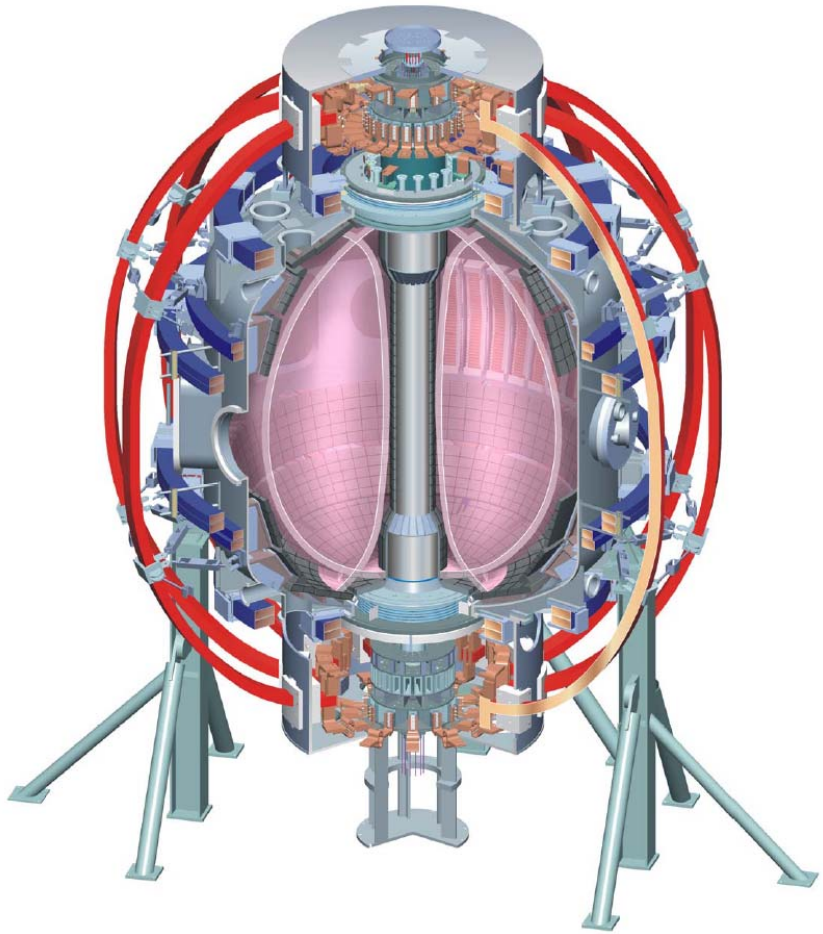
Existence and saturation dynamics of high-k fluctuations in H-mode plasmas

