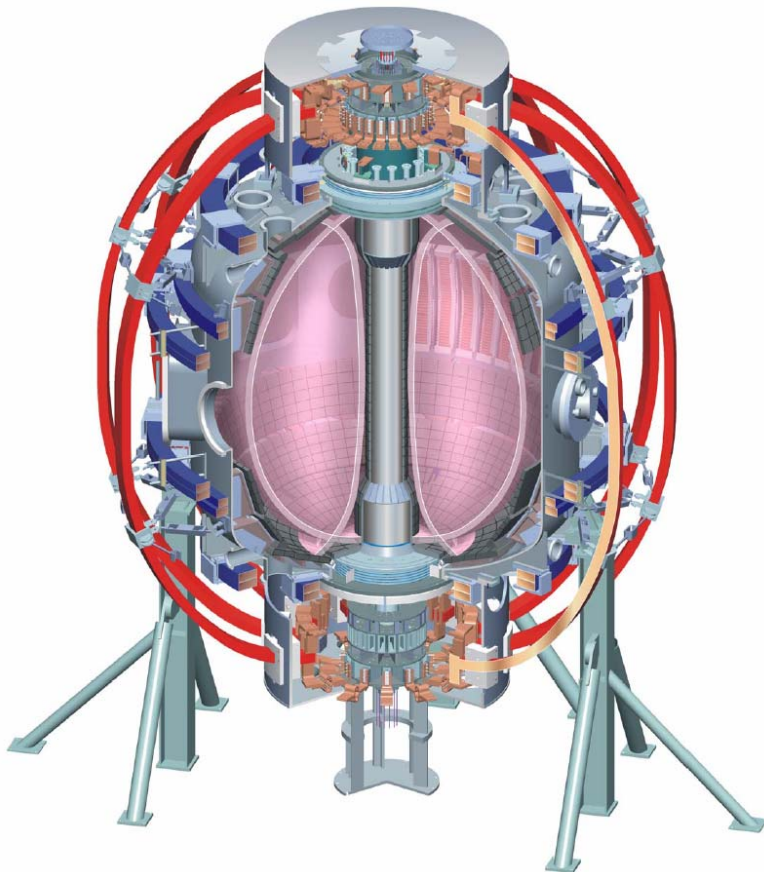


# High-k fluctuations in H-mode plasmas (XP-714)



D. R. Smith, S. M. Kaye,  
E. Mazzucato, and H. K. Park  
*Princeton Plasma Physics Lab*

W. Lee  
*POSTECH*

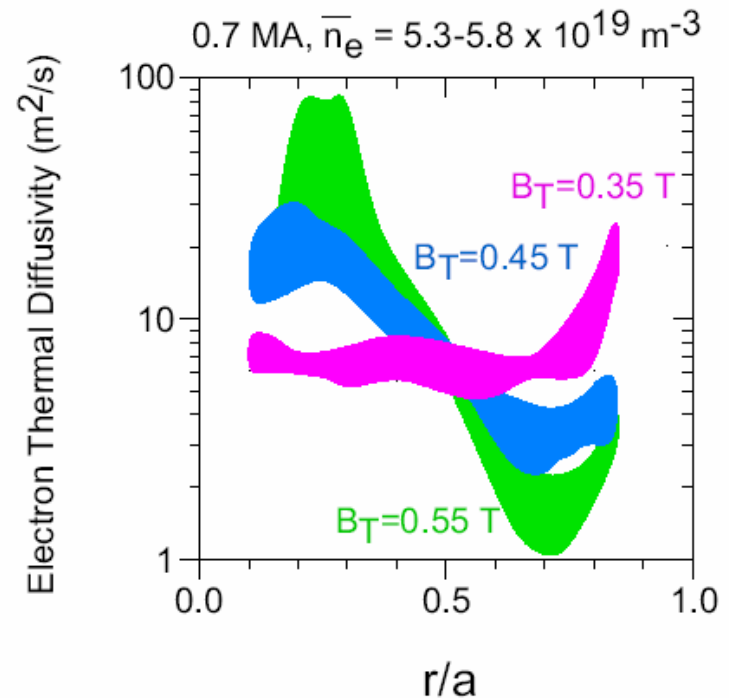
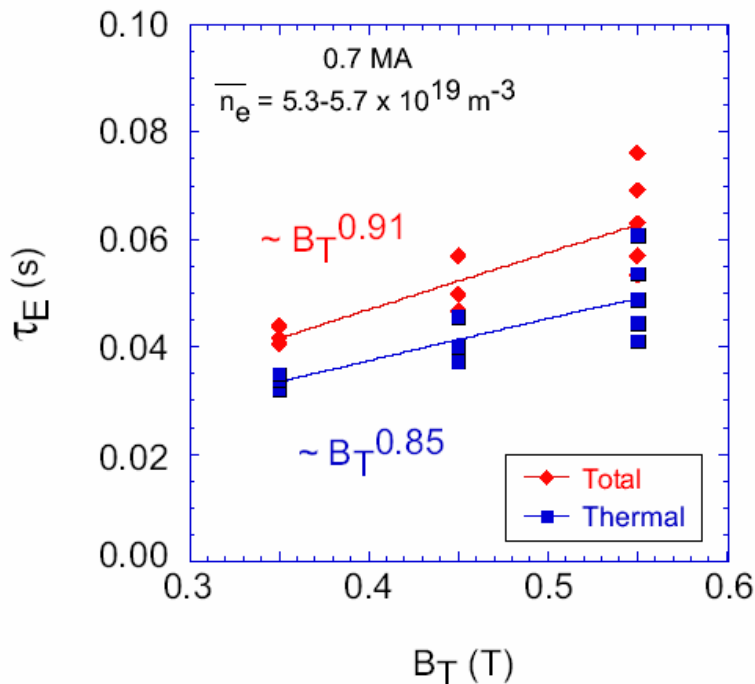
C. W. Domier and N. C. Luhmann, Jr.  
*University of California at Davis*

