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ITR/P5-41: Exploring Measurement Capabilities of ITER ECE System

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The Electron Cyclotron Emission diagnostic provides essential information for plasma operation and for establishing performance characteristics in ITER [1].
The ECE diagnostic design has to address the specifications in the ITER project measurement requirements. The different requirements are specified with different spatial, temporal and spectral resolutions and accuracy. The relativistic downshift at high temperatures, which in ITER is substantial, will strongly influence the access to the plasma for ECE. Integrated performance for the temperature measurement is, however, adequate when all Te systems (ECE and two Thomson scattering systems) are considered together. A prioritization has been given to the core electron temperature measurement and to NTM detection. For the characterization of the temperature perturbation caused by NTMs, ECE is the only diagnostic that can deliver this measurement.
However, there are other measurements that can be exploited by ECE, thus increasing significantly the contribution of the diagnostic to the scientific and operational program of ITER. There is a functional requirement for the broadband measurement system to measure the total radiated power due to ECE. The specified frequency for the broadband measuring system is from 70 GHz up to 1 THz. The diagnostic capability to measure the spectra at these frequencies has to be assessed during the detailed design phase, taking into account the physics and technical constraints the layout of the transmission line, the back-end instrumentation and the performance of the system for priority measurements.
The present design of the system permits measurements of both the X and O mode radiation simultaneously along two lines-of-sight, one perpendicular to the plasma and another at the slightly oblique (toroidal) angle of about 10 degrees. In scenarios with strong additional heating (radio frequency, neutral beam and possibly alpha heating), deformations of the electron distribution function can occur. Simultaneous observation of several ECE harmonics, together with oblique ECE, can provide some important information for modeling the velocity distribution.
A complete update on the ITER ECE measurement capabilities and their impact on the system design will be included in the contributed paper.

[1] A.E. Costley, Fus Sci Technol. 55, 1 (2009)

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