C-Mod SOL Turbulence vs. GEMR

S.J. Zweben, B.D. Scott, J.L. Terry, B. LaBombard,
J.W. Hughes, D.P. Stotler, S.D. Scott

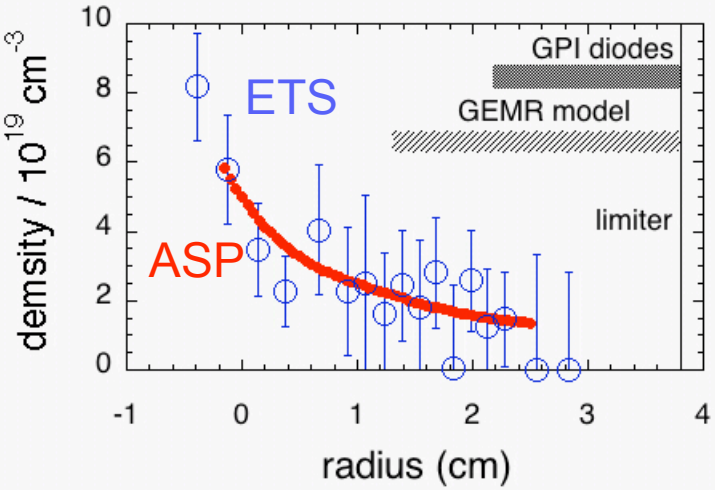
C-Mod meeting 10/6/08

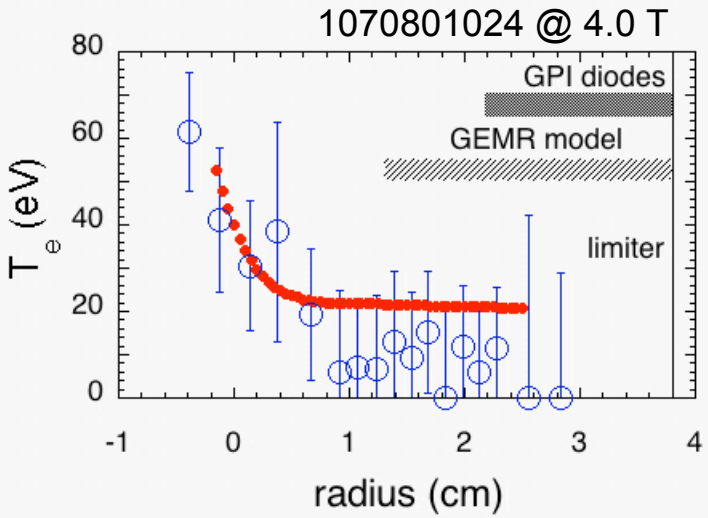
- Choose discharges best suited for the GEMR model (limited, near-circular, Ohmic, wide outer SOL)
- Vary B and n at fixed q(a) => MP429 (2006, 2007)
- Input B, n,T_e to GEMR => calculate turbulence (2008)
- Compare measured and computed turbulence

Caveats

- GEMR is a "local model" which can not calculate radial profiles of SOL turbulence, so mid-SOL parameters were chosen as the GEMR inputs
- The GPI imaging system was not working well during 2006-2007, so only the GPI fast diode data used
- The 6.8 Tesla cases were done in MP429, but the GEMR code did not converge so this B was not used
- Effect of GPI cloud sightline averaging not yet included
- This comparison should be considered a *'first iteration'* of an attempt to 'validate' the GEMR code

Data from MP429



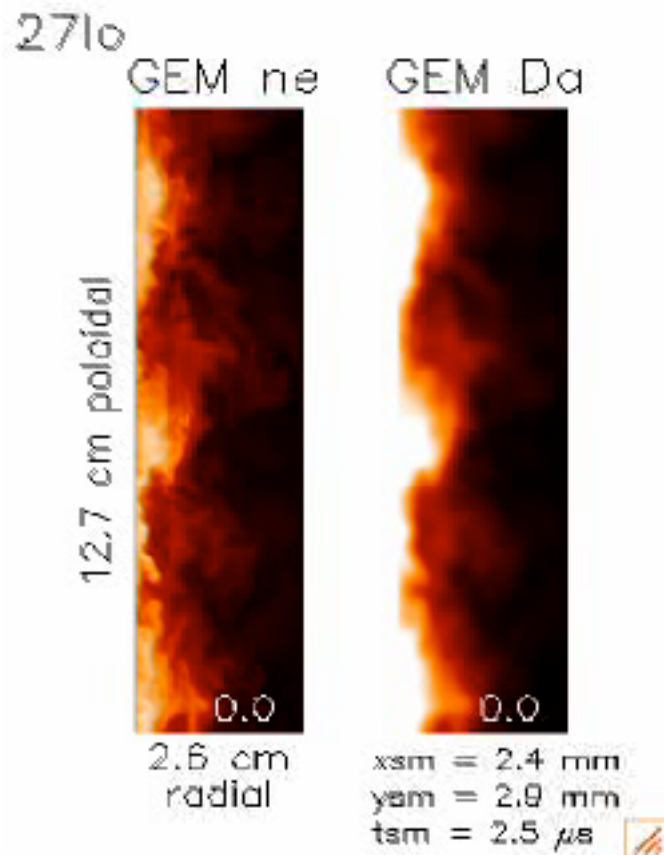


B (T)	I(MA)	$\langle n_e \rangle / 10^{14}$	$n_e(a)/10^{13}$	#shots
2.9	0.4	0.84-1.36	~ 3	10
4.1	0.6	1.36-2.02	~ 5	4
5.4	0.8	1.56-2.51	~ 7	8

