The role of ELMs and inter-ELM phases in the transport of impurities in JET


EUROfusion Consortium, JET, Culham Science Centre, Abingdon, OX14 3DB, UK
1 Consorzio RFX, Padova, Italy, 2 Max Planck Institut für Plasmaphysik, Garching, Germany,
3 CCFE, Culham Science Centre, Abingdon, OX14 3DB, UK,
4 Queen’s University, Belfast, UK
5 Laboratorio Nacional de Fusión, CIEMAT, Madrid, 28040, Spain
6 CEA-IRFM F-13108 Saint-Paul-lez-Durance, France
7 Max-Planck Institut für Plasma Physik, 17491 Greifswald, Germany
8 KTH, Royal Institute of Technology, Sweden
9 ITER Organization, Route de Vinon sur Verdon, 13115 Saint Paul Lez Durance, France
10 Department of Physics SUPA, University of Strathclyde, Glasgow, G4 ONG, UK

This contribution is about the experimental and modeling activities carried out at JET in order to assess the physics mechanisms that control the penetration of medium and high Z impurities into the plasma core and to provide physics basis for the ELM-control requirements in ITER. In particular the interest is to assess the relative role of ELM’s and inter-ELM phases in the transport of impurities.

The experiments consisted in injecting traces of Ne, Kr and Mo in ELMy H-mode plasmas characterized by various ELM frequencies and/or input power.

Typical inverse proportionality is seen between the concentration of the injected impurities and the ELM frequency, irrespective of the atomic number.

The comparison between natural ELMs and kick-triggered ELMs at the same frequency in 2 MA, 2.1 T, low triangularity discharges, shows that, within the uncertainties, spontaneous and artificial ELMs are equally effective in flushing impurities out.

Losses of Mo due to single ELM’s are estimated by modeling the SXR data, while ELM induced Neon losses are obtained from the time resolved evolution in between ELMs of edge density profiles provided by charge exchange measurements. The relative Kr content is instead evaluated from Kr XXVI emission lines.

Modeling is based on the JINTRAC suite of codes.

Interestingly, the inward neoclassical pinch associated to the edge kinetic gradients in the inter-ELM phases and evaluated by means of the NEO code is seen to decrease in high power hybrid discharges suggesting that higher power could lead to ITER-like conditions where heavy impurity penetration is expected to be prevented by favorable edge barrier gradients.

Ablations of Mo in coincidence with ELM events are analyzed to investigate the nature of the impurity transport during an ELM, whether diffusive or convective.

*See the author list of “Overview of the JET results in support to ITER” by X. Litaudon et al. to be published in Nuclear Fusion Special issue: overview and summary reports from the 26th Fusion Energy Conference (Kyoto, Japan, 17-22 October 2016)