David Smith
and the high-k team

Princeton Plasma Physics Lab

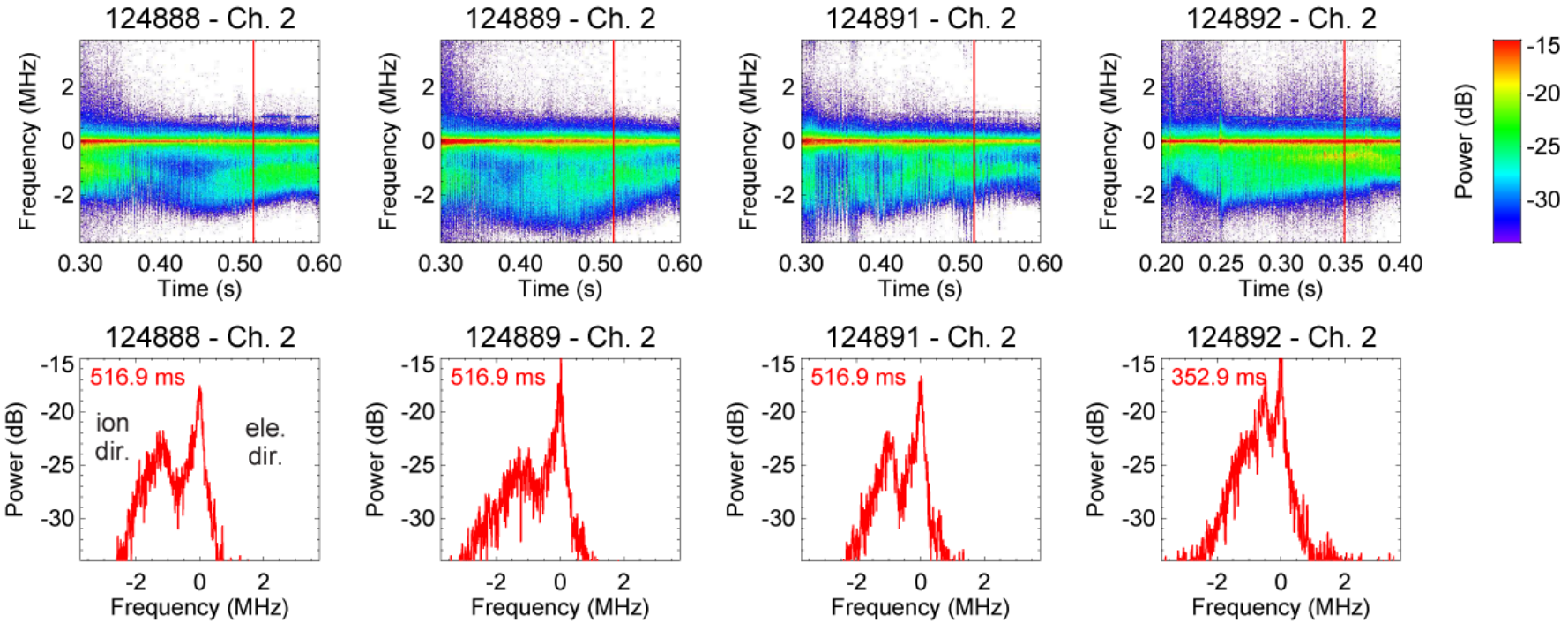


NSTX Physics Meeting
April 14, 2008

Prominent, persistent fluctuations observed in outer plasma

High-k measurements at R ≅ 135 cm and r/a ≅ 0.6

$k_\perp \rho_e$ ~ 0.10-0.15 for channel 2

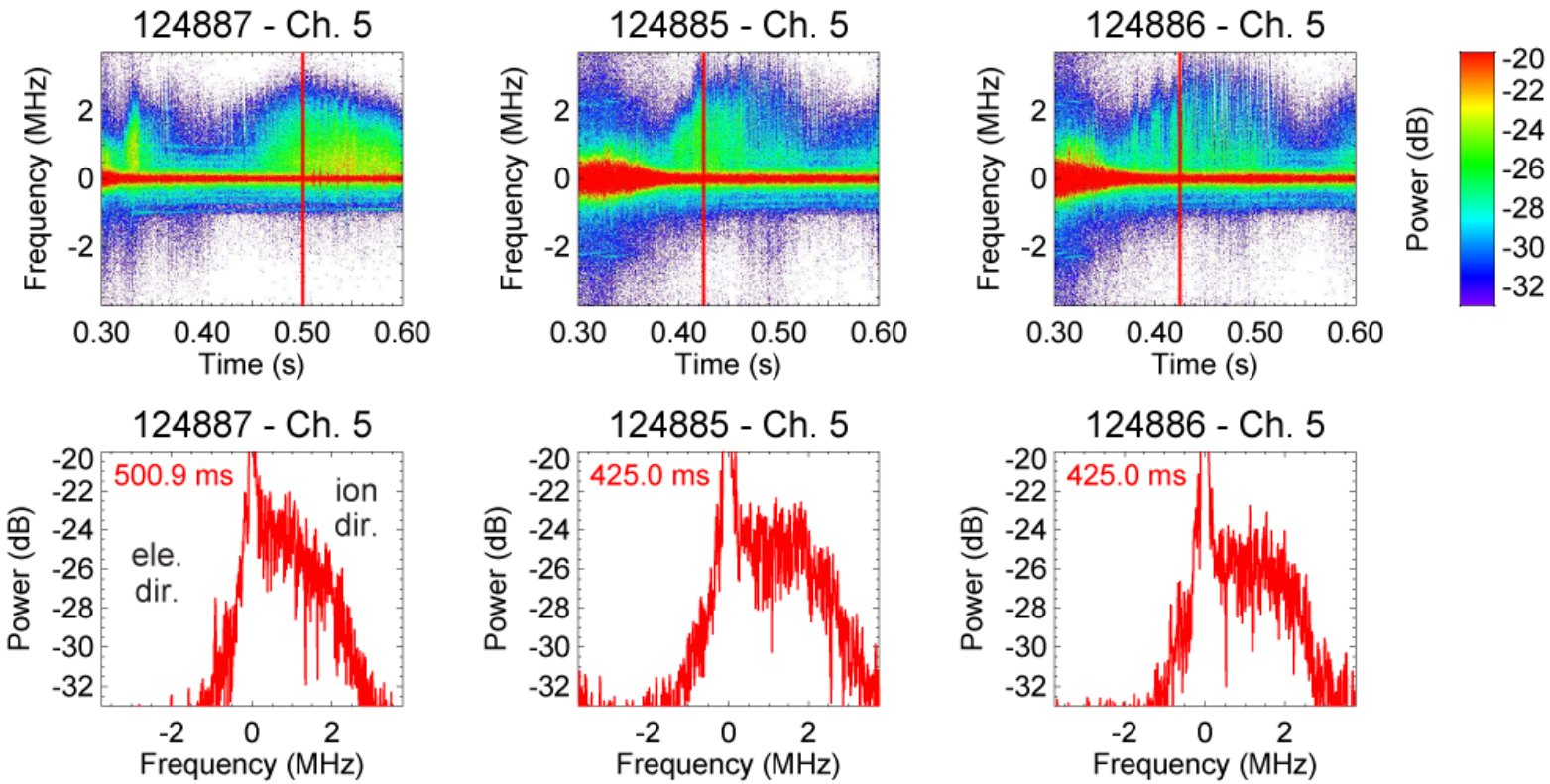


Fluctuations experience a Doppler-shift to ion direction.

Prominent, persistent fluctuations observed in core

High-k measurements at R ≅ 113 cm and r/a ≅ 0.2

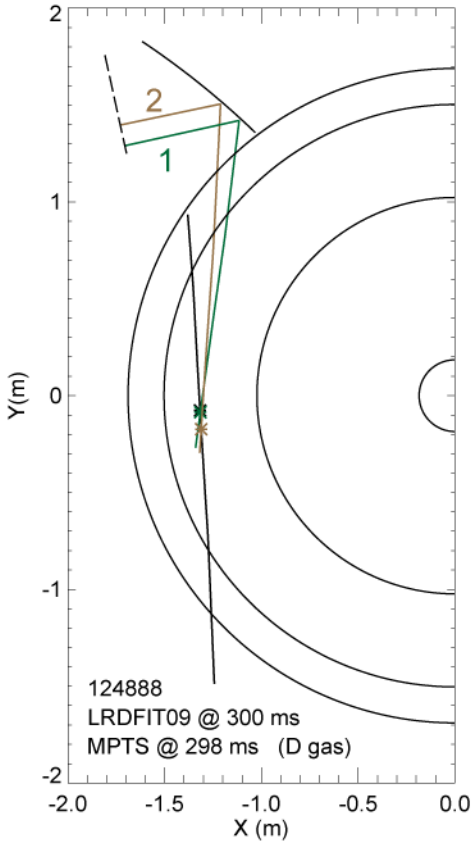
$k_\perp \rho_e$ ~ 0.35-0.40 for channel 5

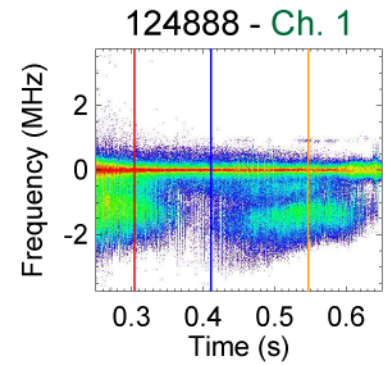


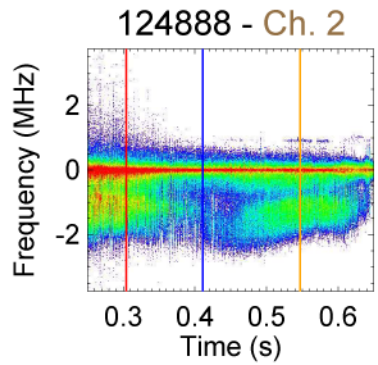
Fluctuations experience a Doppler-shift to ion direction.