=> n correlated with B, so difficult to separate ρ & C scaling

GEMR Model and Results

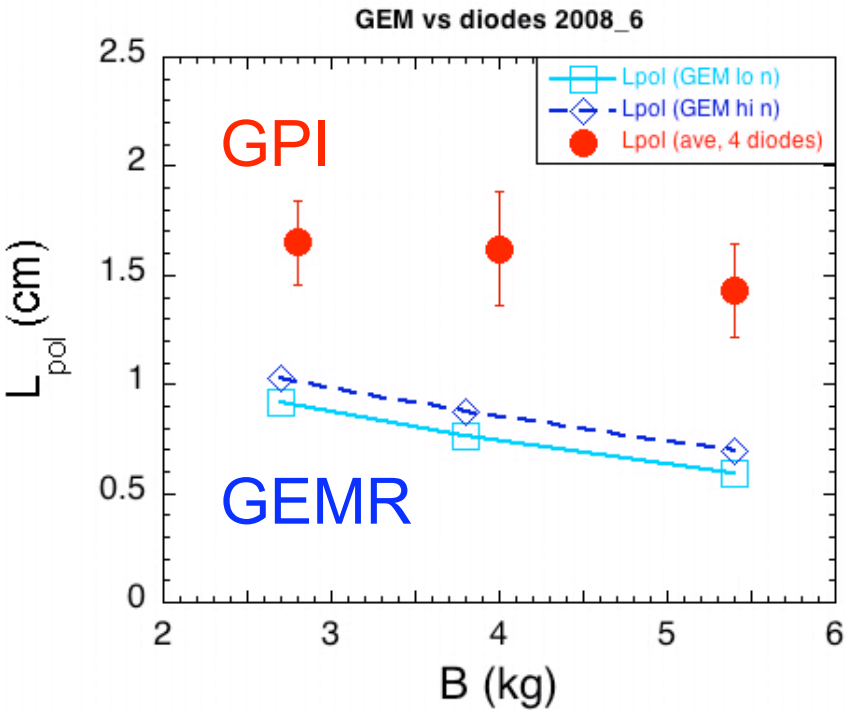
- Output 12.7 cm (poloidal) x 2.6 cm (radial) x 1.4 msec (time)
- Smoothed by resolution of fast diodes and converted to D_α

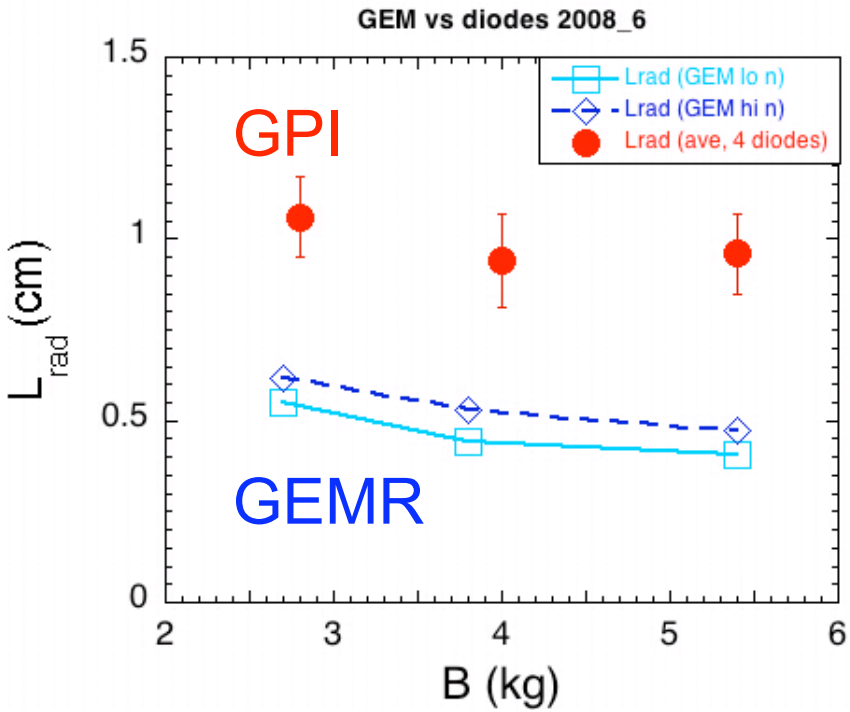


B	n(/10^{13} cm^{-3})	T(eV)
27	1.6 (low)	15
27	3.6 (high)	19
38	2.2 (low)	22
38	4.6 (high)	25
54	1.8 (low)	16
54	3.2 (high)	19

