Comparison of GPI with probe

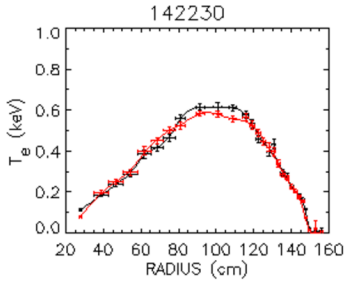
sz 5/6/16 v.4

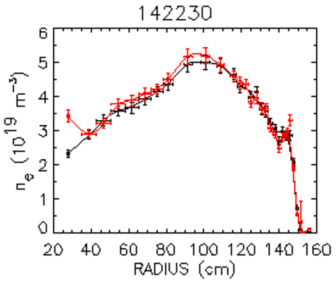
shot list:

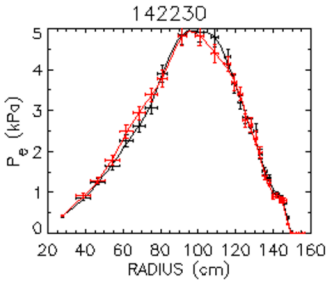
- choose 5 msec intervals for GPI analysis, overlapping with probe time where possible (except for 142234 when probe is later)
- all shots in H-mode during the times indicated below, as far as I can tell
- shots 142230, 142232, and 142234 are similar to each other, 142275 has different edge profiles
- all shots have LSN shape and EFIT02 separatrix the same within 1-2 cm

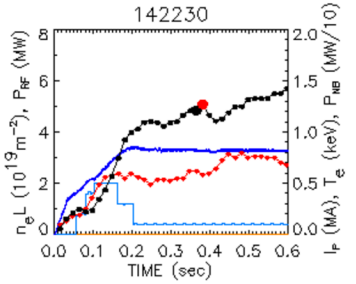
shot	time (msec)	Bt	Ip	NBI	neL(1e15)	sep (m)	Mode	Comments
142230	375-380	0.4	0.8	1.0	5.1	1.51	H w/ear	peak of GPI, overlaps probe time
142232	400-405	0.42	0.8	1.0	5.0	1.52	H w ear	peak of GPI no ELM, before probe time
142234	525-530	0.42	0.8	1.0	6.1	1.52	H w ear	near peak of GPI, overlaps probe time
142275	330-335	0.4	0.8	1.0	5.1	1.50	H flat	peak of GPI, overlaps probe time

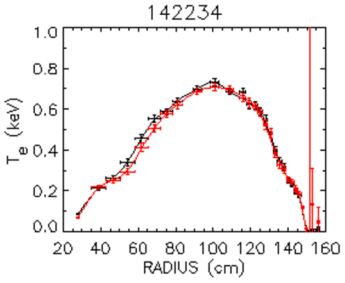
Thomson scattering profiles – whole profile

