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Modeling and Theory of RF Antenna Systems on Proto-MPEX[1]

P.A. PIOTROWICZ, University of Illinois at Urbana Champaign, J.F. CANESES, R.H. GOULDING, D. GREEN, J.B.O. CAUGHMAN, ORNL, D.N. RUZIC, University of Illinois at Urbana Champaign, PROTO-MPEX TEAM — The RF wave coupling of the helicon and ICH antennas installed on the Prototype Material Plasma Exposure eXperiment (MPEX) has been explored theoretically and via a full wave model implemented in COMSOL Multiphysics. The high-density mode in Proto-MPEX has been shown to occur when exciting radial eigenmodes of the plasma column which coincides with entering a Trivelpiece Gould (TG) anti-resonant regime, therefore suppressing edge heating in favor of core power deposition. The fast wave launched by the helicon antenna has a large wavelength and travels at a steep group velocity angle with the background magnetic field; for this reason the fast wave launched by the helicon antenna efficiently couples power to the core plasma. However, the ICH heating scheme relies on a small wavelength slow wave to couple power to the core of the plasma column. Coupling slow wave power to the core of the plasma column is sensitive to the location of the Alfven resonance. The wave-vector and group velocity vector of the slow wave in this parameter regime undergoes a drastic change in behavior when approaching the Alfven resonance. Full wave simulation results and dispersion analysis will be presented with suggestions to guide experimental progress.

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Pawel Piotrowicz
University of Illinois at Urbana Champaign

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