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First Measurements of Multi-scale Density Fluctuations and $\boldsymbol{E}$x$\boldsymbol{B}$ Velocity via Doppler Backscattering in the C-2W Field-Reversed Configuration M. TUSZEWSKI, TAE Technologies, Foothill Ranch, CA, L. SCHMITZ, University of California Los Angeles, CA, M. BEALL, R. SMITH, H. GOTA, T. ROCHE, C. LAU, T. TAJIMA, M. BINDERBAUER, TAE Technologies, Foothill Ranch, CA, TAE TEAM — An advanced multi-channel combined Doppler Backscattering (DBS) diagnostic has been installed at the C-2W Field-Reversed Configuration (FRC) device. First measurements of intermediate wavenumber density fluctuations $2\leq k_{\rm tor}\rho_{\rm s} \leq 10$ and $\boldsymbol{E}$x$\boldsymbol{B}$ velocity in the FRC core plasma (outside the null field region) and in the scrape-off layer are presented. Plans and preparations for the first tests of Cross Polarization Scattering [1] (CPS, for the measurement of perpendicular magnetic field fluctuations from the DBS scattering volume) are also discussed. GENRAY ray tracing predicts that magnetic fluctuations with $2\leq k_{\rm tor}\rho_{\rm s} \leq 30$ can be accessed in the FRC core and scrape-off layer (SOL). DBS data from the previous C-2U FRC experiment [2] already show the absence of ion-scale density turbulence in the FRC core. Global gyrokinetic simulations attribute core stability to Finite Larmor radius effects, short fieldline connection length, and favorable magnetic field gradient. In contrast, multi-scale turbulence including short-scale electron modes has been observed in C-2U via DBS in the mirror-confined SOL plasma, also in agreement with global gyrokinetic simulations which predict unstable drift-interchange modes for $k_{\rm tor}\rho_{\rm s} \geq 1.5$. [1] X.L. Zou et al., Phys. Rev. Lett. 75 1090-93 (1991); [2] L. Schmitz et al., Nature Comm. 7 13860 (2016).

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