NSTX WAVES AND PARTICLES FORUM

EXCITATION AND EMISSION OF ELECTRON BERNSTEIN WAVES

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MOTIVATION

- Emission observations on NSTX in the $8 - 40$ GHz range (*Diem et al.* – 2006/2007) are found to disagree with emission codes.

- Why?

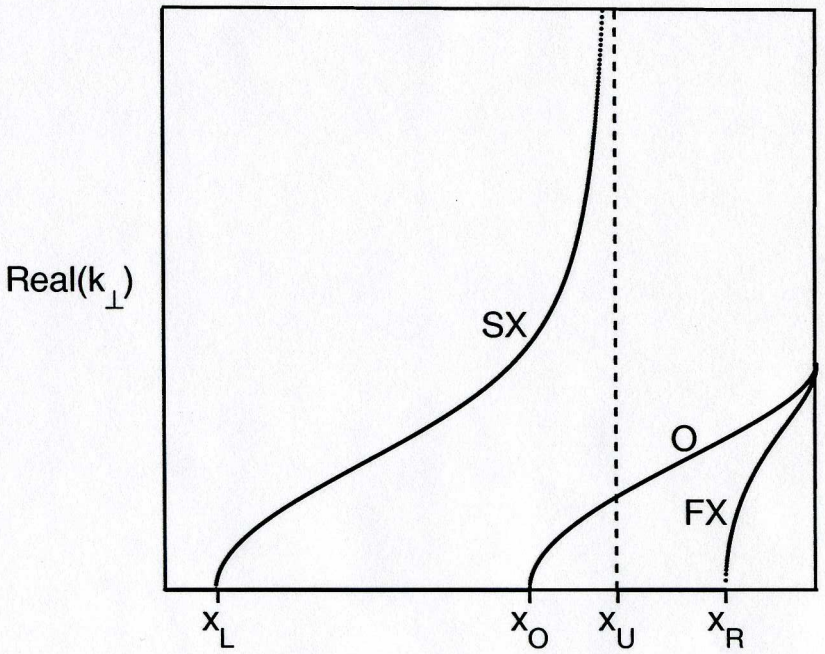
  - What are the assumptions incorporated in the codes?

  - What needs to be added into the codes?

