

Changes in Edge Turbulence with ρ^* and Toroidal Rotation Input in NSTX

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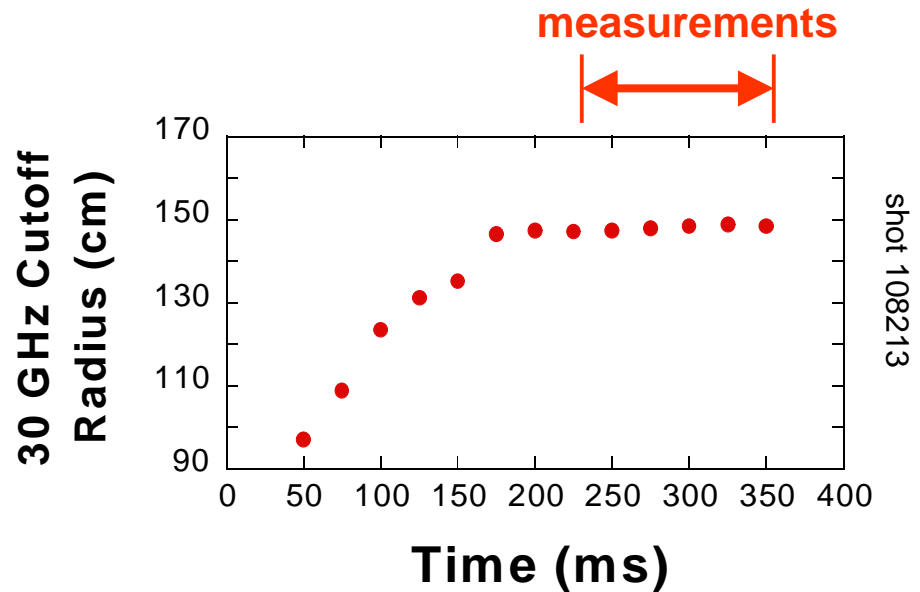
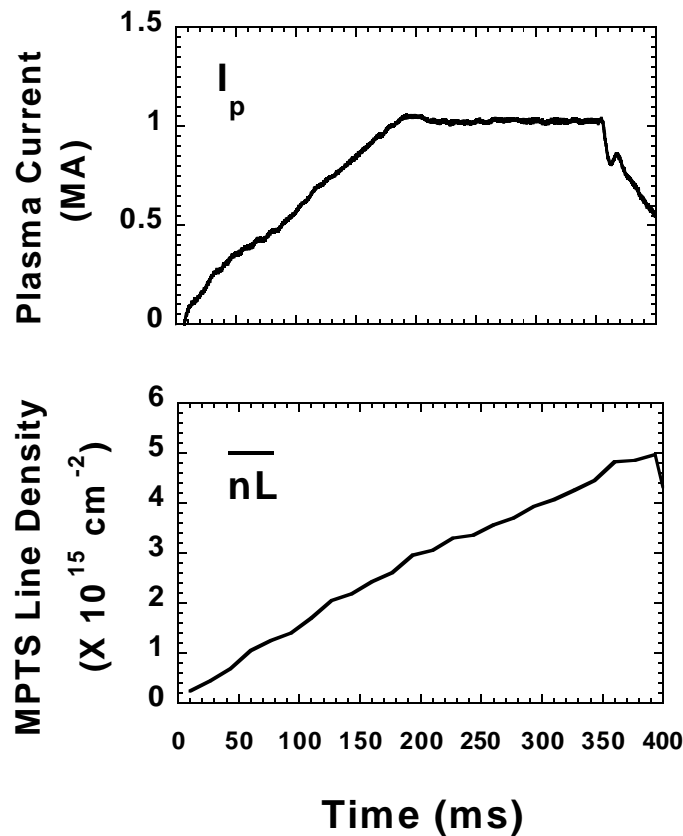


