MHD interference with the edge pedestal motional Stark effect diagnostic due to intensity and sideband fluctuations on DIII-D

J.D. King[1,5], M.A. Makowski[1], C.T. Holcomb[1], S.A. Allen[1], D.N. Hill[1], R.J. La Haye[2], F. Turco[3], C.C. Petty[2], M.A. Van Zeeland[2], T.L. Rhodes[4], W.H. Meyer[1], R. Geer[1], and E.C. Morse[5]

[1]*Lawrence Livermore National Laboratory, Livermore, California USA*
[2]*General Atomics, P.O. Box 85608, San Diego, California, 92186-5608 USA*
[3]*Oak Ridge Institute for Science Education, Oak Ridge, Tennessee USA*
[4]*University of California-Los Angeles, Los Angeles, California USA*
[5]*University of California-Berkeley, Berkeley, California USA*

Accurate measurement of internal magnetic field direction using motional Stark effect (MSE) polarimetry in the edge pedestal is desired for nearly all tokamak scenario work. A newly installed 500 kHz 32-channel digitizer on the MSE diagnostic of DIII-D allows full spectral information of the polarimeter signal to be recovered for the first time. Fourier analysis of this data has revealed magnetohydrodynamic (MHD) fluctuations in the plasma edge pedestal at $\rho \geq 0.9$. By correlating edge localized mode (ELM) fluctuations seen on lock-in amplifier outputs with MSE spectrograms it has been shown that edge pedestal tearing mode (TM) fluctuations cause interference with MSE second harmonic instrument frequencies. This interference results in unrecoverable errors in the real time polarization angle measurement that are more than an order of magnitude larger then typical polarimeter uncertainties. These errors can cause as much as a 38% difference in local q. By using a redundant measure of the linear polarization found at the fourth harmonic photo-elastic modulator (PEM) frequency, MHD interference can be avoided. However, because of poorer signal-to-noise the fourth harmonic signal computed polarization angle shows no improvement over the MHD polluted second harmonics. Design of future edge pedestal dual PEM tokamak polarimeters should utilize higher fundamental frequencies with a greater difference between each PEMs frequency, to avoid MHD interference.

This work was preformed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Grant No. DE-AC52-07NA27344 and the USDOE under DE-FC02-04ER54698, DE-AC05-06OR23100, DE-FG03-08ER54984 and DE-FG03-89ER51116.