Comparison of SOL Turbulence in Limited and Diverted Plasmas

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- Compare edge turbulence in limited vs. diverted plasmas to see possible effect of parallel boundary condition

- Compare edge turbulence in limited plasmas with GEM turbulence simulation code (Scott, IPP Garching)

Alcator
C-Mod

APS-DPP 2006 Philadelphia #JO1.00008   Oct. 31, 2006

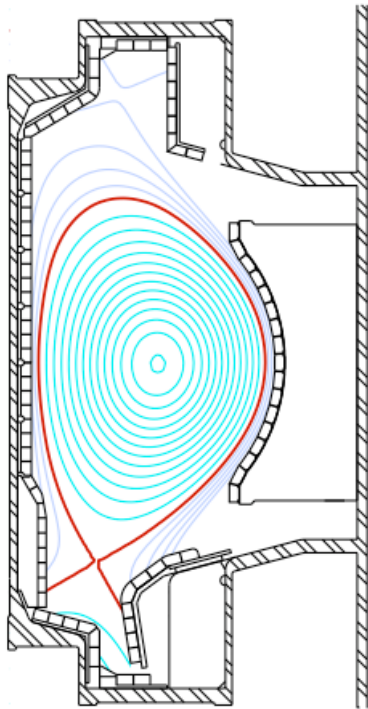# Edge Turbulence Diagnostics
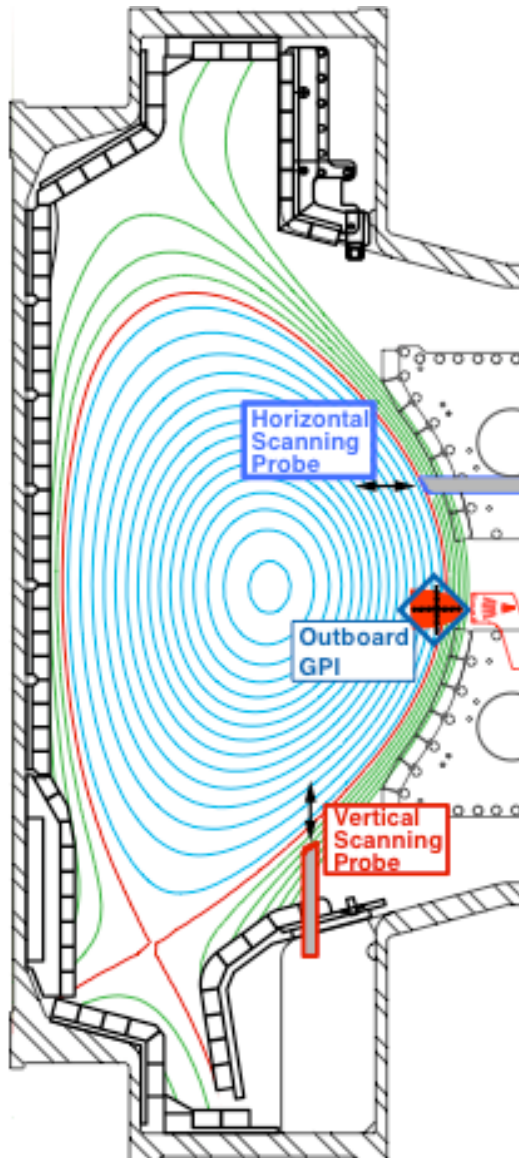
- **Gas puff imaging (GPI):**

