isotope scaling of the L-H transition power threshold, P_{LH}, in JET is derived from early experiments in Hydrogen (H), Deuterium (D) and Tritium (T) with C wall (JET-C) [1]. More recent experiments have studied P_{LH}(H) and P_{LH}(D) in JET-C [2,3] and JET-ILW [4], and have shown considerable variability in P_{LH} associated with divertor geometry, divertor strike point configuration, Carbon vs. ILW, Neutral Beam Injection (NBI) vs. Radio Frequency heating (RF) and plasma current or q_{95}, particularly for Hydrogen. Here we consider the dataset with toroidal field B_{tor}=1.8 T of all L-H transition experiments at JET, to see what we can learn about the isotope scaling of the L-H power threshold. It contains the only n_e scan for all 3 isotopes in the old data.

Reanalysing the old P_{LH} data, and using $P_{Martin} = 0.0488 n_{e20}^{0.717} B_t^{0.803} S^{0.941}$ [5] as a convenient metric, we find that $P_{LH}^{Old}(D, RF) = P_{Martin}$, while $P_{LH}^{Old}(H, RF \,\&\, NBI) = 1.6\, P_{Martin}$. In Tritium the data is in a very narrow density range, (1.5-1.8)×10^{19} m^{-3}, lowest n_e with NBI, higher with RF, with different slopes, so the n_e scaling of $P_{LH}^{Old}(T)$ is quite uncertain, with $P_{LH}^{Old}(T)$ values falling between (0.67-0.9)P_{Martin}. In the JET-ILW $P_{LH}^{ILW}(H, RF + NBI) = 2.6\, P_{Martin}$ for the configuration (strike points in corners of divertor) most similar to the old one, but we lack data in D at this field and shape.

For scaling to high field it is especially important to investigate the low field point, which can heavily influence extrapolations. One implication of this study is that we should create a $P_{LH}(D)$ dataset at 1.8 T in Corner configuration and consider studying $P_{LH}(T)$ in Corner at 1.8 T in a broad density range in the forthcoming isotope campaigns at JET.

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*See the author list of X. Litaudon et al 2017 Nucl. Fusion 57 102001