FAST ION COLLECTIVE THOMSON SCATTERING DIAGNOSTIC FOR ITER

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Collective Thomson Scattering (CTS) using millimeter waves measures the frequency distribution of radiation scattered from a gyrotron beam passing through the plasma. From the measured spectrum it is possible to deduce the velocity distribution of fast ions. On the receiver side the CTS diagnostic resembles an ece diagnostic, and can be used for ece measurements. Fast ion CTS diagnostics are operational at TEXTOR and installed at ASDEX Upgrade. A detailed integrated design for a fast ion CTS diagnostic on ITER has recently been completed [1]. This system is based on an earlier feasibility study and a conceptual design [2]. The study concluded that a system based on a probe frequency in the 60 GHz range is able to fulfill the requirements for measuring the alpha distribution from 100 keV to 3.5 MeV with a time resolution of 100 ms and a spatial resolution of 1/10 of the minor radius. The system consists of two launching antennae placed in a port plug on the low field side and two receiver systems, one on the low field side for measuring the fast ion velocity component in the direction perpendicular to the magnetic field, and one on the high field side (HFS) for measuring the fast ion velocity component in the direction parallel to the magnetic field.
On the HFS the antenna system consists of two mirrors and up to 10 microwave horns. This system is located behind the blanket modules, with the signal passing from the plasma through a cut-out in a blanket module to the first mirror. The height of the cut-out is limited to approximately 6 wavelengths, and the space behind the blanket modules is very limited. In order to experimentally investigate the effect of the cut-out dimension on the microwave beam propagation, a simplified mock-up of the ITER blanket module and the CTS HFS receiver system was made. To support the measurements a finite difference scheme solving the wave equations in the frequency domain, a so-called FDFD was developed. However, the system is very large relative to the wavelength, and an intractably large number of nodes in the finite difference grid is needed for a full 3D simulation. Assuming no variations of the cut-out in the horizontal direction the problem can be decomposed into a series of tractable 2D problems. For the scattered beams coming from the plasma, detailed calculations of beam overlap and scattering have been performed for various ITER scenarios. The design of the front-end components and the expected performance of the system will be presented.

References

[1] H. Bindslev, A. W. Larsen, F. Meo, P. K. Michelsen, S. Michelsen, A. H. Nielsen, S. Nimb, E. Tsakadze, **Detailed integrated design of the collective Thomson scattering (CTS) system for ITER (**EFDA Contract 04-1213)

[2] H. Bindslev, F. Meo, S. Korsholm, **ITER Fast Ion Collective Thomson Scattering, Feasibility study and Conceptual design of 60 GHz system** (EFDA Contract 01.654)