First MAST-U Equilibrium Reconstructions using the EFIT++ Code

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The MAST-U spherical tokamak has extensive capabilities to produce and explore strongly shaped plasmas and alternative divertor configurations, especially the Super-X. Robust and accurate reconstructions of plasma equilibria are the foundation of many physics analyses, and important intershot for informing operation of the tokamak.

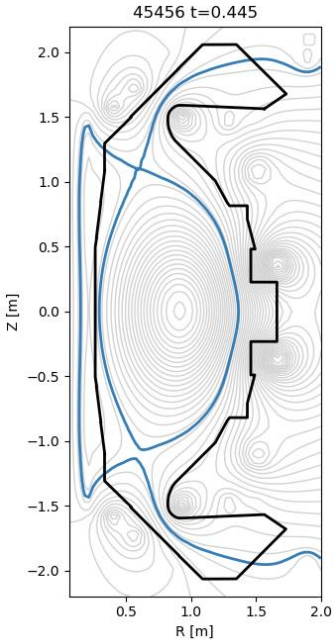

Figure 1: Magnetics only EFIT++ equilibrium reconsruction for MAST-U shot 45456 at t=0.445s.

MAST-U is equipped with a range of magnetic sensors including b-field sensors and flux loops. In this work the Grad-Shafranov equation for the plasma equilibrium is solved using the EFIT++ code[1], which has been updated to provide routine magnetics only reconstructions during the first physics campaign. The results of the analysis show a good agreement with the magnetics data, and the quality of equilibrium reconstructions is further assessed by comparing with diagnostics not used as constraints. For example, in the divertor region there is good agreement between EFIT++ and strike point locations measured with Infra-Red thermography and Langmuir probes, and the divertor leg position measured with Multi-Wavelength Imaging.

The next steps for analysis of MAST-U equilibria are discussed. This includes the first results and impact of adding additional constraints to the EFIT++ reconstructions of the electron pressure profile from Thomson Scattering, ion temperature from Charge Exchange and the magnetic pitch angle from the Motional Stark Effect system to the EFIT++ reconstructions.

[1] Appel, L. C. et al. "Equilibrium reconstruction in an iron core tokamak using a deterministic magnetisation model." *Comput. Phys. Commun.* 223 (2018): 1-17.