

Electron Bernstein Wave Research on NSTX in 2002

Presented by

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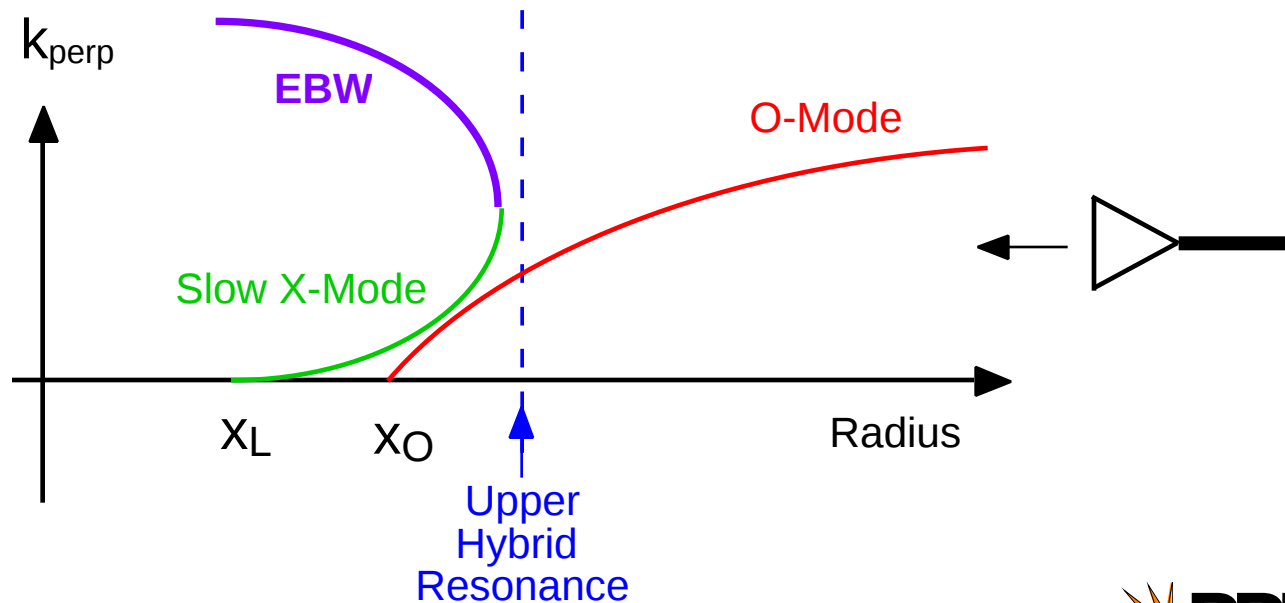
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CompX

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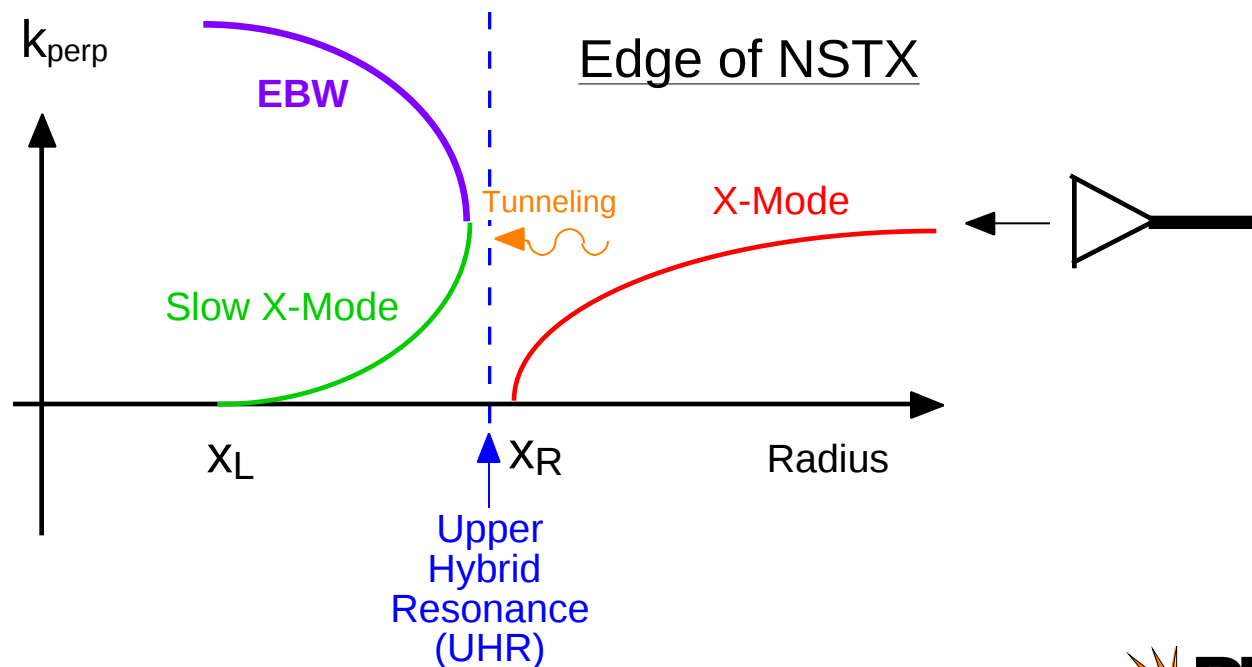
O-X-B EBW Heating Promising for Overdense Stellarators, But May Not be Appropriate for ST