Experiment Overview

- A number of parameter scans to vary ρ^* and toroidal rotation input were performed in NSTX L-mode discharges
 - B_{toroidal} scans (3 - 6 kG on axis) $\Rightarrow \rho^*$
 - NBI line changed (source A, C) \Rightarrow toroidal rotation input
 - n_e , I_p , NBI power were also scanned
- Neon was gas puffed at the edge, and penetration tracked via USXR
- Turbulence was monitored *in the edge of the confinement region* by a two channel 20-30 GHz O-mode homodyne reflectometer located on the outboard midplane ($n_{\text{CR}} \approx 5 \times 10^{12} - 1.1 \times 10^{13} \text{ cm}^{-3}$).
- Cutoff layers where these measurements were made were **a few cm inside the LCFS**: $0.90 \leq r/a \leq 0.98$ ($R \approx 141 - 149 \text{ cm}$)
- $T_e \approx 20 - 100 \text{ eV}$, $L_n \approx 5 - 12 \text{ cm}$

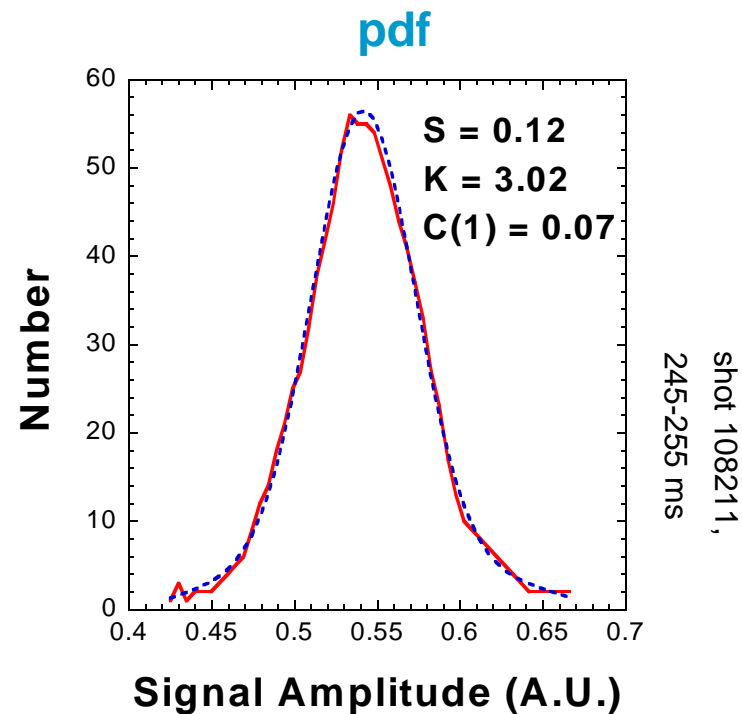
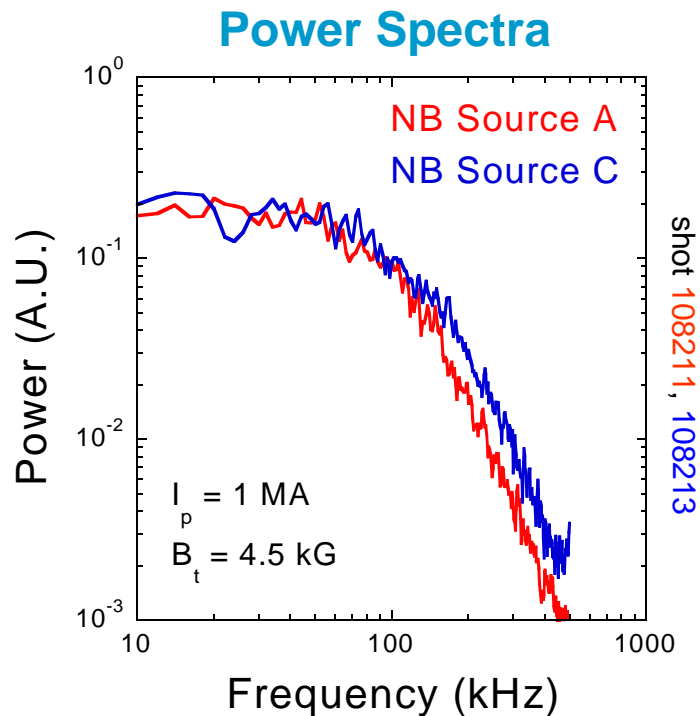
Cutoff Layers were Stationary During Correlation Measurements

- Although the line average density continued to ramp up throughout the shot, the edge density changed little during I_p flattop

