

Quasi-Coherent Modes in the High Density H-mode Regime of W7-AS

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The High Density H-mode (HDH) is a stable ELM-free H-mode regime at the Wendelstein 7-AS stellarator exhibiting no impurity accumulation [1]. This is of particular interest as future fusion-oriented devices are mainly preferred to be run at high densities, a regime often susceptible to impurity accumulation and hence ensuing radiation collapse. As the mechanism responsible for this low impurity concentration has yet been unclear, thus our main aim was to find a possible candidate for the impurity flushing mechanism by investigating MHD modes present in the HDH phase and their relation to the impurity transport.

Our investigations of Mirnov coil signals identified modes appearing in the HDH phase named Quasi-Coherent (QC) modes due to their similarity to the QC modes found in the Enhanced D-alpha (EDA) regime [2] of the Alcator C-Mod tokamak, responsible for the low impurity concentration in that high density ELM-free regime. The analysis indicated that these modes appear in the HDH phase in the Mirnov signals and have remarkably good correlation with the impurity radiation making it a promising candidate for the impurity flushing mechanism.

In order to determine the properties of these modes, the study includes several magnetic configurations, global parameters and plasmas species. It was found that they are bursty, frequency modulated oscillations in the edge magnetic field with frequencies in the 50-150 kHz range with a narrow bandwidth of about 15 kHz. The Lithium Beam Emission Spectroscopy did not detect these modes in the SOL, thus the location of these modes is thought to be inside the separatrix, presumably in the pedestal area. These modes as of yet have only been observed with the Mirnov coil arrays, as other diagnostics fail to measure the needed frequency regime and location due to the very high densities. The universality of the QC mode in the HDH phases is being tested by analysing specific density scans for given heating power, magnetic configurations and plasma species (Hydrogen or Deuterium plasmas). An estimate of the poloidal mode number have been obtained as well by a reciprocating probe housing two poloidal field pick-up coils (MRCP), that had been inserted into the plasma to measure the radial decay of the magnetic field perturbations along the distance to the separatrix.

This contribution aims at characterizing the Quasi-Coherent modes present in the HDH phase of the W7-AS and their possible role as the impurity flushing mechanism responsible for the low impurity concentration in this regime. A careful comparison of the QC modes to other similar MHD modes present in stable ELM-free regimes of other devices is attempted as well in order to gain better insight into the nature of these modes.

References

- [1] K. McCormick *et al.*, PRL **89**, 015001 (2002)
- [2] A. Mazurenko *et al.*, PRL **89**, 225004 (2002)