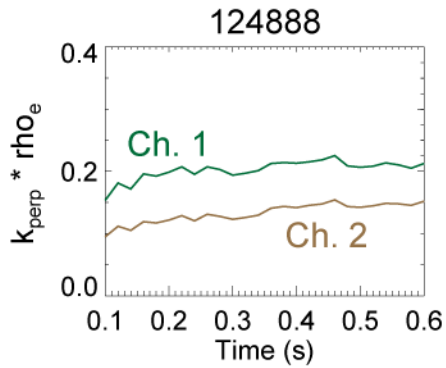
Outboard measurements (1)

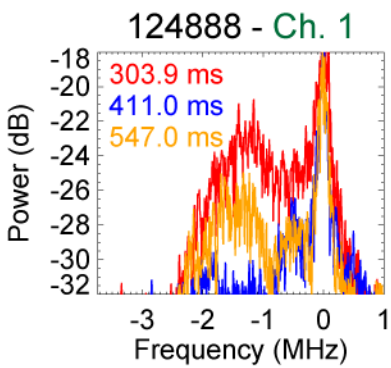
R ~ 135 cm and r/a ~ 0.6

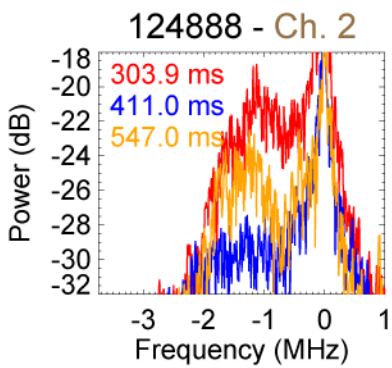


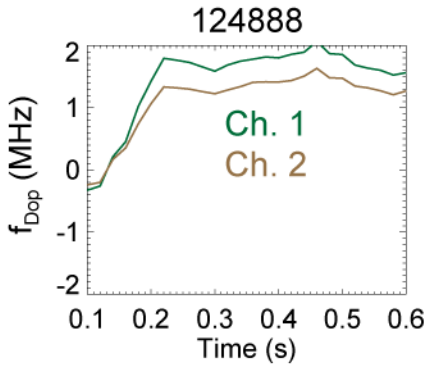








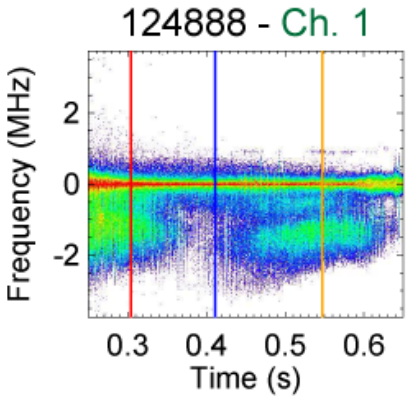


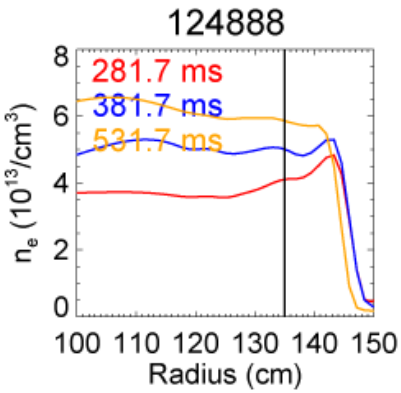


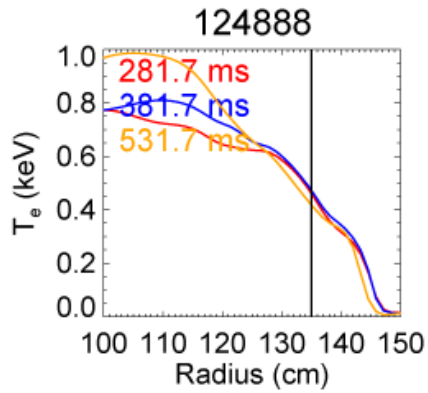
Why do fluctuations fall and rise?

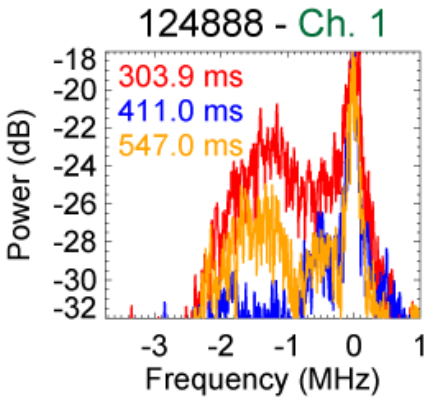
Outboard measurements (2)

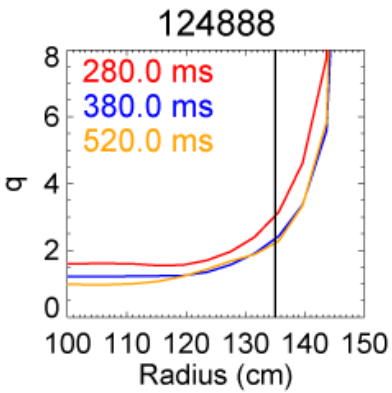
Common quantities don't explain fluctuation dynamics...