Correlation Lengths vs B

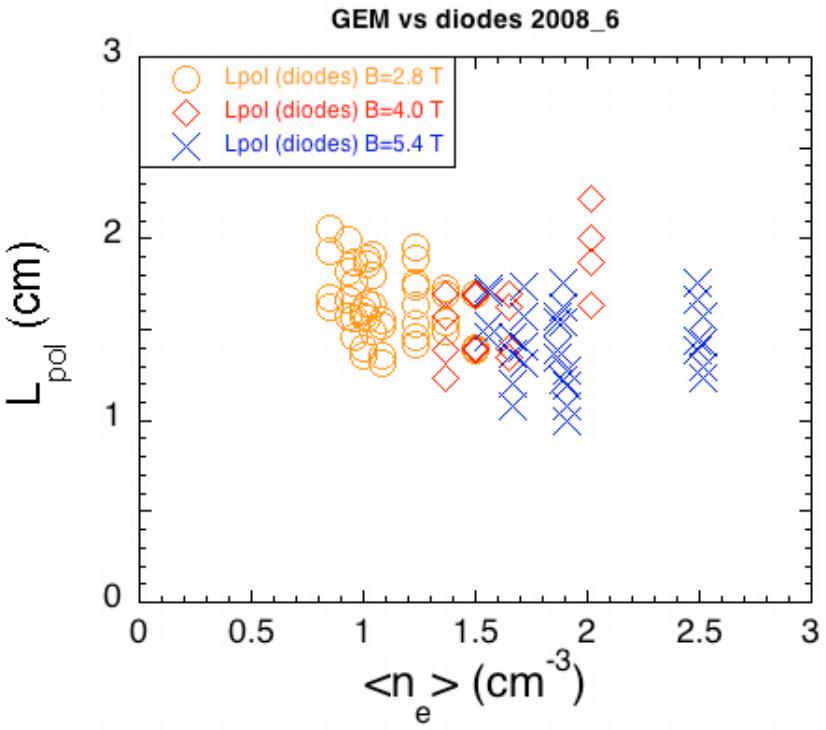
- GPI data averaged over all shots at different densities
- GEMR results averaged over 0.5-0.75 of radial grid

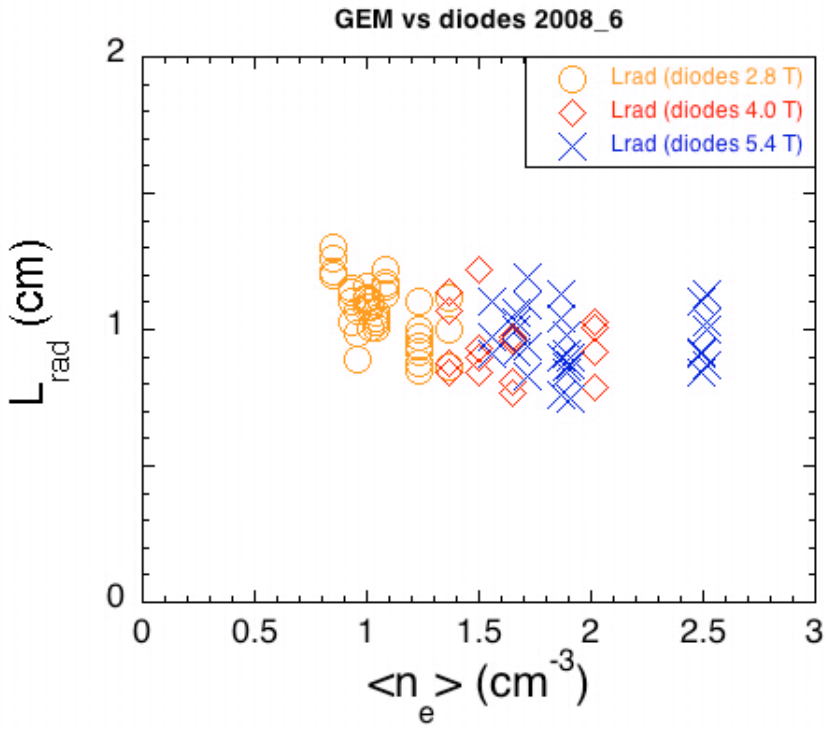




Correlation Lengths vs <n>

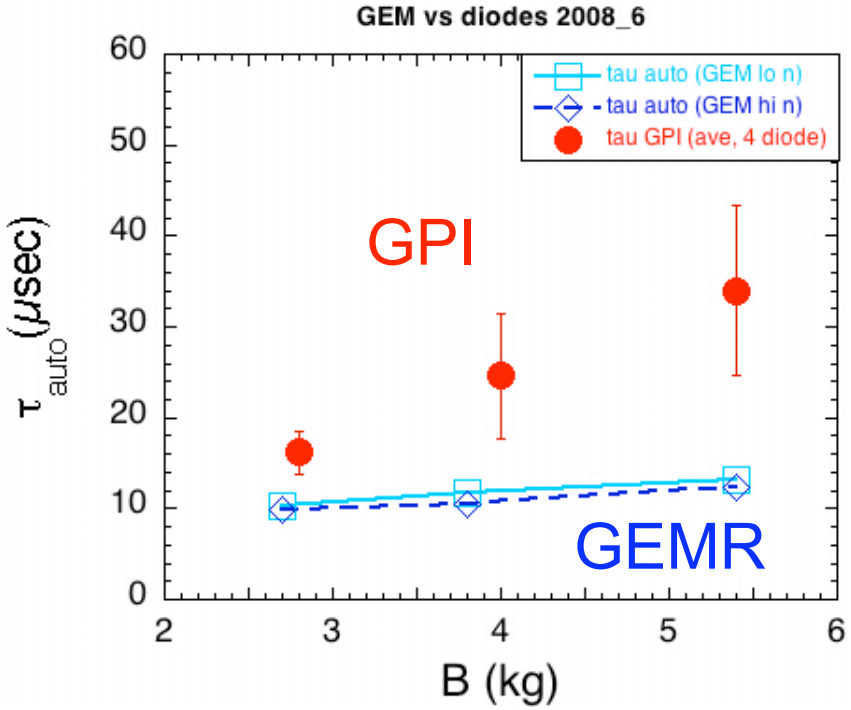
- Each of 4 GPI diodes for each shot, colored vs. B field
- GEMR results averaged over 0.5-0.75 of radial grid

