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Recent progress on the electron cyclotron emission diagnostics development for ITER

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The ITER electron cyclotron emission diagnostic design [1] is progressing and will soon transition into development. The measurement and analysis of the electron cyclotron emission (ECE) is one of the primary diagnostics for measuring the electron temperature (Te) and electron temperature fluctuations (Te) on ITER. Here we describe the current design of that diagnostic. ITER will operate at three axial toroidal magnetic fields of 5.3 T, 2.65 T, and 1.8 T. Operation of the diagnostic at full field is the main interest but critical features of the other emission spectra will be described. EC emission is collected by two very similar optical systems: one will view the plasma radially, and the other will be an oblique view; however, both will measure Te. The oblique view allows detection of the non-thermal distortion in the bulk electron distribution. The two views were designed using Gaussian Beam analysis. In-vacuum calibration sources located in each view, can be switched into each view remotely, allowing measurement of any degradation of in-vessel optics. After the emission leaves the vacuum vessel, it is split into O- and X-mode polarizations and transmitted to the detection instruments (75 - 1000 GHz) via transmission lines. The transmission lines are filled with compressed air/dry N2, a choice which was made to simplify construction and analysis, and to comply with safety requirements in ITER as a nuclear installation. Near the instruments, a switchyard is used to select polarization and view for each of the detection instruments. Only the design for the 220 - 340 GHz radiometer used for 5.3 T operation will be described in detail though the unique features of the other instruments will be described as well. All the components were designed to produce the best possible performance. However, the ITER plasma scenarios have evolved during the diagnostic design process, including operation at 1.8 T. This requires the addition of a 75 - 125 GHz RF front-end plug-in for the radiometers.

References

[1] Taylor et al, EPJ Web of Conferences 147, 02003 (2017)

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