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Discriminating the Trapped Electron Mode Contribution in Density Fluctuation Spectra and Turbulent Transport

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Core turbulence in tokamak plasmas is driven by two main instabilities: Ion Temperature Gradient (ITG) and Trapped Electron Modes (TEM). Experimental identification is challenging because both instabilities are unstable in the limit of long wavelengths. Analysis of Tore Supra and Textor discharges suggest a link between the onset of quasi coherent modes, a broad secondary peak on the reflectometry signal, and the destabilization of TEM. First studied on T-10 and Textor Tokamak, its wavelength is lower than the inverse of the ion Larmor radius. It was termed quasi-coherent due to marked poloidal and toroidal correlation. On Tore Supra and Textor, this extra peak which is centred between 40-120 kHz with a bandwidth of few tens kilohertz, could be observed from the edge to the core on the low field side; stabilized on the high field side, its amplitude is damped at the top of the machine. All these characteristics point to a link with drift wave instabilities.
In ohmic plasmas in Tore Supra and Textor, quasi-coherent modes are detected only in Low Ohmic Confinement (LOC) regime. They are stabilized at LOC SOC transition and they disappear in the Saturated Ohmic Confinement (SOC) regime where one expects TEM stabilization. Perpendicular velocity measurements made from the top of TEXTOR by correlation reflectometry show that QC modes rotate 300 m/s faster in the electron diamagnetic direction than density fluctuations at lower frequency. In Tore Supra, quasi-Coherent modes destabilization by Electron Cyclotron Resonance Heating has also been observed. Quasi-coherent mode amplitude increases during the ECRH phase. Moreover, they are observed only in region where quasilinear simulations predict TEM to play an important role. Thus both in terms of amplitude and radial localization, quasi-coherent mode observations coincide with the excitation of TEM instabilities.
Although the nature of these modes is still under investigation, these observations support a link between quasi-coherent mode and an enhanced electron transport due to TEM destabilization.

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