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Neutral Beam Source and Target Plasma for Development of a Local Electric Field Fluctuation Diagnostic[1]

M.R. BAKKEN, M.G. BURKE, R.J. FONCK, B.T. LEWICKI, A.T. RHODES, G.R. WINZ, University of Wisconsin-Madison — A new diagnostic measuring local $\vec{E}(r,t)$ fluctuations is being developed for plasma turbulence studies in tokamaks. This is accomplished by measuring fluctuations in the separation of the π components in the H_α motional Stark spectrum. Fluctuations in this separation are expected to be $\tilde{E}\big/E_{MSE} \sim 10^{-3}$. In addition to a high throughput, high speed spectrometer, the project requires a low divergence ($\Omega \approx 0.5°$), 80 keV, 2.5 A H^0 beam and a target plasma test stand. The beam employs a washer-stack arc ion source to achieve a high species fraction at full energy. Laboratory tests of the ion source demonstrate repeatable plasmas with $T_e \sim 10$ eV and $n_e \approx 1.6 \times 10^{17}$ m^{-3}, sufficient for the beam ion optics requirements. T_e and n_e scalings of the ion source plasma are presented with respect to operational parameters. A novel three-phase resonant converter power supply will provide 6 mA/cm^2 of 80 keV H^0 at the focal plane for pulse lengths up to 15 ms, with low ripple $\delta V/80$ keV $\approx 0.05\%$ at 280 kHz. Diagnostic development and validation tests will be performed on a magnetized plasma test stand with ~ 0.5 T field. The test chamber will utilize a washer-stack arc source to produce a target plasma comparable to edge tokamak plasmas. A bias-plate with programmable power supply will be used to impose $\tilde{E}$ within the target plasma.

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