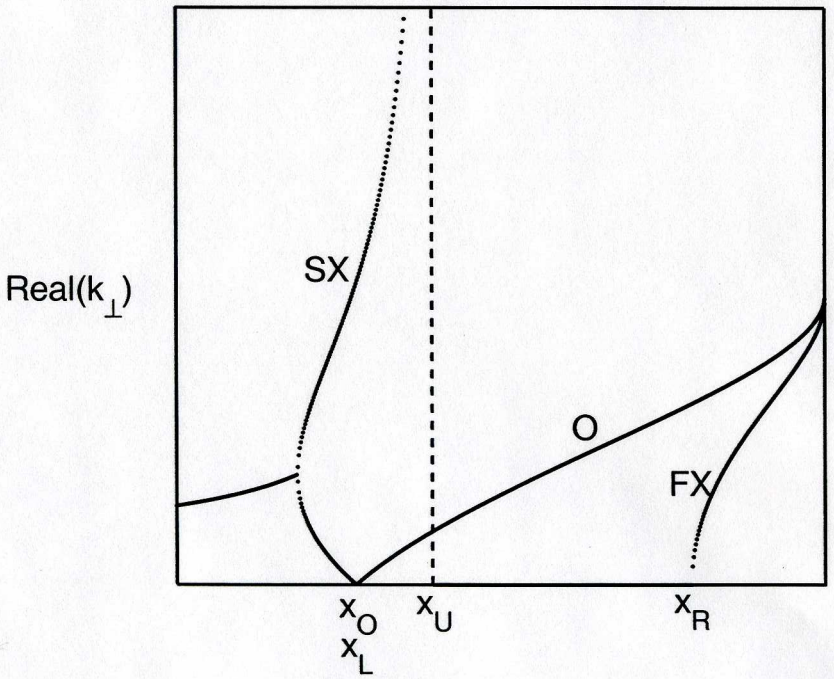
MODE CONVERSION PROCESSES

COLD PLASMA MODEL

X-B Conversion

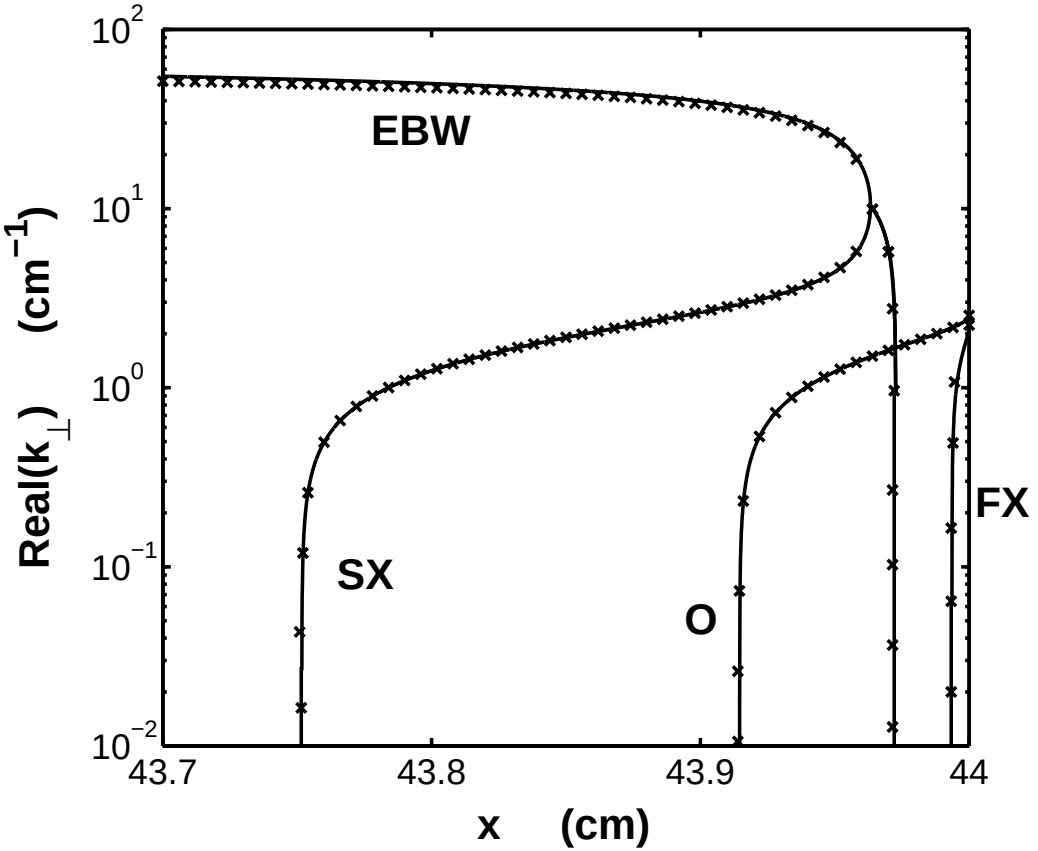


O-X-B Conversion



MODE CONVERSION PROCESS

KINETIC PLASMA MODEL



MODE CONVERSION EQUATIONS

- Slab geometry with inhomogeneity in the x-direction; y and z variations are of the form $e^{ik_y y + ik_z z}$
- Sheared magnetic field
  $\vec{B}_0(x) \equiv B_y\hat{y} + B_z\hat{z} = B_0(x)\sin\Psi(x)\hat{y} + B_0(x)\cos\Psi(x)\hat{z}.$
- Derive cold plasma permittivity from linearized fluid (momentum) and Maxwell's equations.
- Assume EBWs are electrostatic waves and replace cold plasma K_{xx} by the kinetic form for a Maxwellian plasma expanded to order $(k_\perp \rho_e)^2$
- Conservation of kinetic energy flow density leads to

$$K^K_{xx} E_x \rightarrow K_{xx} E_x - \frac{d}{dx}\left(\chi_1 \frac{dE_x}{dx}\right)$$