- Efficient O-X-B EBW heating with ~ 1.5 MW at 140 GHz already observed for overdense W7-AS with $\sim 35^\circ$ oblique launch
- MAST beginning major O-X-B EBW heating and current drive program at 60 GHz:
 - but O-X-B launch angle very sensitive to q profile on ST



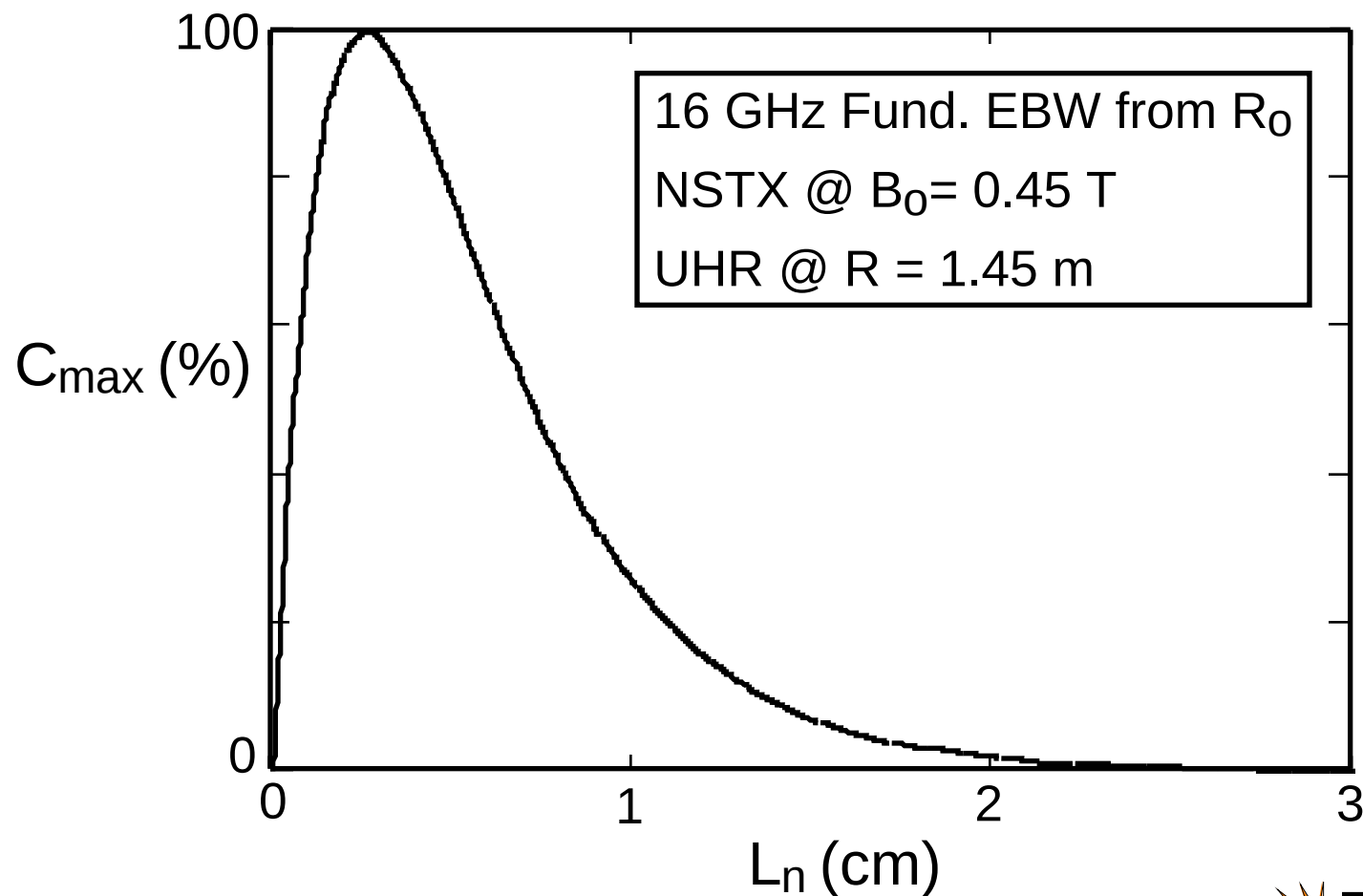
X-B Conversion Allows $n_{||} \sim 0$ Launch

