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Optical Design for Li Beam Zeeman Polarimetry Measurements on DIII–D*

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Knowledge of the edge current density is important in tokamak research for understanding local MHD stability, ELM behavior, and pedestal physics. Measurements of the magnetic field pitch angle, obtained from the polarization characteristics of the sigma component of the Zeeman triplet of Li emission at 670.8 nm, will be used together with the equilibrium solver, EFIT, to infer the plasma edge current density on DIII–D. This paper describes the design and performance of the optical system used for this measurement. A four element optical system images a horizontal Li beam on an array of 32 × 3, 1 mm dia. optical fibers, providing 32 spatial channels with 5 mm radial resolution in the plasma. Low Verdat constant glass is used for all optical elements near the DIII–D vessel to minimize the effects of Faraday rotation caused by stray magnetic fields. Before entering the fiber optics, the light passes through two crossed (45 degrees) photo elastic modulators (PEM) and a linear polarizer, which converts the various polarization states into an intensity modulated signal at the fundamental and 2nd harmonic of the PEM frequencies. For each spatial channel, light from a three fiber bundle is collimated and passes through a temperature tuned etalon (free spectral range, FSR = 0.3 nm; design finesse, F = 10) in order to select only one sigma line of the triplet. The FSR is large enough to adequately cover the expected Zeeman triplet and small enough to achieve a low bandwidth (0.03 nm) at reasonably low F. A 1.0 nm wide interference filter is used to block all but 3–4 peaks of the etalon. The light is then focussed on GaAs photo multiplier detectors. Details of the design and performance results will be presented.

Suggested Category: 9. Interferometry, Polarimetry

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