XP to investigate the k-space isotropy of ETG turbulence

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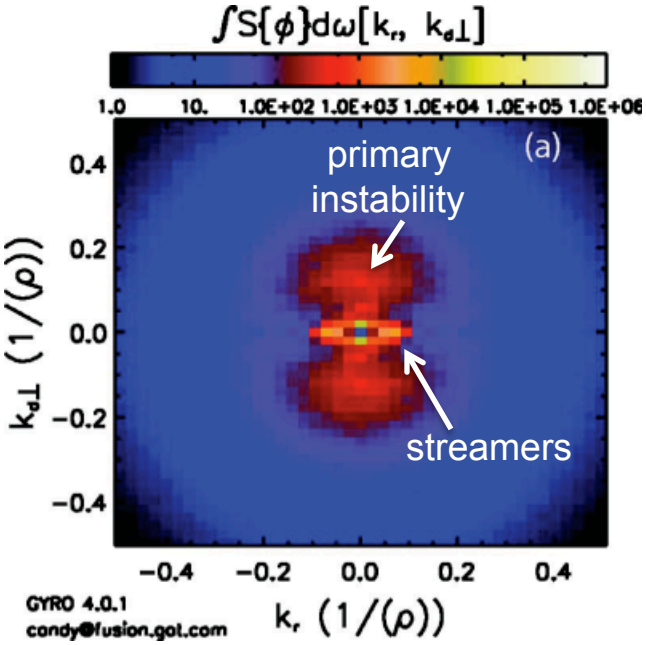
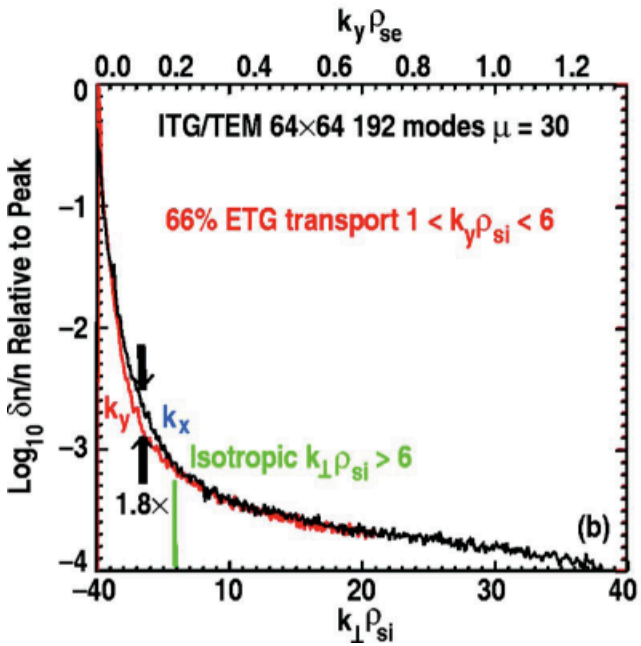
The k_r-k_θ isotropy of ETG turbulence is an area of contention among NL GK simulations

Nevins et al, PoP, 2006
predict ETG anisotropy



Waltz et al, PoP, 2007
predict ETG isotropy



ETG radial streamers are anisotropic features
(simulations above do not use the same plasma conditions)

Magnetic shear may control ETG isotropy and ETG-driven electron thermal transport

TABLE III. (χ_e) vs magnetic shear.

	s=0.1	s=0.2	s=0.3	s=0.4	s=0.5	s=0.6	s=0.7	s=0.8
Adiabatic ions	3.9±0.1	5.3±0.6	6.8±1.0	10.2±1.3	128±35	>800	>800	>600
Kinetic ions	4.4±0.2	5.5±0.2	7.0±0.6	9.2±1.2	10.7±2.0	14.3±2.2	10.5±0.9	13.6±2.2

wave numbers ($k_\perp \rho_e > 0.2$).

