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# MAST-U experimental programme: From first plasma to first campaign

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The first stage in the experimental programme of MAST-U is planned for late 2019. A modelling framework, using time-dependent vacuum field calculations, has identified viable direct induction scenarios on MAST-U that achieve suitable null quality for rapid breakdown combined with the requirements for plasma equilibrium and passive vertical stability during the early plasma current ramp up [1]. The resulting discharge parameters provide breakdown with a loop voltage of 4.5V, which around half of the total available. The loop voltage gives an electric field of 1.5-2 V/m and a null is formed with a connection length of between 400 and 800 m [1]. The null is formed with the poloidal D coils carrying currents of 5 kA or less, which is well within the capabilities of the supplies. Key to the success of MAST-U is the ability to form advanced divertor configurations, specifically the Super-X divertor [2]. Using a free boundary equilibrium solver (FIESTA) and representative current profiles, a 700 kA plasma current, double null MAST-U discharge has been simulated (κ = 2, li=0.94). The simulated discharge allows understanding of the coils required to form and control a conventional divertor and then shape this into a Super-X configuration. The elongation and internal inductance operating space has been investigated by generating a database of scenarios that will guide scenario development. MAST-U has an experimental campaign covering pedestal physics, fast particles, scenario development and exhaust physics. The focus is on the exhaust physics area, specifically understanding the advantages and disadvantages of the Super-X divertor. The increased divertor radius is thought to encourage detachment as the target temperature is proportional to 1/Rtgt2 [3]. SOLPS modelling [4] shows a reduction of the detachment threshold by a factor 2.4 by changing the target radius by 0.7m. Initial experiments will aim to test model predictions through development of conventional and super-X scenarios; utilising the extensive range of diagnostics available on MAST-U to measure the radiated power, target heat loads and temperatures.
[1] D Battaglia et al, Nucl. Fusion, accepted for publication, 2019
[2] Valanju et al, Phys. Plasmas 16 (2009) 056110
[3] TW Petrie et al, Nucl. Fusion 53 (2013) 113024
[4] D Moulton et al, Plasma Phys. Control. Fusion 59 (2017) 065011
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