

Overview of new MAST physics in anticipation of first results from MAST Upgrade

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MAST Upgrade will operate in 2018 with unique capabilities to explore plasma exhaust and alternative divertor configurations to address this key issue for DEMO.

Modelling of the interaction between filaments with BOUT++ indicates filaments separated by more than 5x their width move independently, and their velocity is slightly perturbed by if their separation is 1 width, suggesting radial density profiles can be modelled as the superposition of filaments. Secondary filaments on MAST are found up to 1ms after type-I ELMs that correlate with plasma interaction with surfaces near the X-point. A quiescent region devoid of filaments near the X-point has been routinely observed, extending from the separatrix to a normalised flux of 1.02. Counter-streaming flows of doubly ionised carbon along field lines, generated by localised gas puffing, have been observed and reproduced in EMC3-EIRENE simulations. MAST-U will be an excellent facility for understanding detachment onset and control in closed divertors. SOLPS modelling predicts the upstream density needed to reach detachment will be over 2x lower in the Super-X configuration compared with the conventional divertor due to increased total magnetic flux expansion. Analytic modelling predicts detachment control in a Super-X is more amenable to external control.

Detailed measurements of transport through the edge have been made in MAST L-mode plasmas to characterise a Geodesic Acoustic Mode 2cm from the separatrix. Interpretation of plasma potential profile measurements using ball-pen probes have been improved through kinetic modelling, showing that electrons polarise the material around the probe, leading to ExB drifts of ions to the probe.

Measurements of the effects of sawteeth on fast ion confinement on MAST indicate that passing and trapped particles are equally redistributed by the sawtooth crash. There is no apparent energy threshold for redistribution, indicating redistribution due to a mechanism resonant with the m=1 perturbation.

Gyrokinetic simulations of ETG turbulence in MAST are in close agreement with the measured collisionality dependence of the energy confinement time. Beam emission spectroscopy measurements show that flow shear leads to eddy tilting in up-down symmetric plasmas and skewed density fluctuations. First results from MAST Upgrade operations will be presented.

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