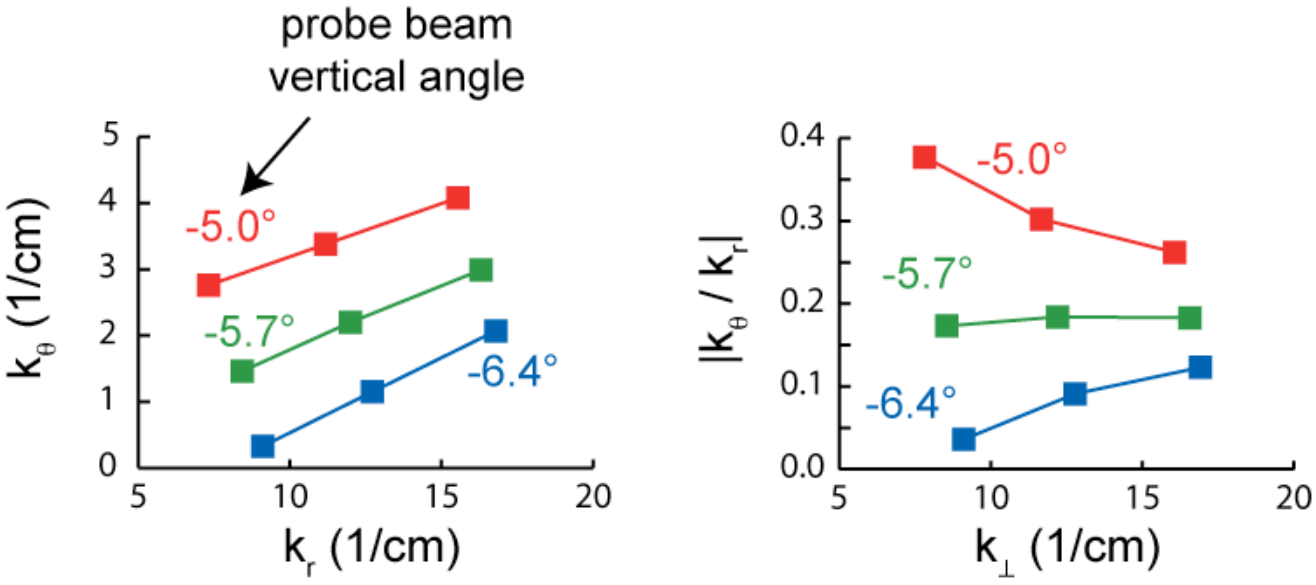
The transition to a nearly monochromatic spectrum occurs abruptly as the magnetic shear is increased and is closely associated with the sharp increase in the electron heat transport as the magnetic shear is increased from $s=0.3$ to 0.4. Very high electron heat transport $[\chi_e \gg 10(\rho_e/L_T)\rho_e v_{te}]$ is, in our experience, always accompanied by a nearly monochromatic fluctuation spectrum with $k_r \approx 0$. This spectrum corresponds to coherent "streamers" with a macroscopic radial scale in the perpendicular plane within configuration space.