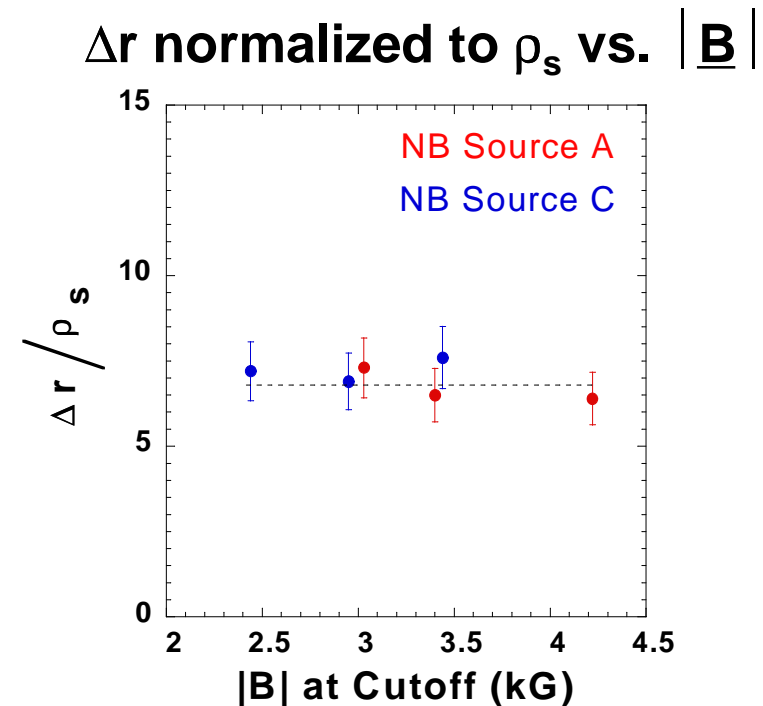
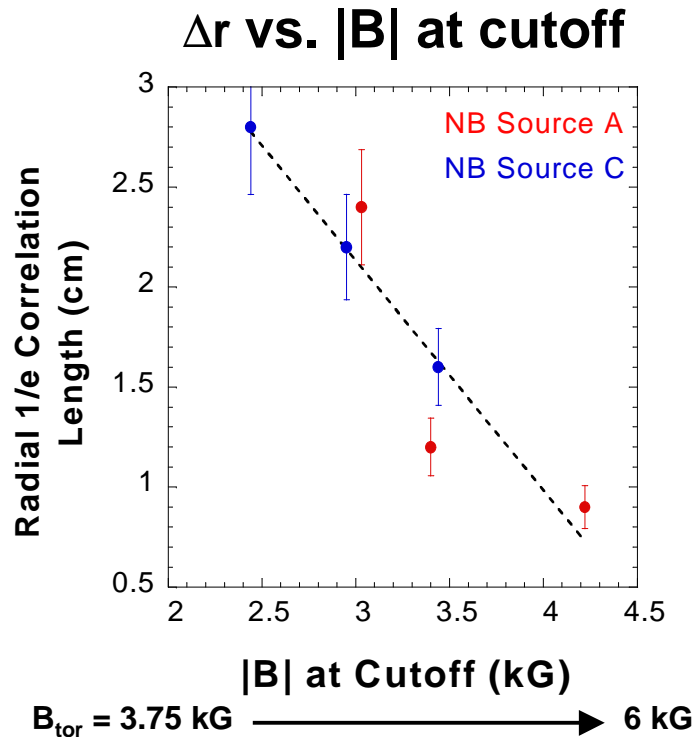


Power Spectra, Autocorrelation, pdf's

- *Broadband Power Spectra*
- *Small (if any) Doppler shifts observed with changes in NB line, I_p , B_t*
- *Autocorrelation times (1/e) $\tau_{AC} \sim 10 \mu\text{s}$, and showed no parametric changes*
- *Gaussian pdf's with low intermittency*