- ~ 100% B-X conversion recently demonstrated for CDX-U EBW emission
- X-B efficiency same as B-X efficiency at low power (~Watts), but at higher power maybe non-linear effects



B-X Conversion Efficiency Sensitive to L_n at Upper Hybrid Layer. On NSTX $C_{\max} \sim 100\%$ for $L_n \sim 0.4$ cm

EBW to X-Mode Conversion Efficiency

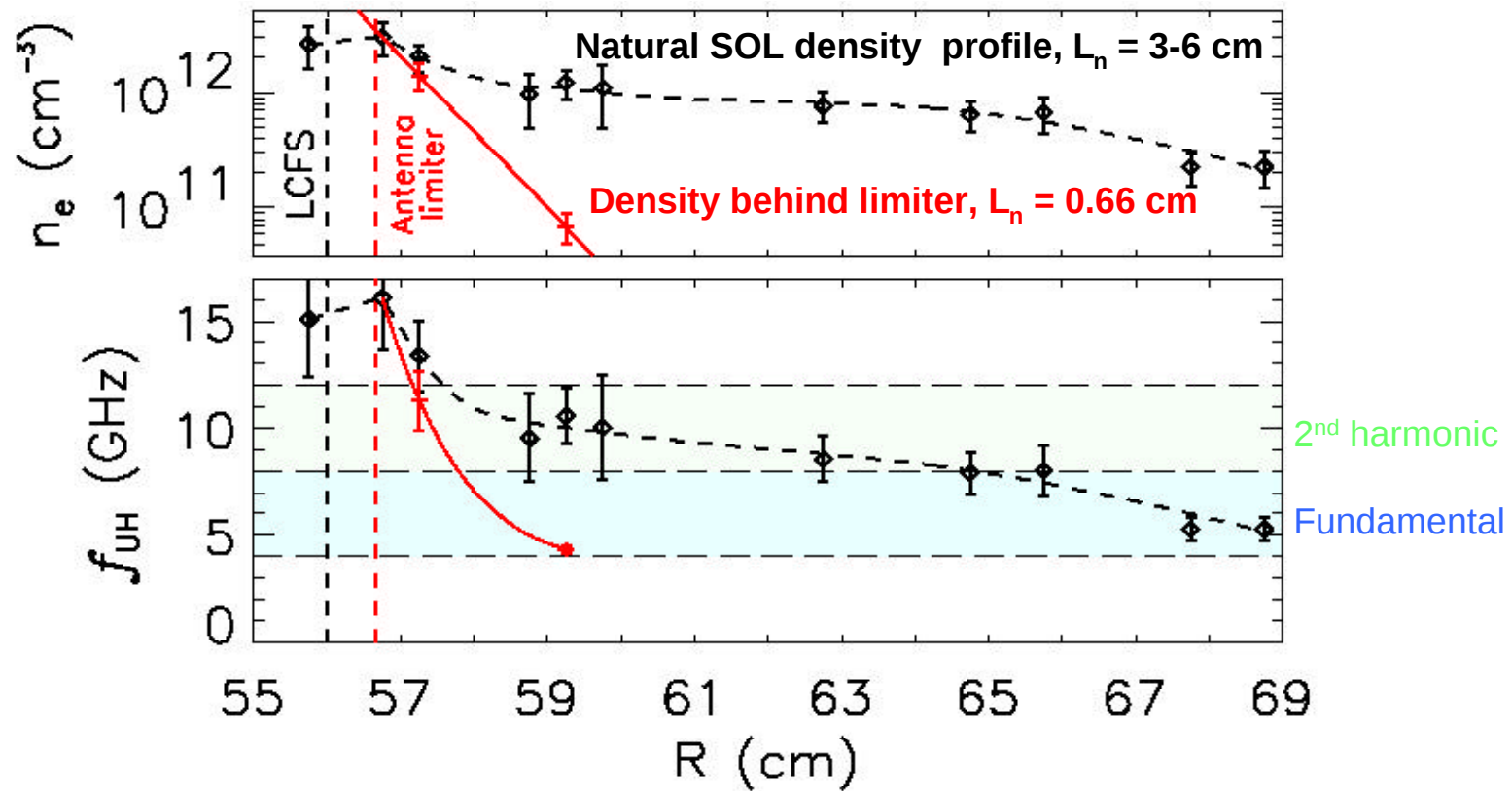


EBW Emission Results from NSTX & CDX-U from 2000-2001 Influence 2002 Plans

- Measured B-X conversion efficiency (C_{bx}) $\approx$ 10% on CDX-U and NSTX, due to long L_n (2 - 6 cm) at UHR
- C_{bx} increases from 5% to 15% at NSTX L-H transition due to natural L_n shortening at UHR during H-mode
