6th Asia-Pacific Conference on Plasma Physics, 9-14 Oct, 2022, Remote e-conference

Near-Edge Alfven modes in DIII-D high β_p plasmas

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New analysis of a DIII-D high bootstrap current fraction scenario[1] demonstrates that the Beta-Induced Alfven Eigenmode (BAE) plays an important role in controlling transport in the outer core region (ρ~0.75). First, multiple fluctuation measurements show evidence for a mode peaking in this region with frequency and wavenumber consistent with characteristics of the BAE. Second, a detailed stability analysis indicates that the BAE is primarily excited by the unfavorable magnetic curvature drive in this region, which lies close to the kinetic ballooning mode (KBM) boundary[2]. Because the BAE and KBM share the same drive from the bulk thermal plasma[3], only a small amount of additional free energy is needed to destabilize the BAE . Gyrokinetic simulations with CGYRO[4] predict that the small but finite fast ion fraction at these radii is sufficient to provide this additional drive and robustly destabilize the BAE (Figure 1).

Finally, nonlinear CGYRO simulations predict that the BAE can efficiently drive experimentally relevant levels of the electron particle flux (Γ_e) and electron energy flux (Γ_e). When additional contributions from neoclassical transport and electron temperature gradient (ETG) turbulence are considered, the experimental fluxes in all three channels are reproduced within uncertainties (Figure 2). Implications for transport in the inner core region of this scenario, and in other advanced tokamak scenarios, will be discussed as well.

References
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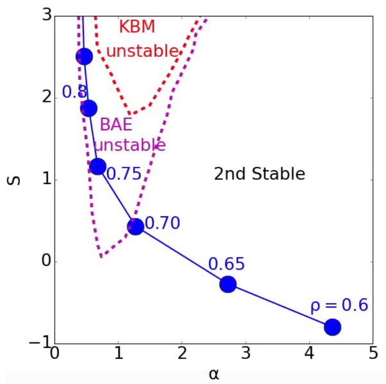

Figure 1: Outer core region ($\rho > 0.75$) is close to KBM boundary(red), the BAE can be further destabilized via a small amount of fast ions(magenta). Instabilities boundaries are predicted by CGYRO

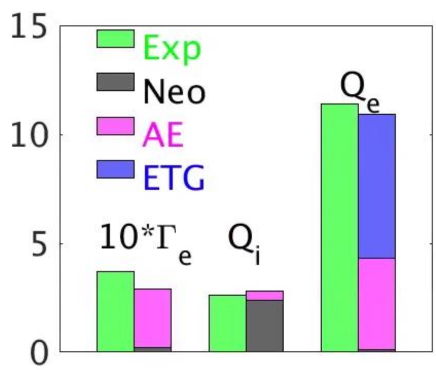

Figure 2: Transport analysis at $\rho = 0.75$ from nonlinear CGYRO prediction, experimental relevant Γ_e can be driven by BAE, which can also drive part of electron thermal flux (mostly via magnetic fluttering)