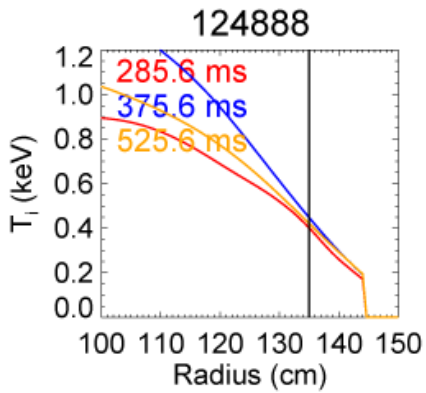


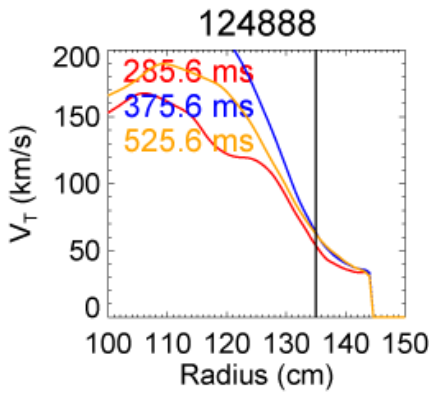






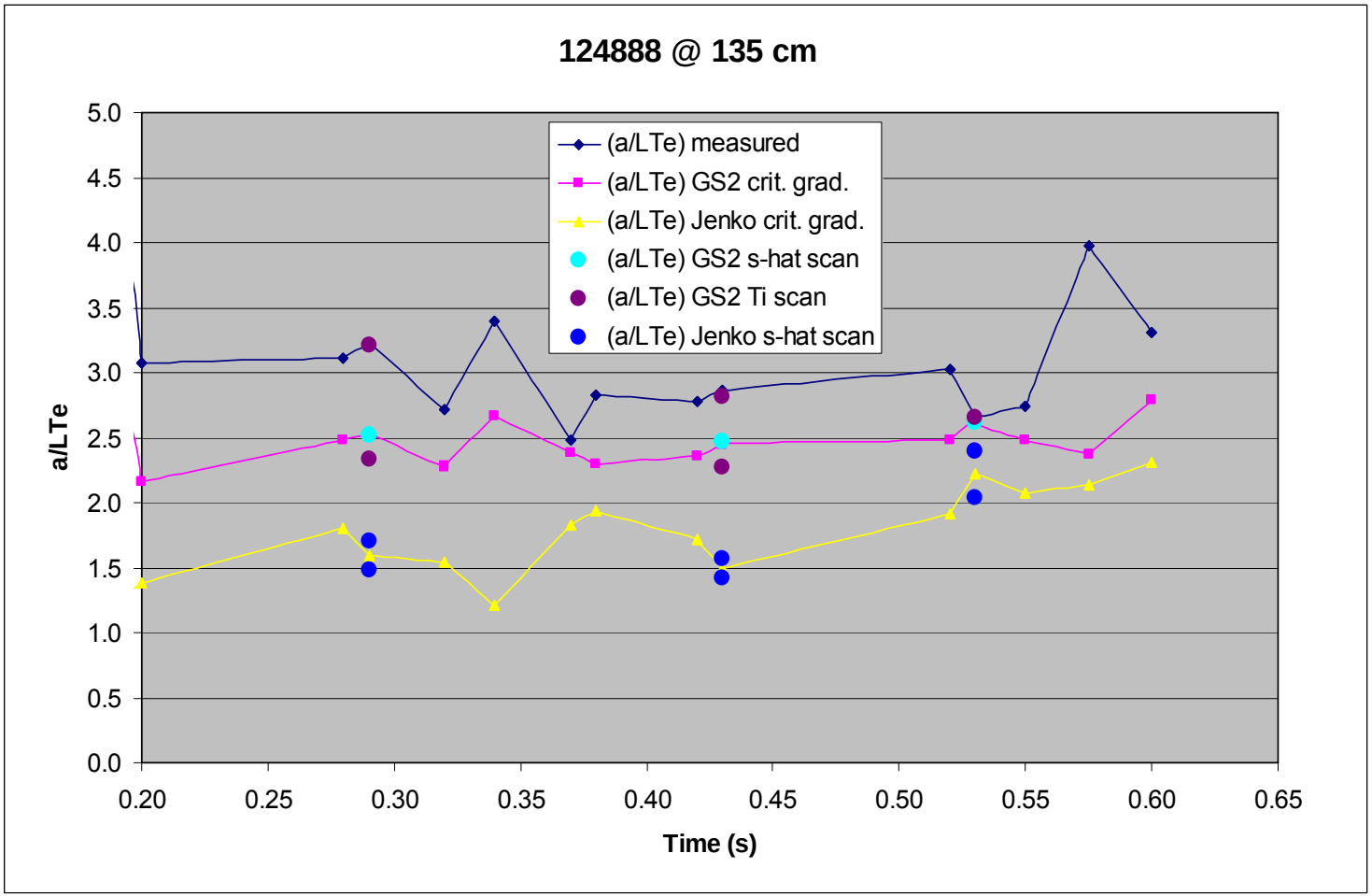






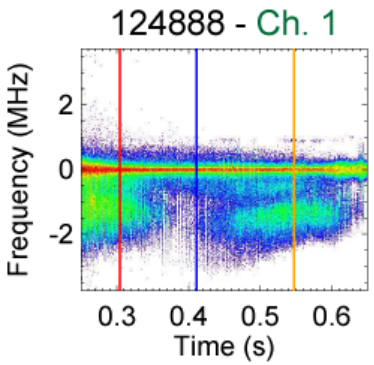
Outboard measurements (3)

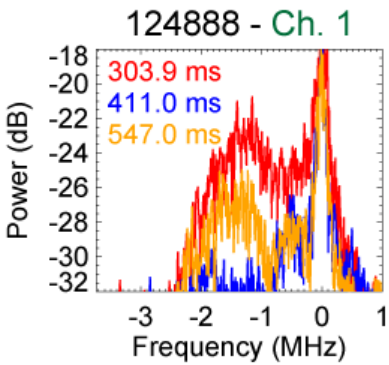
According to linear GS2, Te gradient is above the critical gradient, but Te gradient fails to explain the fall and rise of fluctuations...

