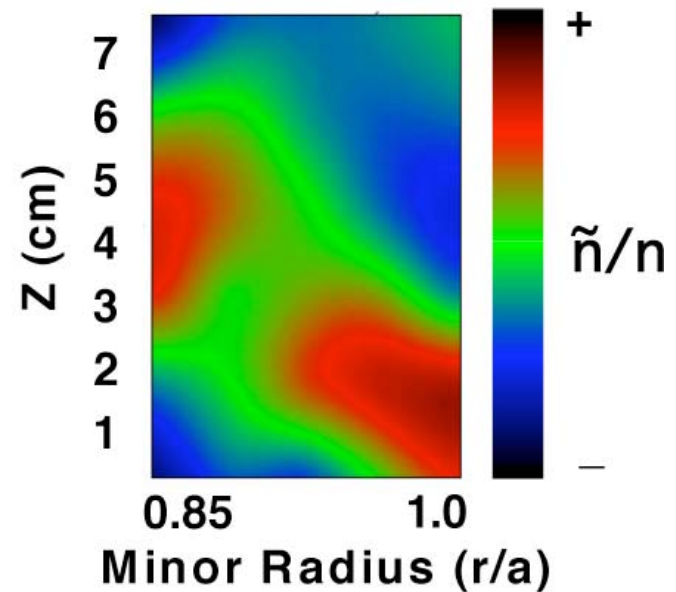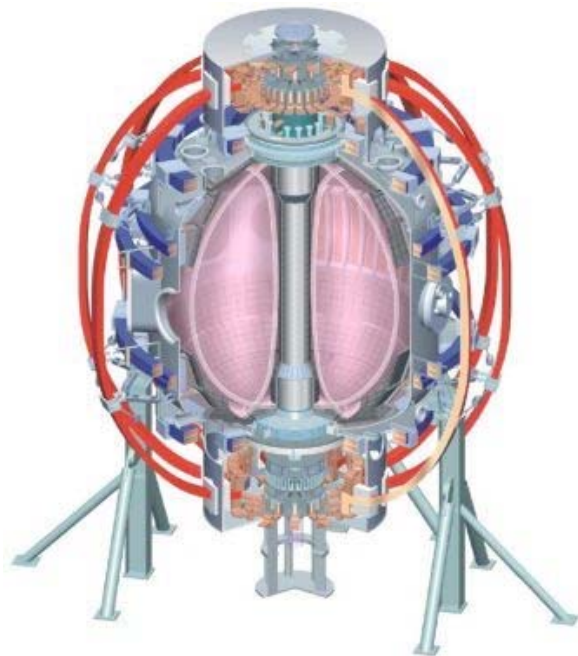# Experimental proposals utilizing the BES diagnostic for the Turbulence and Transport TSG

D. R. Smith, R. J. Fonck, and G. R. McKee
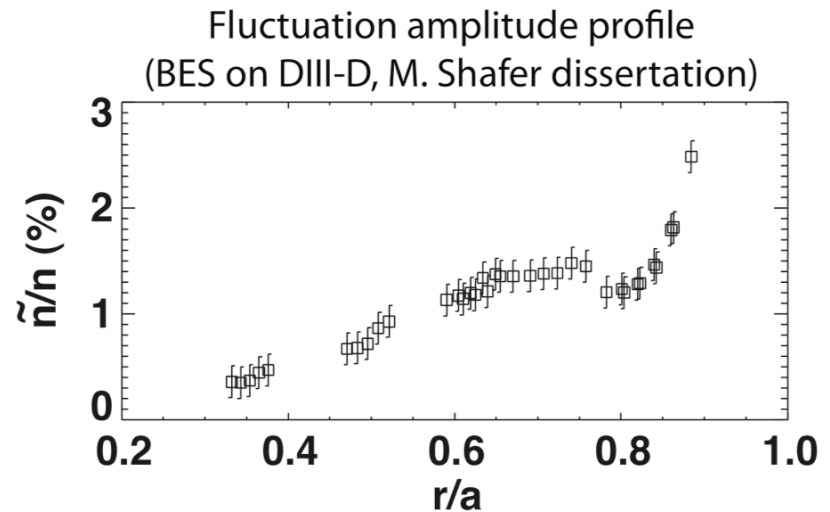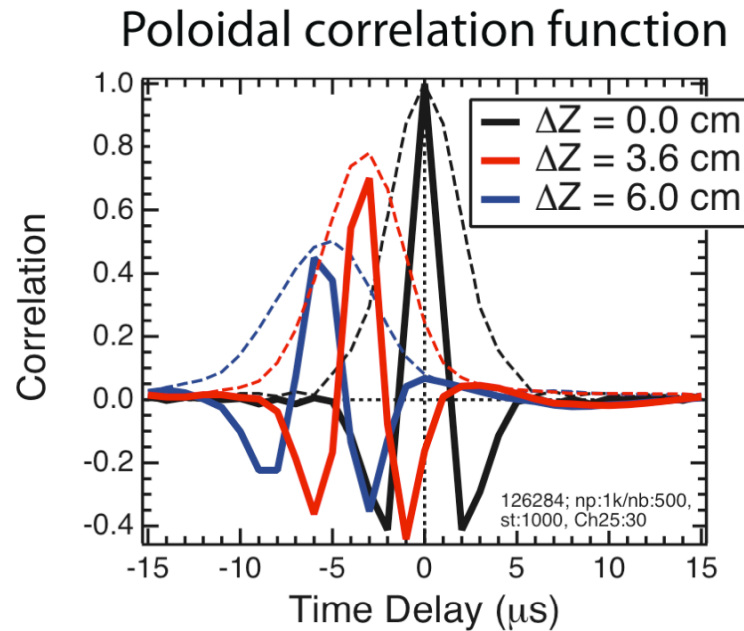*University of Wisconsin-Madison*