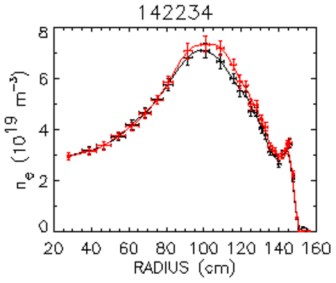


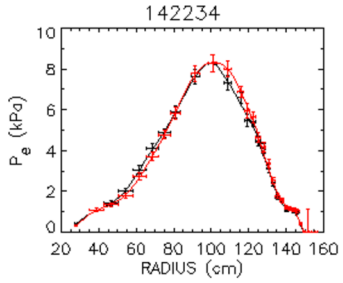


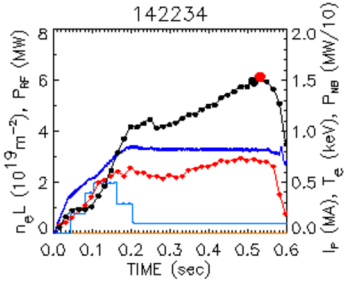


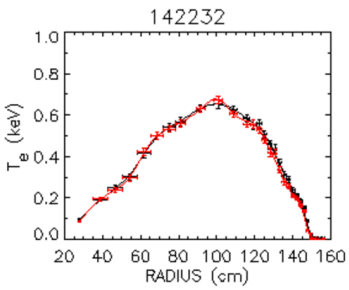


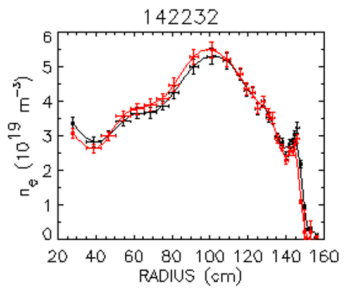


