U.S. DEPARTMENT OF ENERGY | Office of Science

NSTX-U

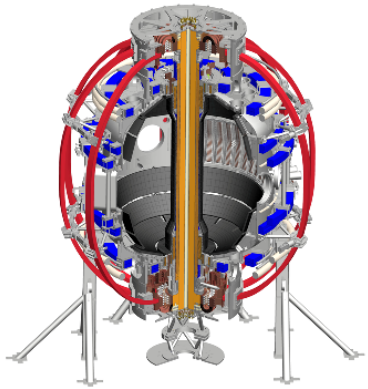
UCLA Diagnostics Systems on NSTX-U

T.L. Rhodes, Neal Crocker, Tony Peebles, Shige Kubota,
Physics and Astronomy Dept, UCLA

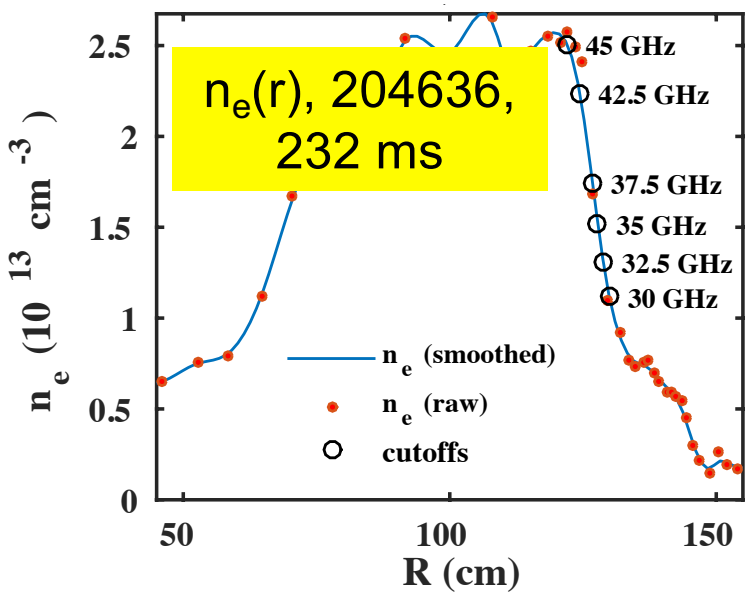
Presented at the NSTX-U Results Review, T&T Session
Sept 22, 2016

