

# Alignment and Calibration Schemes for ITER CXRS-Pedestal Diagnostic

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Charge eXchange Recombination Spectroscopy (CXRS) diagnostic shall provide the key measurement for ITER advance plasma control and physics studies. ITER CXRS-pedestal has a primary role of edge ion temperature, plasma rotation (toroidal and poloidal velocity) and impurity density measurements in the pedestal region ( $r/a=0.85-1.0$ ). Meeting the measurement requirements for these parameters in ITER is more challenging than the present tokamaks due to restricted access for diagnostics components in addition to the harsh environment of ITER.

Some of these challenges are like the calibration offset that limits the velocity measurement accuracy requirement. As well as precise alignment required because of the lower angle between the line of sight with a toroidal plane that introduces additional error in the measurement. Therefore, to meet the measurement requirements in ITER, robust calibration and alignment schemes are being developed. CXRS-pedestal shall cover broad wavelength range, the emission of (He, Be, Ne, Ar, C) recombining lines (460-532nm) and Beam Emission Spectroscopy (BES)  $H\alpha$  (656.3nm) spectral line simultaneously, compatible with the spatial resolution of 20 mm (that demands a fine alignment) with 5Hz DNB modulation: 100ms exposure with DNB ON, 100ms background exposure. Statistical and systematic errors including atomic modeling along with low light signal due to strong attenuation of the diagnostic neutral beams require better light transmission path and high throughput spectrometer detection system. To access this requirement, preliminary performance assessment carried out using Simulation of Spectra (SOS) code to see the dependency of the measurement accuracy on SNR.

In this contribution, details of the design and development of the ITER CXRS-pedestal diagnostic system in view of alignment & calibration in the suitable transmission system, this includes the optimum light transmission path analysis using ZEMAX ray tracing tool. This will ensure the required alignment for accurate measurement from the DNB and plasma cross-section area of the pedestal region. The various calibration and alignment schemes are studied and shall be developed to test the performance in the ITER-India Lab to meet the ITER requirement.

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