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# Oral_11: ITER Beam Aided Diagnostics

*Monday, 6 September 2021 15:00 (30 minutes)*

The plan for ITER is to have a comprehensive suite of diagnostics for machine protection, basic machine control, advanced plasma control, and physics studies. This includes measurements typically seen on present day fusion devices, however ITER is unlike any device presently operating. In particular the high fusion production rate and large plasma size combined with the high density and long pulse make diagnostic designs extremely challenging. The high fluency of neutron and gamma radiation from DT operation result in design issues affecting thermal loading, activation, and darkening of optics. This leads to complex optical design paths utilizing mirrors in a labyrinth to reduce activation and mitigate neutron streaming. The difficulty of access and long pulse makes maintenance of the plasma facing optical component, usually a mirror, a challenging problem. Coating from plasma deposition is expected to significantly degrade the reflectivity of the plasma facing mirror surface over time. A cleaning system that is based on a plasma source in close proximity to the mirror will be integrated into the design to remove deposited impurities by sputtering and restore the mirror reflectivity to an acceptable level for the diagnostic measurement. The large high density plasma means the heating neutral beam (HNB) energy is 1 MeV to penetrate the plasma, which has consequences for both the motional Stark effect (MSE) and the charge exchange recombination spectroscopy (CXRS) diagnostics. In the case of MSE it is an advantage. The larger beam energy results in a larger Lorentz ($v \times B$) electric field and spectral splitting. We can take advantage of this and use a new approach for MSE measurements utilizing the spectral splitting. However, for CXRS it is problematic. Above about 100 keV/amu the charge exchange cross sections drop precipitously, so much so that a dedicated diagnostic beam (DNB), operating at 100 keV, will be used for all the CXRS measurements. Numerous constraints on the optical design require multiple viewing systems to obtain a profile to cover the minor radius for both MSE and CXRS.

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