

Correlation microwave diagnostics on the Wendelstein 7-X stellarator for Operational Phase 2

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Correlation microwave radiometry and reflectometry diagnostics are used to measure electron temperature and plasma density fluctuations on Wendelstein 7-X (W7-X) [1] and the capabilities of these diagnostics are being extended for the second operational phase of W7-X. The ZOOM device [2] is a 16-channel, frequency scannable radiometer extension that is used as a high-resolution radial correlation electron cyclotron emission (CECE) diagnostic when connected to the ECE radiometer on W7-X [3]. A new toroidally displaced radial correlation system with a focusing antenna has been installed that is optimized for core electron temperature fluctuation measurements between 30% and 70% of the plasma minor radius. A secondary CECE antenna has also been installed for plasma density-electron temperature cross phase measurements in the outer 80% of the plasma minor radius. The poloidal correlation reflectometer (PCR) diagnostic [4] measures plasma density fluctuations in the same toroidal plane as the new CECE antennas and has overlapping measurement volumes. A second frequency synthesizer and detection system has been added to the PCR system allowing access to plasma densities up to $4.5 \times 10^{19} \text{ m}^{-3}$ and radial correlation length measurements in the outer 80% of plasma minor radius.

[1] T. Klinger *et al.*, *Plasma Phys. Control. Fusion* **59** 014018 (2017).

[2] Ch. Fuchs and H.J. Hartfuss, *Rev. Sci. Instrum.* **72** 383 (2001).

[3] M. Hirsch *et al.*, *EPJ Web of Conferences* **203**, 03007 (2019).

[4] A. Krämer-Flecken, S. Soldatov, B. Vowinkel, and P. Müller, *Rev. Sci. Instrum.* **81** 113502 (2010).