UCLA

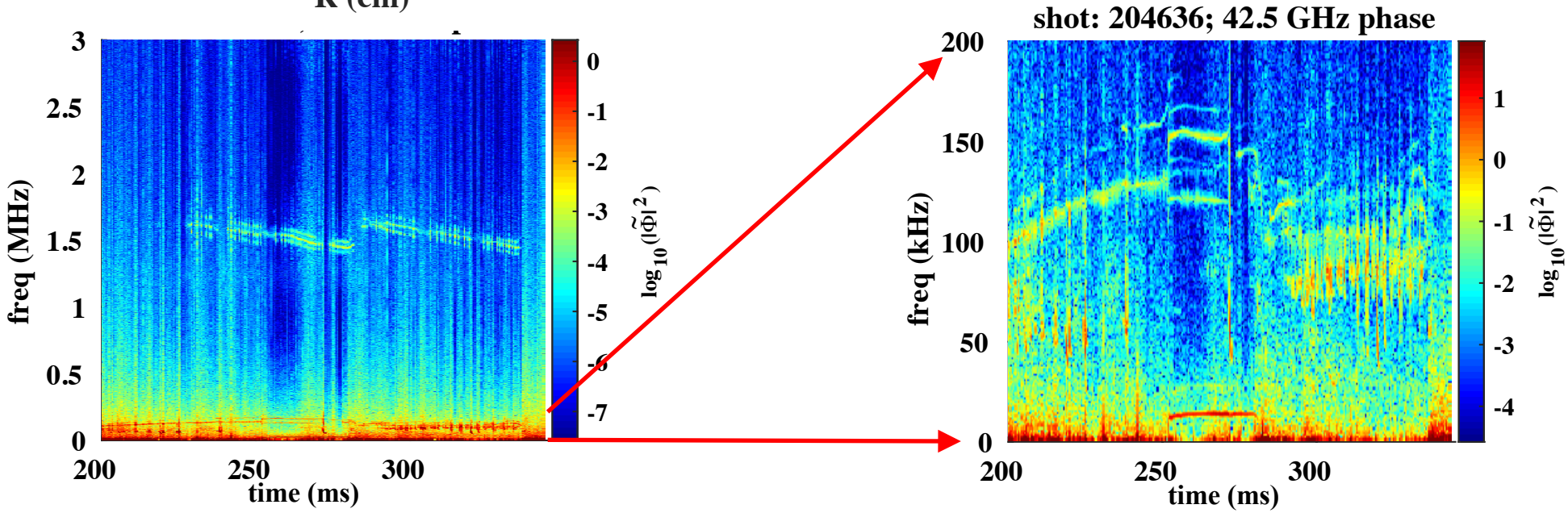
PPPL



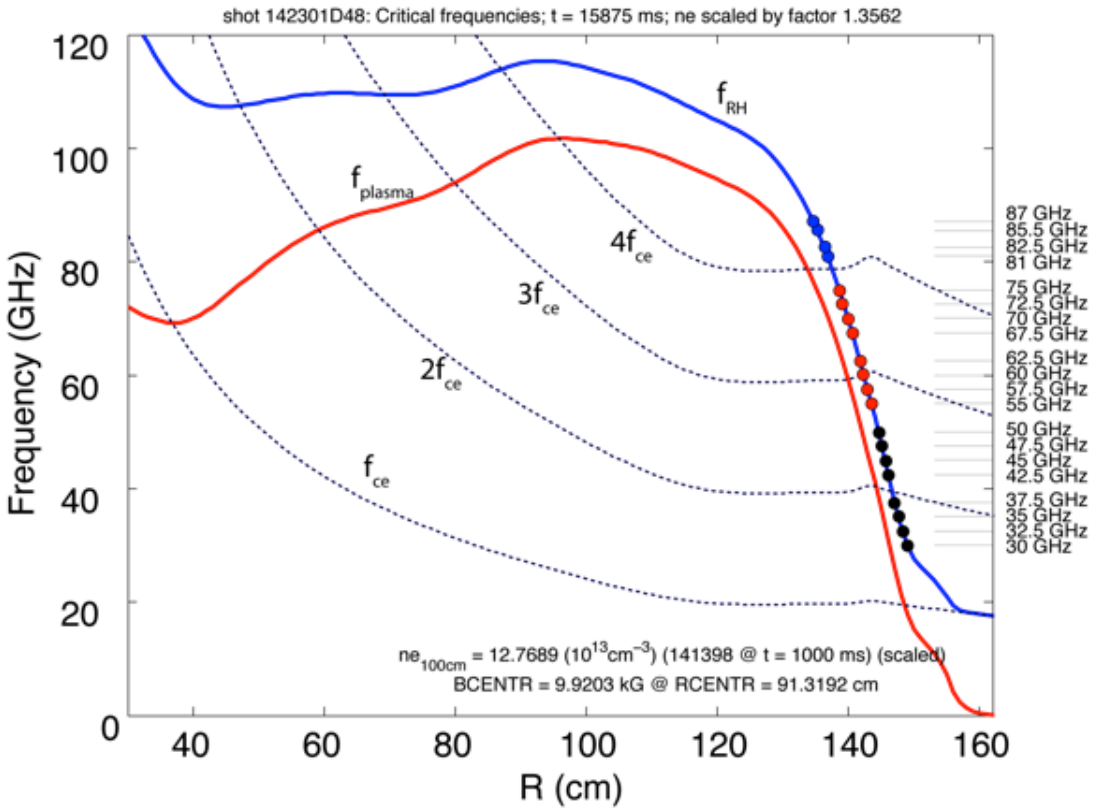
16-channel UCLA fluctuation reflectometer is operational