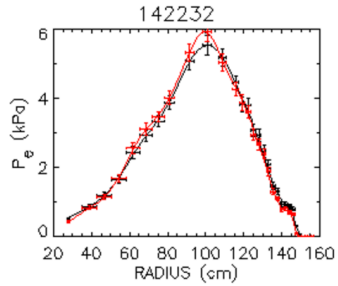


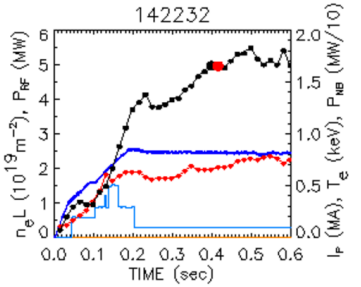


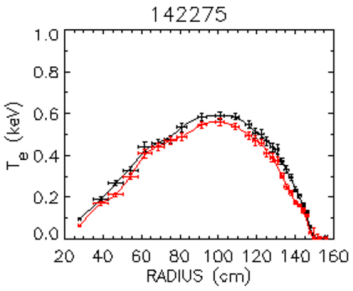


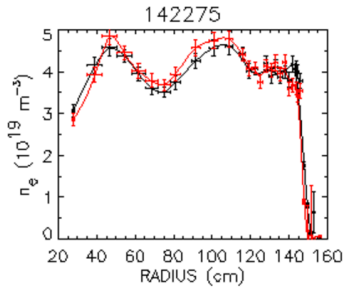


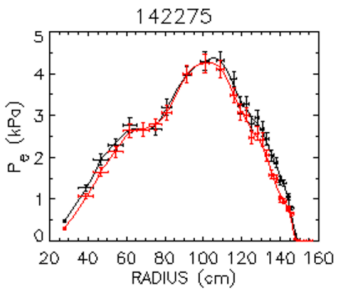


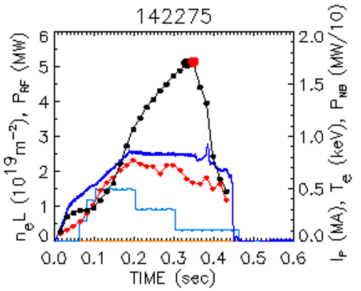