- Local limiter on CDX-U increased C_{bx} to $\sim$ 100% by decreasing L_n at UHR; results consistent with theory
- Strong correlation between density fluctuations at the UHR and EBW T_{rad} fluctuations on CDX-U

Local Limiter Shortens L_n for High Mode Conversion Efficiency

CDX-U

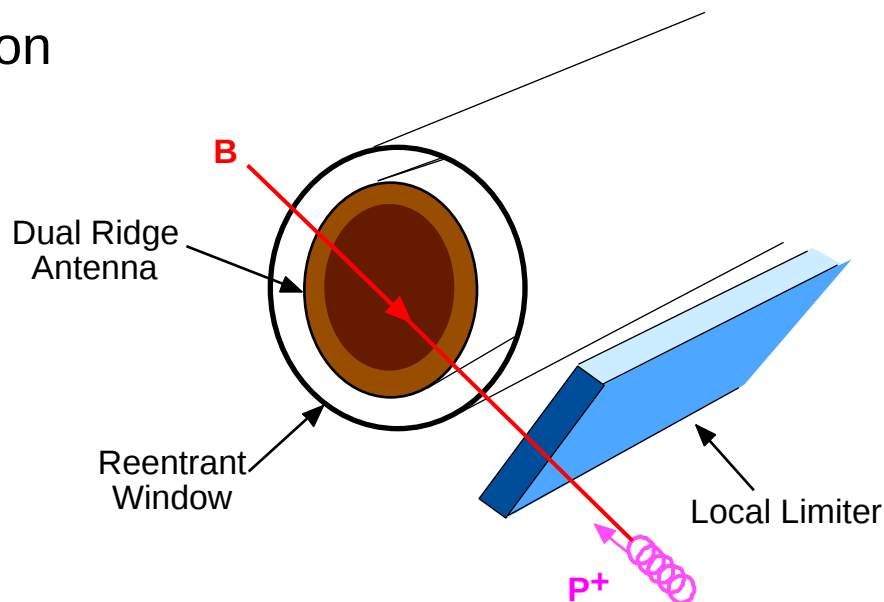


Install Local Limiter Next to Existing EBW Reentrant Window on NSTX to Shorten L_n



- Local limiter installed on ion streaming side of EBW antenna, below midplane

- Limiter will be outside LCFS

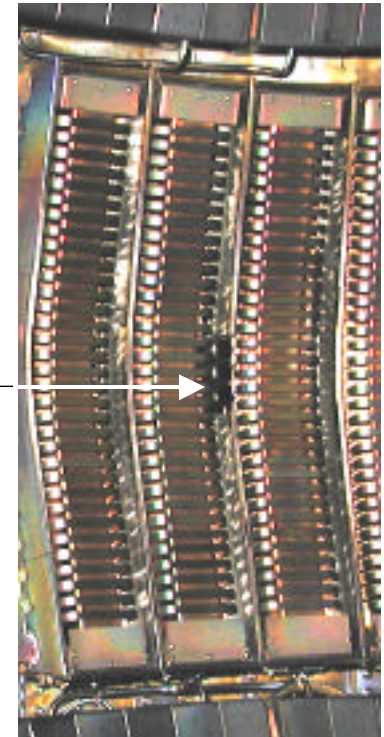


- UCSD scanning probe near NSTX EBW antenna may provide L_n measurements with and without local limiter

