Low-frequency coherent modes in TJ-II plasmas

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Low-frequency (below ~ 100 kHz) quasi-coherent modes have been studied in TJ-II plasmas. In low-density \( n_e \approx 0.6 \cdot 10^{19} \text{ m}^{-3} \) ECH plasmas, electromagnetic modes were related with H, signal bursts and electron temperature oscillations with mode frequencies around 30 kHz and chirping [1, 2]. In NBI plasmas \( n_e \geq 10^{19} \text{ m}^{-3} \), quasi coherent ~ 30 kHz modes, and ~ 60 kHz modes at some critical density, have been also documented [3]. The present work is a survey of the phenomenology of these quasi-coherent modes in NBI plasmas, as a first step before they are properly identified according to data from plasma profiles and the expected dispersion relations. The importance of this study lies on the relationship between these modes and particle confinement. For instance, the ~ 30 kHz modes seem stable while the ~ 60 kHz modes are unstable and chirp down during particle expulsions noted in H, burst. It is frequently observed that the average density increases slowly and the edge radiation power remains approximately constant when the lowest frequency modes are active; however, when the radiation increases in the edge area, such modes reduce considerably their amplitude and the density increases at a faster pace, typical of documented L-H transitions in TJ-II. The poloidal mode numbers \( m \) obtained from a poloidal arrangement of Mirnov coils [4] is almost always negative, which indicates propagation in the electron diamagnetic direction—or, in NBI plasmas, in the \( E \times B \) direction; and related with existing magnetic resonances inside, but near, the plasma edge. Preliminary analyses indicate that these modes in TJ-II may be like those found in DIII-D [5] or ASDEX-U [6] (electromagnetic nature, density oscillations, wave induced particle transport, propagation in the electron diamagnetic drift direction, wave number related with edge iota value). A special effort has been devoted to localize spatially the modes and their relation with iota value, plasma rotation and rotational shear, and particle transport.