Systematic study of broadband turbulence properties in Ohmic, ICRH and LH sawteeth plasmas

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Abstract

In tokamak plasmas, the q=1 surface acts as a periodic transport barrier preventing impurities to enter the inner core [1]. In Tore Supra, the transport coefficients were observed to drop to neoclassical level in Ohmic plasmas [2]. We have investigated the evolution of broadband (BB) turbulence in Ohmic, Ion Cyclotron Resonance Heating (ICRH) and Lower Hybrid (LH) sawtooth discharges owing of the large database of core reflectometer [3] measurements ($> 300\,000$ fluctuation spectra obtained from 2002 to 2011). This database was built by applying a parametrization method to decompose the fixed-frequency spectra in several components [4].

In Ohmic plasmas, the broadband (BB) component contribution (E_{BB}) drops systematically near the plasma core. The width and position of this E_{BB} basin are well correlated to the $q = 1$ surface. With ICRH, the BB contribution rapidly increases with increasing ICRH power and the E_{BB} basin disappears. In discharges with LH only, the BB contribution E_{BB} is only slightly higher than in Ohmic and the basin remains even at high LH power. To understand this different behavior and the large scattering of E_{BB} in ICRH discharges, several parameters were investigated like the average temperature gradient, the width of the E_{BB} components...

For subset of discharges, the measurements were split in short interval (~3 ms) to get an almost instantaneous frequency spectra w.r.t. to the sawtooth period (~30-40 ms in Ohmic). The evolution during the sawtooth of E_{BB} inside and outside the basin could thus be investigated. In most Ohmic discharges, no evolution of the BB contribution inside the basin is observed during the quiescent phase of the sawtooth: E_{BB} remains at an almost constant low level ($< 10\,\%$); it only increases just before and just after the sawtooth crash, when the spectra become much wider. Time evolution during ICRH and LH discharges will also be presented.

References

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