ELM Energy/Particle Plasma Losses and Fluxes on Plasma Facing Components

Alberto Loarte

EFDA-Close Support Unit Garching
Max-Planck-Institut für Plasmaphysik
D-85748 Garching bei München, Germany

Energy fluxes caused by Type I ELMs in next step tokamak devices may lead to energy fluxes on Plasma Facing Components (PFCs) which limit their lifetime due to the associated evaporation and/or melting. Systematic studies to characterise the loss of energy and particles and their transport to PFCs have been carried out in all major divertor tokamaks and have provided a common qualitative/quantitative picture of the processes involved in the transport of energy during ELMs. Despite this common picture, the detailed understanding of these processes in terms of the various physics mechanisms involved is far from complete :

a) The size of the ELM energy loss is intrinsically related to the mechanisms involved in ELM energy transport (smaller ELMs are observed when the dominant mechanism for transport is convection) but not to the volume in which the plasma parameters collapse at the ELM. This indicates that there is not a simple relation between characteristics of the ELM MHD trigger and the ELM energy loss, as initially proposed within the peeling-ballooning model picture of the ELM.

b) The transport of energy from the bulk plasma to the PFCs (divertor and main chamber limiters) seems to be correlated with the dominant transport mechanism for main plasma ELM energy loss. More conductive ELMs lead to a large proportion of the ELM energy flowing to the limiters than to the divertor targets, which is consistent with the measured large radial propagation velocities (~ 1 km/s) of the density perturbation in the SOL caused by the ELMs.

The paper will review the experimental evidence behind the above observations and will discuss their interpretation in terms of present models for the ELM collapse and suggest areas where theoretical/modelling developments for the understanding of Type I ELMs are required.