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Observation of fast-ion driven Alfvén-eigenmodes in JET and their effect on turbulence and thermal transport

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Recent experiments using the 3-ion ICRH heating scheme [1] have been successful at generating substantial populations of MeV range fast ions in the deep core of JET, mimicking the effect of fusion-born alpha particles in future burning plasmas. We analyze an ICRH heated L-mode in which a wide variety of Alfvén eigenmodes (AEs) were destabilized by ICRH MeV fast ions, as observed through magnetics, reflectometer and Doppler backscattering (DBS) measurements. As ICRH heating power was increased and AEs were destabilized, we observed an increase in the electron thermal transport (dominant to the ion thermal transport inside rho = 0.4) and an increase in the deep core ion temperature. This is consistent with previous nonlinear turbulence simulations suggesting that AEs can stabilize ion-scale turbulence [2,3]. However, the contribution of the dominant electron thermal transport remains a mystery. We report on the transport and gyrokinetic modelling using GS2 and CGYRO in two distinct phases: a stable AE phase and an unstable AE phase, as measured via magnetics and DBS measurements. We probe the origins of the anomalous electron thermal transport in the presence of MeV range fast ions and unstable Alfvén eigenmodes. The implications of these scenarios to burning plasmas will be discussed.

References
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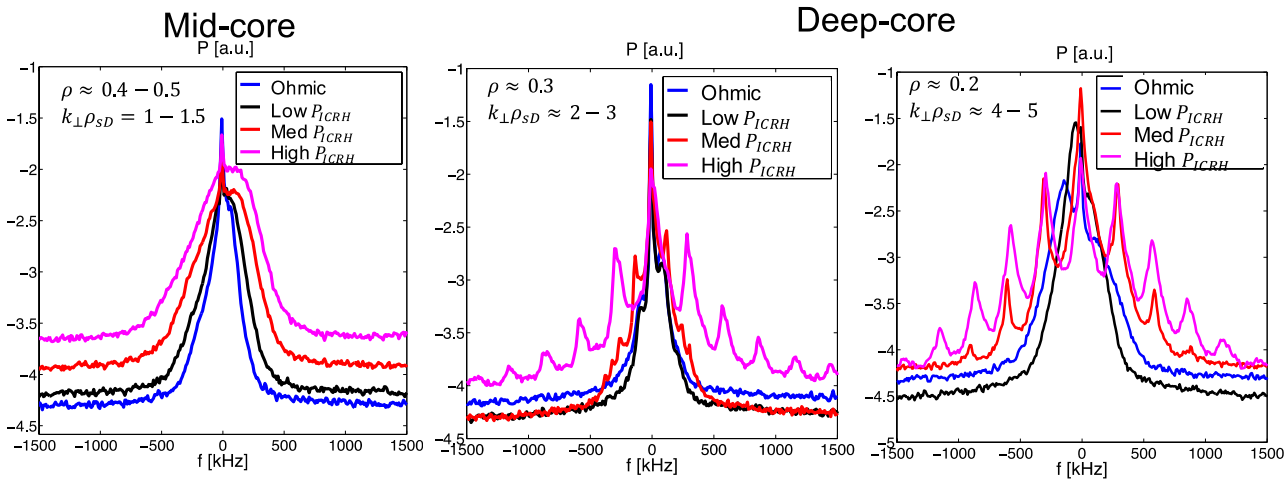

Figure 1: DBS frequency spectra showing broadband fluctuations from turbulence in the mid-core of a JET ICRH heated L-mode plasma. The appearance of toroidal Alfvén eigenmodes (TAEs) takes place in the deep core.