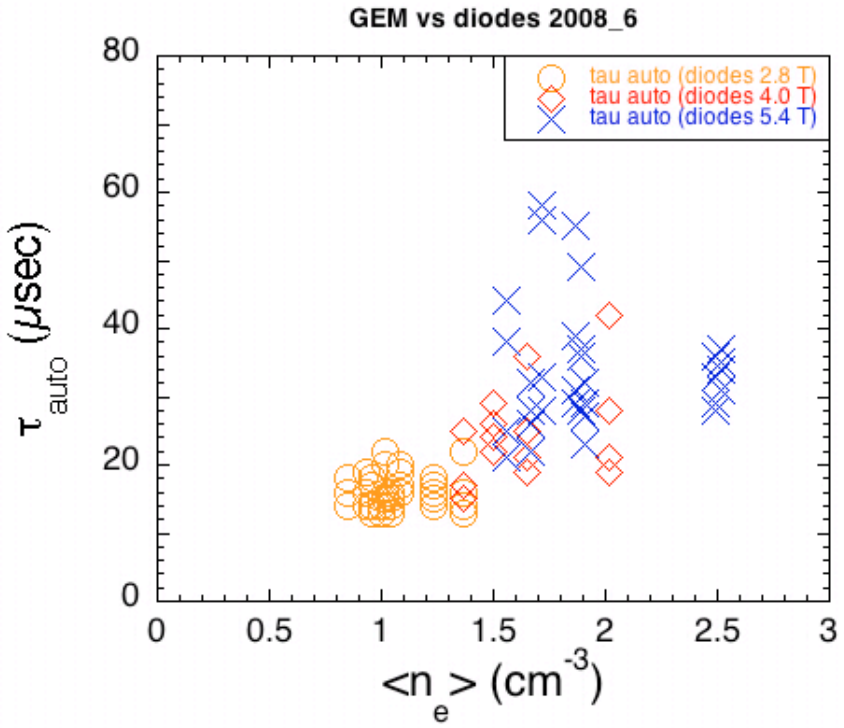




Autocorrelation Time vs. B and <n>

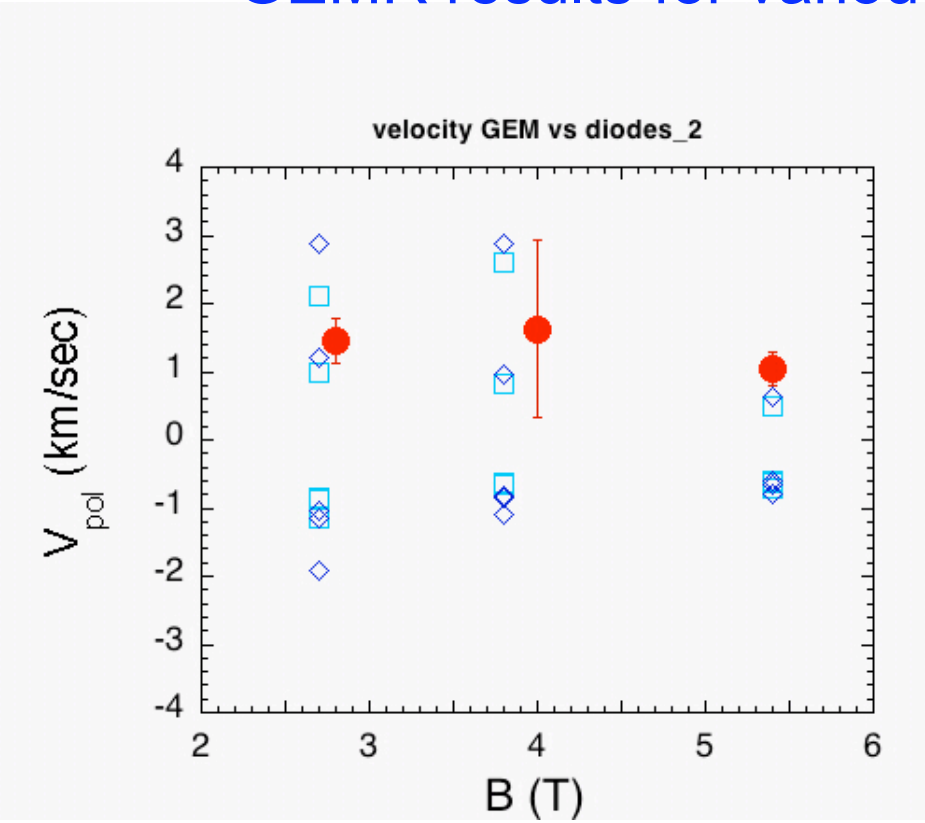
- GPI data averaged over all <n> cases or vs. <n>
- GEMR results averaged over 0.5-0.75 of radial grid

