

A comparison of measurements from radial and poloidal correlation ECE diagnostics on Wendelstein 7-X

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The stellarator Wendelstein 7-X (W7-X) is designed to produce an approximately quasi-omnigenous magnetic configuration that is optimized to have low neoclassical transport under steady state conditions relevant for a fusion reactor [1]. Electron temperature (T_e) fluctuations driven by drift wave turbulence are below the sensitivity of a single Electron Cyclotron Emission (ECE) diagnostic, but they can be measured by correlating the signal between two independent ECE measurements [2]. A two-sightline poloidal correlation ECE (CECE) diagnostic has been developed and installed on W7-X that operates through spatial decorrelation of the electron cyclotron emission. The poloidal CECE diagnostic is sensitive to long wavelength T_e fluctuations that are relevant for the study of Ion Temperature Gradient and Trapped Electron Mode turbulence. Similarly, the ZOOM device [3] that is installed on W7-X functions as a radial CECE diagnostic through spectral decorrelation of the electron cyclotron emission. Over a 1s long plasma discharge, both radiometers are sensitive to T_e fluctuations of less than 0.3%. The poloidal CECE has 8 fixed-frequency channels per sightline covering 10 cm on the high-field side of the magnetic axis, while the radial CECE has 16 variable-frequency channels over 6 cm that can be shifted across the plasma minor radius. These correlation radiometers have been used to measure the magnitude of T_e fluctuations as well as the radial correlation length in plasma with electron cyclotron resonant heating. The ECE radiation spectrum is measured to be asymmetric across the magnetic axis of W7-X, and relativistically downshifted emission affects measurements on the low-field side of the magnetic axis. In this contribution, T_e fluctuation measurements from the two radiometers will be presented and compared to gyrokinetic calculations of Trapped Electron Mode turbulence in W7-X, and the impact of relativistic downshift on T_e fluctuation measurements will be discussed.

References

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