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Turbulence and radial electric field asymmetries measured at TJ-II plasmas

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Dedicated experiments have been carried out for a systematic comparison of turbulence and radial electric field measured at poloidally separated positions in the same flux-surface in the stellarator TJ-II. The rationale behind this study is twofold, verification of the spatial localization of instabilities predicted by the Gyrokinetic simulations in stellarators and verification of the electrostatic potential variation on the flux surface as calculated by Neoclassical codes and its possible impact on the radial electric field. Poloidal asymmetries in the turbulence wavenumber spectrum and in the Er profile have been found that depend on density, heating conditions and magnetic configuration. These quantities have been measured using a Doppler reflectometer that covers the radial region from rho = 0.6 to 0.9, at different perpendicular wave-numbers of the turbulence: 1-14 cm-1, and at two plasma regions poloidally separated.
Different plasma scenarios have been studied with different profile shapes. These include, high power on-axis ECH heated plasmas vs. low power off-axis ECH heated plasmas; ECH vs. NBI heated plasmas; standard vs. high iota magnetic configurations, and Hydrogen vs. Deuterium dominated plasmas.
Differences in the turbulence intensity are found when comparing the k-spectra measured at poloidally separated positions in the same flux-surface, in ECH heated plasmas in the standard magnetic configuration. However, almost no asymmetries are found in NBI heated plasmas, i.e. higher density, lower electron temperature, where very similar turbulence intensity and spectral shape are measured at both plasma regions. Besides, no significant differences have been found when comparing Hydrogen and Deuterium dominated plasmas. The asymmetry in the turbulence intensity found in the standard magnetic configuration reverses in the magnetic configuration with high rotation transform. Radial electric field profiles measured at the two plasma regions show pronounced differences in low density plasmas, i.e. plasmas in neoclassical electron root confinement. At higher densities the Er asymmetry gradually decreases and almost disappears in ion root plasmas.
The detailed comparison of the k-spectra and Er profiles under different plasma scenarios are presented, providing valuable information for comparison with Gyrokinetic and Neoclassical simulations.

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