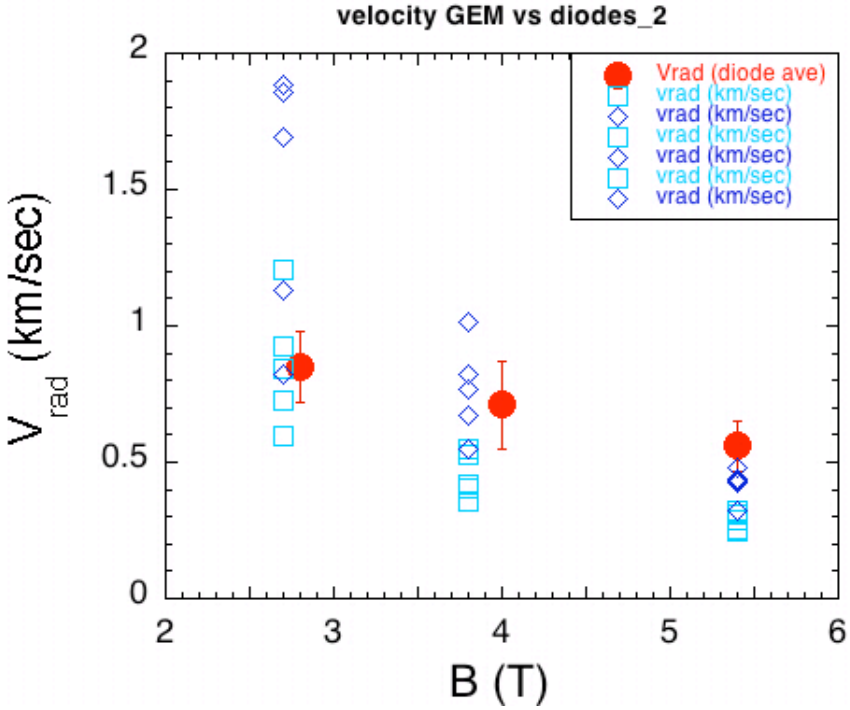




Poloidal and Radial Velocities

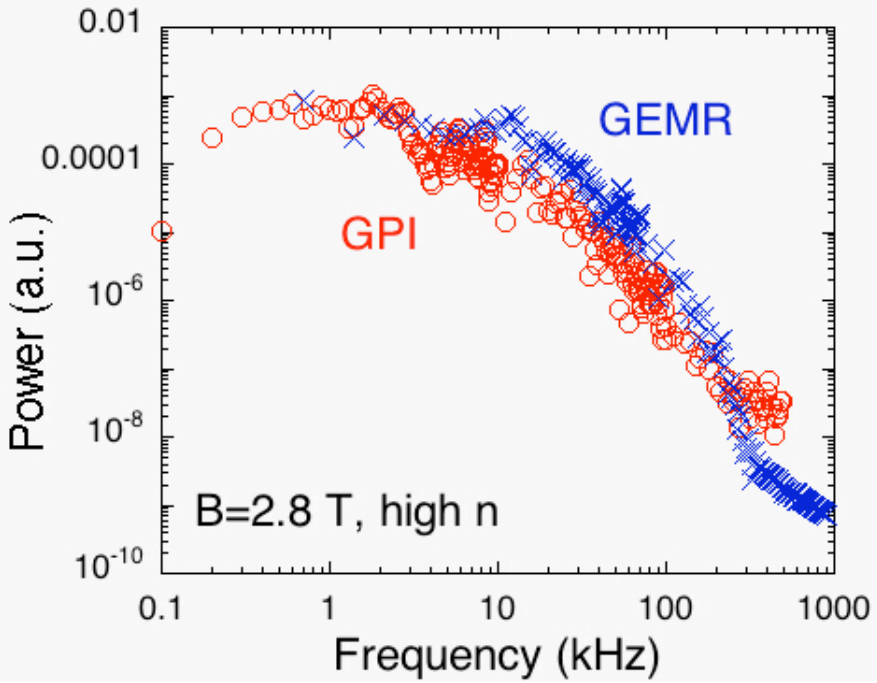
- GPI data averaged over all diodes and density cases
- GEMR results for various radii within 0.5-0.75 of grid

