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MAST-U Super-X ELM simulation imaged by a simulated fast camera diagnostic

An ELM simulation for the MAST-U Super-X tokamak has been obtained using the nonlinear MHD code, JOREK. In previous MAST experiments the fast camera was used to image filaments during operation and due to the aspect ratio of MAST it was possible to image the whole tokamak. Here the image/video shows a simulated fast camera diagnostic, which has been used to image the filaments during an ELM simulation.

Edge localised modes (ELMs) are instabilities occurring in H-mode tokamak plasmas, resulting in filamentary structures that erupt violently from the plasma edge, degrading confinement and transporting heat and particles to the divertor. High heat fluxes are incident on the divertor targets during large ELMs, which will cause excessive erosion in future tokamaks [1]. The fast camera diagnostic can be used to image ELM filaments. On the MAST tokamak the fast camera images light, from the visible spectrum, during a discharge. The data gathered can be used to analyse the filamentary structure and dynamics.

This image/video submission attempts to replicate the fast camera diagnostic using a simulation of an ELM crash for a MAST-U Super-X tokamak plasma. The ELM simulation was obtained with nonlinear MHD code, JOREK [2], using the diffusive neutrals model. This simulation includes multiple toroidal mode numbers for a more realistic ELM crash, which results in a more violent crash and suppressed MHD activity after the ELM. When the crash occurs, filamentary structures erupt from the plasma edge. The filaments that form move out into the scrape-off-layer and the filaments rotate due to the inclusion of a rotational profile for the parallel velocity. An increase in the visible light is then seen around the baffle region and in the divertor, due to the flux of heat and particles. In this case, the visible light in the divertor region is so bright that a filter has been applied, which restricts the maximum light, in order to observe the filaments. The video represents a duration of 0.324 *ms*, which is a part of the full ELM simulation obtained. The JOREK fast camera diagnostic code was developed and first used for MAST simulations shown in [3]. This code has now been slightly adapted as the neutral density can be used directly from the simulation data instead of applying a fit, which was previously done in the two-temperature reduced MHD model in [3]. Per image there are 384,000 pixels corresponding to the lines of sight on which the radiation is integrated over, where the photon emissivity coefficient data is given as a function of density and temperature.

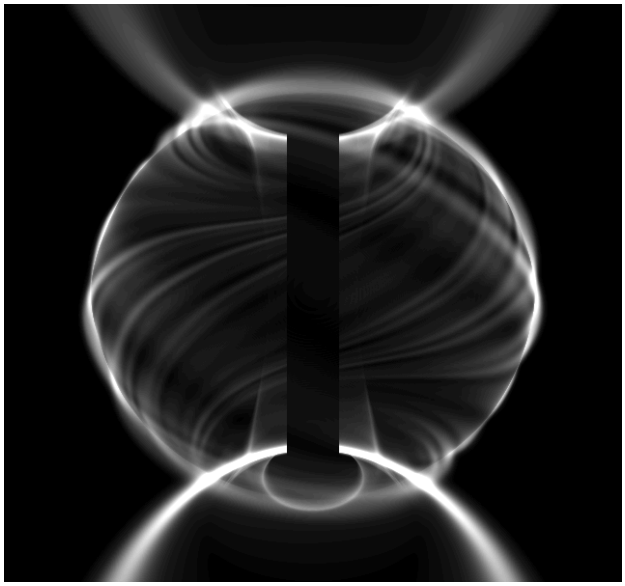

Fig. Filamentary structures are imaged during a MAST-U Super-X ELM simulation.

REFERENCES

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