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4.39 A diagnostic ion beam detector to measure poloidal magnetic flux

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Local, non-perturbative measurements of current density and magnetic fluctuations in magnetically confined fusion plasmas will provide information to advance equilibrium, transport, and stability studies. We are developing a diagnostic ion beam detector and technique (based on conservation of canonical momentum) to determine localized poloidal flux, flux fluctuations, poloidal magnetic field, and toroidal current density in axisymmetric toroidal plasmas from measurements of ion velocity. A K+ beam has been injected into reversed field pinch plasmas and the detector used to successfully measure the intensity and incoming angle of K2+ ions created along its path. We have developed simulation tools, including effects of field asymmetries, to unfold the poloidal flux from measurement of the beam angle and establish accuracy of the technique. Temporal and angular variations of measured signals are consistent with simulations. Since the detector operates with a direct view of the plasma, we have developed features to reduce noise currents induced by plasma particles and photons. The detector and technique also target a goal of developing more compact and economical diagnostic tools that retain heavy ion beam probe attributes. This work is supported by US DoE Award DE-SC0006077.

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