

L-H transition studies at JET: challenges to theory

E. R. Solano¹, C. Silva², G. Birkenmeier^{3,4}, J. Hillesheim⁵, E. Delabie⁶, J. Garcia⁷, C. G. Maggi⁵, F. Parra-Diaz⁸ and JET Contributors*

¹Laboratorio Nacional de Fusión, CIEMAT, Madrid, Spain

²Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, Portugal

³Physik-Department E28, Technische Universität München, 85748, Garching, Germany

⁴Max-Planck-Institut für Plasmaphysik, D-85748 Garching, Germany

⁵CCFE, Culham Science Centre, Abingdon, Oxon, OX14 3DB, UK

⁶Oak Ridge National Laboratory, Oak Ridge, TN 37831-6169, TN, United States of America

⁷CEA, IRFM, F-13108 Saint Paul Lez Durance, France;

⁸Rudolf Peierls Centre for Theoretical Physics, University of Oxford, Oxford OX1 3PU, UK

We present results from a variety of dedicated L-H transition studies at JET-ILW, emphasizing the discrepancies between experimental data and accepted models of the transition.

From earlier experiments in JET-ILW it is known that as plasma isotopic composition changes from deuterium, through varying deuterium/hydrogen concentrations, to pure hydrogen, the value of the density at which the threshold is minimum, $n_{e,\min}$, increases, leading us to expect $n_{e,\min}(T) < n_{e,\min}(D)$. Preliminary analysis of the first JET-ILW Tritium L-H experiments, shows transient ohmic L-H transitions for $n_e < n_{e,\min}(D)$, as expected. At higher densities, with NBI heating, we see hints of $P_{LH}(T) < P_{LH}(D)$.

An analysis of Doppler reflectometer measurements of the radial electric field in D and He plasmas has been carried out. We do not find a critical radial electric field value or v_{ExB} rotation before the transition. Instead, it appears that the diamagnetic velocity, proportional to ∇p , may be a better indicator of the required conditions for an L-H transition.

In H vs D it has been shown that the reason for the increased P_{LH} in H is that lower confinement in H implies higher fuelling and power are required to match the edge pressure profiles before the transition. This also tells us that ∇p before the transition is important, and is a reminder that P_{LH} is in fact determined by plasma transport characteristics in L-mode. Planned confinement studies in T may help elucidate this connection.

*See the author list of 'Overview of JET results for optimising ITER operation' by J. Mailloux et al to be published in Nuclear Fusion Special issue: Overview and Summary Papers from the 28th Fusion Energy Conference (Nice, France, 10-15 May 2021)