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Experimental observation from DIII-D of the effect of E×B shear on EHO's structure and edge transport

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Quiescent High-confinement mode (QH-mode) [1] is one of the promising operating scenarios for ITER. This operating condition preserves the favorable high confinement feature of H-mode but without the Edge localized Mode (ELM) -- which is a main concern for ITER due to its large transient heat load to plasma facing components. The Edge Harmonic Oscillations (EHOs), a coherent narrowly edge- localized electromagnetic mode with multiple harmonics, is thought to be the key element which provides the continuous enhanced edge transport channels in QH-mode. Theoretical work [7] proposed that the EHO is a saturated kink/peeling mode which is destabilized by large rotational shear that prevents it from entering the explosive phase as an ELM, and consistent experimental results [4-6] have been observed.

The work presented here is performed to track how the E×B shear affects the EHO mode structure in order to search for an explanation of the enhanced edge particle transport by EHO. The large rotational shear is usually created by Neutral Beam Injection (NBI); thus, the E×B shear rate can be scanned through the modulation of the input NBI beam or direction of injecting beams. Two edge fluctuation diagnostics: Beam Emission Spectroscopy (BES) [2] and Microwave Imaging Reflectometry (MIR) [3] (figure 1) are employed here to observe the eigenmode structure evolution of EHO in the pedestal region. The BES system can measure density fluctuations from 1 to 500 kHz for wavenumbers <3 cm^{-1} which favors the measurement of radial wavenumber of the EHO. The radar-like MIR system, vertically covering from -11 cm to +9 cm with ~3 cm poloidal extent, is used for the investigation of the poloidal structure of EHO. The E×B shearing rate is measured with the Charge Exchange Recombination (CER) system. Our results show that the radial wavenumber is strongly correlated with the E×B shear rate while the poloidal wavenumber is less affected (0.02 cm^{-1} ± 0.01 cm^{-1}) by the E×B shear rate. During the EHO existence, with the E×B shearing rate ramping down, the radial wavenumber is also observed to be decreasing (figure 2).

Acknowledgements

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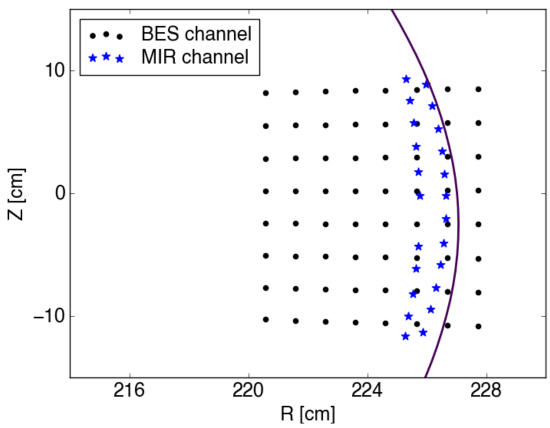

Figure 1 diagnosing range of BES and MIR

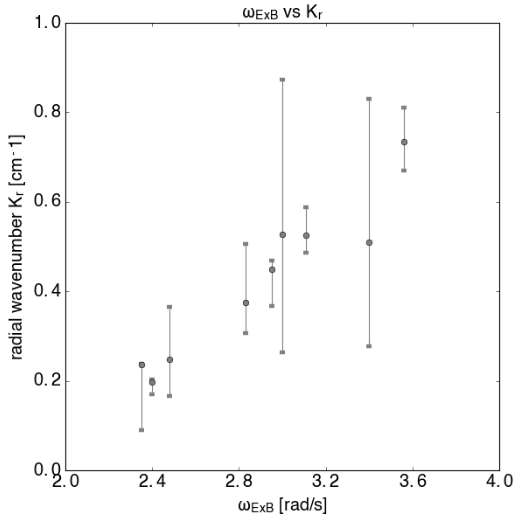

Figure 2 radial wavenumber is strongly correlated with E×B shear rate