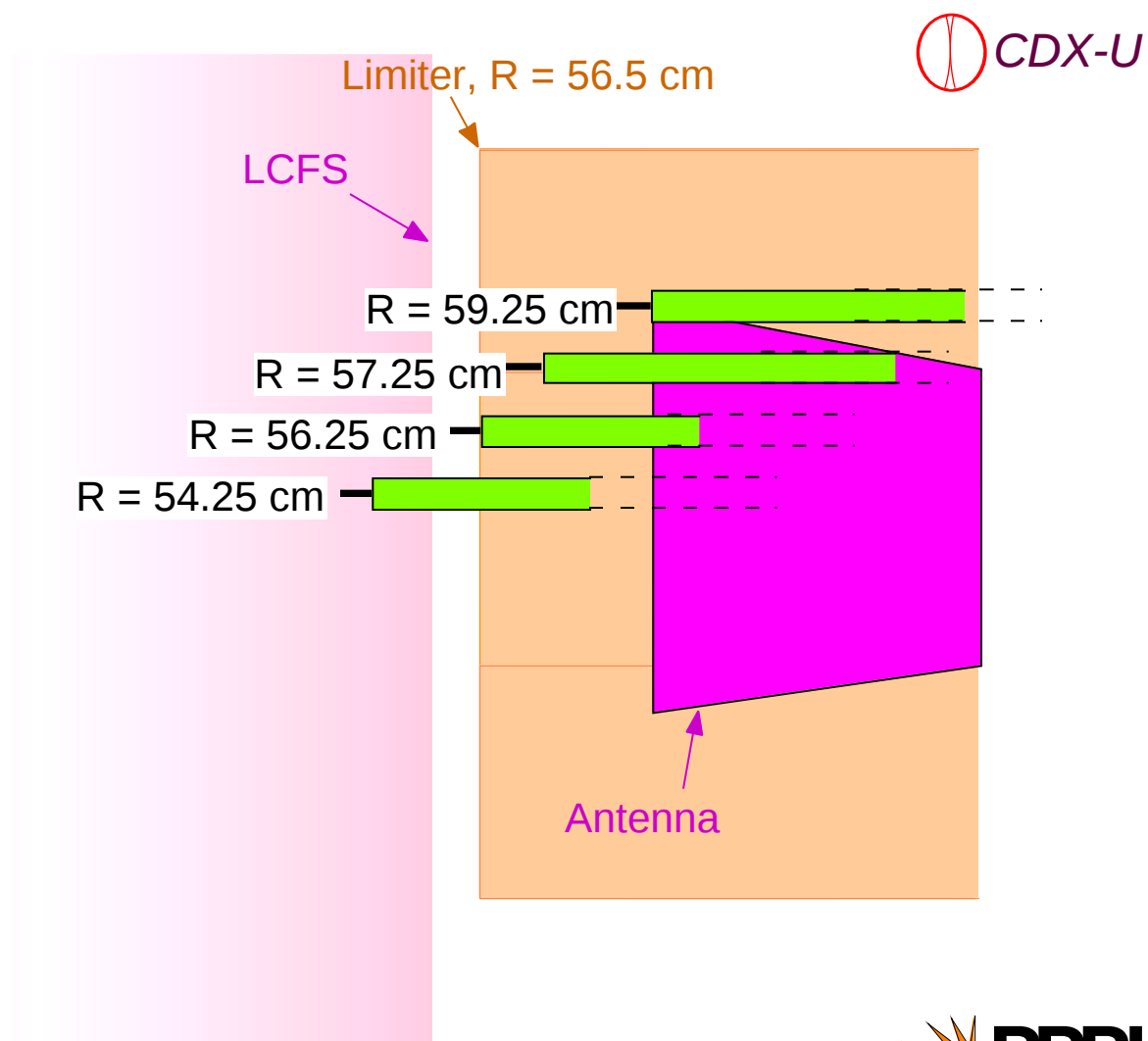
EBW Heating and Current Drive Research Program Planned for NSTX and CDX-U with ORNL



