Refractometer for ITER – progress in the development

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The reflectometer from the high magnetic field (HFR) was originally composed in only components from the high magnetic field, but it turned out that it is quite difficult  
to fulfill all the requirements for reflectometer, especially for measuring integrated plasma density along the observation chord. On the other hand, such measurements can be performed in the mode of "transmission" using the transparency window of ITER plasma for the extraordinary wave between the upper and lower cutoff frequencies (~40–110 GHz) lower than frequency of absorption at the electron cyclotron resonances. The analysis showed that such measurements could be carried out with the installation of an additional antenna system (1–2 antennas with waveguide system) in the Equatorial port 8, just in front of the antenna system of the HFR. In this case, for the reception/emission of microwave radiation a regular HFR antenna could be used.

Based on this preliminary analysis at the request of IO ITER, in the DA of Russian Federation a proposal for the HFR has been prepared to add measuring channels on the low magnetic field side (LFS) in the Equatorial port 8, the use of these channels typically in transmission from HFS (high magnetic field side) to LFS mode [1]. This gives the possibility to realize the line-average density measurements in the HFR.

The extension of the HFS reflectometer by refractometer channel, in addition allows to determine line-average density in ITER according to the measured value of the propagation time of the radiation in plasma, will also allow us to estimate the peaking factor of the plasma density profile within the framework of the parabolic model, provided simultaneous measurements at several frequencies [2, 3]. This should also significantly improve the quality of plasma density profile measurements by HFR ITER, especially in the regimes with high level of plasma turbulence.

This work presents the first results of the work on integration of the Refractometer channel in HFR. The issues concerning the selection of the functional diagram of the Refractometer, ray-tracing of microwave radiation in plasma of ITER, calculations of signal-to-noise ratio (SNR) of measurements in transmission mode, integration of Refractometer channel in ITER, preparation of key documents to a mini-CDR, which is tentatively scheduled for the beginning of 2017.

References

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