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## ECE diagnostics at W7-X stellarator

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W7-X is currently equipped with two ECE diagnostics: a 32 channel heterodyne radiometer measuring X2 mode from 120-160 GHz corresponding to a central magnetic field of 2.5 T with a spatial resolution of 1-2 cm behind cold resonance position and a temporal resolution in the order of  $\mu$ s, and a Michelson interferometer measuring the higher ECE harmonics in the spectral range of 50-500 GHz with a temporal resolution of 22 ms and a spectral resolution of 5.66 GHz. Both diagnostics are absolutely calibrated using a time integrated hot-cold calibration technique using a black-body ceramic hot source with a maximum radiation temperature of 600 °C and liquid nitrogen.

Stellarators inherently don't have Greenwald density limit and aim at achieving high confinement using higher  $n_e$ , hence, the X3 emission was explored for the high density,  $n_e$ , application of ECE. An X3 radiometer covering 190-220 GHz will be commissioned in the next operational campaign to track  $T_e$  for high  $n_e$  O2 ECR and NBI heated plasma beyond X2 mode cutoff of  $1.2 \times 10^{20} m^{-3}$ . W7-X is planned to operate at reduced magnetic field of 1.7 T to achieve high  $\beta$  and a W-band radiometer is planned to be used for X2-mode measurement for these reduced field operations.

For  $T_e$  fluctuation measurements and turbulence studies, a 32 channel correlation ECE system is used. Furthermore, a zoom system is available which can be frequency tuned to measure different parts of ECE spectrum with a higher spatial resolution for the purpose of ECRH power deposition measurement using heatwave experiments for understanding and controlling plasma profile shaping.

In addition, the recent observations of strong  $T_e$  edge barriers also planned to be probed by the zoom system. A collective Thomson scattering diagnostic is operated at W7-X in frequency range of 172-176 GHz to measure scattering spectrum of incident radiation from the collective plasma fluctuations.

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