# Understanding and Predicting Pedestal Scenarios in NSTX-U

PI: D. R. Hatch
Co-PIs: M. Kotschenreuther, S. M. Mahajan

Incoming postdoc: Joel Larakers

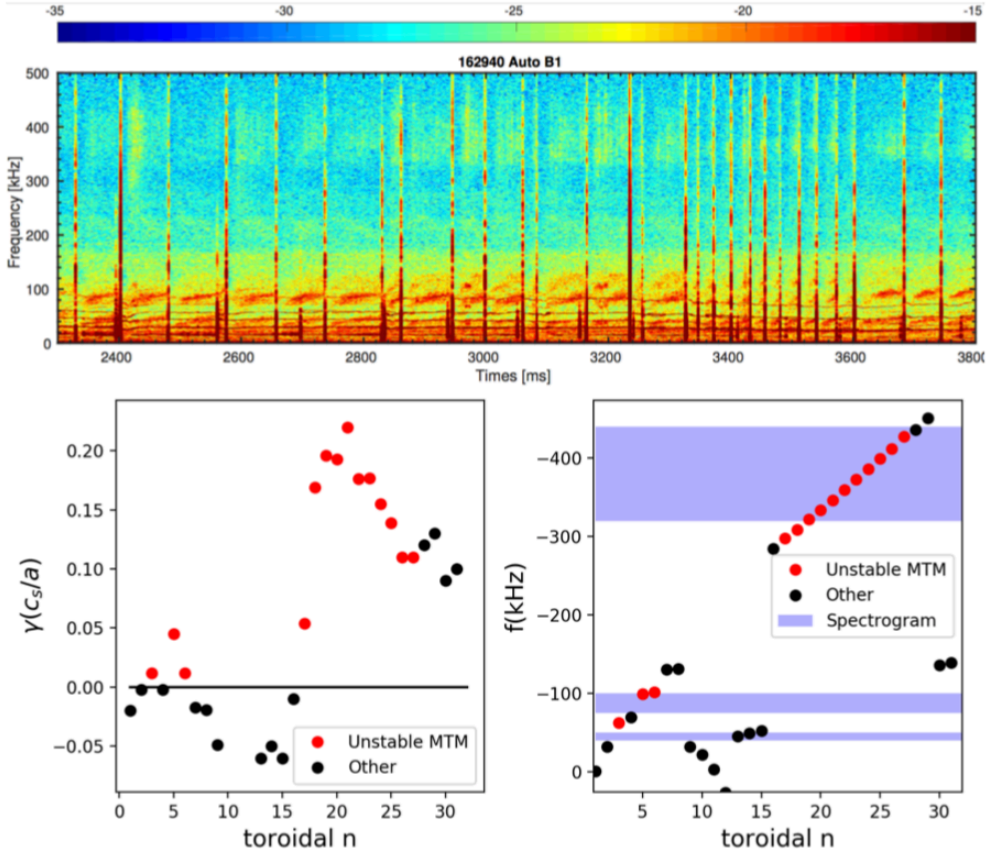
Graduate student: _____

IFS, UT Austin

# Interpreting Pedestal Magnetic Fluctuations

Example from DIIID:

- Pedestal fluctuation bands align (almost) exactly with frequencies of unstable MTMs.
- Comprehensive physical interpretation of distinctive band structure.




Hassan et al. manuscript submitted

# A Preliminary Look at NSTX Magnetic Fluctuations

Some qualitative alignment with MTM frequencies.

However: this depends on an ion direction Doppler shift (taken blindly from the data but very counterintuitive).

Early goal: determine source of pedestal magnetic fluctuations: MHD or MTM?

If the former, shift MTM studies to core.