MODE CONVERSION EQUATIONS

- Define

$$\vec{F}^T = [E_x \; E_y \; E_z \; (i\chi_1 E_x') \; cB_z \; (-cB_y)]$$

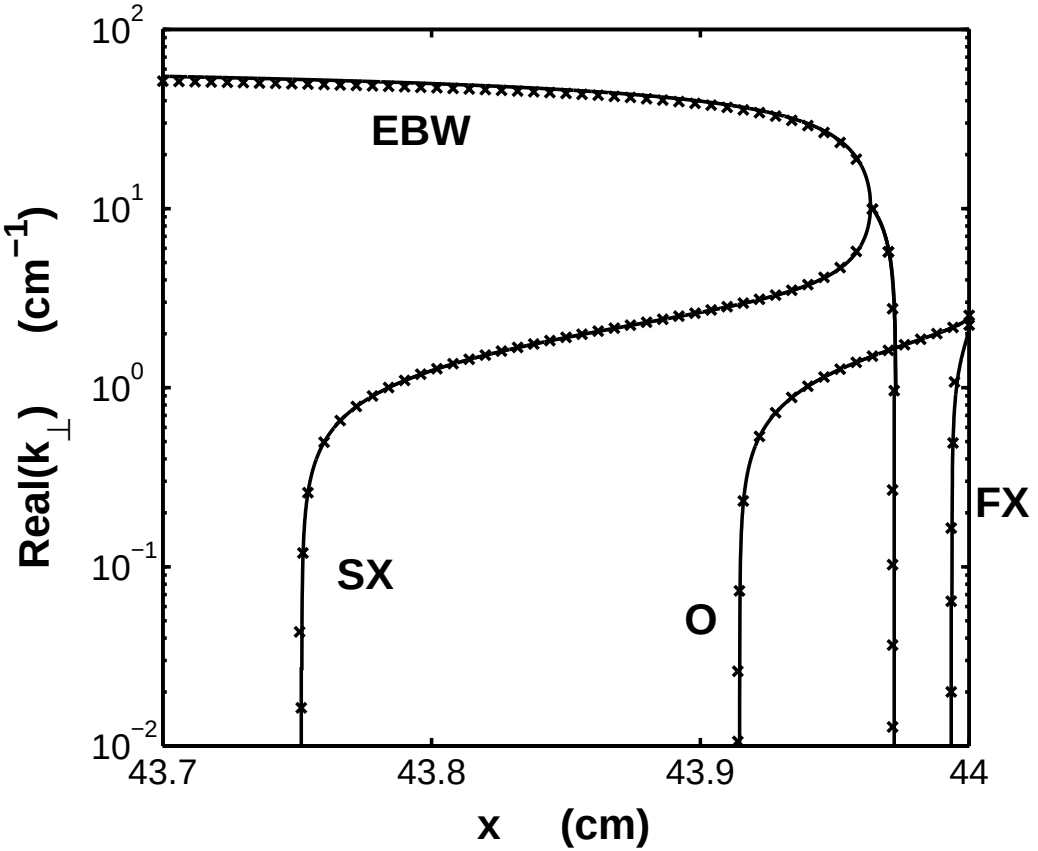
- Then

$$\frac{d\vec{F}}{d\xi} = i\overleftrightarrow{A} \cdot \vec{F}$$

- The sixth order system describes the propagation of X and O modes and EBWs. They are solved with the appropriate boundary conditions.

MODE CONVERSION PROCESS

KINETIC PLASMA MODEL



SHORT TERM PLANS

- This model is being implemented into the Preinhaelter-Urban code in collaboration with George Vahala.

- It will also be implemented into Dr. Harvey's SDG-RF package.

LONGER TERM PLANS

- Consider more experimental surprises that are definitely coming our way!
- Include two-dimensional effects (variation in the poloidal direction).
- Do we need to include collisions?

LONG TERM (FY 09-13) PLANS

- Parametric processes at the edge (Porkolab).
- Relativistic effects in wave propagation and damping (Decker, Peysson, Harvey).
- Wave-particle interactions: optimizing current drive.
- Varied problems guided by experiments and evolving thought processes.
- Problems based on issues raised in this and future forums by the NSTX scientists.