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EX/P5-17: MAST Contributions to the Exhaust Challenge, Including Testing of Super-X

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Developing an effective technical solution for handling plasma exhaust is a key part of designing DEMO. Over the last two years, the exhaust has been actively studied in MAST experiments, and in the analysis and design work for the upgrade project. This paper reports on recent experiments, and on the design of the upgraded divertor; with its capability of exploring the Super-X configuration.
The upgrade features great flexibility in the length and expansion of the low-field-side divertor legs, within chambers that are well closed off from the main chamber. The recent experiments have extended the characterisation of the present, open, MAST divertor, for direct comparison with results from the upgrade. Target profiles are measured with Langmuir probes and IR thermography. The density limit has been explored as a function of fuelling location and plasma current. Detachment of the inner leg of a single null configuration has been studied.
For the first time, a fixed retarding field energy analyser has been used to measure the ion temperatures in the divertor of a tokamak. A similar device has been exposed to the upstream plasma. These measurements are used to constrain SOLPS modelling.
A series of experiments has investigated the ability of massive gas injection to control the transient heat loads to the divertor during disruptions. An upgrade to the disruption mitigation valve system has been used with a selection of gases to study the effects of impurity mass and injection quantity. Investigation has shown that the most effective mitigation is seen for high mass (Z>4) impurities which reduce the divertor heat load to 40% of the total stored energy.
Detailed analysis has refined the design of the divertor for the upgrade of MAST. Operational flexibility has been assessed in terms of connection length and flux expansion, thereby specifying the power supply currents, voltages and accuracy of control. Studies have refined the shape of the entrance to the divertor and indicated the potential of Super-X-like geometries. Improvements have been made in the divertor chambers - for active pumping and diagnostic access. Prospects for the experimental programme will be discussed in the paper.

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