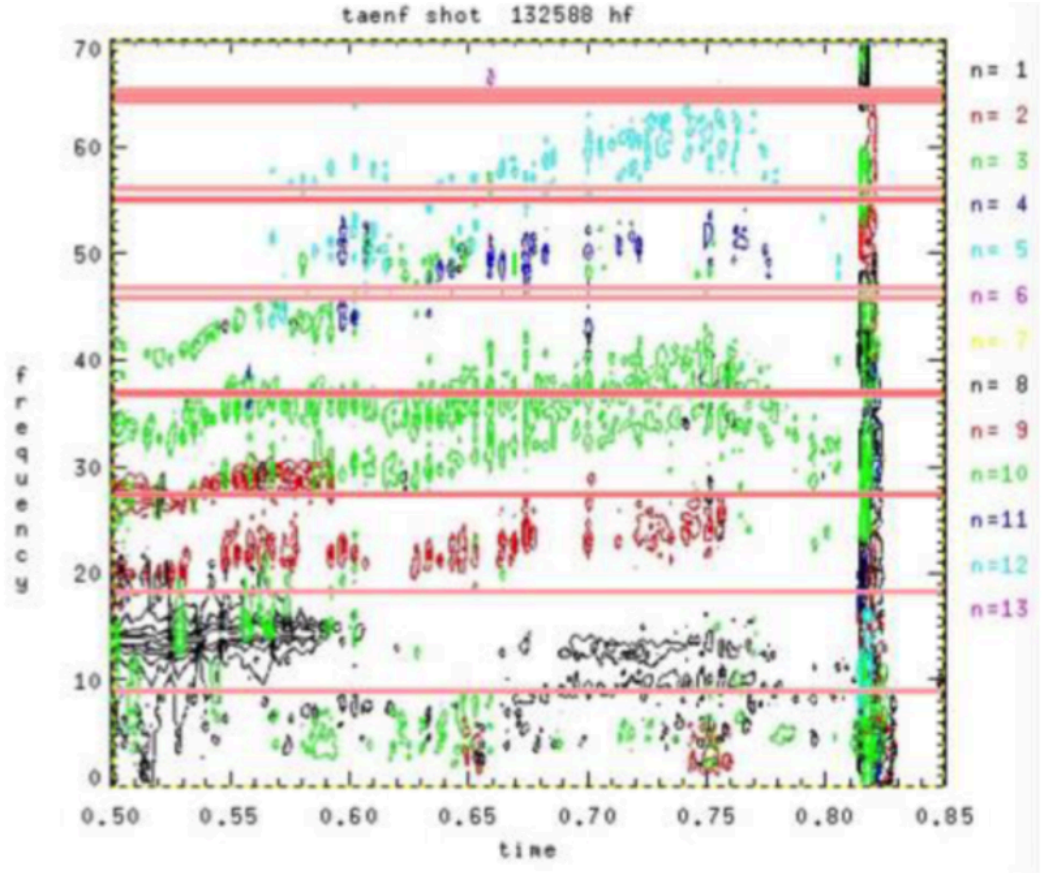


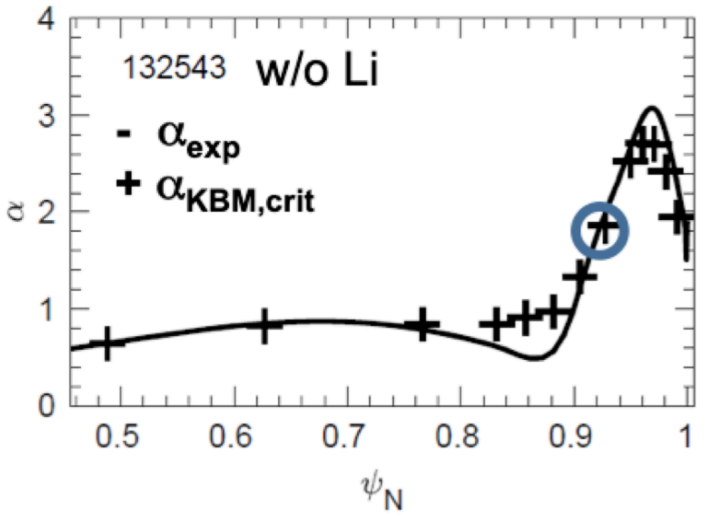

**Figure 2:** Spectrogram of magnetic fluctuations for NSTX discharge 132588.

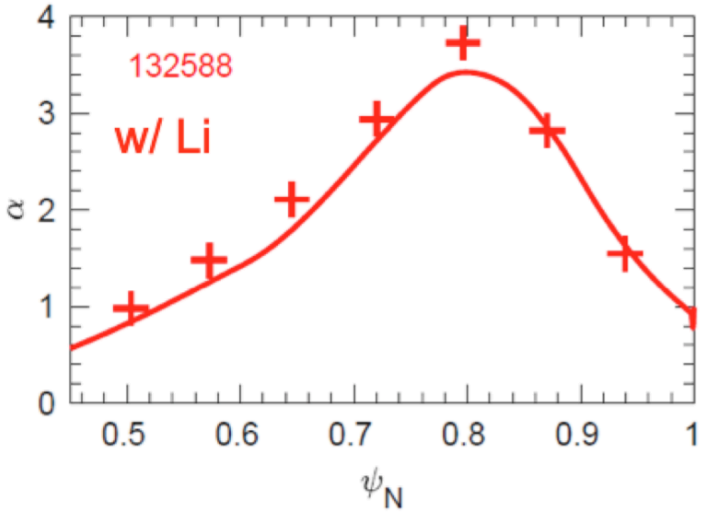
# Evidence of KBM-Limitation in Pedestal and Core (Guttenfelder)

Is this universal?