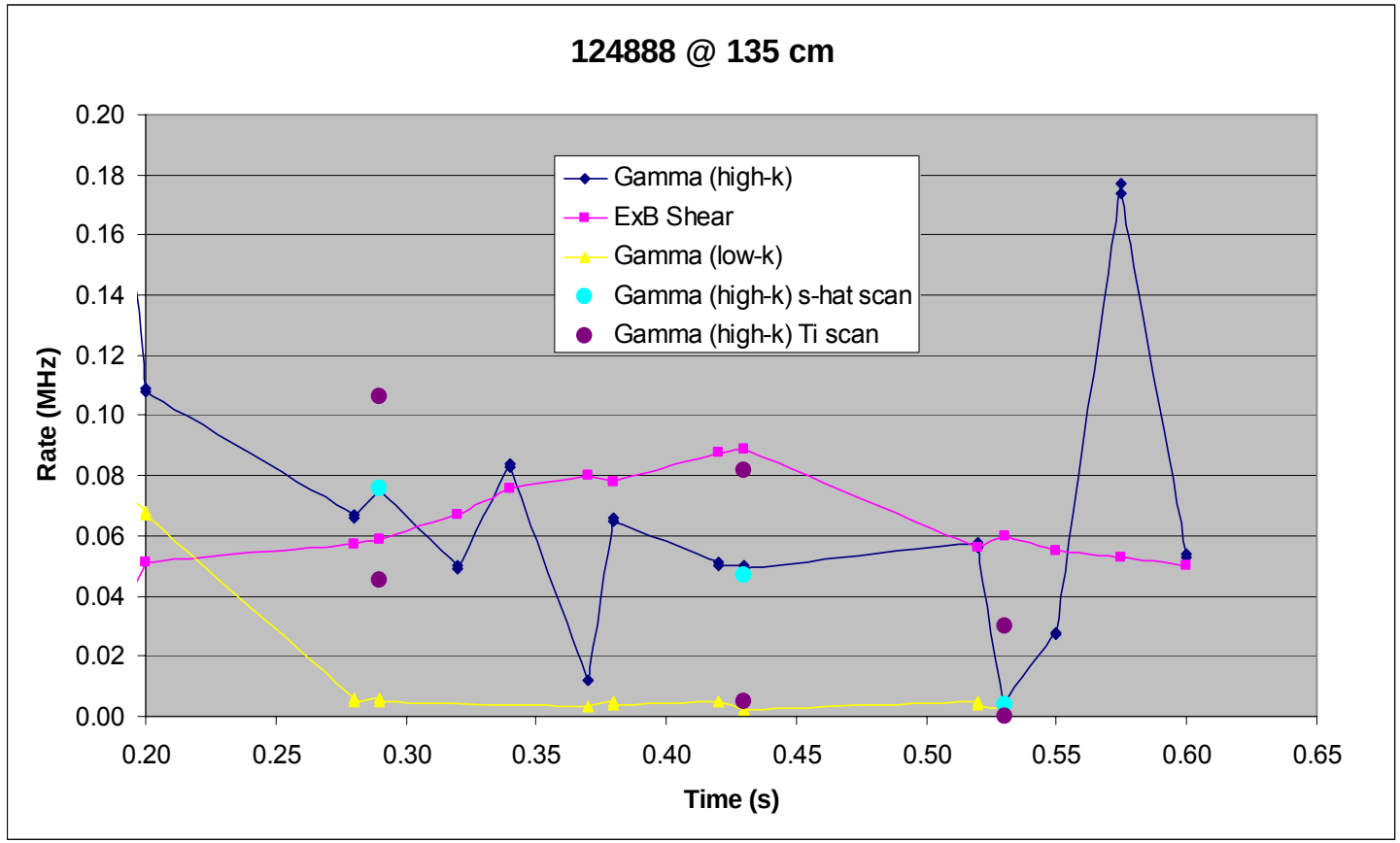


Outboard measurements (4)

Mode growth rate and ExB shear rate appear to show the necessary pattern to explain the saturation dynamics.