*NSTX Results Review*  
*July 23, 2007*

# XP-714 Objective



- XP-532 (Kaye): Confinement improved at higher  $B_T$  due to improved electron transport
- XP-714: Repeat  $B_T$  scan of XP-532 and measure high-k fluctuations at multiple radii



# Shot Matrix



1248xx  
(data w/ wide bandwidth detection)

	$r/a \sim 0.25$	$r/a \sim 0.75$
$B_T = 3.5$ kG	82, 83	92
$B_T = 4.5$ kG	<b>87</b>	88
$B_T = 5.5$ kG	85, 86	<b>89</b> , 91

# Elements of Analysis



## High-k fluctuation measurements:

$$k_{\perp} \rho_e \sim 0.1 - 0.6$$

$$k_{\perp} \sim 5 - 20 \text{ cm}^{-1}$$

$$\Delta k_{\perp} \sim 0.7 \text{ cm}^{-1}$$

$$\Delta R \sim 6 \text{ cm}$$

## Ray tracing:

fluctuation wave vectors  
& measurement efficiencies

## TRANSP:

transport coefficients

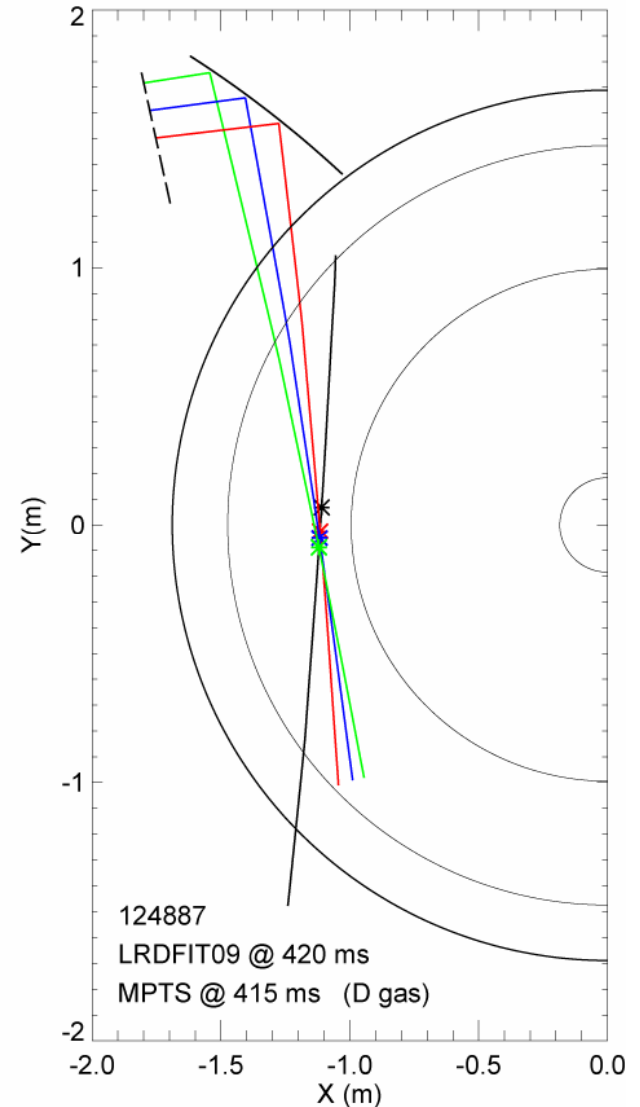
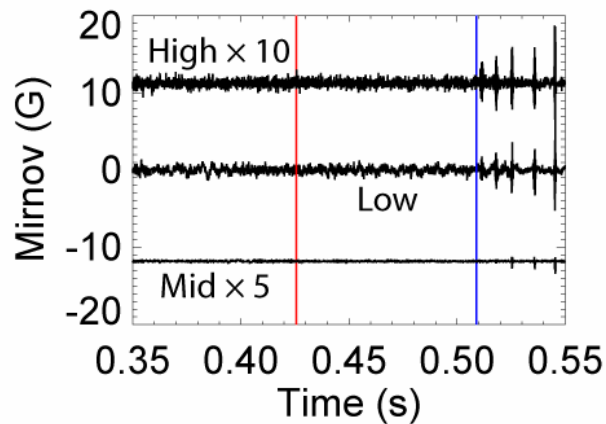
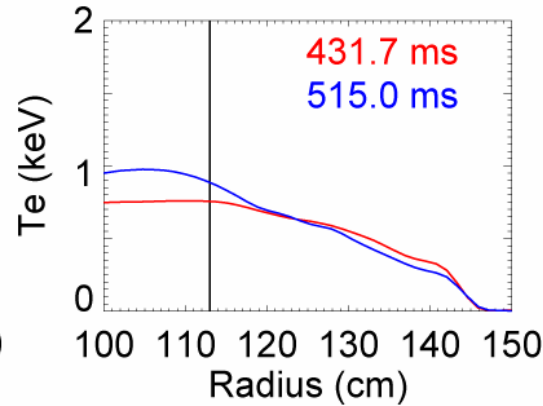
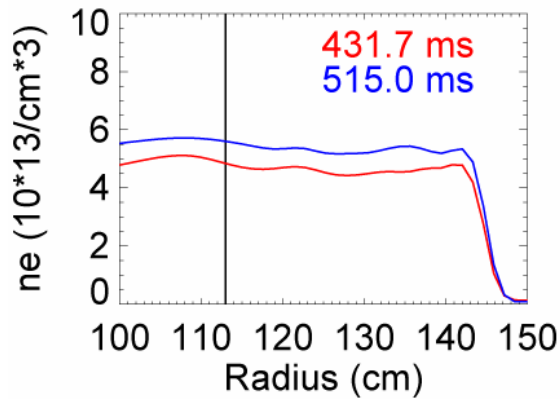
## GS2:

micro-instability linear  
growth rates & frequencies

# Case 1: $R = 113 \text{ cm}$ & $r/a = 0.25$



124887 @ 113 cm & 430-510 ms



# Case 1: High-k fluctuations



124887 - Ch. 3

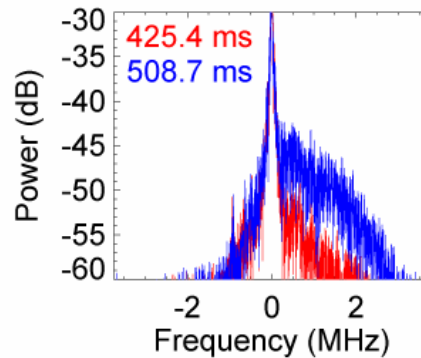
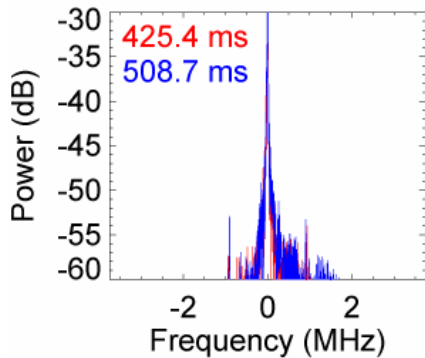
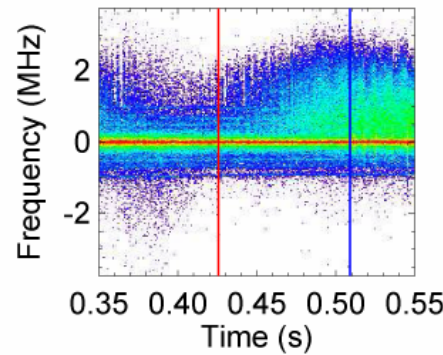
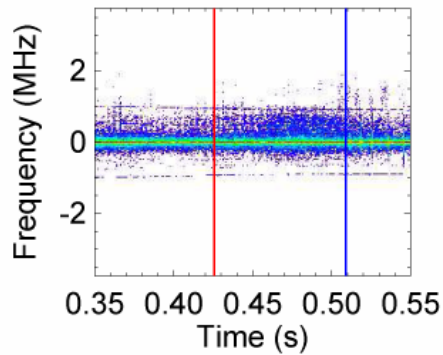
$$k_{\perp}\rho_e \sim 0.2$$