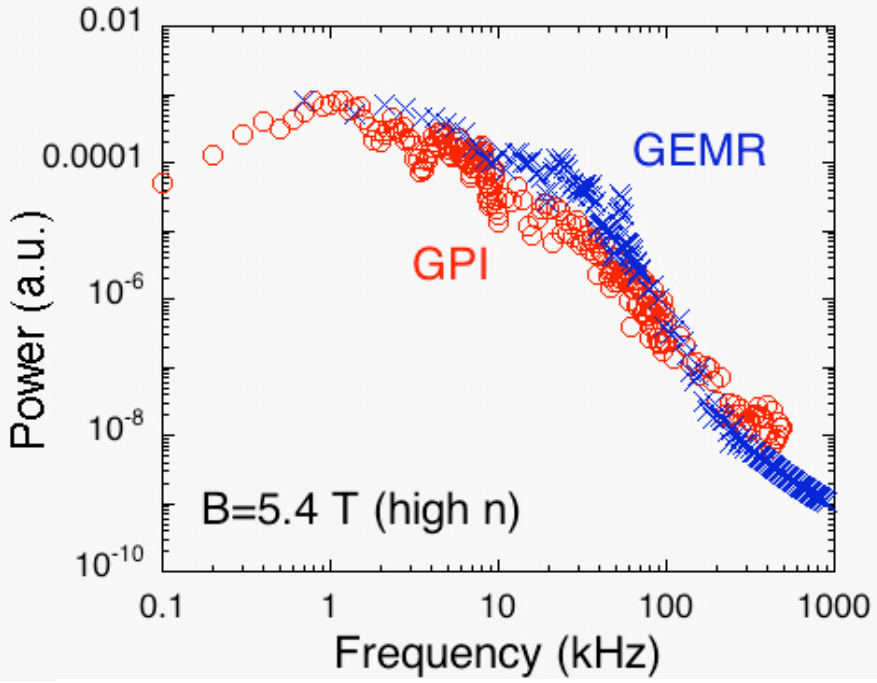




Frequency Spectra

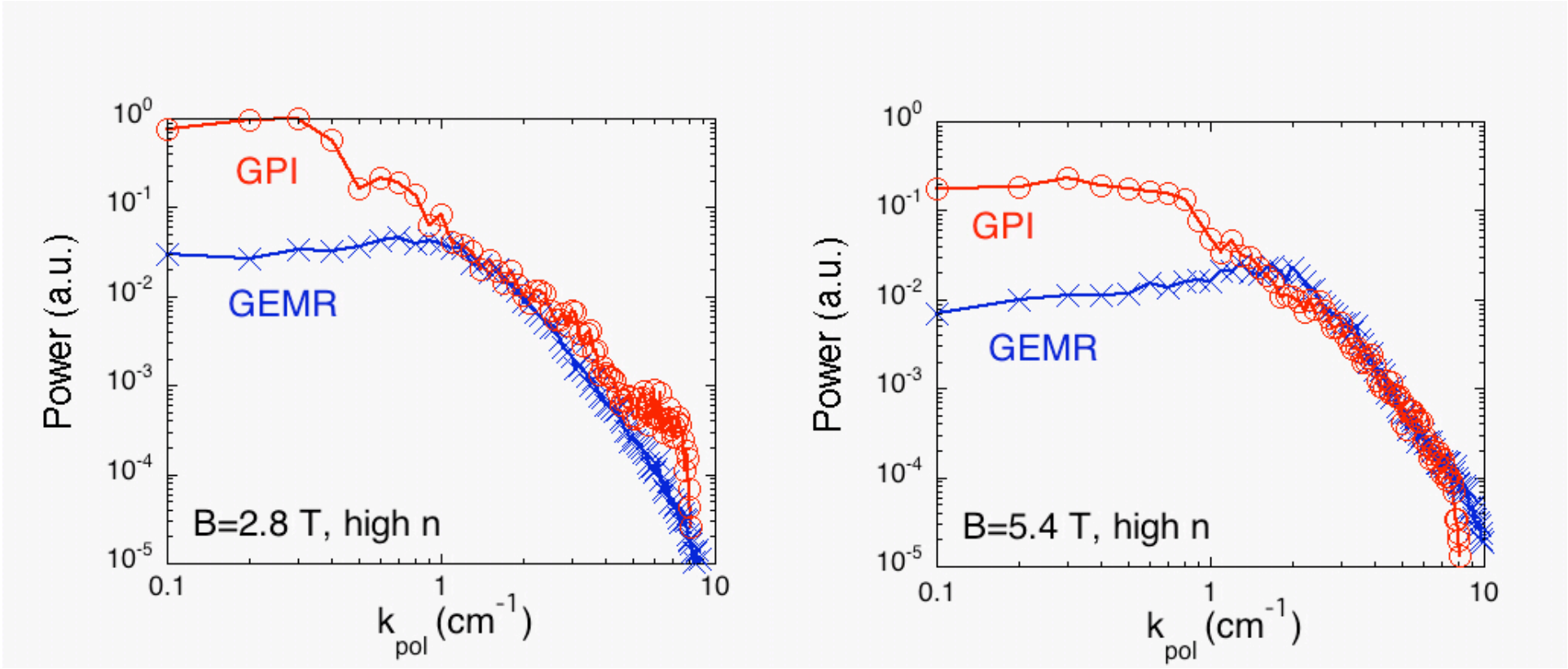
- GPI data averaged over all diodes for one discharge
- GEMR results averaged over 0.5-0.75 of radial grid