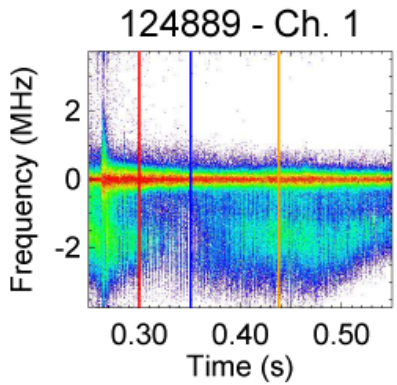


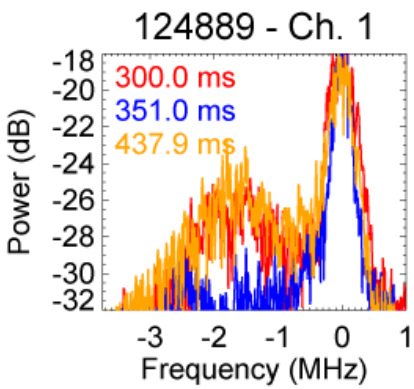


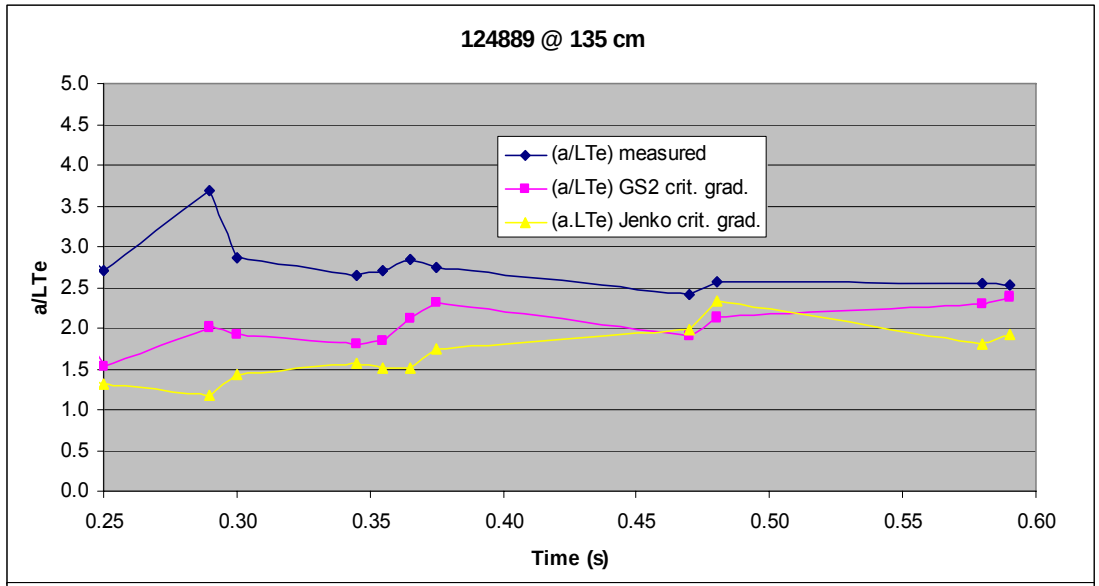


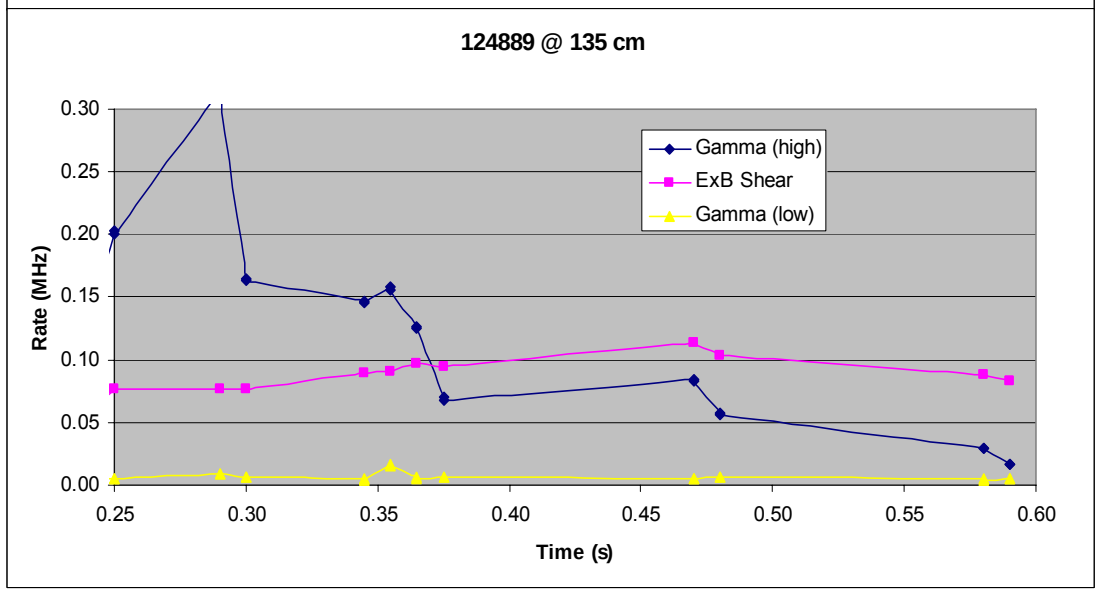
Outboard measurements (5)

Similar story for similar shot...



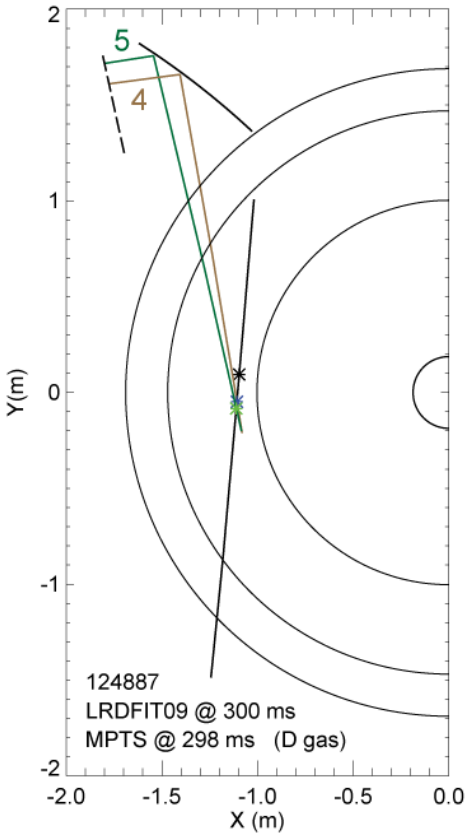


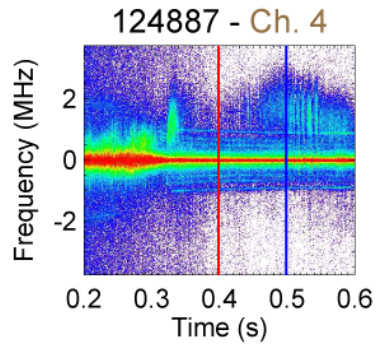


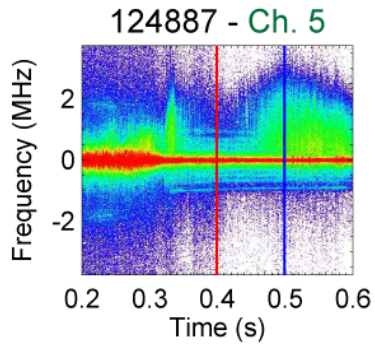


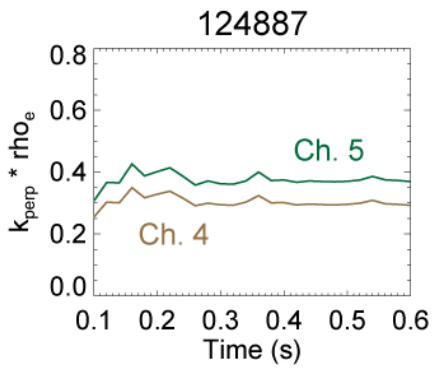
Inboard measurements (1)

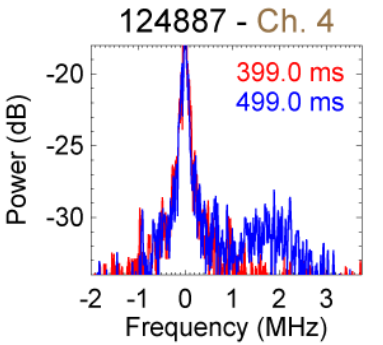
R ~ 113 cm and r/a ~ 0.2

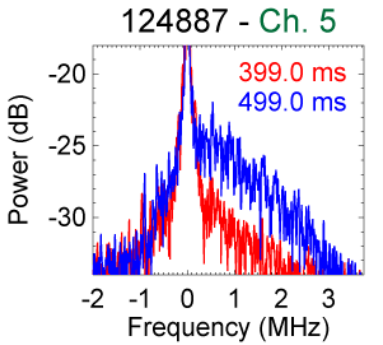


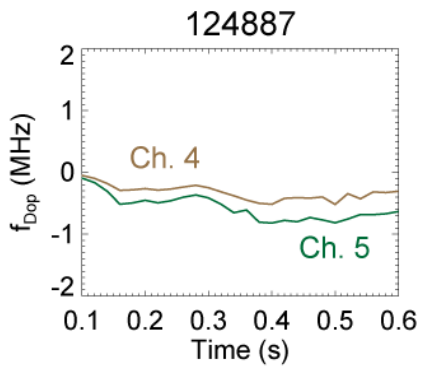








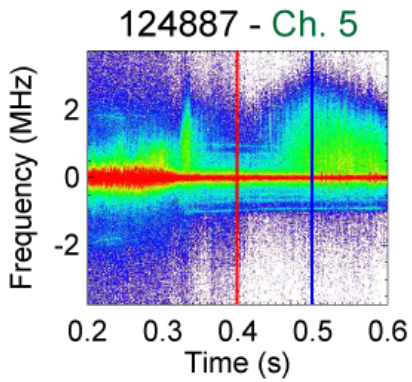


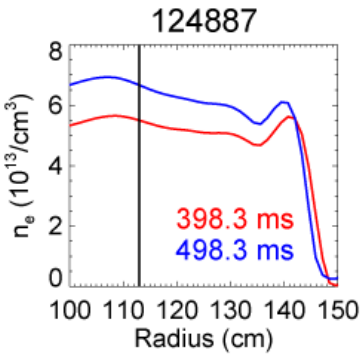


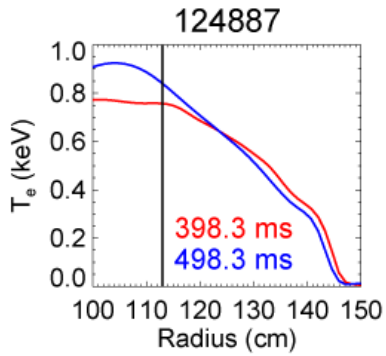
Why do fluctuations rise?
(and what's the brief activity at 330 ms?)

