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Electron Bernstein Wave (EBW) current drive profiles and efficiency for STEP

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The UK's Spherical Tokamak for Energy Production (STEP) reactor design program is now exclusively investigating concepts using microwave-based heating and current drive (HCD) systems. Electron Bernstein Wave (EBW) HCD is a relatively immature technology compared to Electron Cyclotron (EC) HCD but is of interest due to the promise of high current drive efficiency and access to dense plasmas at low magnetic fields where EC is cut off. This presentation will discuss estimated EBW current drive efficiency on STEP.

GENRAY and CQL3D were used to estimate the current drive profiles and normalised current drive efficiency $\zeta_{CD} = \frac{32.7 I_{CD}[A] n_e[10^{20} m^{-3}] R[m]}{P[W] T_e[keV]}$ for several reactor concepts with varying temperature, density, geometry and magnetic field. $\zeta_{CD} > 1.0$ was readily found for $\rho = 0.65{-}0.9$ while $\zeta_{CD} > 0.5$ was found for $\rho \geq 0.5$

The absorption location of the EBW exhibits a large shift away from the cyclotron harmonic due to Doppler broadening of the resonance at finite temperature. Estimations of the shift from these scans is being used to develop a fast model to support integrated scenario modelling in the neighbourhood of the preferred concept.

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