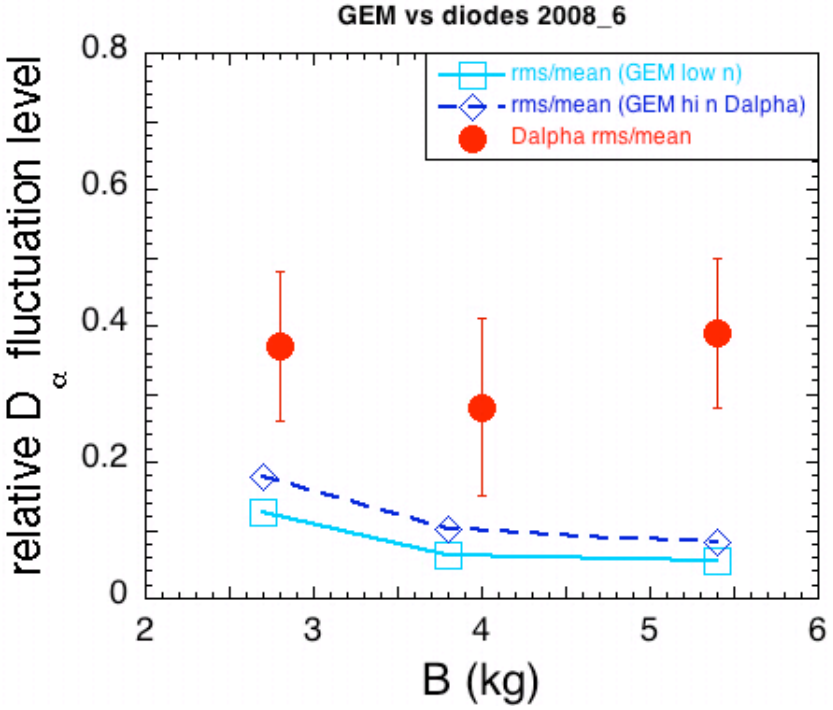
k-Spectra

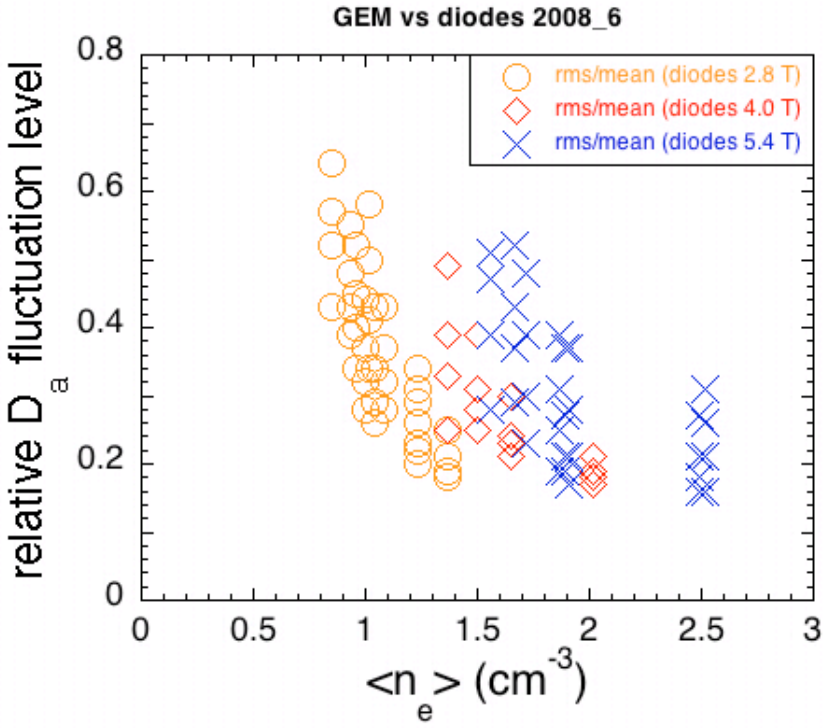
- GPI data averaged over all diodes for one discharge
- GEMR results averaged over 0.5-0.75 of radial grid



Relative Fluctuation Levels

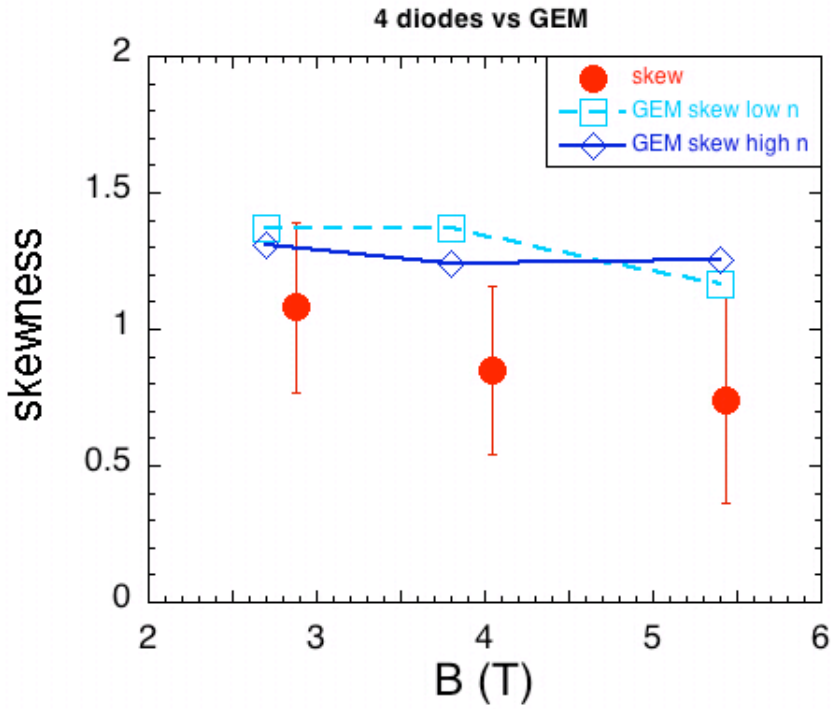
- GPI data averaged over all <n> cases, or vs. <n>
- GEMR results averaged over 0.5-0.75 of radial grid