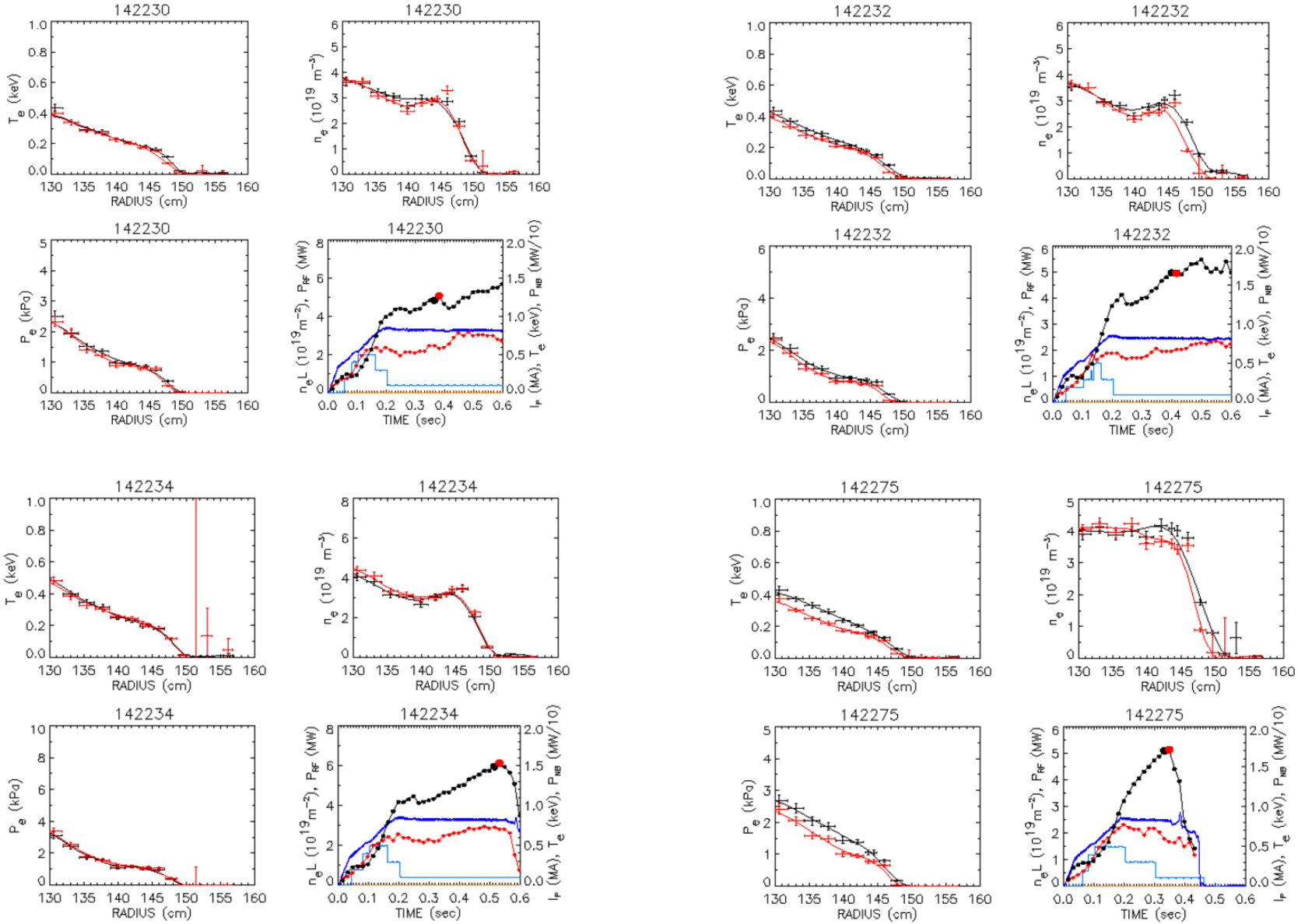




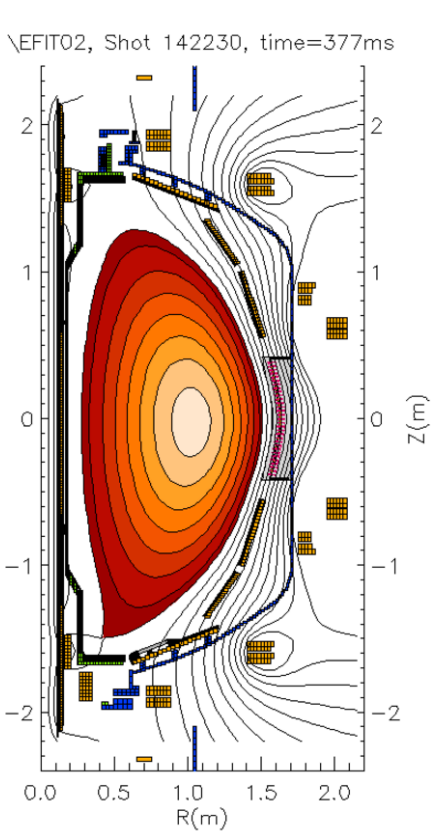


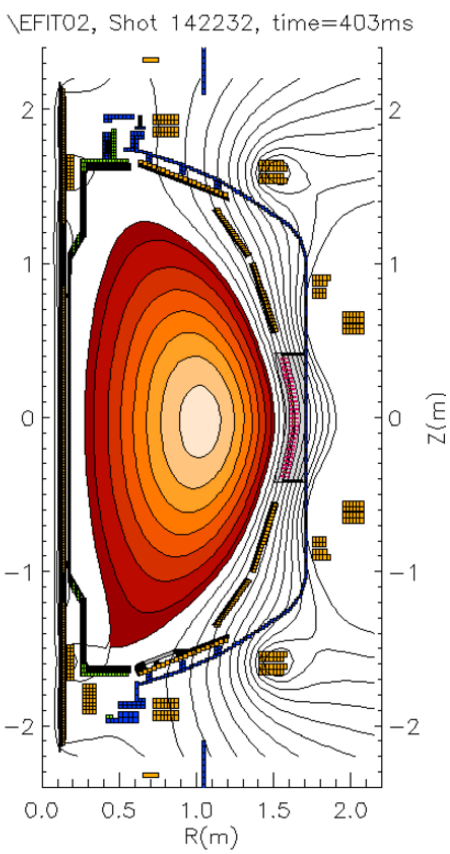


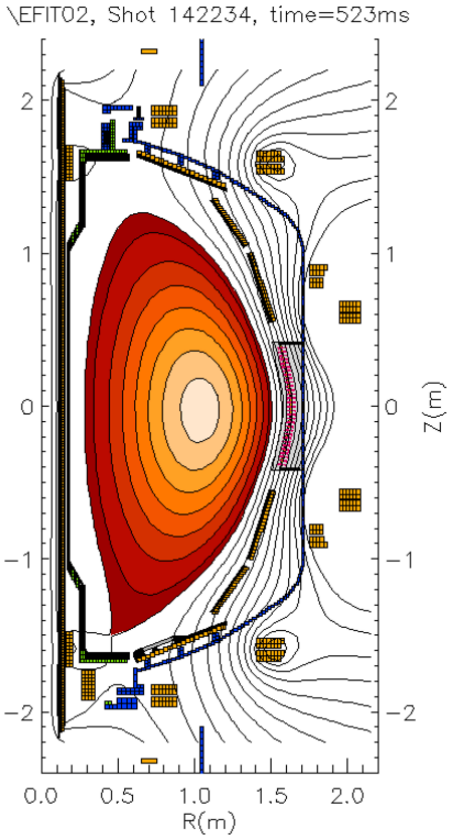
Thomson scattering profiles – outer midplane

