Highlighted studies of turbulence, flow shear and mode structure in MAST-U using UCLA Doppler Back-scattering system

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An eight channel Q-band (33-50GHz) Doppler back-scattering/reflectometry system, provided by the University of California Los Angeles is installed on MAST-U [1]. These channels can target the core plasma in low density plasmas, as well as probing the pedestal of H-mode plasmas. Wave-guide switches enable remote switching between O mode and X mode, giving the capability to do cross-polarization scattering [2], and a movable lens is used for poloidal & toroidal steering [3] to match the scattered wavenumber with the field line pitch.

The radial profile of turbulence intensity and phase velocity, are compared with profiles, and can probe the core of L mode plasmas and the pedestal of H-mode plasmas. Of particular importance is the role of on and off-axis beams to drive rotation and produce ExB shear. This data may help to explain why the off-axis beam is more favorable in order to avoid disruptions and deleterious MHD.

Also, when the beam is steered normal to the flux surfaces, i.e. acting as a reflectometer, the system shows clear signatures of modes can be observed including fishbones, Toroidal and Compressional Alfven eigenmodes, which using proper phase analysis model fitting [3] can deliver the displacement radial eigenfunctions of these modes.

1. T. Rhodes et al, Rev Sci Instrum 93, 113549 (2022)
2. R. Hong et al, Rev Sci Instrum 92, 063505 (2021)
3. V.H. Hall-Chen et al, Rev Sci Instrum 93, 103536 (2022)
4. N. A. Crocker *et al.,* Nucl. Fusion **58**, 016051 (2018).

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