

## **Synthetic Aperture Microwave Imager (SAMI-2): design, implementation & commissioning at MAST-U**

*Tuesday, 21 June 2022 14:00 (2h 30m)*

The second incarnation of the Synthetic Aperture Microwave Imager (SAMI-2) is a tokamak diagnostic operating in the frequency range 20-40 GHz with up to 30 dual-polarisation receiving antennas and 2 transmitting antennas.

SAMI-2 has two core missions [references to work with the original SAMI]:

(a) imaging spontaneous emission of electron Bernstein waves converted to electromagnetic waves in the plasma edge [1], this being particularly relevant to the forthcoming EBW current drive project on MAST-U;  
(b) measuring the magnetic pitch angle at a given density [2]: in this second mode of operation, SAMI-2 injects a microwave signal at the plasma and images the Doppler back-scattered signal returned to the diagnostic from the critical density surface. Since turbulence in magnetised plasmas is elongated along magnetic field lines, the largest back-scattered amplitude is oriented perpendicular to the field. Measurements at multiple locations will enable us to deduce the edge current density, which is an important quantity for understanding edge stability.

SAMI-2 represents a bottom-up redesign of the SAMI principle to advance the technique from proof-of-principle to production measurements. Each antenna feeds a RF downconversion PCB that we designed, each with four IQ mixers (for two polarisations and two simultaneous local oscillator frequencies) [3]. The data is then amplified, filtered and digitised via more custom PCBs with control being provided by an off-the-shelf FPGA board. Data is either read into memory on the FPGA board or streamed in real-time over multiple 10 Gb/s network connections.

In this presentation we will describe the technical details of the diagnostic, and its installation and commissioning at MAST-U

References

[1] V.F. Shevchenko, R.G.L. Vann, S.J. Freethy & B.K. Huang, *J. Inst.* 7 P10016 (2012)

[2] D A Thomas et al., *Nucl. Fusion* 56 026013 (2016)

[3] J O Allen, "Design of the Synthetic Aperture Microwave Imager-2 for measurement of the edge current density on MAST-U", PhD thesis, University of York (2021)

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