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TH/P7-12: ExB Shear Suppression of Turbulence in Diverted H-mode Plasmas; Role of Edge Magnetic Shear

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KSTAR tokamak has achieved H-mode plasmas well ahead of its original schedule [1]. An interesting feature of KSTAR plasmas at the H-mode transition is an abrupt increase in its edge q value [2]. Often, this happens as the plasma becomes diverted, losing a contact with the outer limiter. Motivated by the KSTAR results, we investigate how plasma boundary shape such as x-point modifies the ExB shearing rate and microturbulence at the edge in this work.

The ExB shearing rate for an isotropic turbulent eddy in a shaped plasma is given in Ref. [3]. We can characterize the potentially beneficial effects of magnetic shear, safety factor, and elongation by adopting a simpler high aspect ratio version [4] of the ExB shearing rate, and a simple double-null analytic model equilibrium previously used for resistive MHD instability analyses in diverted H-mode plasmas [5]. This model exhibits a logarithmic divergence of q_MHD, and stronger algebraic divergence of magnetic shear. Furthermore, strong global shear at the edge is expected to reduce the radial correlation length of edge turbulence and consequently facilitate reduction of transport which leads to the H-mode transition [5].

We are currently validating this working hypothesis of the ExB shear suppression of turbulence further facilitated by strong magnetic shear against KSTAR H-mode data. While direct E_r measurements are not available from KSTAR, we can estimate it by using toroidal velocity measured by Charge Exchange Recombination Spectroscopy, neoclassical poloidal velocity, modeled pedestal pressure profile, and the radial force balance relation for impurity ions. Turbulence growth rate will be estimated for the modeled profiles, using the TRB gyrofluid code [6,7], and will be compared to the ExB shearing rate.

References

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