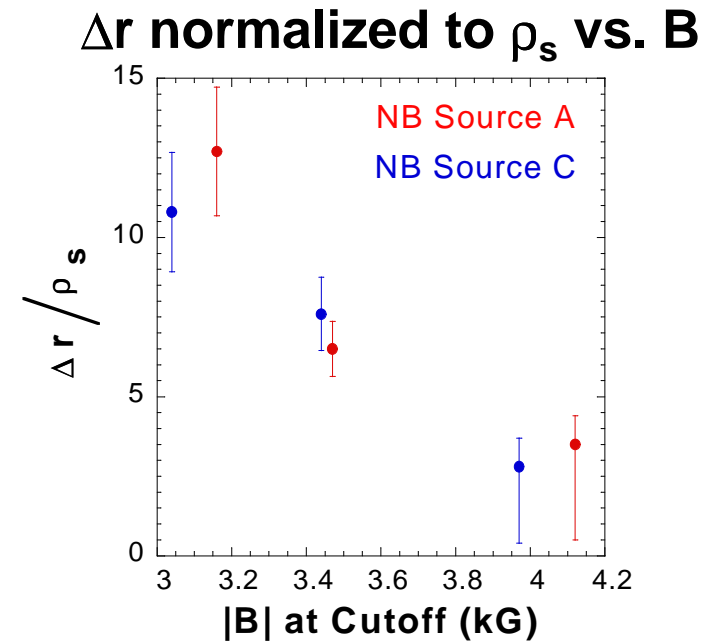
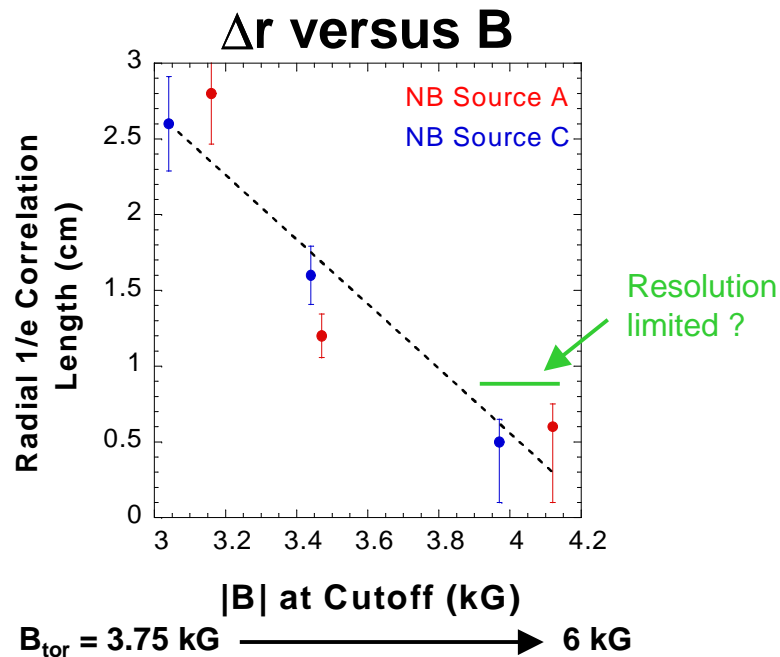
Radial Correlation Lengths Scaled with ρ_s at Fixed I_p/B_{tor} (Constant $q_{cyl,edge}$)



- $q_{cyl,edge} \equiv aB_\phi / R_0 B_\theta$; nL constant
- Neon penetration rate decreased with B_{tor}
- q_{95} varied $\approx 6 \rightarrow 7.5$
- Little change in toroidal rotation (CHERS)

