

Introduction

An ELM is an eruption of particles and heat from the edge of a fusion plasma [1]. They occur when the pressure at the edge becomes too great for the magnetic confinement, such that heat and particles must be released to maintain stability [1]. ELM dynamics, such as time evolution, spatial structure and heat loads, were studied to better understand the heat fluxes delivered to the divertor during these violent events. These issues will become increasingly important as we move to larger devices, such as ITER [2].

Time evolution of ELM heat fluxes

Infrared camera data was used to understand the evolution of the heat flux during an ELM in time.

• To investigate how the ELM heat flux changes during the ELM rise, a measure of progression through the ELM rise needs to be calculated for each frame.

• This was performed by calculating the time of the peak in the IR measurements relative to the midplane Dₖ spike. This is demonstrated in figure 4.

Spatial structure in MAST ELM heat flux profiles

• Filamentary structure in the heat flux profiles arises as the connection length to the field lines change as the filaments advect radially, tracing a spiral pattern on the divertor.

• Because each ELM filament is ejected at a random toroidal location, the filamentary structure will be randomly distributed radially, depending on where it was ejected toroidally (see figure 5).

• This method was applied to the ELMs in two DND MAST shots, demonstrating how the box-carring reduces the filamentary structure, see figure 6.

Heat Load

• The coverage of all strike points by the IR cameras in MAST (see fig. 2) allows us to investigate where the power ejected during an ELM is deposited within the machine

• This was performed by generating a database of ELMs in MAST plasmas. So far, this has focussed on the lower single null configuration

• ELMs were detected from their spikes in the midplane Dₖ.

• For each ELM, parameters such as frequency and peak heat flux were calculated from the raw data

Conclusions and Further Work

• The time evolution of ELM heat fluxes was studied in MAST using IR thermography

• By box-carring the data, filamentary structure was removed from the heat flux profiles

• This suggests that the structure due to filaments lies in a random pattern on the divertor

• The effect of time bins was compiled, showing an ‘average’ ELM heat flux profile evolve throughout the rise time of the ELM.

• Power asymmetries are being investigated in LSN discharges on MAST

• IR camera coverage of strike points on MAST facilitates detailed power balance studies

• Once the database of MAST ELMs has been benchmarked, a study in the power asymmetry in LSN plasmas will be performed.

References

[2] Loarte A. et al 2010 Prog. 23rd Int. Conf. on Fusion Energy

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