Local vs global KBM?

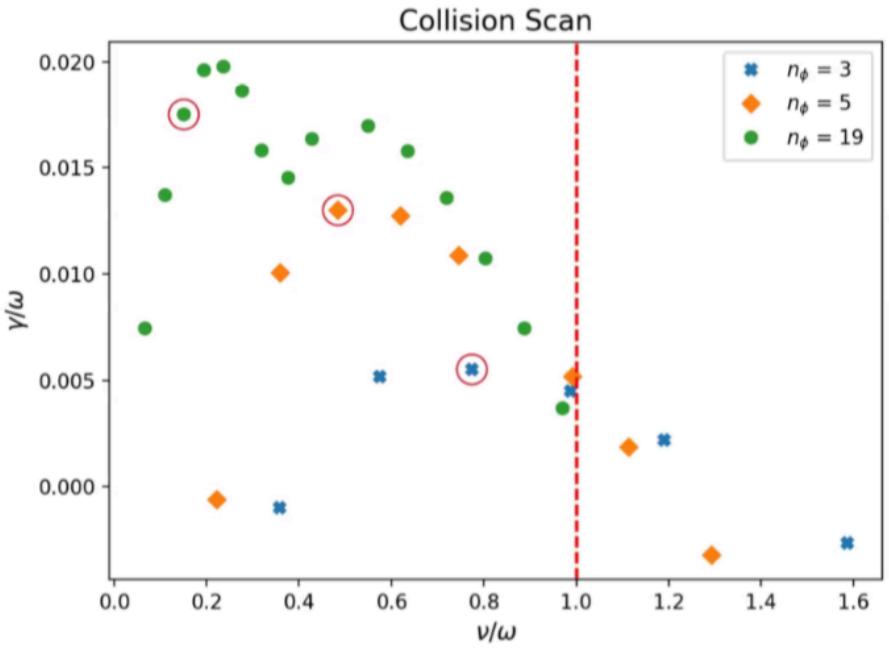
Nonlinear simulations?



# Understand Key Parameter Dependences for NSTX-U

- Collisionality
  - Origin of favorable collisionality scaling?
  - Possible relation to MTM?
- Aspect ratio
  - Can carry out direct comparisons—fix multiple parameters, change aspect ratio / geometry
- Wall conditioning
  - Understand striking changes in pedestal width, confinement
  - In general, what is the main particle transport mechanism, what is its relation to sources, etc.?



# Reduced models for MTM stability and Transport

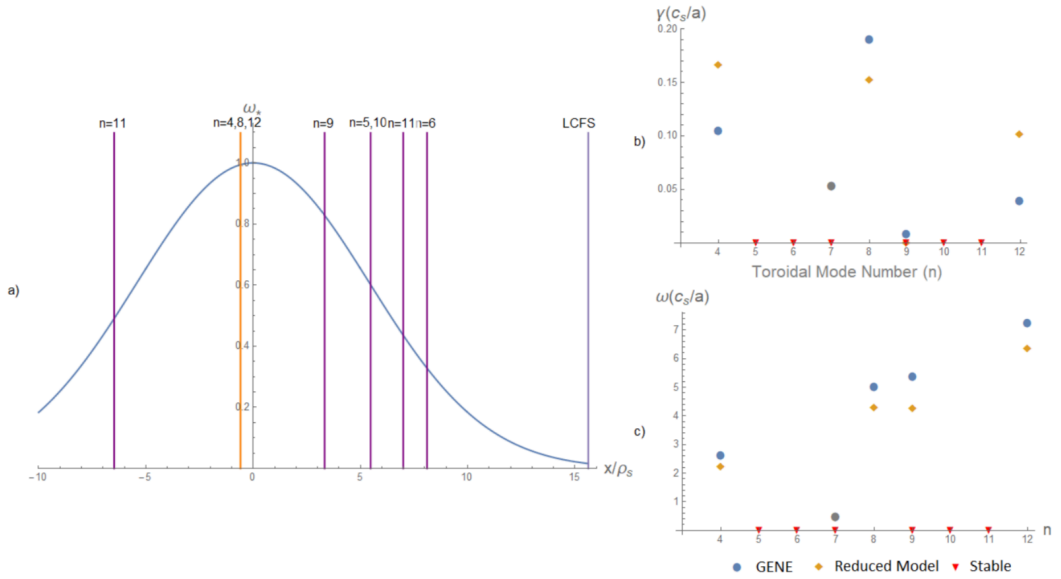
Reduced model for pedestal MTM stability.