$$k_{\perp}\rho_s \sim 12$$

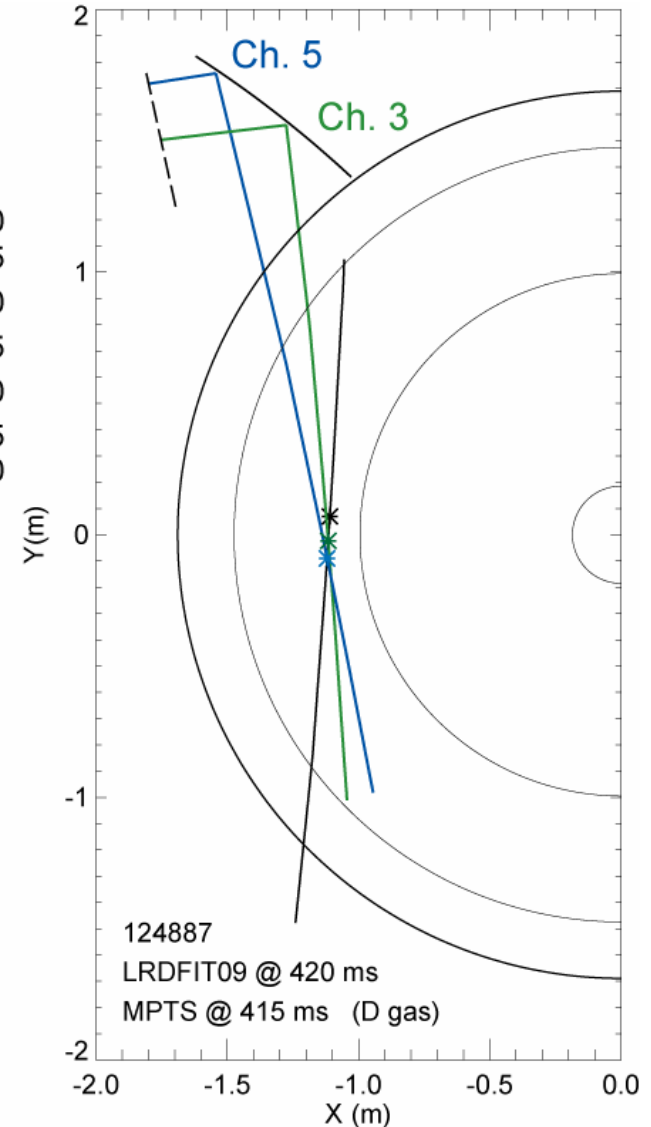
124887 - Ch. 5

$$k_{\perp}\rho_e \sim 0.4$$

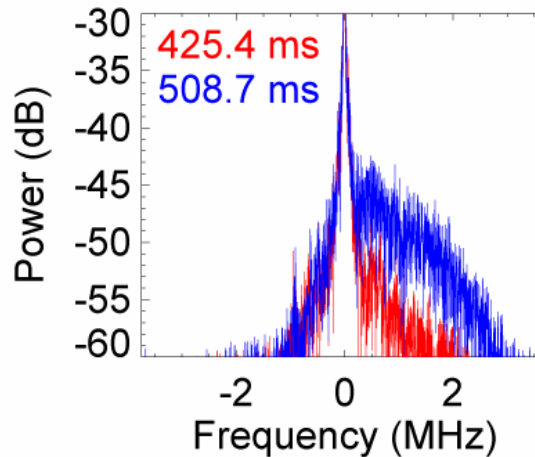
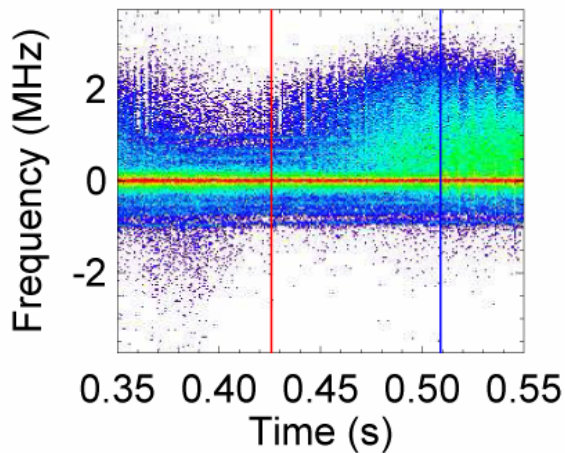
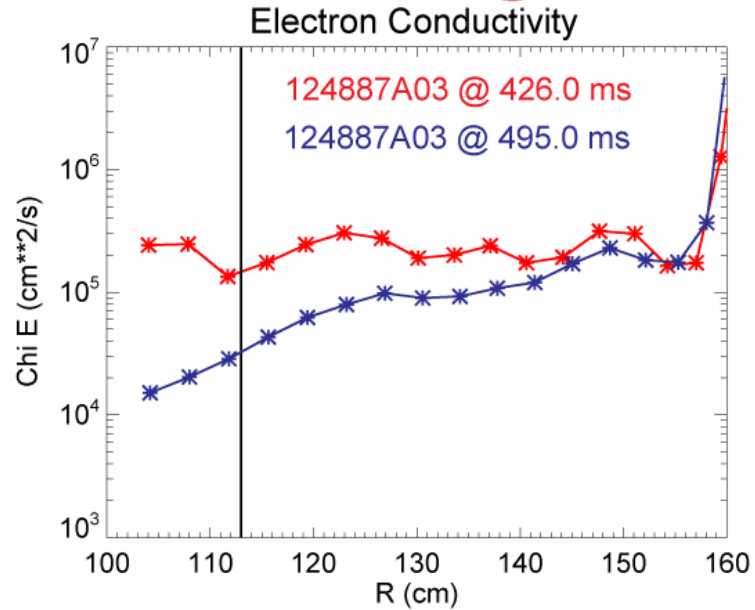
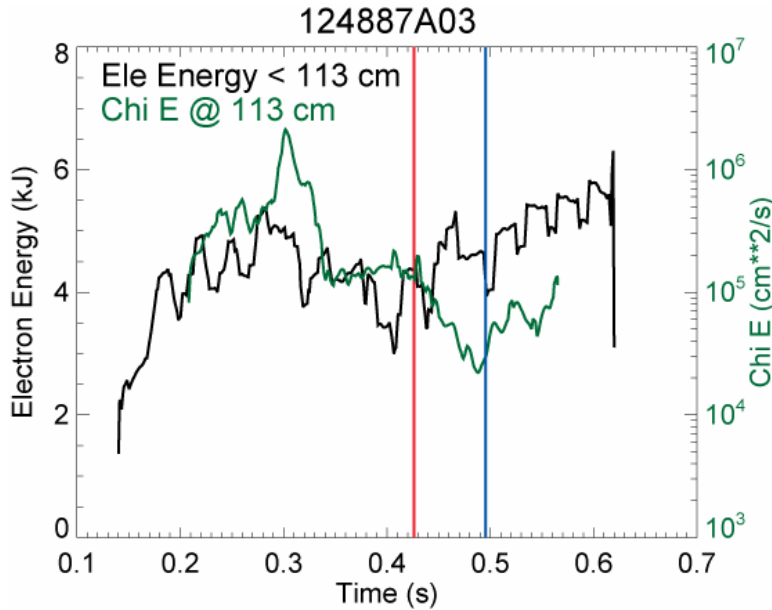
$$k_{\perp}\rho_s \sim 22$$