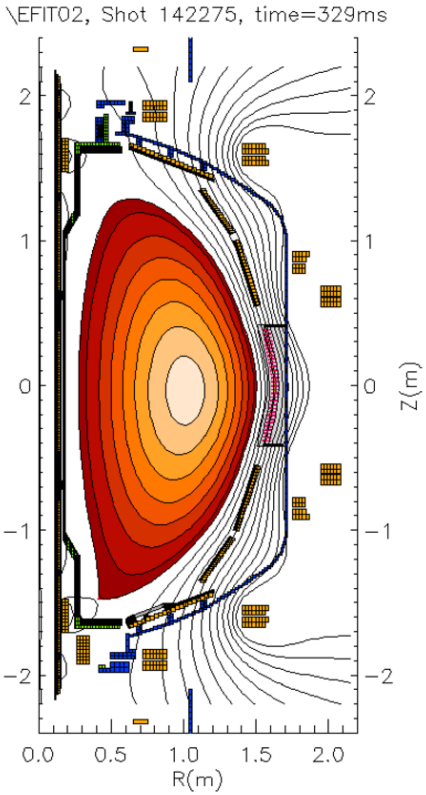


EFIT02 flux surfaces





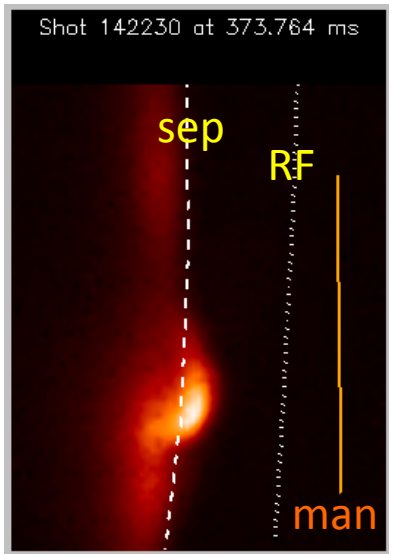




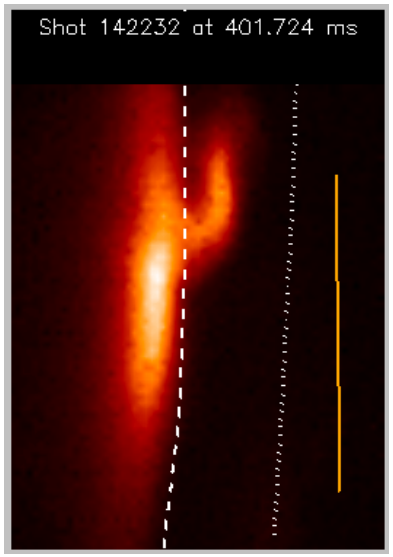
Typical GPI images (from fcplayer.pro)

- same field of view inside machine for all shots (same for whole year of 2010)
- images are raw data from camera, 2.1 µsec exposure at 400,000 frames/sec
- all images 64 (horiz) x 80 (vert) pixels, approx 24 cm (radial) x 30 cm (poloidal)
- dashed lines are EFIT02 separatrix, dotted lines RF limiter, orange line GPI manifold

