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Poloidal Magnetic Field Measurements and Analysis With the DIII–D LIBEAM System*

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For over thirty years, neutral lithium beams have been employed as a localized, non-invasive diagnostic on a variety of plasma experiments worldwide, providing a number of key physics measurements. On DIII–D the LIBEAM diagnostic has been designed to provide precise measurements of the local poloidal magnetic field in the edge region, a parameter of basic importance to developing steady-state, high performance tokamaks. We utilize the Zeeman splitting and known polarization characteristics of the collisionally excited 670.8 nm Li resonance line to interpret local field components viewed using a closely packed ($\delta R \sim 5$ mm) array of 32 viewchords. A dual photoelastic modulator/linear polarizer combination serves to amplitude modulate the light in exact correspondence to its input polarization state. Subsequent narrowband spectral filtering using etalons and standard interference filters is used to isolate one of the three Zeeman components, and the polarization state of that component is recovered using a PC-based, multichannel digital lock-in detection system. Edge magnetic pitch angle profiles for a variety of shots have been reconstructed using a small number of chords and detailed analysis of the lockin and DC signal levels. Present system performance appears to be limited by various broadening mechanisms in the beam that tend to decrease the polarization fraction in the observed component. A careful analysis of this effect and some strategies for improving the measured polarization will be presented.

Suggested Category: 8. Optical (IR, Visible, UV)

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