  - views D_α light from puff

  - 23 fast diodes in 2-D array

  - 2-D view 64x64x300 frames

- **Langmuir probes**

  - radially scans across SOL

  - n, T_e time-averaged profiles

  - $\tilde{n}/n$, V_f fluctuations
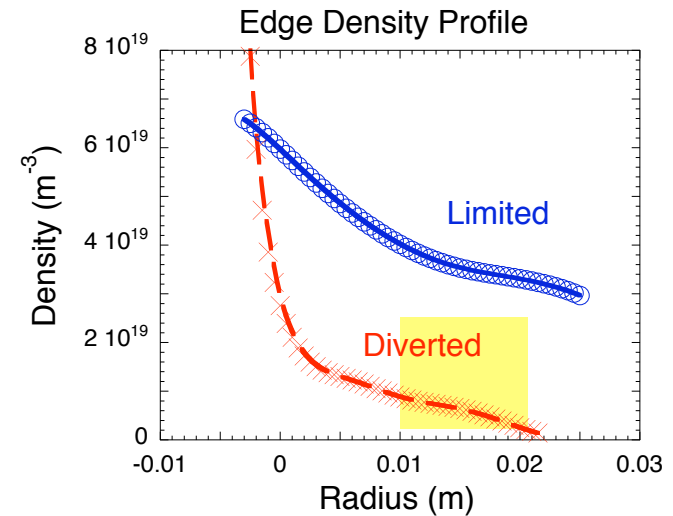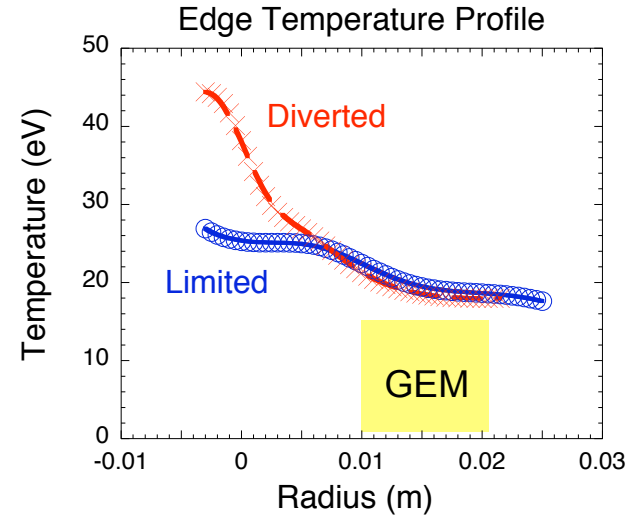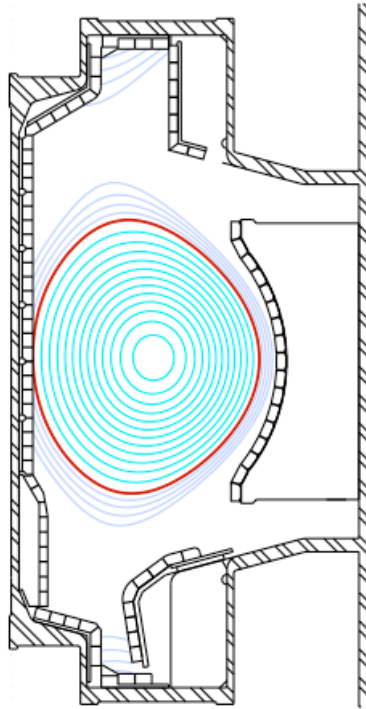
Limited vs. Diverted Plasmas

I= 0.8 MA
B= 5.4 T
n_e=1.4e20 m^{-3}
OH Diverted

I= 0.8 MA
B= 5.4 T
n_e=2.7e20 m^{-3}
OH Limited

Shot= 1060316003   Time= 1.160   Ip = 0.80

Shot= 1060412026   Time= 1.160   Ip = 0.78

Edge Temperature Profile

Edge Density Profile

Edge Fluctuations Similar in Both

- Fluctuation levels both ñ/n ~ 0.3 in outer midplane SOL

- Shapes of frequency spectra are similar (~ 1-200 kHz)