4 proposed experiments

- Survey of low-k fluctuations in NSTX

- Investigation of low-k fluctuations as a source of anomalous momentum transport

- Investigation of multi-scale turbulence: T_e/T_i and E×B shear dependences

- Investigation of the k-space isotropy of ETG turbulence (submitted in FY09)

XP1: Survey of low-k fluctuations in NSTX

- Goal: Conduct initial survey of low-k fluctuation properties (e.g. amplitudes, correlation lengths, correlation times) in several NSTX operating regimes

- Method
  - Radial, poloidal, and 2D BES arrays
  - Edge and core measurement locations
  - L-mode and H-mode plasmas
  - B_t/I_p, P_{nbi}, and V_{nbi} scans
  - Compare BES and GPI measurements

- Runtime: 2 days

Poloidal correlation function

Legend:
- ΔZ = 0.0 cm
- ΔZ = 3.6 cm
- ΔZ = 6.0 cm

126284; np:1k/nb:500,
st:1000, Ch25:30

Fluctuation amplitude profile
(BES on DIII-D, M. Shafer dissertation)

XP2: Investigation of low-k fluctuations as a source of anomalous momentum transport
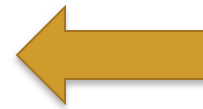
- Goal: Document $\tilde{n}_i$ scalings of diffusive and convective anomalous momentum transport for comparison to theory

- Motivation
  - Competing theories implicitly predict different $\tilde{n}_i$ scalings for the turbulent momentum pinch
  - "Low-k turbulence-based models predict greater pinch velocities in the core than are typically observed" (Kaye)

- Method
  - Use n=3 nRMP breaking at several discharge times for perturbative momentum transport analysis (successful in outer plasma in XPs 813 and 908 (Solomon))
  - Apply NBI pulses (successful in core plasma in XP 820 (Kaye))
  - Scan Bt/Ip for natural rotation variation
  - Analyze with GK simulations

- Contribution: FY08 Joule milestone

- Runtime: 1 day

XP2: momentum transport (con't)

XP 813 (Solomon) showed Ln dependence can distinguish turbulent momentum pinch theories
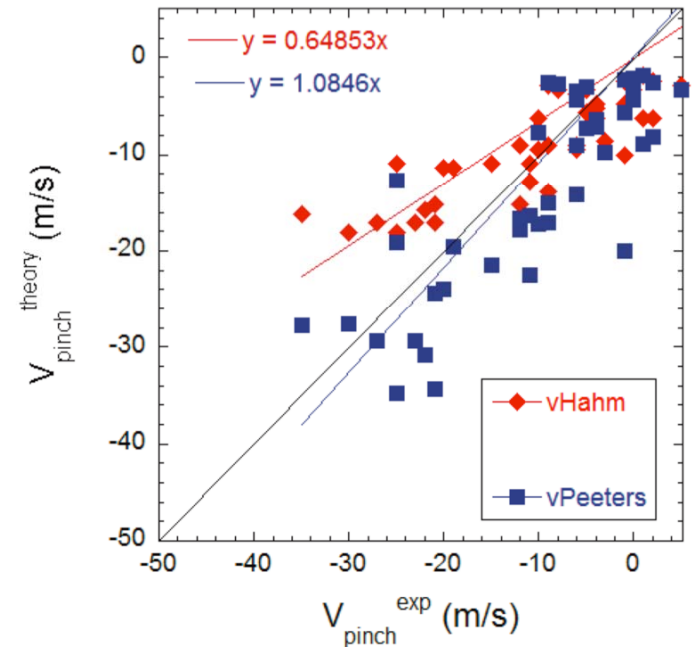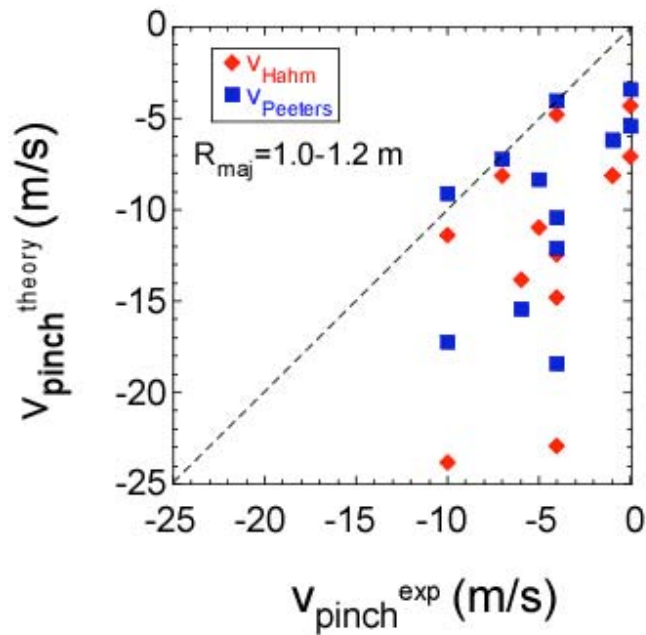
XP 820 (Kaye) showed low-k turbulence theories over-predict pinch velocities