Slab MTM (applicable to low-n frequency bands)

Global: can predict distinctive band structures.

Reproduces sensitive dependence of rational surface alignment.

Larakers et al. PRL 2021




Further develop such models for NSTX-U. For pedestal and/or core depending on where MTM is most relevant. Will likely need to generalize geometry.

Also extend quasilinear models for MTM transport (Xie et al. PoP 2020)

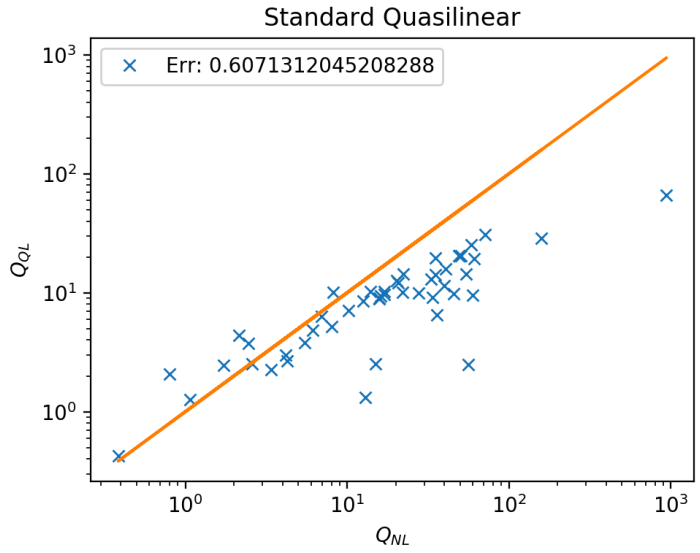
# Pedestal ETG

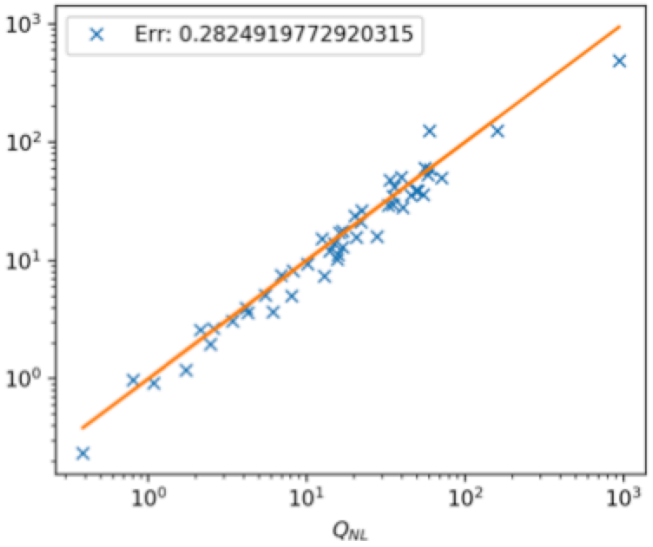
Understand the role of ETG in the NSTX(U) pedestal.

Some work already by Canik.

Are global effects relevant?

Generalize reduced model for pedestal ETG (standard A).



# Major Objectives

1. Identify the source of magnetic fluctuations in the NSTX pedestal (Postdoc)
2. Identify the major transport mechanisms responsible for each transport channel in the NSTX(U) pedestal (Graduate Student)
3. Understand particle transport in the NSTX(U) pedestal in relation to wall conditioning (Graduate Student)
4. Study microtearing modes in NSTX(U) in both the pedestal and core (Postdoc)
5. Develop reduced models for MTM stability and thresholds (Postdoc)
6. Develop reduced models for MTM transport (Postdoc)
7. Understand the collisionality dependence of MTM transport on NSTX(U) (Postdoc)
8. Understand the direct role of aspect ratio on pedestal instabilities (Student)
9. **Open to new avenues in response to NSTX-U team, new data, emerging opportunities!**