- SOL is collisional in both cases, so this is not surprising

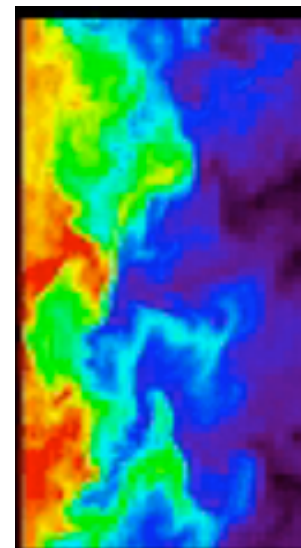

Probe Fluctuation Profile

Power Spectra ρ = 1-2 cm
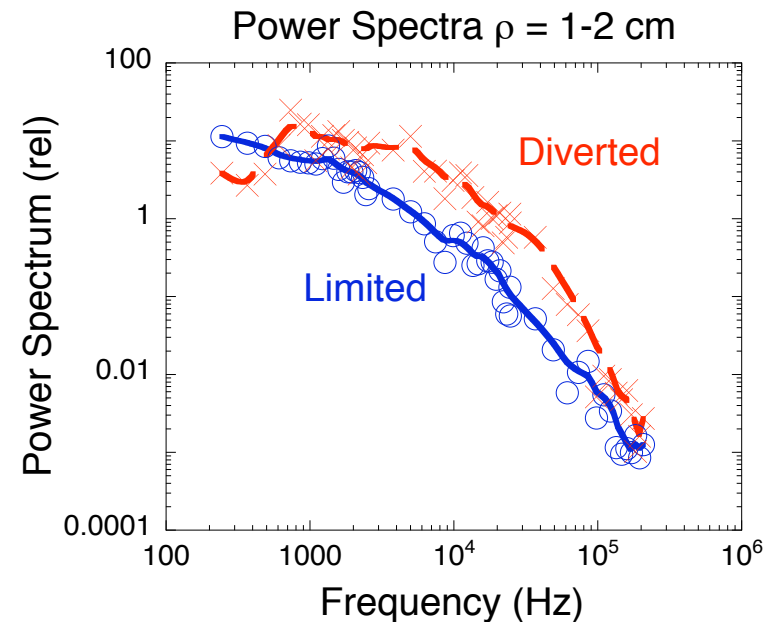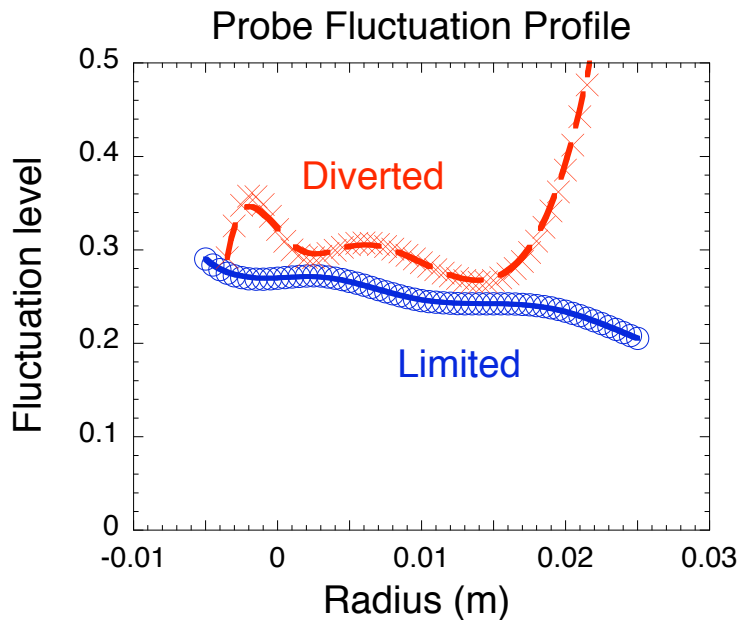
GEM Simulation Code

- 3-D electromagnetic gyrofluid edge turbulence code*

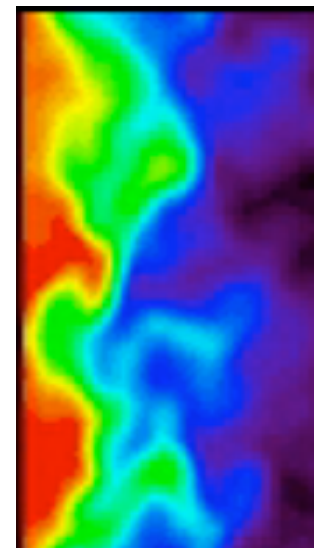- Inputs profiles and uses circular flux surfaces in SOL

C-Mod limited plasma SOL:

- 2.6 cm radial x 6.4 cm poloidal

- 360 μsec duration (1000 points)