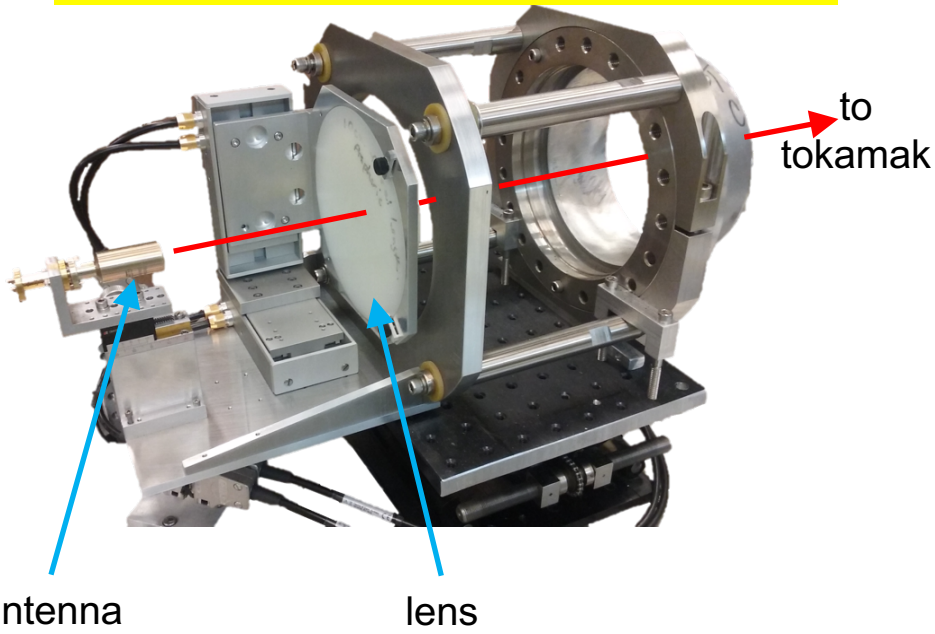
- Example data from this year showing higher frequency GAEs, and lower frequencies that are likely TAEs and other MHD
- Diagnostic addresses understanding of beam driven mode physics and code validation
- Cross-Machine studies - NSTX-U and DIII-D



UCLA will add two new measurement capabilities – Doppler backscattering (ñ, flows) and cross-polarization scattering ($\tilde{B}$)

