

Design and Development of Doppler Shift Spectroscopy and Characterization of Negative Neutral Hydrogen Beam

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Doppler Shift Spectroscopy (DSS) is a passive diagnostic for measurement of neutral beam parameters such as beam divergence, stripping loss and beam inhomogeneity. The diagnostics is based on collection of emission resulting from the collision of the negative beam with the background hydrogen gas during the neutralisation process. The collected emissions can be resolved due to the relative velocity of the beam and the background, and which can be analysed for estimating the beam parameters. In order to design the diagnostics, the signal levels have to be computed by a forward modelling approach. The design has been done for the ITER-Diagnostic Neutral Beam (DNB) (100keV-60A). In this modelling, a line-line intersection of the beamlets and the line of sights (LOS) have been considered and the emissivity of the beamlets has been computed. An endoscopic LOS has been developed for effective signal collection and the spectrograph specifications has been pinned down and the signal to noise ratio (SNR) has been estimated. An algorithm for line width analysis to deconvolve the broadening factors for divergence estimation has been developed. Experiments to test the diagnostics and the algorithm for divergence and beam inhomogeneity estimation has been performed in ROBIN (RF Operated Beam source in India for Negative Ion Research) (35keV, 10A).

In this poster, the modelling of the beam emissivity, the design of the diagnostic setup, the line width analysis methodology and the experiments performed for divergence and beam inhomogeneity estimation for several beam source conditions shall be presented.

Ref:

1. Deka, A. J. *et al.* Evaluation of beam divergence of a negative hydrogen ion beam using Doppler shift spectroscopy diagnostics. *J. Appl. Phys.* **123**, (2018).
2. Deka, A. J., Bharathi, P., Sudhir, D., Bandyopadhyay, M. & Chakraborty, A. K. Spectral modelling of neutral beam for Doppler shift spectroscopy diagnostics of INTF. in *AIP Conference Proceedings* **2011**, 80011 (2018).