- smoothed by ~ 3 μs and 3 mm

* B. Scott, PPCF (2003) A385
  T. Ribero and B. Scott, PPCF (2005) 1657

unsmoothed   smoothed

radial   radial

GEM vs. C-Mod Comparison

- Frequency spectra are similar over range of GEM run

- Correlation lengths of GEM ~ x2 smaller than C-Mod
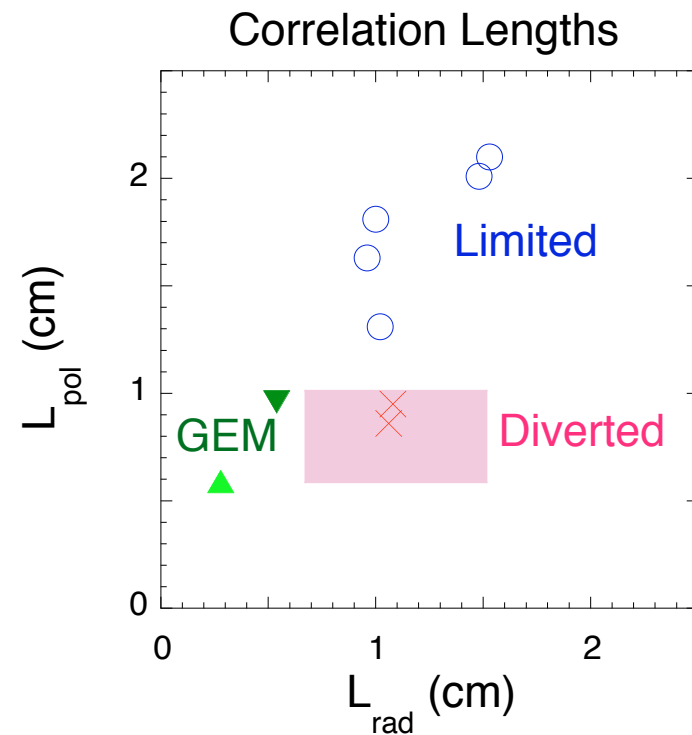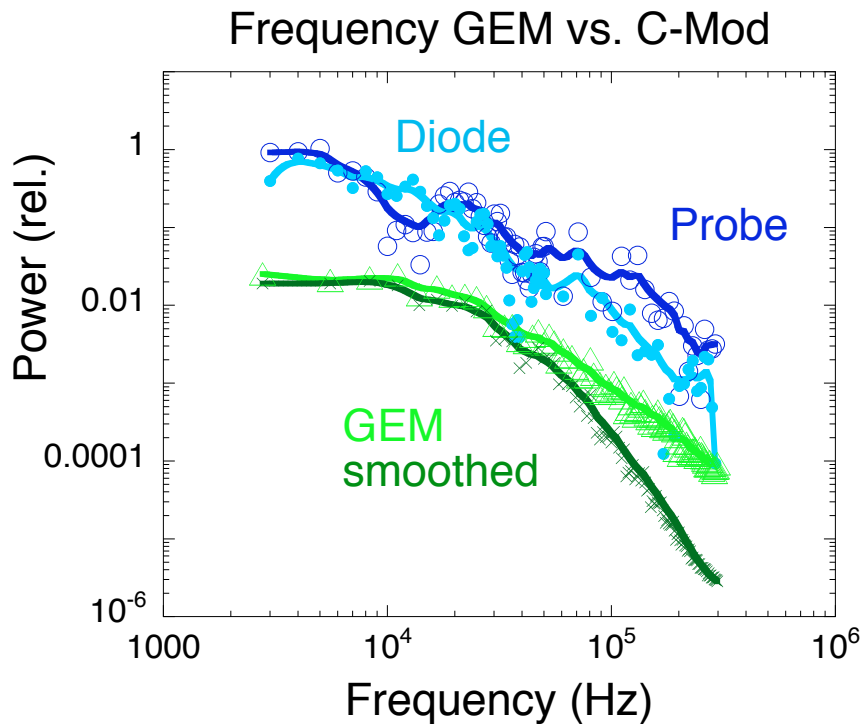
GEM vs. C-Mod (Preliminary)

$\rho \sim$ 1-2 cm in SOL, GEM smoothed

	L_{rad} (cm)	L_{pol} (cm)	τ_{auto} (μsec)	$\tilde{n}/n$ (%)
GEM	0.54	0.96	8.7	4-5
C-Mod	0.9-1.6	1.3-2.1	12-21	20-30

<u>Conclusions</u>

- SOL turbulence similar in limited and diverted plasmas, probably because both cases are very collisional

- GEM code results show fairly good agreement with C-Mod limiter plasmas (this was only a "first-try")

- Near-term directions:

    - compare $\delta\varphi/T_e$ and 2-D turbulence velocities

    - do B and n scans to check ρ_s and ν scaling

    - look for smaller space/time scales in C-Mod