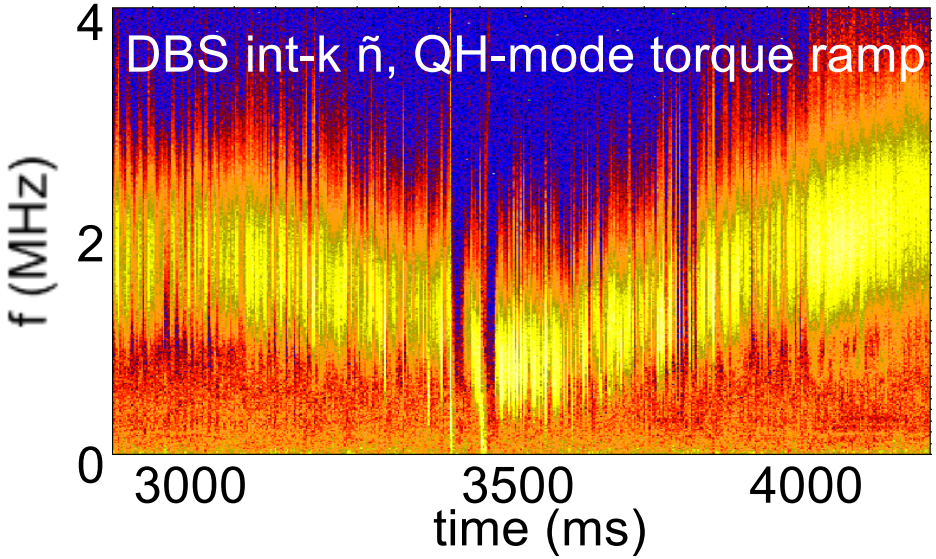


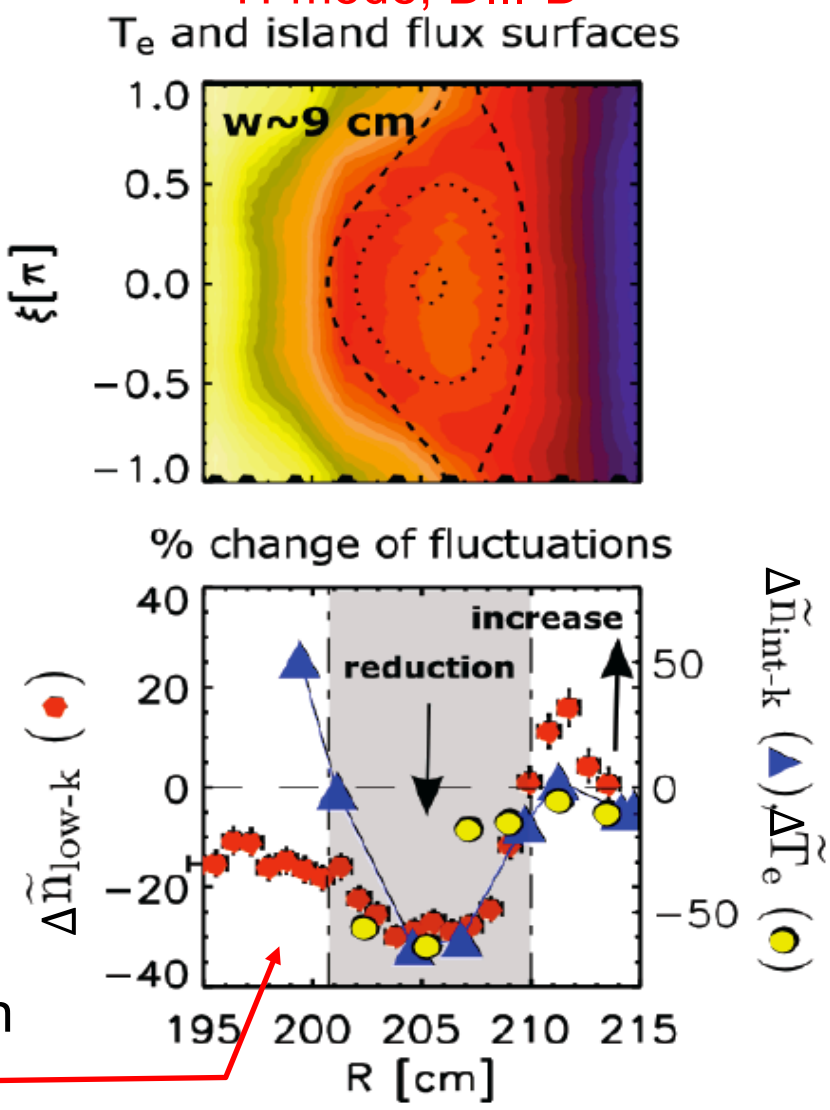
Launch antenna/optics, angle remote controlled



- New four-channel high-frequency DBS/reflectometer/CPS system
  - Expands existing fluctuation reflectometer (from 16 to 20 channels)
- Original plan was phased installation with DBS in first year followed by CPS in second year.
  - We were asked to accelerate CPS – we believe this can be done
- DBS electronics, optics, and remote control constructed and lab tested

