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Title: Electron Bernstein Wave Coupling, Propagation and Current Drive in National Spherical Torus Experiment (NSTX) and Pegasus

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The spherical torus (ST) can be an attractive candidate for a high beta fusion reactor only if the plasma is sustained non-inductively. In order to stabilize the plasma some plasma current may need to be driven off-axis by an external radiofrequency source. The “overdense” character of the ST plasma precludes electron cyclotron current drive but allows electron Bernstein wave current drive (EBWCD). Obliquely viewing, dual-polarization EBW emission (EBE) radiometry, 3-D EBW ray-tracing and Fokker-Planck modeling support a multi-megawatt EBWCD system design for NSTX using efficient EBW coupling via obliquely launched, elliptically polarized microwaves and Ohkawa EBWCD to generate off-axis current. An EBW coupling efficiency of 80±20% at 16.5 GHz was achieved on NSTX, in good agreement with modeling predictions. The polarization of the measured EBE was consistent with the elliptical polarization predicted by modeling. Numerical EBWCD modeling for high beta NSTX plasmas at 14 and 28 GHz predicts current drive efficiencies of 40-50 kA/MW and an EBW-driven current density that peaks at a normalized minor radius ~ 0.7 outboard of the magnetic axis. EBW experiments on the Pegasus ST with up to 1 MW of 2.45 GHz power will investigate nonlinear edge effects, power deposition and EBWCD. Modeling for Pegasus plasmas predicts an EBWCD efficiency of 20 kA/MW and an EBW-driven current density of 20-100 kA/cm^2 on axis.