On the application of electron cyclotron emission imaging to the validation of theoretical models of magneto-hydrodynamic activity

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Abstract. Two-dimensional imaging of electron temperature perturbations provides a powerful constraint for validating theoretical models describing magneto-hydrodynamic plasma behavior. In observation of Alfvén wave induced temperature fluctuations, electron cyclotron emission imaging (ECEI) provides unambiguous determination of the 2D eigenmode structure. This has provided support for non-perturbative eigenmode solvers which predict symmetry breaking due to poloidal flows in the fast ion population. It is shown that for Alfvén eigenmodes, and in cases where convective flows or saturated perturbations lead to non-axisymmetric equilibria, electron plasma displacements oriented parallel to a gradient in mean temperature are well defined. Furthermore, during highly dynamic behavior, such as the sawtooth crash, highly resolved 2D temperature behaviors yield valuable insight. In particular, addressing the role of adiabatic heating on time scales much shorter than the resistive diffusion time through the additional diagnosis of local electron density allows progress to be made towards a comprehensive understanding of fast reconnection in tokamak plasmas.

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