THEORETICAL STUDIES OF ELECTRON BERNSTEIN WAVES

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Results from our theoretical/compuational research to-date:

- Identified the appropriate regimes in parameter space spanned by the frequency and parallel wavelength for efficient conversion of X mode and O mode to electron Bernstein waves.

- Established that the spatial location and density gradients for optimal mode conversion to electron Bernstein waves are different for X or O mode excitations.

- Derived symmetry relations between the coefficients for the excitation of electron Bernstein and the coefficients for the emission of electron Bernstein waves from a thermal plasma

- thus, experiments measuring emission of electron Bernstein waves on CDX-U and NSTX can be a useful guide to optimal mode conversion scenarios for heating and current drive.

- From ray trajectory analysis showed that the spatial location inside the plasma where electron Bernstein waves damp on electrons is dependent on the poloidal launch position of the wave
  - for near central heating electrons it would be ideal to launch electron Bernstein waves along the equatorial plane
  - for current drive it is necessary to investigate further the positions for launching the waves.

The future theoretical and computational issues that need to be addressed:

- Have available a fully functional code for calculating mode conversion emission/excitation of electron Bernstein (to/from X and O modes, respectively)
  - for between-shot analysis
  - for help in determining the appropriate conditions for optimum heating and current drive.
- Studies of possible parametric interactions at the edge during high power electron Bernstein wave coupling experiments on NSTX
  - presently due to the low powers, experiments cannot identify existence of parametric excitations
  - the coupling, via mode conversion, to electron Bernstein waves could be significantly modified by parametric interactions within the mode conversion region.

- Develop analytical/computational tools for studying current drive by electron Bernstein waves
  - effect of trapped particles on current generated and power dissipated
  - interaction with the bootstrap current (neoclassical transport effects)
  - identify ideal launch positions for stabilizing neoclassical tearing modes and/or modifying the current profile
- Determine the need to incoporate relativistic effects in the propagation and damping of electron Bernstein waves.