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**Instabilities in Beam-Plasma Waves in a Model of the Beam-Driven FRC** BRADLEY SCOTT NICKS, ALES NECAS, TOSHI TAJIMA, Tri Alpha Energy, TRI ALPHA ENERGY TEAM — Using a semi-analytic solver, the kinetic properties of plasma waves are analyzed in various regimes in the presence of a beam. This analysis is done to model the strong beam-driven Field-Reversed Configuration (FRC) plasma kinetic instabilities in the neighborhood of the ion cyclotron frequency. As the frequency is relatively high, and wavelength small, the plasma is taken to be local and thus homogeneous, comprised of bulk ions, electrons, and beam ions, with a uniform background magnetic field. The beam ions are given an azimuthal drift velocity with respect to the magnetic field, but otherwise have various Maxwellian velocity distributions. First, the magnetic field is varied to create regimes of low and high $\beta$, and the mode structures are compared. The low-$\beta$ case (corresponding to the scrape-off layer and near the separatrix) features primarily the beam-driven ion Bernstein instability. The high-$\beta$ case (the core of FRC) is primarily electromagnetic and features the AIC instability when temperature anisotropy is included. The most unstable modes are incited by near-perpendicular beam injection with respect to the magnetic field. Finally, the results of the semi-analytic solver are compared with those from the EPOCH PIC code [1] to evaluate the influence of nonlinear effects. This theoretical modeling was used in conjunction with EPOCH to investigate the beam driven instabilities in Tri Alpha Energy's C-2U experiment [2]. [1] T.D. Arber *et al.*, Plasma Phys. Control. Fusion 57.11 (2015): 113001. [2] M.W. Binderbauer *et al.*, AIP Conference Proceedings **1721**, 030003 (2016).

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