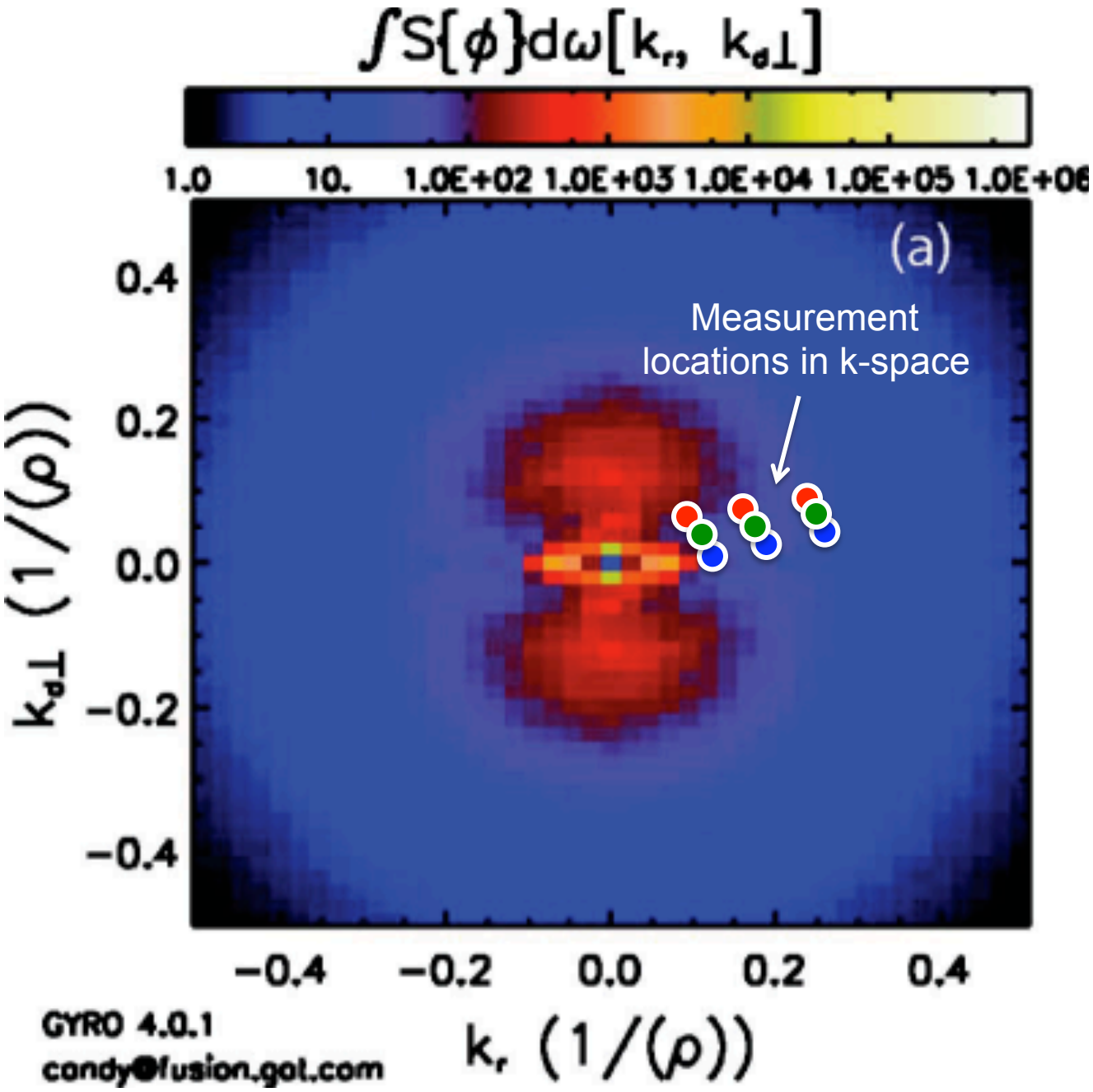
This rapid increase in the electron heat transport with increasing shear would appear to be the most dramatic result of our study of ETG turbulence. As such, we employed the

Nevins et al, PoP, 2006

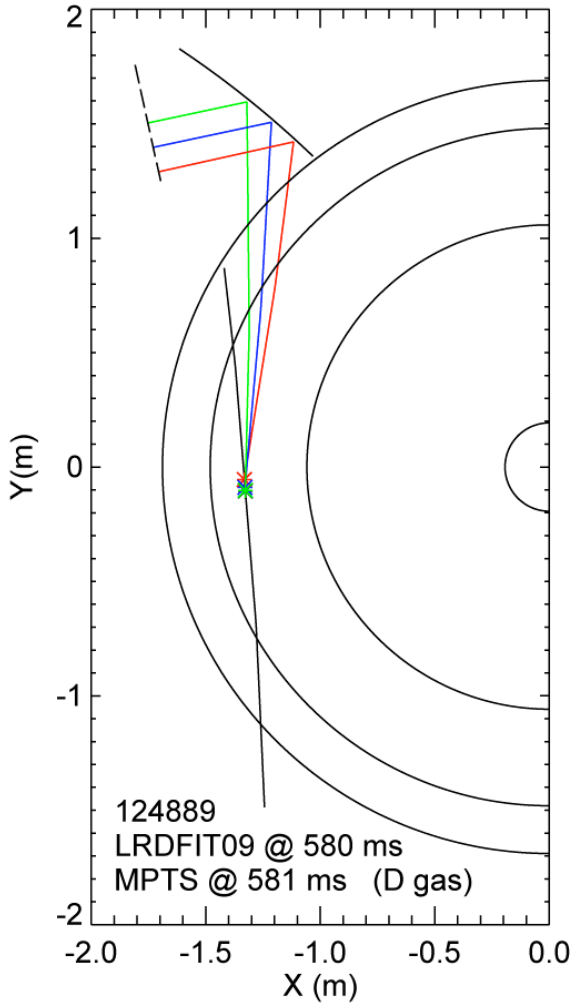
The NSTX high-k scattering system can access a wide range of k_θ/k_r ratios

