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P5.1092 Plasma edge current fluctuation measurements during the ELM cycle with the atomic beam probe at COMPASS

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The evolution of the edge plasma current in magnetically confined plasmas is identified as a critical parameter of Edge Localized Mode (ELM) destabilization. While the plasma pressure gradient, the other critical parameter, is routinely measured with high spatial and temporal resolution on fusion experiments, the plasma edge current measurement capabilities are limited. The Atomic Beam Probe (ABP [1][2]) is an extension of the widely used Alkali atomic beam emission spectroscopy diagnostic [3] offering a novel solution for plasma edge current measurement. The atomic beam, which is injected into the plasma, is ionized due to the collisions with the plasma particles. The ions originating from the beam follow a curved path in the magnetic field and might hit the wall of the machine. The impact location and the number of ions carry information about the toroidal plasma current distribution, the density profile and the electric potential in the plasma. The capabilities of the diagnostic technique have been demonstrated at COMPASS [4]: measurements were carried out with 1-2 mA lithium and sodium beam, beam modulation up to 100 kHz, beam size reduction to 5 mm (beam current reduced to 50 μA), and in various scenarios (1 - 1.38 T, 150 - 300 kA). Along with experimental work, extensive ion orbit modelling efforts have been made in order to interpret the results. The measurement location in the modelled plane was identified matching the modelled and the measured ion distribution on the 100 ms timescale, while radially localized and poloidally extended current fluctuations have been applied to the equilibrium profiles in the model to match the measured fluctuations on the 100 μs timescale. First experimental results will be presented demonstrating the linear response of the detector to current changes and the ion distribution movement during the ELM cycle. Parallel fast density and current fluctuation measurements will also be shown, emphasizing the unique capabilities of the combined BES and ABP diagnostic.

[1] P. Hacek et al., Review of Scientific Instruments 89, 113506 (2018)
[2] D. I. Refy et al., Accepted at RSI (2019)
[3] G. Anda et al., Lithium beam diagnostic system on the COMPASS tokamak. Fus. Eng. Des. 108 (2016)
[4] R. Panek et al., Plasma Phys. Control. Fusion 58 014015 (2016)

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