Observation of MHD instability and direct measurement of local perturbed magnetic field using motional Stark effect diagnostic

R.J. Jayakumar[a)], M.A. Makowski[a)], S.L. Allen[a)], M.E. Austin[b)], A.M. Garofalo[c)], R.J. La Haye, H. Reimerdes[c)] and T.L. Rhodes[d)]

General Atomics, P.O. Box 85608 San Diego California 92186-5688

[a)]Lawrence Livermore National Laboratory, Livermore, California

[b)]University of Texas at Austin, Texas

[c)]Columbia University, New York

[d)]University of California Los Angeles, California

The local oscillating component of the poloidal magnetic field in plasma associated with MHD instabilities has been measured using the motional Stark effect (MSE) diagnostic on the DIII–D tokamak. The magnetic field perturbations associated with a resistive wall mode (RWM) rotated by internal coils at 20 Hz was measured using the conventional MSE operation mode. These first observations of perturbations due to a MHD mode were obtained on multiple MSE channels covering a significant portion of the plasma and the radial profile of the amplitude of the perturbed field oscillations was obtained. The measured profile is similar to the profile of the amplitude of the electron temperature oscillation measured by electron cyclotron emission (ECE) measurements. In a new mode of measurement, the amplitude of a tearing mode rotating at a high frequency (~7 kHz) was observed using the spectral analysis of high frequency MSE data on one channel. The spectrum consists of the harmonics of the light modulation employed in the MSE diagnostics, their mutual beat frequencies and their beat frequencies with the rotation frequency of the tearing mode. The value and time variation of the frequency of the observed perturbations is in good agreement with that measured by Mirnov probes and ECE. The paper demonstrates that the MSE diagnostic can be used for observing low and high frequency phenomena such as MHD instabilities and electromagnetic turbulence.