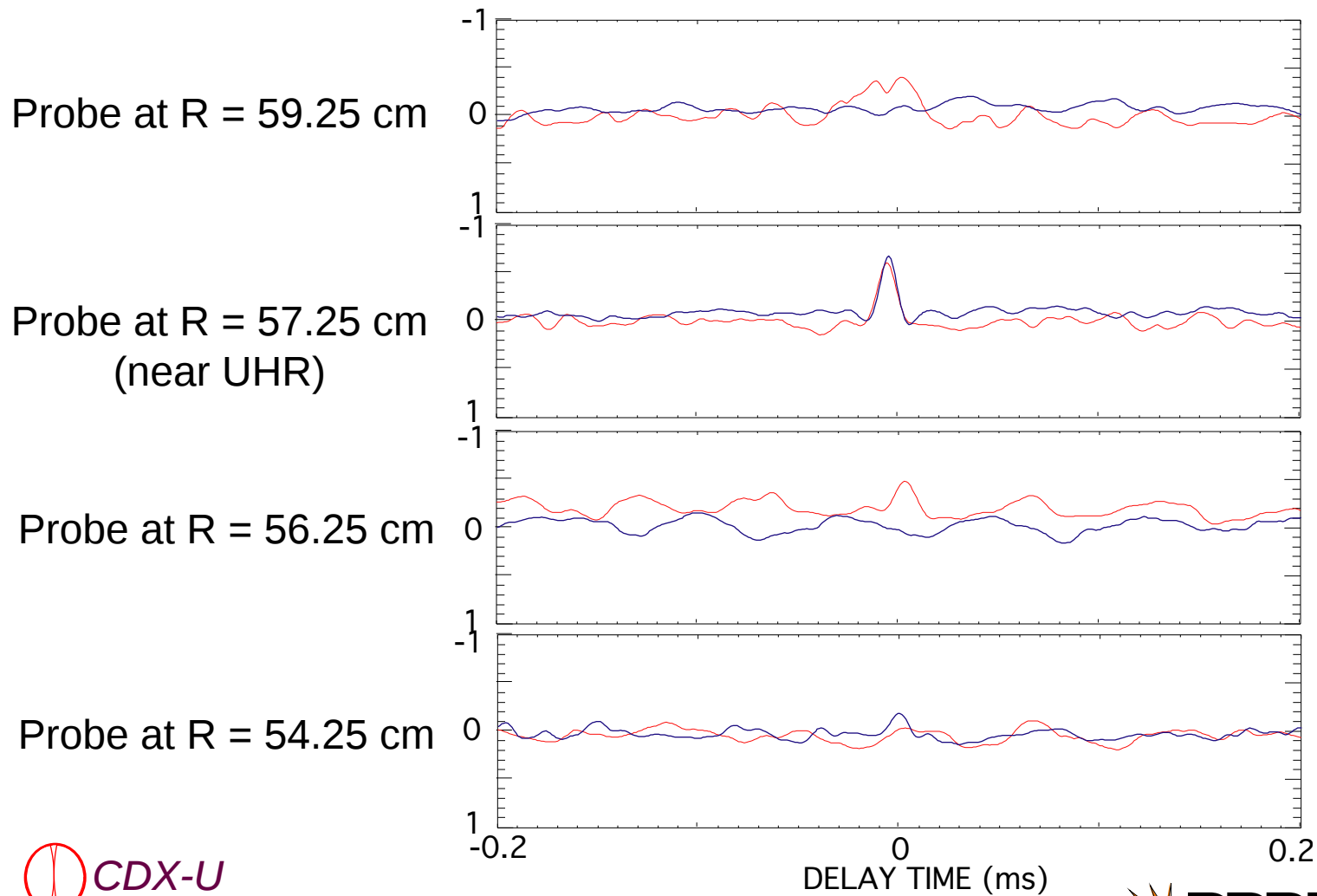
- CDX-U EBW heating planned with local limiter in FY02. (4-5 GHz pulsed klystron or magnetron)
- Recent NSTX EBW coupling experiments with ECH launcher, without local limiter, show poor coupling as expected
- New horn to be installed in HHFW antenna (provides local limiter):
 - EBW emission and 15 kW, 18 GHz coupling
 - possible electron tail heating?
- Complete ~1 MW 28 GHz design by end of FY03