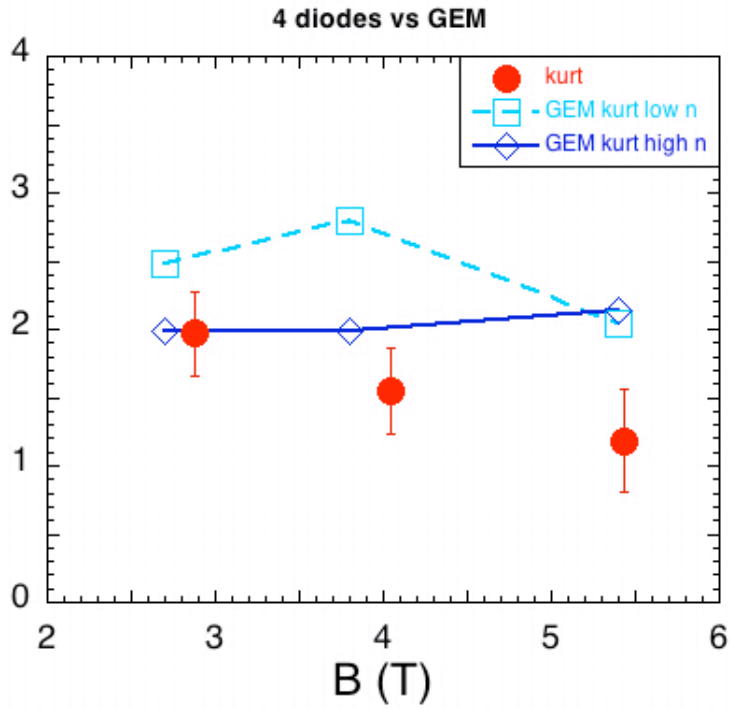




Skewness and Kurtosis

- GPI data averaged over all diodes and density cases
- GEMR results averaged over 0.5-0.75 of radial grid

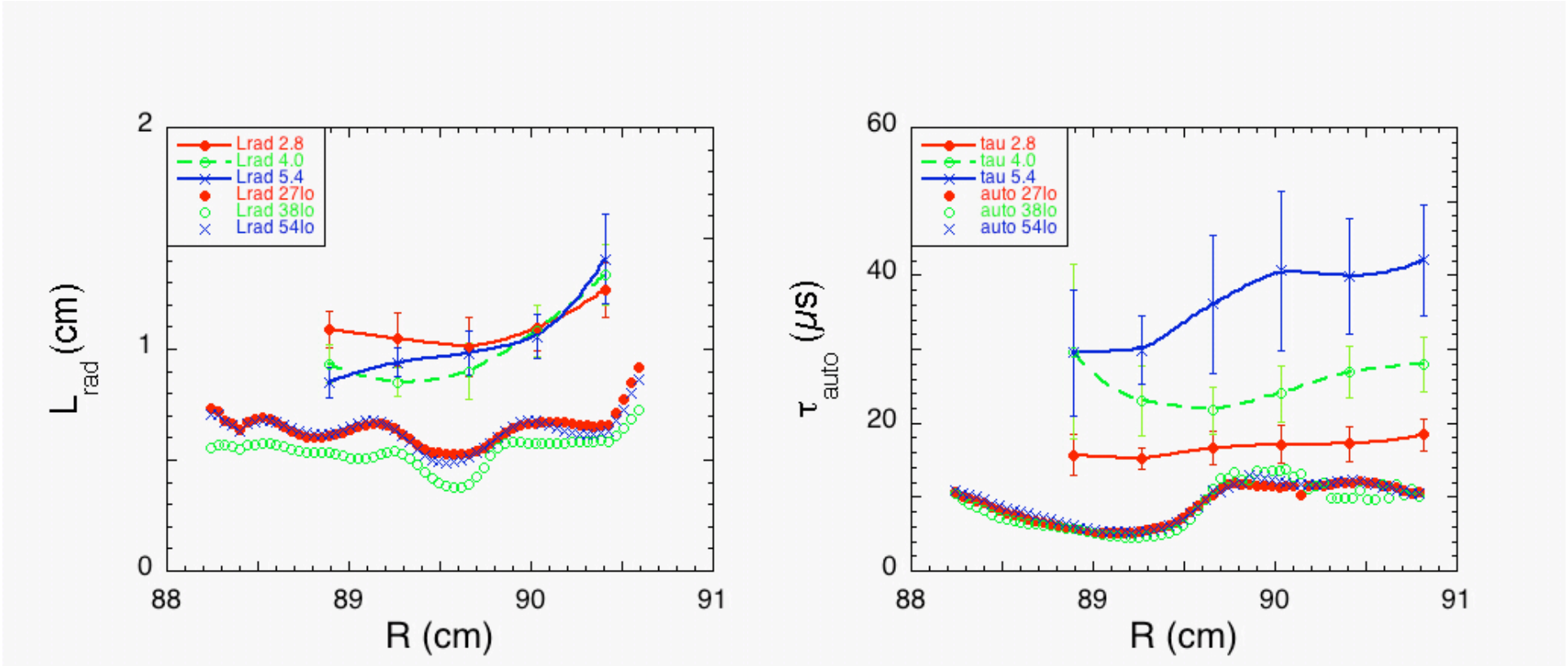




Summary

- GEMR correlation lengths ~2x lower than GPI data
- GEMR correlation times ~1.5-2.5 x lower than GPI data
- GEMR velocities close to GPI data (except for sign !?)
- GEMR frequency spectra similar to GPI data
- GEMR k-spectra similar to GPI data except $k \leq 1$ cm^{-1}
- GEMR fluctuation level ~2-5 times lower than GPI data
- GEMR skewness and kurtosis similar to GPI data

Profiles of L_{rad} and τ_{auto} time



Profile of rms/mean and V_{pol}