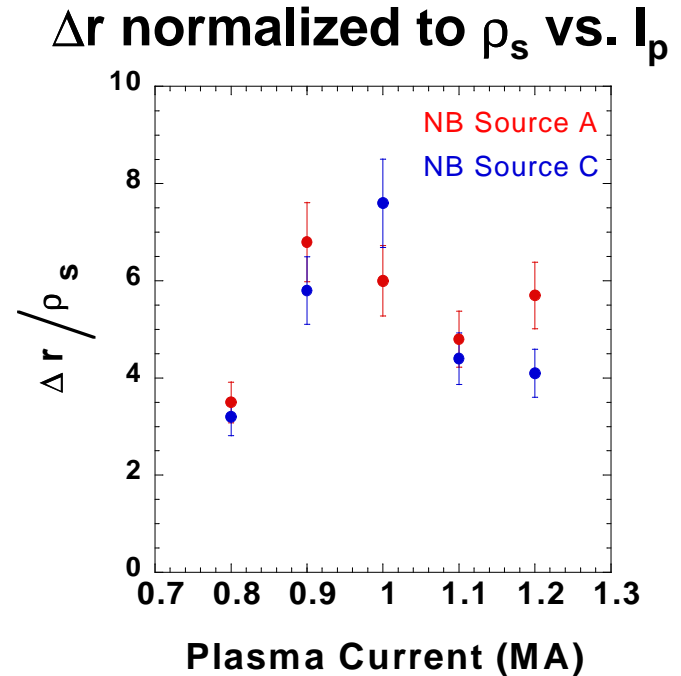
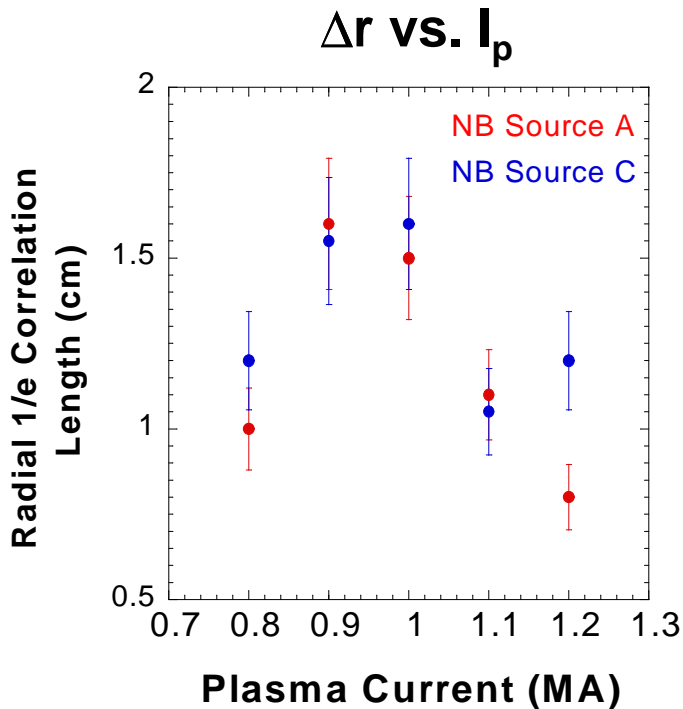
- $\Delta r \approx 6-7 \times \rho_s$ ($\rho_s \propto 1/|B|$)
- $\Delta r \approx 4-5 \times \rho_{s,tor}$ ($\rho_{s,tor} \propto 1/B_{tor}$)
- $\Delta r \approx 3-4 \times \rho_{s,pol}$ ($\rho_{s,pol} \propto 1/B_{pol}$)

Normalized Correlation Lengths Decreased with B_{tor} at Fixed I_p (1 MA)



- Scaling by $\rho_{s,toroidal}$, $\rho_{s,poloidal}$ showed the same trend
- Edge neon penetration rate *increased* with B above 4.5 kG, core penetration decreased somewhat (D. Stutman)
- q_{95} varied $\approx 5 \rightarrow 9$
- Central toroidal rotation appeared to increase with B (CHERS)

No Clear Trend in Δr with I_p at Fixed B_{tor}



- $B_t = 4.5$ kG, nL constant
- q_{95} varied $\approx 7.5 \rightarrow 5.5$
- Neon penetration rate decreased with I_p (D. Stutman)
- I_p threshold? (neon penetration and Δr)

Summary

- The scaling of radial correlation lengths, Δr , with discharge parameters **a few cm inside the LCFS** ($0.90 < r/a < 0.98$) has been investigated in NSTX L-mode plasmas.

I	II	III
B_{tor} scan @ constant q_{cly} (I_p/B_{tor})	B_{tor} scan @ constant I_p	I_p scan @ constant B_{tor}
$\Delta r / \rho_s$ constant	$\Delta r / \rho_s$ decr. with B_{tor}	no clear trend in $\Delta r / \rho_s$

- Autocorrelation times $(1/e) \tau_{\text{AC}} \sim 10 \mu\text{s}$, and showed no parametric changes
- No significant changes in correlation lengths or Doppler shifts were observed as the NB line was changed
- Detailed comparisons with gyrokinetic simulations (e.g. GYRO, etc.) and data from other devices (e.g. DIII-D) are planned for the future.