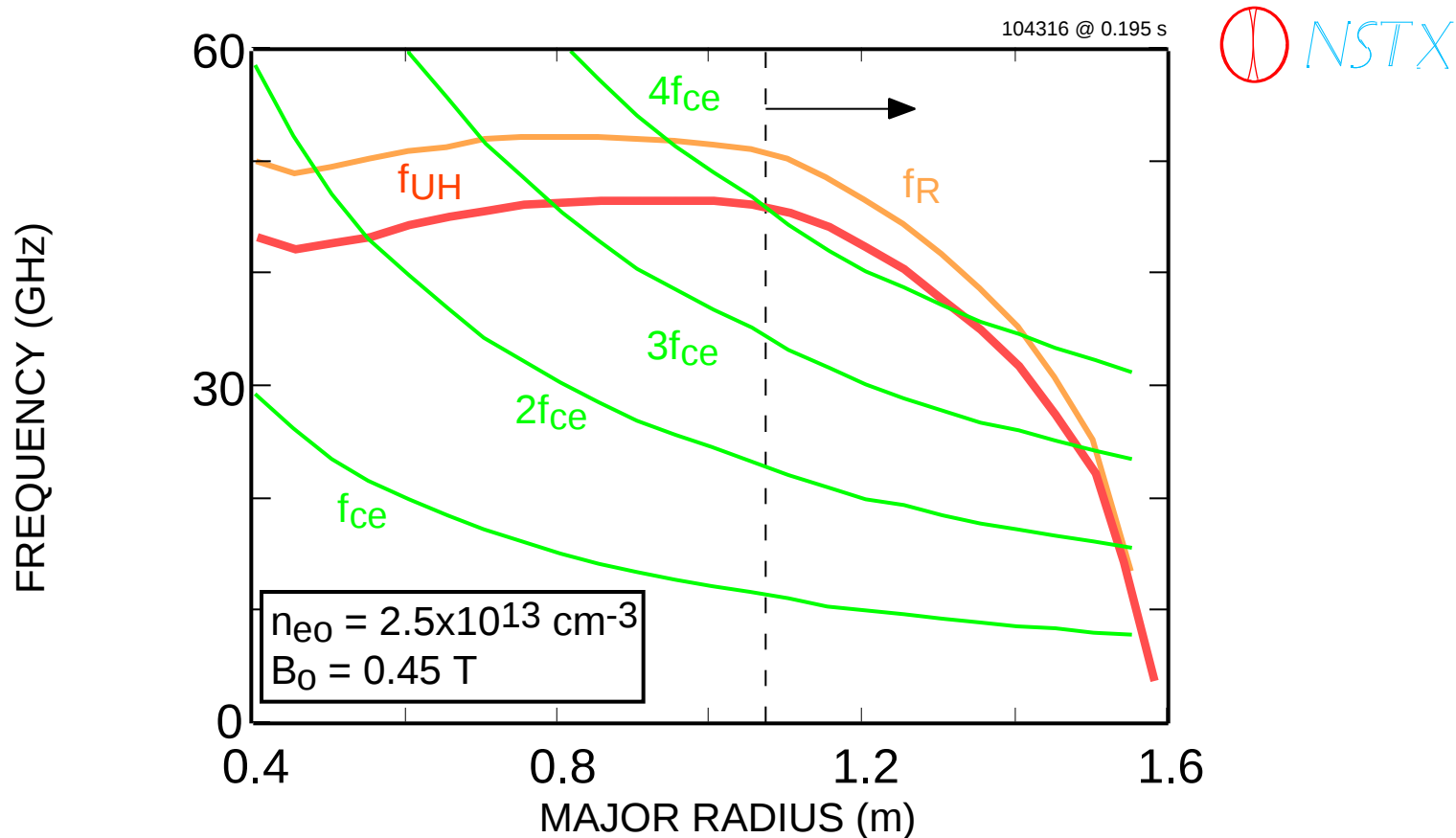
Density Fluctuations Measured by Probe Array Mounted Near EBW Antenna on CDX-U



EBW T_{rad} Fluctuations Correlate with Density Fluctuations Near Upper Hybrid Resonance



Use EBW Emission to Look for Density Fluctuations at Upper Hybrid Resonance in NSTX



- Radial coverage from axis to edge requires radiometers operating from 8 to 45 GHz for $B_0=0.45 \text{ T}$ NSTX plasma