Measurements of the Internal Magnetic Field Using the B-Stark Motional Stark Diagnostic on DIII-D

N.A. Pablant, K.H. Burrell[a], R.J. Groebner[a], E.A. Den Hartog[b], C.T. Holcomb[c], D.H. Kaplan[a], J.S. Ko[b], and H.P. Summers[d]

University of California-San Diego, La Jolla, California 92093, USA
[a]General Atomics, San Diego. P.O. Box 85608, California 92186-5608, USA
[b]University of Wisconsin-Madison, Madison, Wisconsin 53706, USA
[c]Lawrence Livermore National Laboratory, Livermore, California 94550, USA
[d]University of Strathclyde-Glasgow, Scotland, UK

antoniuk@fusion.gat.com

We describe the design, performance and results from the B-Stark diagnostic system installed on the DIII-D tokamak. This system is a version of a motional Stark effect (MSE) diagnostic based on the relative line intensities and spacing of the Stark split D_α emission from injected neutral beams. We present a study of the performance of the diagnostic in measuring the magnitude and direction of the internal magnetic field. We show that the B-Stark diagnostic can make effective measurements over a range of plasma conditions. Measurements were made with toroidal fields in the range 1.2–2.1 T, plasma currents in the range 0.5–2.0 MA, densities between 1.7–9.0 x 10^{19} m^{-3}, and neutral beam voltages between 50–81 keV. The results are compared to values found using EFIT and the MSE polarimetry system on DIII-D, showing good agreement. Calibration of the diagnostic is discussed, and we present results of using an *in-situ* beam into gas calibration to determine the viewing direction and the polarization dependent transmission properties of the collection optics. We also present a comparison of two fitting models for the Stark spectrum. In the first model the level populations of the *n*=3 state of the injected neutral deuterium are free parameters. In the second model we use an atomic physics code, part of the ADAS package, to calculate these values. These comparisons are used to quantify the validity of the ADAS model for B-Stark analysis. Finally we discuss the potential of this diagnostic for use in future devices, such as ITER, where this technique may have advantages over diagnostics based on MSE polarimetry. This work was supported in part by the U.S. Department of Energy under DE-FG02-07ER54917, DE-FG02-89ER53296, DE-FG02-89ER53296 and DE-AC52-07NA27344.