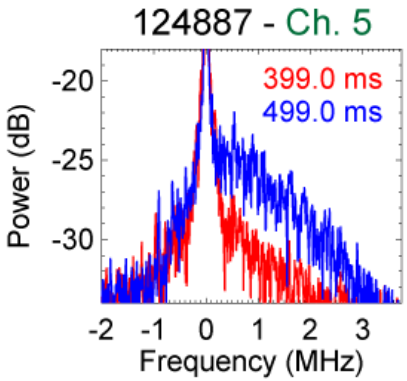
Inboard measurements (2)

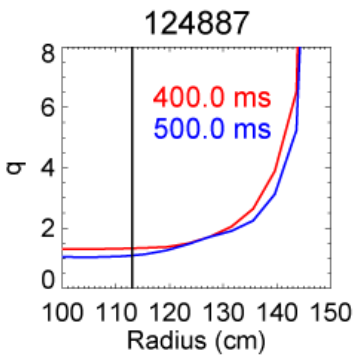
Rise in Te gradient may explain fluctuation dynamics...

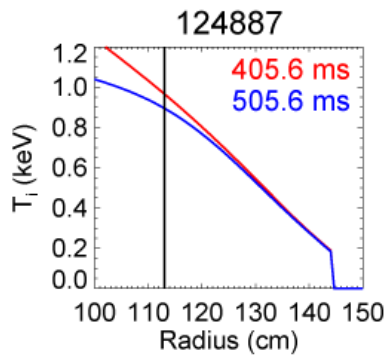


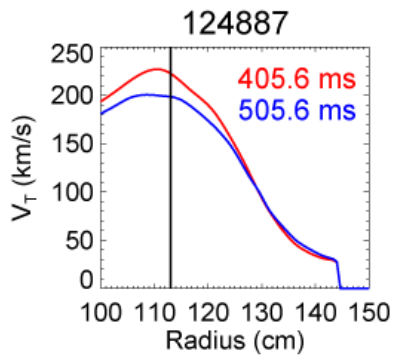






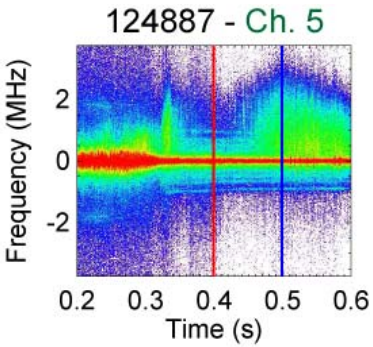


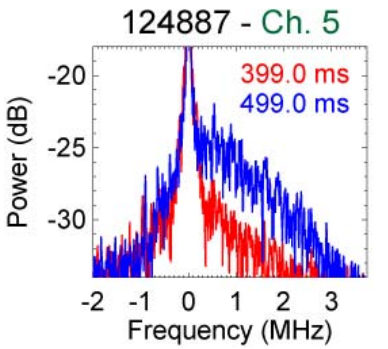


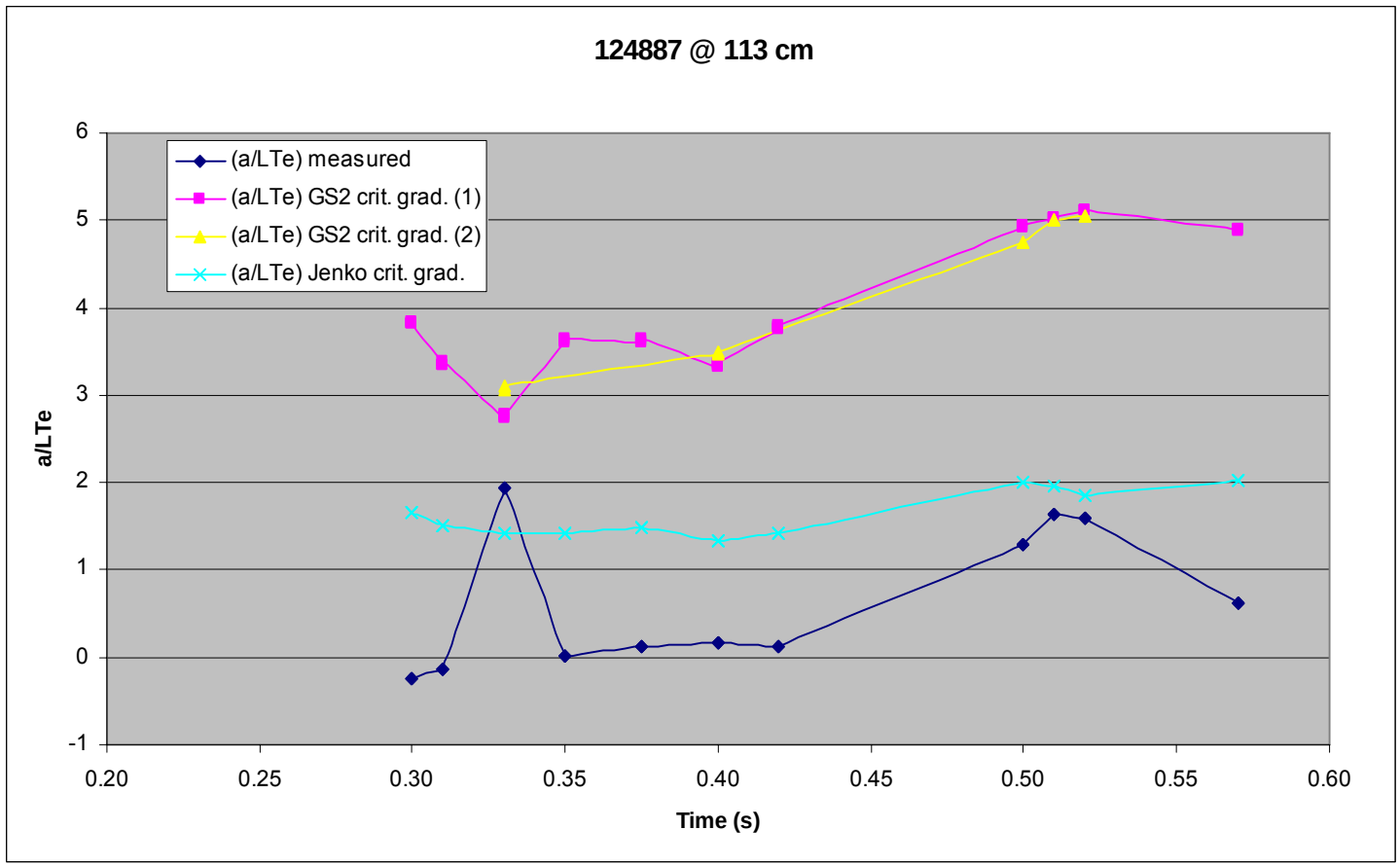


Inboard measurements (3)

