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10.29 Measuring dynamic fast ion spatial profiles with fusion protons in the Madison Symmetric Torus

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Neutral beam injected fast ions play a dominant role in the C-2W plasma at TAE, heating the plasma and sustaining the field-reversed configuration, making the diagnosis of these fast ions a major pillar of our research program. Recently, a collaboration between TAE Technologies and the University of Wisconsin was conducted to develop a method for measuring a fast changing fast ion spatial profile with a fusion proton detector. The steerable detector was designed and built at TAE and installed on the Madison Symmetric Torus (MST) reversed field pinch (RFP) plasma. The fusion proton emission profile resulting from injection of a 25 kV deuterium neutral beam is measured with 5 cm spatial resolution and 100 μ s temporal resolution over the course of several 10s of reproducible shots. The fast ion density profile is reconstructed by orbit tracing through the reconstructed equilibrium. The fast ion density profile is observed to flatten during global magnetic tearing mode activity, dropping by 30% in the core and increasing by a similar amount at the edge. The profile is observed to remain stiff during energetic particle mode (EPM) activity, consistent with measurements with a collimated neutron detector.

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