$\omega > 0$  is ion diamagnetic direction

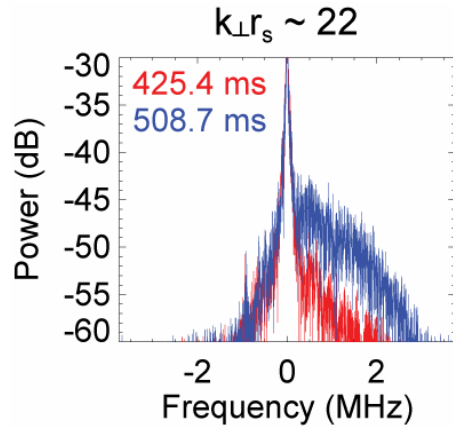


# Case 1: TRANSP analysis

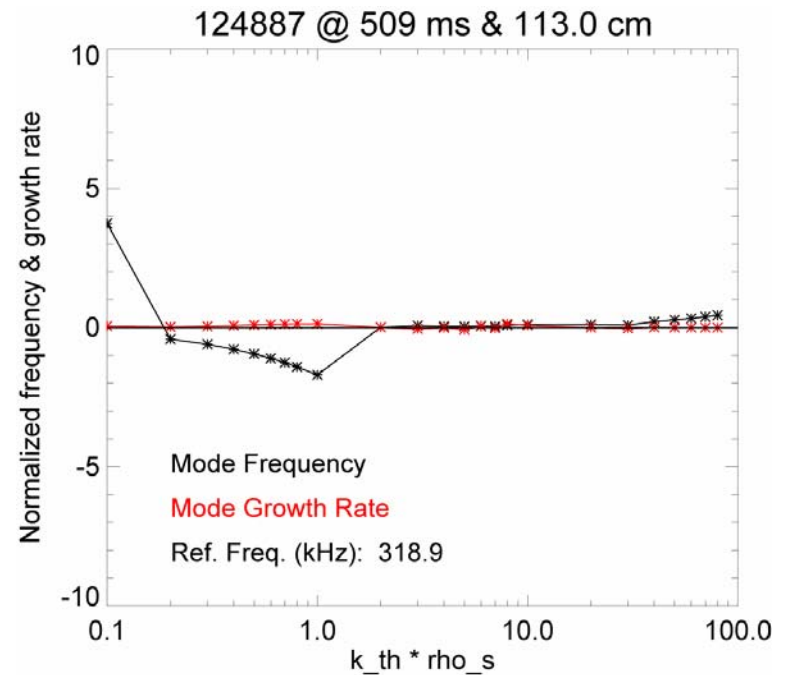
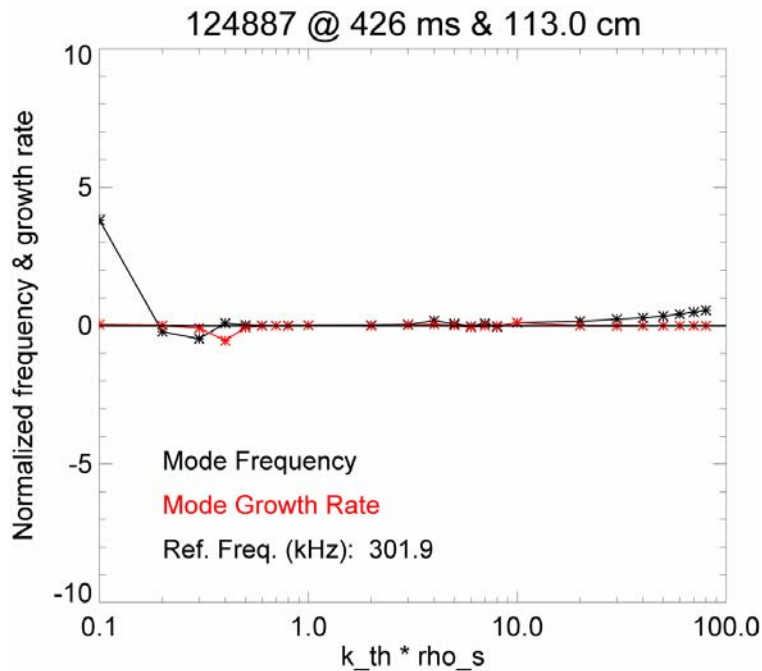


TRANSP:  $\chi_e$  falls as  
 $k_{\perp}\rho_s \sim 22$   
fluctuations increase

# Case 1: GS2 analysis



GS2: all modes stable  
at both times

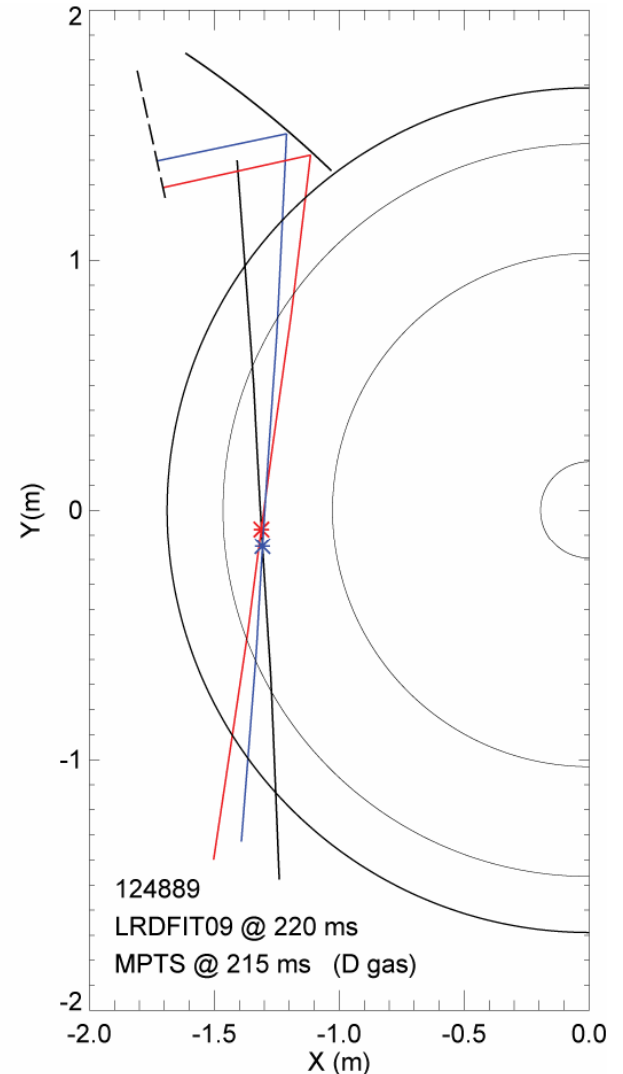
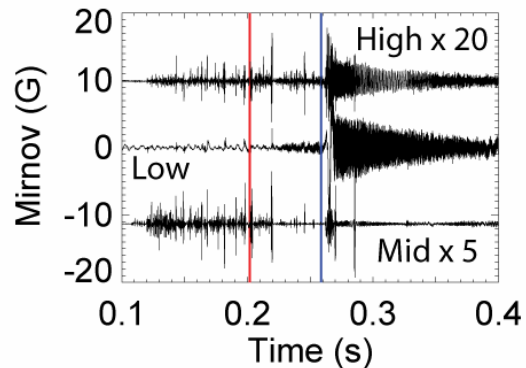
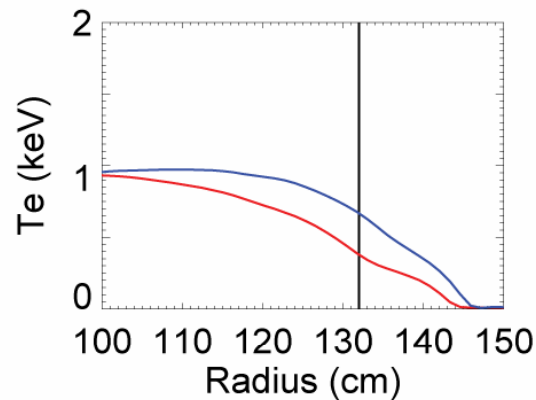
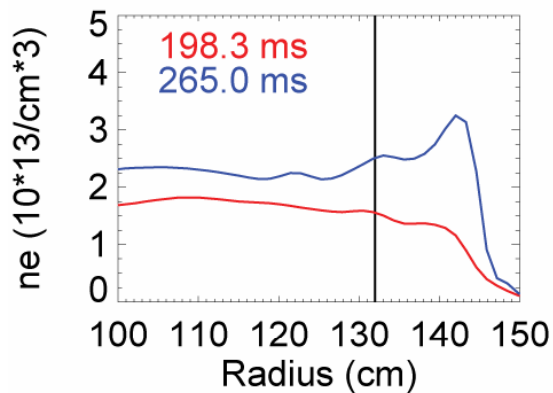