Te gradient is always **well below** the critical gradient
(except during the early burst of fluctuations around 330 ms).
Is this evidence of turbulence spreading to the core?







Inboard measurements (4)

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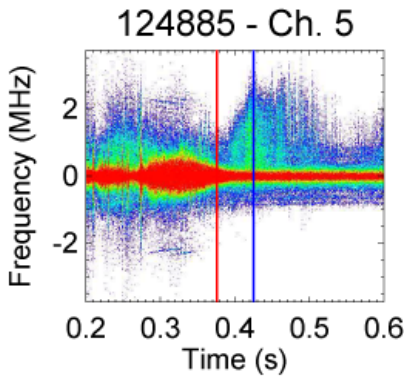

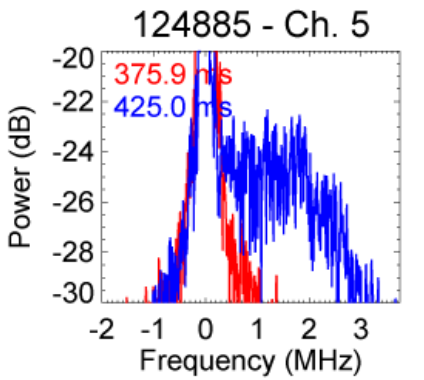

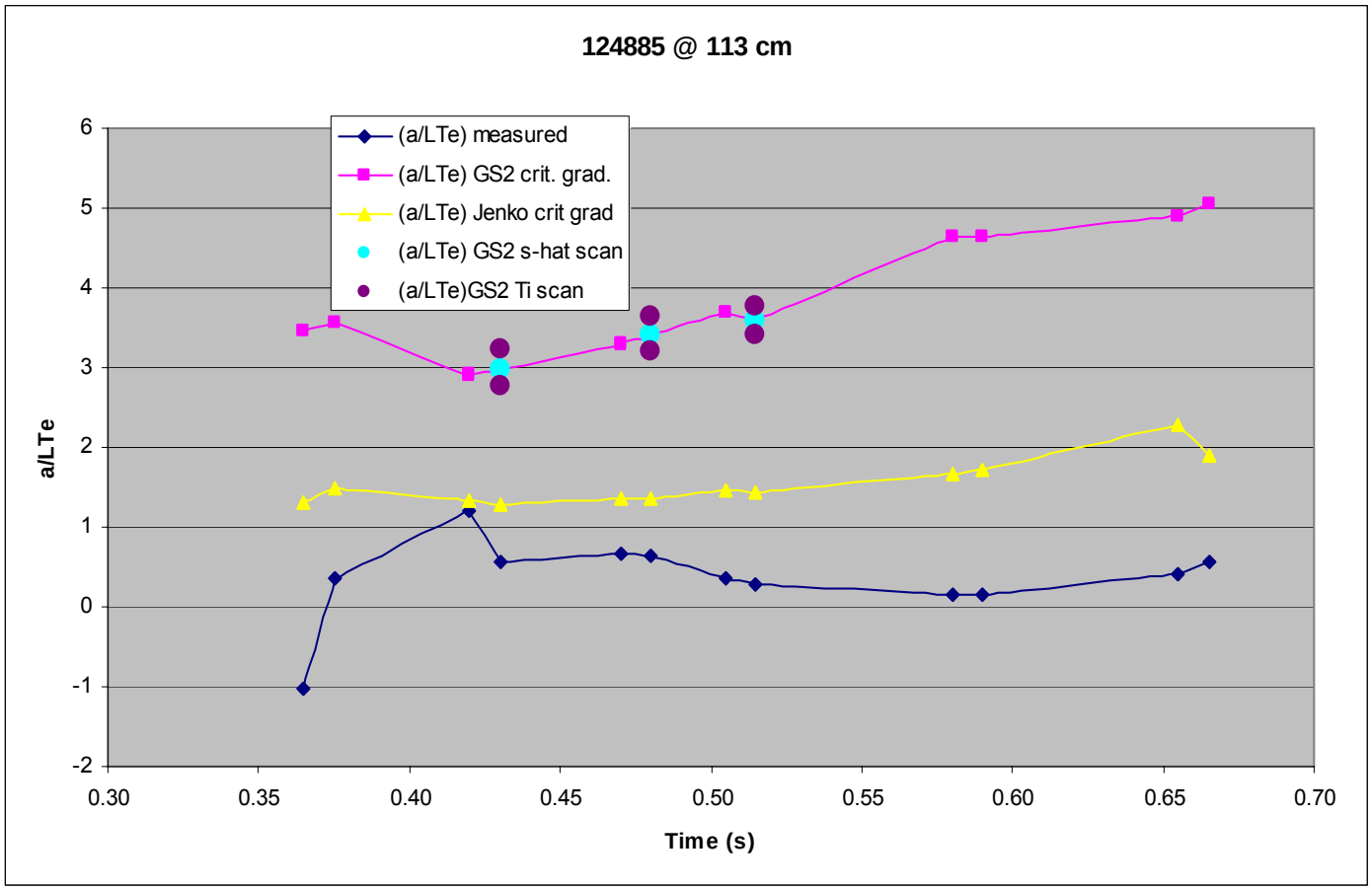

Summary

- Outboard measurements at R=135 cm and r/a=0.6
  - Fluctuations initially appear while ETG is linearly unstable
  - Saturation dynamics appear to be regulated by ExB flow shear
- Inboard measurements at R=113 cm and r/a=0.2
  - Fluctuations appear while ETG is linearly stable
  - Possible evidence for turbulence spreading from edge to core
- Shots in this talk exhibited low, steady-state MHD activity. Future work will investigate shots with less MHD activity.