unique capability for NSTX



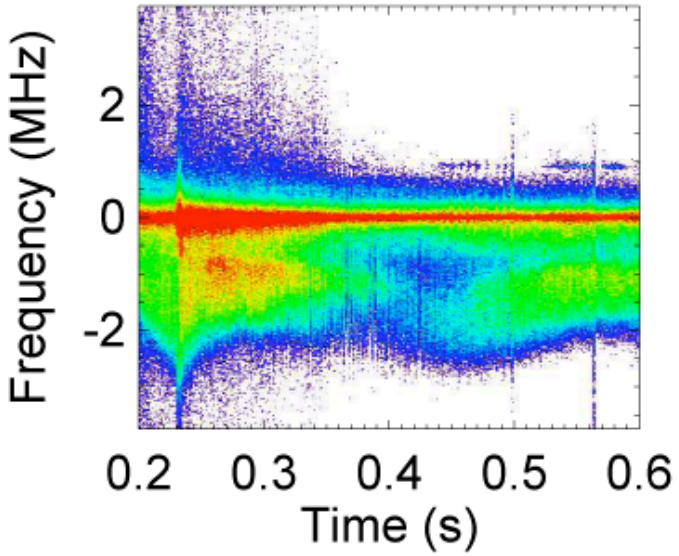

∫S{φ}dω[k_r, k_θ⊥]
1.0
10.
1.0E+02
1.0E+03
1.0E+04
1.0E+05
1.0E+06
(a)
Measurement
locations in k-space
0.4
0.2
0.0
−0.2
−0.4
k_θ⊥ (1/(ρ))
−0.4
−0.2
0.0
0.2
0.4
k_r (1/(ρ))
GYRO 4.0.1
candy@fusion.gat.com

Previous measurements provide a starting point

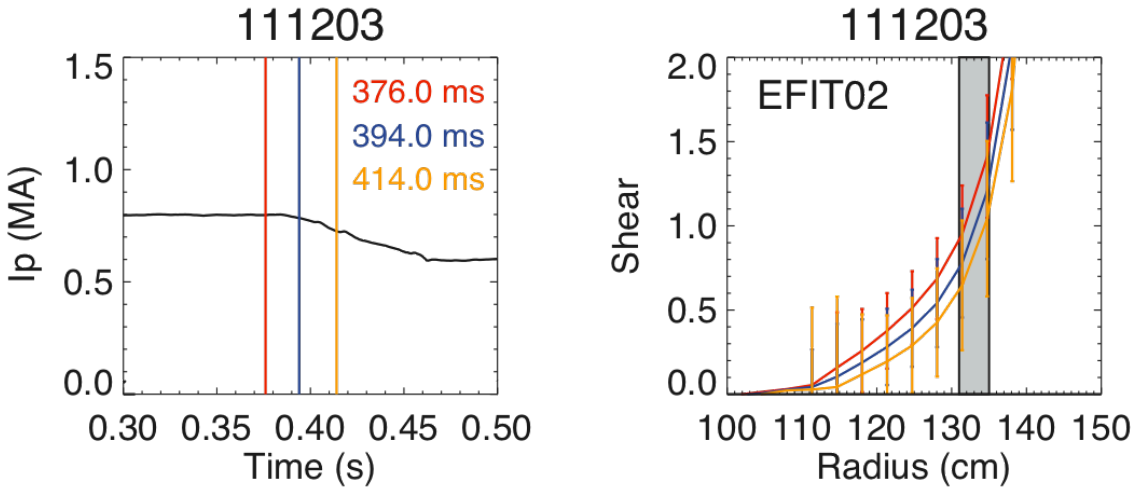


124889: 700 kA, 5.5 kG, &
4 MW NBI

high-k measurements
at R=133 cm and r/a=0.55



Transiently alter magnetic shear with current ramp-downs to probe isotropy-anisotropy transition



S. Sabbagh used current ramp-downs in XP414 to obtain high β_p and β_N

Shot grid

	Ip = 1.0 MA & no ramp-down	Ip ramp-down to 0.8 MA with several ramp timings
PB Z angle -5.0°	×2	~ 5
-5.7°	×2	~ 5
-6.4°	×2	~ 5

- Aim for late, fast Ip ramp-downs
- k_r and k_θ values on slide #4 for 1 MA Ip