- Goal: Investigate the multi-scale nature of turbulence (ITG/TEM/ETG) by inducing different responses in different regions of k-space

- Motivation
  - ITG and TEM/ETG exhibit opposite Te/Ti dependencies
  - Generally $\{\gamma_{ITG}, \gamma_{TEM}\} << \gamma_{ETG} \sim \gamma_{E×B}$, so modes may respond differently to E×B variations

- Method
  - Scan Bt/Ip and P_{NBI} for Te/Ti variation (consider NBI+HHFW)
  - Scan n=3 nRMP breaking to alter E×B shear
  - Analyze with GK simulations

- Contributions: NSTX milestone R(11-1) and ITPA TC-10

- Runtime: 2 days

XP4: Investigation of ETG turbulence isotropy

- Goal: Document the isotropy or anisotropy of ETG turbulence

- Motivation
  - NL GK simulations do not agree regarding the isotropy of ETG turbulence around $k_\perp \rho_e \approx 0.1$
  - Radial streamers (anisotropic structures) and ETG transport exhibit a strong dependence on magnetic shear

- Method
  - Use novel high-k scattering configurations to vary k/kr
  - Use current ramp-downs to transiently alter magnetic shear
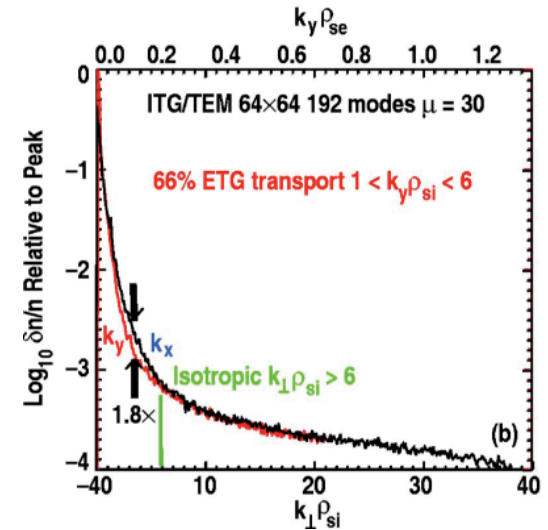 - Analyze with GK simulations

- Runtime: 1 day
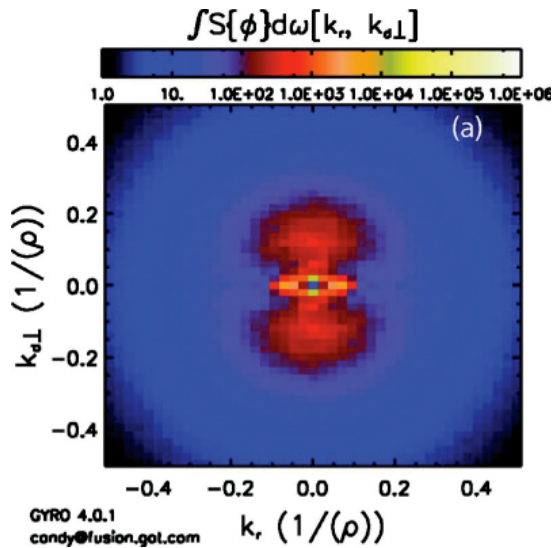
Nevins et al, PoP, 2006
predict ETG anisotropy

Waltz et al, PoP, 2007
predict ETG isotropy

Use novel high-k scattering
configurations to vary k_θ/k_r