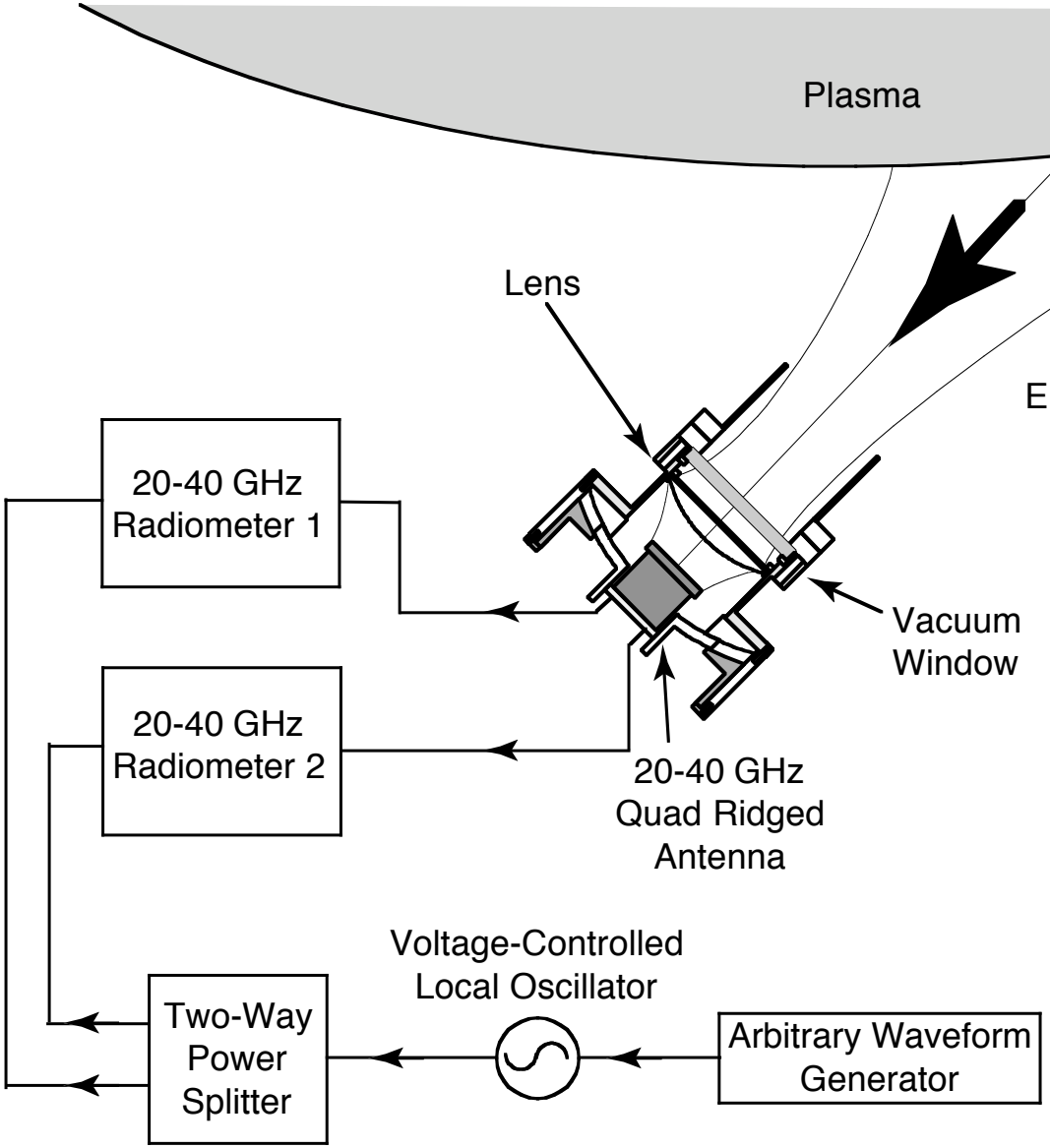
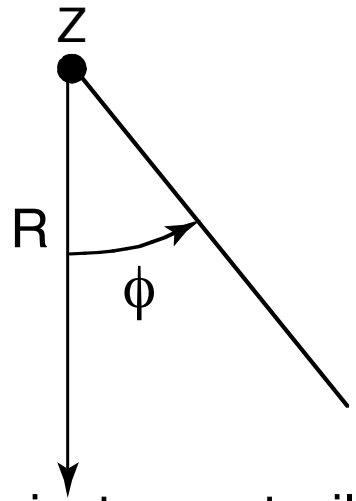
XP 514: Thermal Electron Bernstein Wave Conversion to O-Mode at 20-40 GHz

G. Taylor, P. Efthimion, J. Wilgen, J. Caughman

- Goals for this experiment:
  - *Measure $T_e(R,t)$ via thermal EBW emission*
  - *Analyze polarization of thermal EBW emission*
  - *Demonstrate >80% coupling of thermal EBWs at ~ 28 GHz*

