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OV/3-2: Overview of Physics Results from MAST towards ITER/DEMO and the Upgrade

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New diagnostic, modelling and plant capability on MAST have delivered important results in key areas for ITER/DEMO and the upgrade. Linear gyro-kinetic calculations highlight the interplay of kinetic ballooning and micro tearing modes in setting the pedestal width. Using the upgraded 18 coil ELM control array ELM mitigation by resonant magnetic perturbations (RMP) has now been demonstrated with n=3, 4 and 6 proving the importance of the alignment of the perturbation to the magnetic field lines with the unique phasing capability. Already a 2D equilibrium deformation consistent with lobe structures at the X-point, only observed when the RMPs affect the plasma, destabilises the ELM despite the lower pressure gradient. The interplay of edge flow shear and turbulence at the L-H transition measured by a new 50 kHz Doppler spectroscopy diagnostic shows limit–cycle like dynamics during ˜4-5 kHz H-mode dithers. Further insight into dn/dr, j and v may be provided by a novel 3D electron Bernstein emission imaging system. For the first time ELM resolved scrape-off-layer T_i profiles have been characterised simultaneously in the divertor and mid-plane with retarding field analysers. Divertor design is aided by ELM resolved data on the n_e and I_p dependence of target heat flux profiles. Under conditions foreseen for the upgrade (off-axis NBI, q_min>1.3, I_p> 0.8 MA) measurements of profiles of the neutron and fast ion D_alpha emission indicate a substantial reduction of the fast-ion redistribution compared to on-axis injection. To model the fast-ion redistribution due to the wave particle interaction driven by the super Alfvénic beam ions accurately dynamic friction is now included into the modelling recovering the observed non-linear mode behaviour well. Low-k turbulence, measured using a new 2D beam emission spectroscopy diagnostic, shows L-mode turbulence at r/a>0.7 propagating in the ion diamagnetic direction with respect to the local ExB flow and reduced turbulence levels in H-mode. Using in detail event triggering on NTMs the T_e perturbation due to the 2/1 island has been measured allowing detailed assessment of the NTM stability. Further studies of disruption mitigation with massive gas injection compared different gas mixtures and injection locations including a newly developed controllable high-field-side valve. Work supported by UK EPSRC and EURATOM.

Country or International Organization of Primary Author

UK

Primary author: Mr MEYER, Hendrik (UK)

Presenter: Mr MEYER, Hendrik (UK)

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