MAST Upgrade – Construction status and early research plans

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The MAST Upgrade programme research programme has three primary objectives: 1) To develop reactor-relevant advanced divertor concepts, 2) add to the knowledge base for ITER and 3) explore the feasibility of using a spherical tokamak as the basis for a fusion Component Test Facility.

To deliver this capability the load assembly is being comprehensively upgraded in stages and the first stage, known as "core scope", is now well into the assembly phase. Core scope includes 17 new shaping and divertor poloidal field coils (14 inside the vessel), and a new closed pump-able divertor structure to make a highly flexible exhaust physics platform. This stage of the upgrade will also provide a 50% increase in the toroidal field (from 0.585 (85kA) to 0.92 (133 kA) Tesla at R = 0.7m) and a near doubling of the inductive flux from the central solenoid (0.9 to 1.7Vs (1.6 Wb)), which should allow access to plasma current of 2MA. One of the present neutral beams will be moved off-axis for improved current profile control and fast ion physics studies. It will be equipped with an extensive gas fuelling system comprising 76 gas outlets allowing a good toroidal uniformity in the gas fuelling.

Many new diagnostics are included in the upgrade; in particular magnetic diagnostics for real time plasma position and shape control, as well as post pulse equilibrium reconstruction. The divertor has extensive Langmuir probe coverage, bolometry arrays, reciprocating probes, Thomson scattering, coherence imaging for divertor flows, imaging spectroscopy and infrared imaging.

Early research will focus on exhaust studies and specifically the production and control of various divertor configurations. The closed divertor will lead to lower main chamber neutral densities; as a result quantifying divertor closure, H-mode access and density-limits will be an early priority. The programme will expand to include advances in areas such as fast ion instabilities, core transport, pedestal and ELM physics.

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