# Case 2: $R = 132 \text{ cm}$ & $r/a = 0.75$



124889 @ 132 cm & 200-260 ms



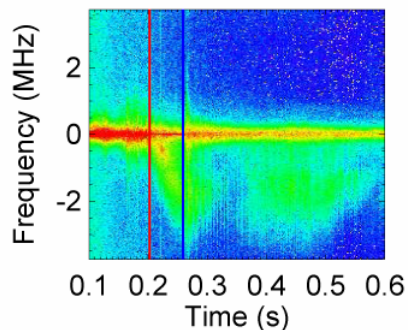
# Case 2: High-k fluctuations



124889 - Ch. 1

$$k_{\perp} \rho_e \sim 0.22$$

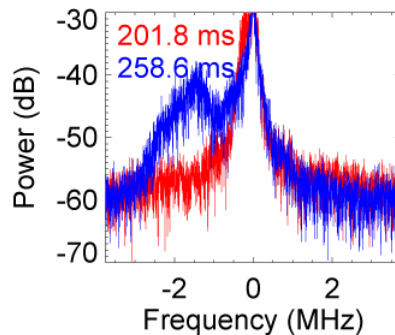
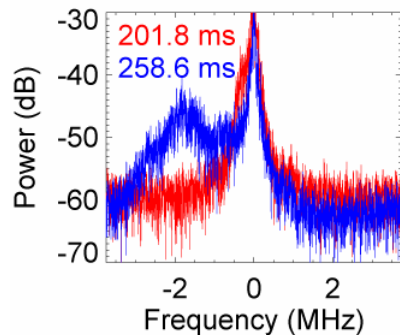
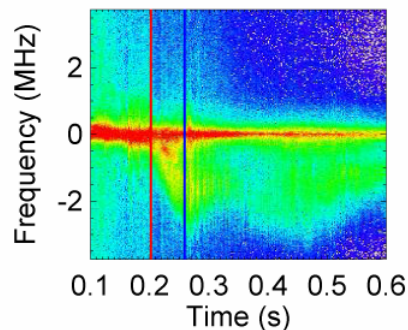
$$k_{\perp} \rho_s \sim 13.1$$