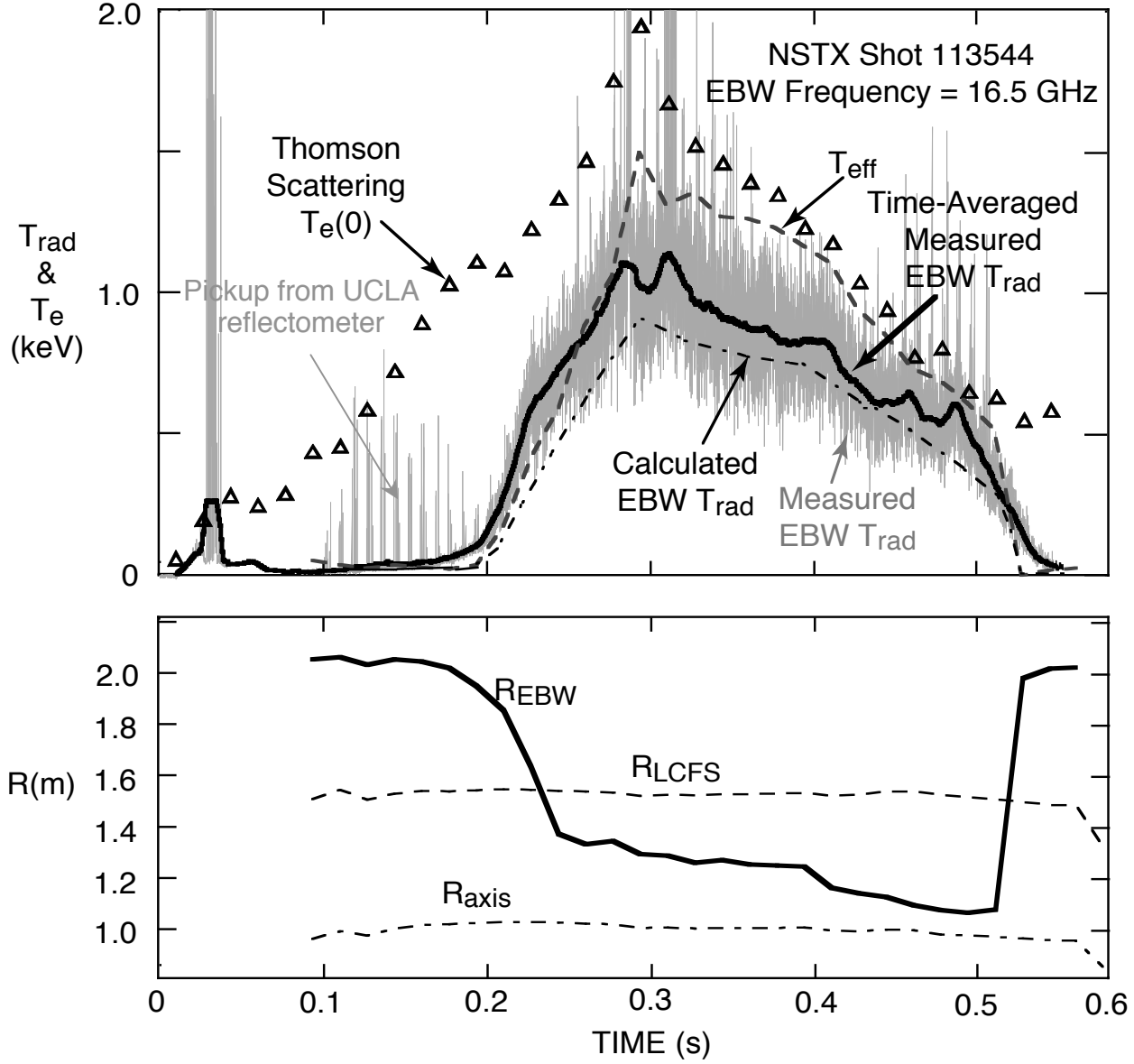
Dual Channel 20-40 GHz Radiometer & Steerable Quad-Ridged Horn Provide Orthogonal Polarization Measurements





