First Doppler Reflectometry Results from the DIII-D Tokamak

L. Schmitz, G. Wang, A.E. White, T.L. Rhodes, W.A. Peebles

University of California, Los Angeles

W. Solomon

Princeton Plasma Physics Laboratory, Princeton, NJ

Doppler Reflectometry is potentially useful for measurements of ExB flows, electric field shear, and plasma turbulence, and has been previously successfully used on the ASDEX-Upgrade [1] and the TORESUPRA [2] tokamaks. Bistatic and monostatic antenna configurations have recently been tested on DIII-D in X-mode and O-mode polarizations (30 Ghz < f < 70 Ghz). An adjustable parabolic mirror inside the vacuum boundary is used to achieve a narrow Gaussian beam spot size of the transmitted/reflected beam ($2w_0 \sim$ 4-6 cm), Antenna tilt angles of 5-20^o with respect to the flux surface normal can be achieved with this set-up depending on plasma shape and probing radius. We present initial ExB flow measurements ($0.5 < r/a < 0.9$) during the L to H-mode transition and in quiescent H-mode (QH mode) plasmas. The measured poloidal velocity, evaluated from a simple diffraction model as well as from GENRAY ray tracing calculations, is found to agree well with the ExB velocity obtained from Charge Exchange Recombination Spectroscopy (CER).

In contrast to conventional (perpendicular incidence) reflectometry, Doppler reflectometry allows measurements of the density fluctuation spectrum for discrete values of the turbulence poloidal wavenumber k_θ. We report preliminary data for $1\ cm^{-1} < k_\theta \rho_s < 3\ cm^{-1}$. In addition to the density fluctuation spectrum, the fluctuating radial electric field can be determined from the time-dependent Doppler shift of the received signal. Reflectometry may therefore be useful for the investigation of Zonal flows ($k_\theta \sim 0$, $k_{par} \sim 0$). Initial results in L-mode discharges are shown. We will discuss plans for radial and toroidal mapping of zonal flows and for investigating the interaction of broadband density fluctuations and zonal flows.

[1] G.D. Conway, B. Scott, J. Schirmer, et al., Plasma Phys. Control. Fusion 47, 1165-85 (2005).

[2] P. Hennequin, D. Honore, A. Truc, Rev. Sci. Instr. 75, 3881-83 (2004).