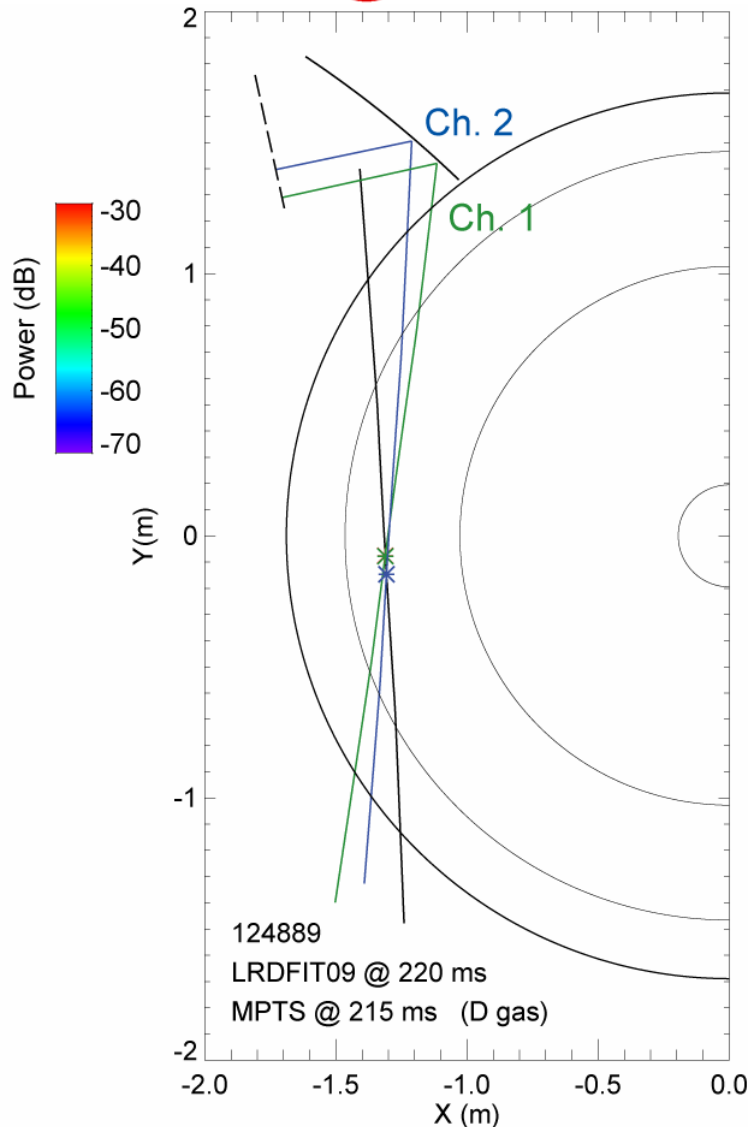
124889 - Ch. 2

$$k_{\perp} \rho_e \sim 0.14$$

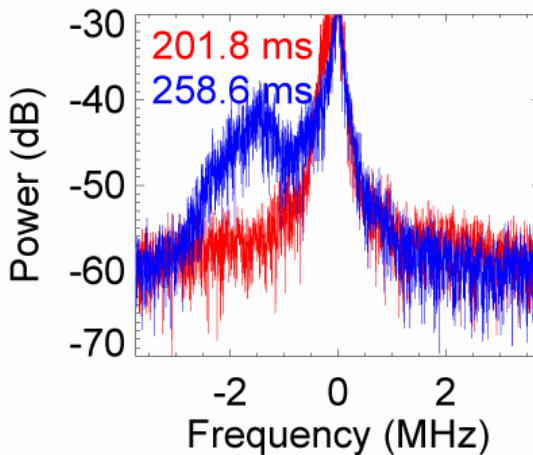
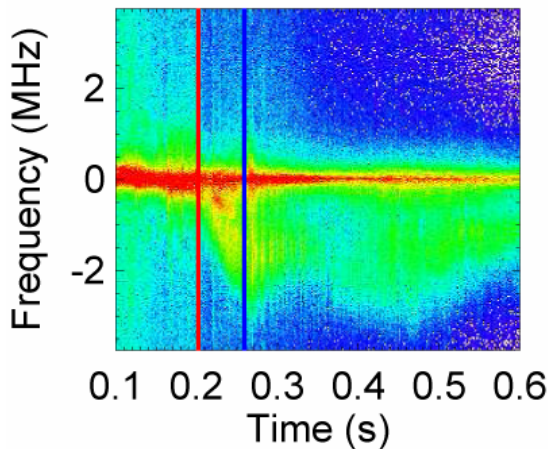
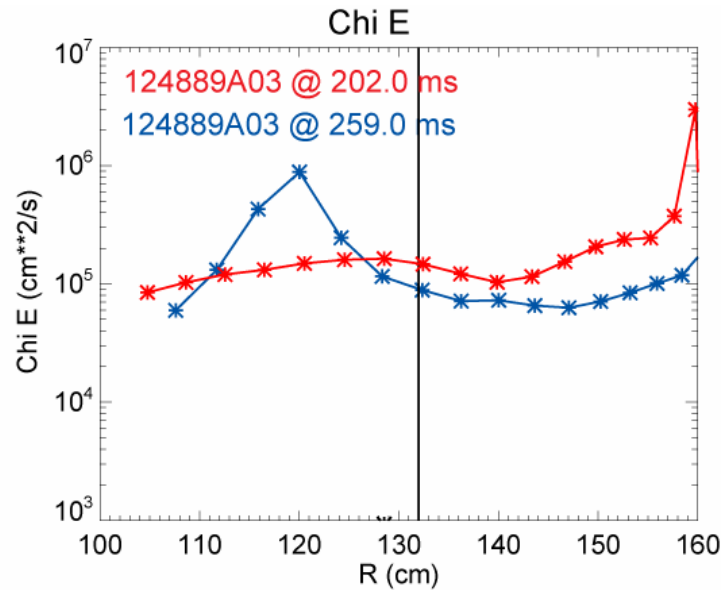
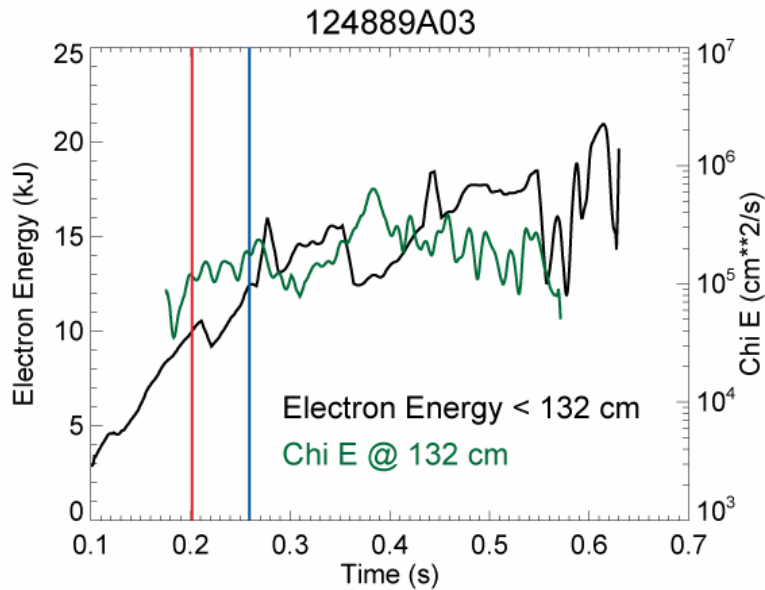
$$k_{\perp} \rho_s \sim 8.5$$