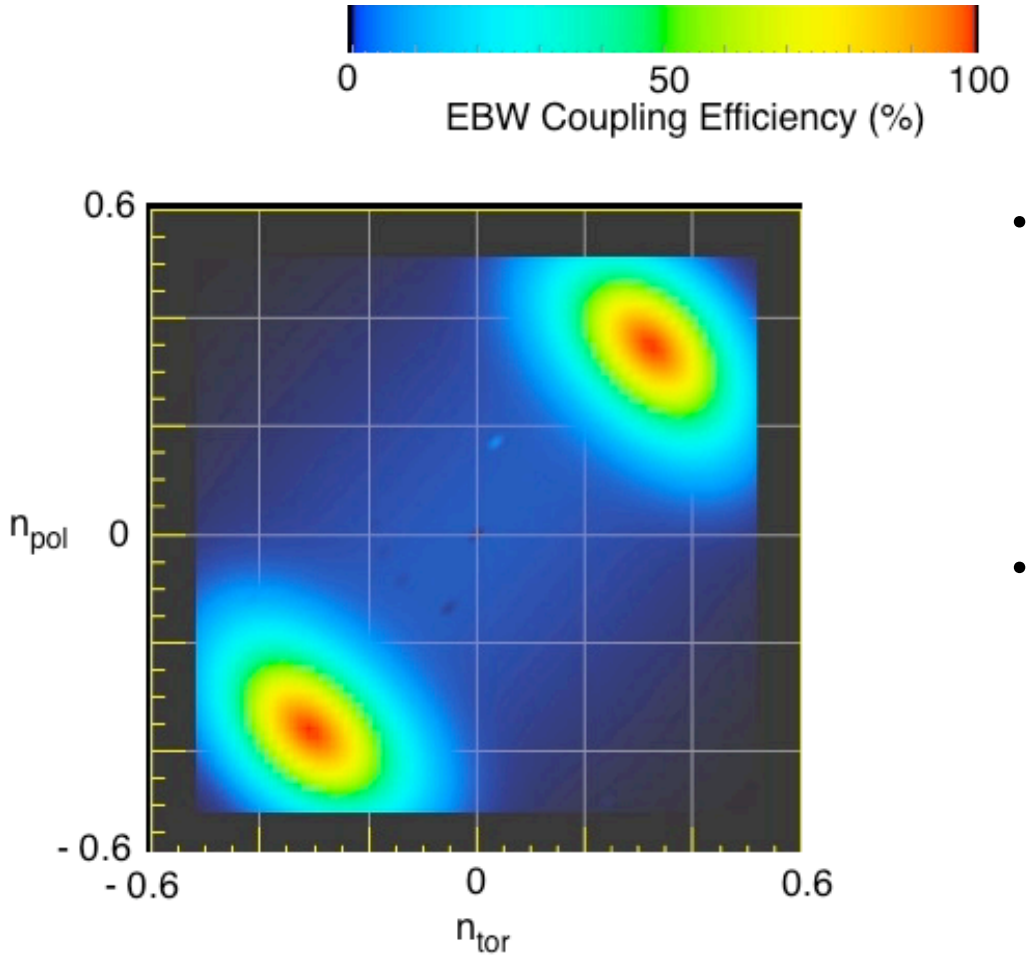
- New instrument will allow measurement of 20-40 GHz thermal EBW emission with ~ 10 μs time resolution to support $T_e(R,t)$ diagnostic development

XP405 Demonstrated ~ 80% B-X-O Coupling at 16.5 GHz via Thermal EBW Coupling



- Full wave coupling model/3-D EBW ray tracing predicts ~ 62-67% coupling in good agreement with measurements
- Modeling predicts circularly polarized emission, consistent with measurements

AORSA1D Full Wave Coupling Calculations Predict Efficient Coupling at ~ 28 GHz



β = 40 % NSTX Plasma

Launch Frequency = 28 GHz

- 28 GHz being considered as operating frequency for megawatt-level NSTX EBWCD system
- Experiment will aim to benchmark modeling predictions, including emission polarization at ~28 GHz

Run Plan

- Initial measurements in “piggyback” mode to identify optimum antenna alignment for a dedicated experiment
- Dedicated experiment will probably use plasma parameters similar to NSTX shot 113544, (I_p = 800 kA, B_o = 4 kG & ~ 2 MW NBI)

  - *would benefit from a relatively long, ~200 ms, I_p flattop*

- Dedicated experiment requires at least 12 shots
- Essential diagnostics:

  - *Thomson scattering $T_e(R)$ and $n_e(R)$*

  - *Scrape off density profile from ORNL and/or UCLA reflectometer for input to full wave coupling code*

  - *EFIT to reconstruct equilibria for 3-D EBW ray tracing*

Run Plan - Dedicated Shots

1. Setup & repeat shot similar to 113544 (outer gap ~ 5 cm) until the plasma condition becomes reasonably reproducible. Run EBW radiometer in swept 20-40 GHz mode (2-3 shots)
2. Set radiometer receive frequency ~ 28 GHz (1 shot)
3. Increase outer gap in 5 cm steps to ~ 20 cm, take radiometer data at ~ 28 GHz and 20-40 GHz swept mode for each outer gap (6 shots)
4. In controlled access, rotate antenna by 45 degrees, then run plasma from step 3 that provided maximum EBW signal with radiometer receive frequency ~ 28 GHz and 20-40 GHz swept mode (2 shots)
5. In controlled access, insert quarter wave plate in front of antenna, then run plasma with radiometer receive frequency ~ 28 GHz and in 20-40 GHz swept mode (2 shots)