Multi-channel DBS for int-k ñ, flow, and ExB velocity

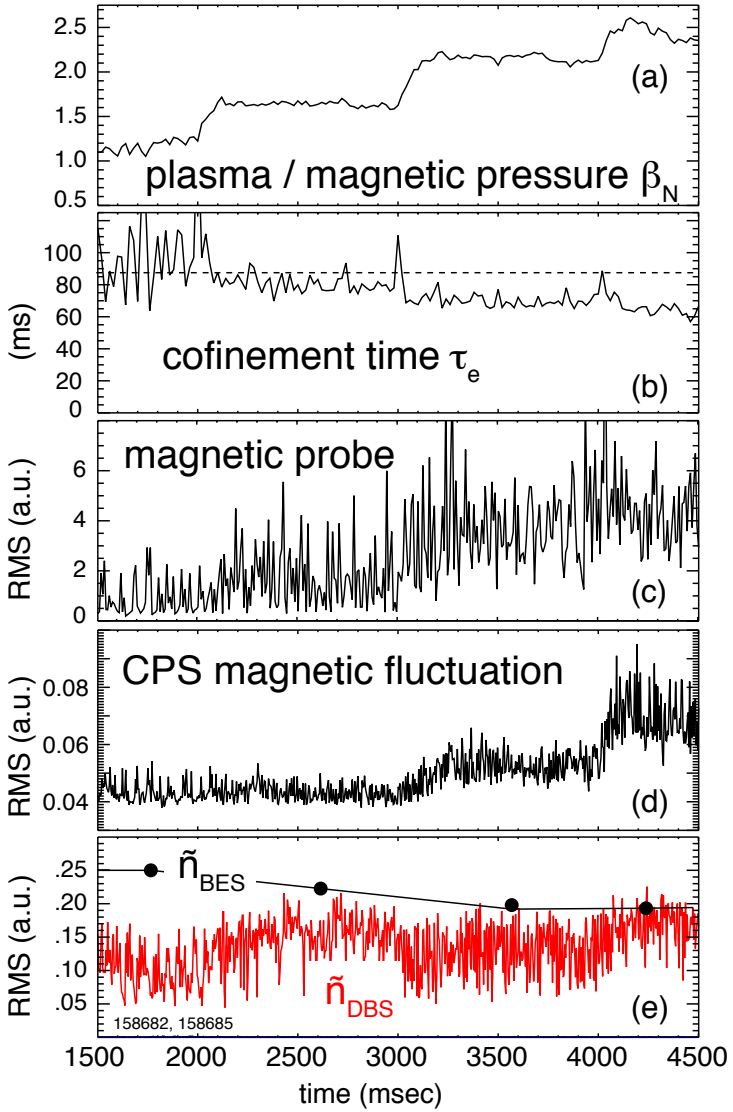




- $k_\theta\rho_s$ ~ 0.5–10, and typical spatial and temporal resolutions Δr≤1 cm and Δt≤1μs
- Fills wavenumber gap between low-k BES and high-k forward scattering.
- Directly impacts testing and validation of codes/simulations
- Recent multi-field/multi-scale NTM interaction (graduate student L. Bardoczi, PRL'16)

Cross-polarization scattering (CPS) to measure internal magnetic fluctuations on NSTX-U

DIII-D, β scan, Hmode



Barada, et al., RSI, 2016

- Addresses key physics questions on existence and behavior of microtearing modes, KBM, EM ETG/DW behavior, etc. and possible affect on transport.
  - Especially important at higher β as EM effects are increasingly important.
- CPS continuing development at DIII-D under a DOE Diagnostic Development Grant
- Measure internal $\tilde{B}$ over broad wavenumber range $k_\theta \rho_s$ ~ 0.2–17; time, space resolutions ($\Delta r \leq 1$ cm, $\Delta t \leq 1\mu s$)
- Directly impacts testing and validation of codes/simulations

UCLA is excited about the scientific prospects on NSTX-U

- Multi-field diagnostics for turbulence and transport studies, beam driven modes, transients (ELMs, EHO, etc.)
- Testing and validation of simulations and theory
- Cross-device experiments are facilitated by similar diagnostics on eg NSTX-U and DIII-D.

Thank you!