$\omega > 0$  is electron diamagnetic direction

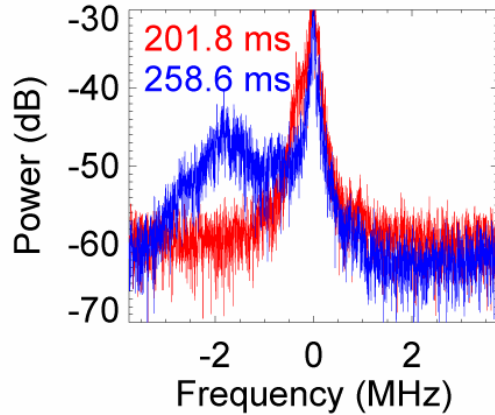


# Case 2: TRANSP analysis

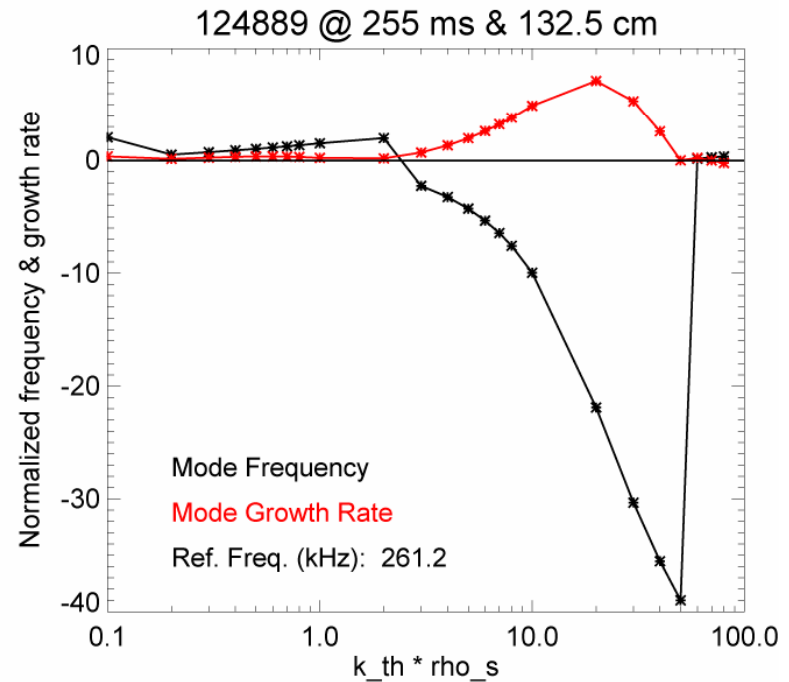
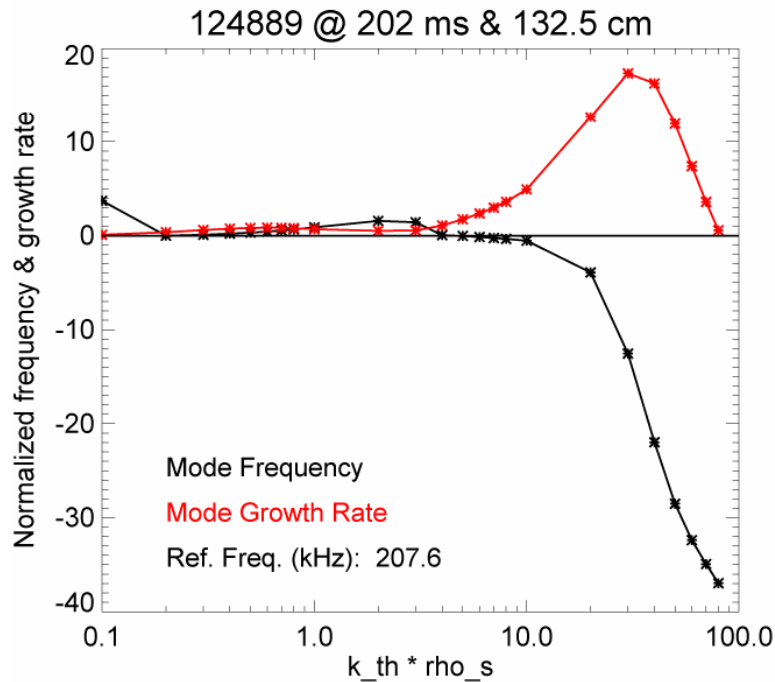


TRANSP:  $\chi_e$  @ 132 cm  
nearly unchanged as  
fluctuations increase

# Case 2: GS2 analysis



GS2: growth rates drop by ~50% at later time despite growing fluctuations



# Summary and plans



- Summary
  - Case 1: High-k fluctuations grow while  $\chi_e$  falls (TRANSP)
  - Case 2: High-k fluctuations grow while  $\gamma$  falls (GS2)
  - Doppler shift from toroidal rotation is in the ion diamagnetic direction
- Plans
  - Determine robustness of MPTS data; redo analysis if necessary
  - Diagnose MHD activity using mirnovs and x-rays
  - Address  $B_T$  dependence of high-k fluctuations