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The role of ELM's and inter-ELM phases in the transport of heavy impurities in JET

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Experimental and modeling activities have started at JET in order to carry out an assessment of the physics mechanisms that control the penetration of high Z impurities from the divertor into the core plasma and to provide firm physics basis for the ELM-control requirements in ITER. The experiments are based on the injection of traces of extrinsic impurities in various ELMy plasmas, thus avoiding the variation of the impurity source with plasma conditions which complicates the interpretation of the data. Soft X-Ray time traces of Mo injections show clear drops at each ELM events. The corresponding losses of Mo can be estimated by modeling the data and can be correlated to the ELM amplitude and to the main density losses. Emission lines of Li-like Ne reveal the dynamics of the region just inside the separatrix. Typical inverse proportionality is seen between the emissivity of the injected impurities and the ELM frequency, irrespective of the atomic number. A detailed comparison is made between natural ELMs and kick-triggered ELMs at the same frequency in 2 MA, 2.1 T, low triangularity discharges. Preliminary considerations indicate that small differences in the impurity behavior may be attributed to the differences in the background plasmas. Modeling is based on the JINTRAC suite of codes that include 2D edge and 1 D core transport descriptions of the ELM cycle, with the kinetic profiles from the experiment. The impurity transport in the SOL during ELM's involves complex mechanisms that affect directly impurities and the background plasma. Comparison with physics based MHD models is foreseen.
The search for ITER-like conditions where an hollow W density profile develops at the edge of the JET plasma is driven by the observation that the proxy for the neoclassical convection at the edge barrier, based on the electron density and temperature normalized gradients, statistically decreases with increasing power suggesting that neoclassical convection could reverse and become outward directed for sufficiently high power. More in general, this work extends to the edge the effort that is being pursued in JET to understand the behaviour of heavy impurities in the plasma core and represents a step in the direction of an integrated and self-consistent approach to the problem of the heavy impurity study and control in present and future devices.

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