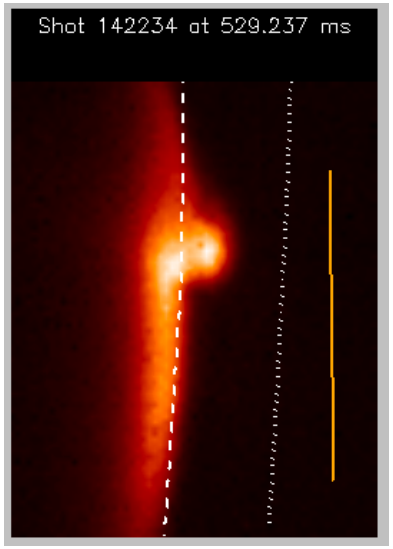
142230



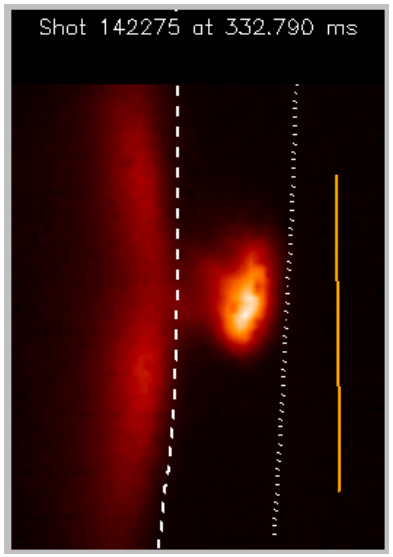
142232



142234

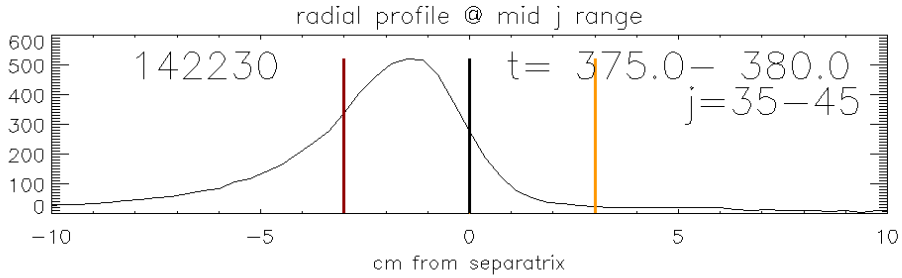


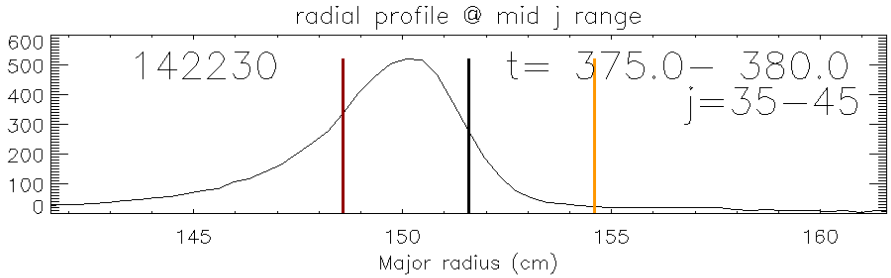
142275

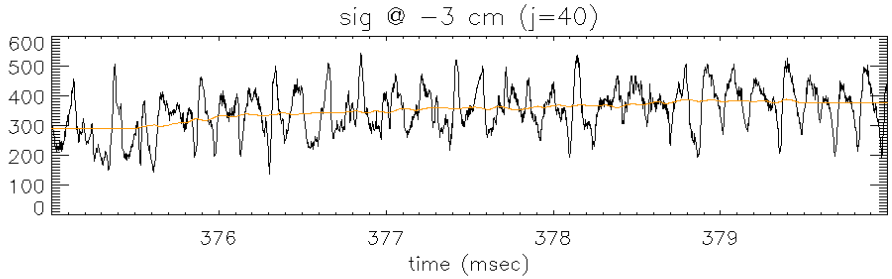


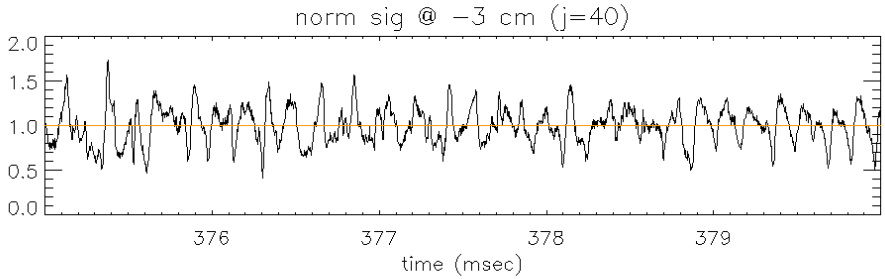
movie of these shots are at: http://w3.pppl.gov/~szweben/GPI_probe/

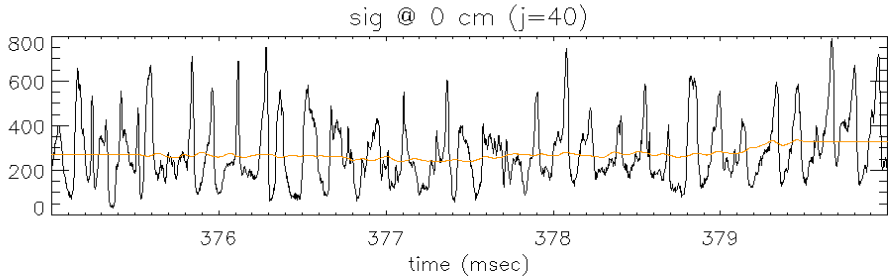
GPI vs. time at three pixels at different radii with respect to EFIT02 sep)- 142230

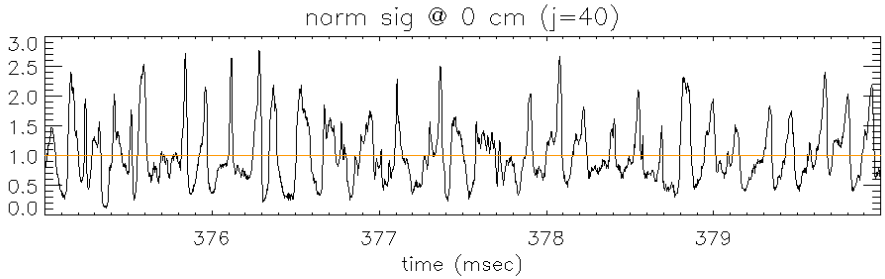


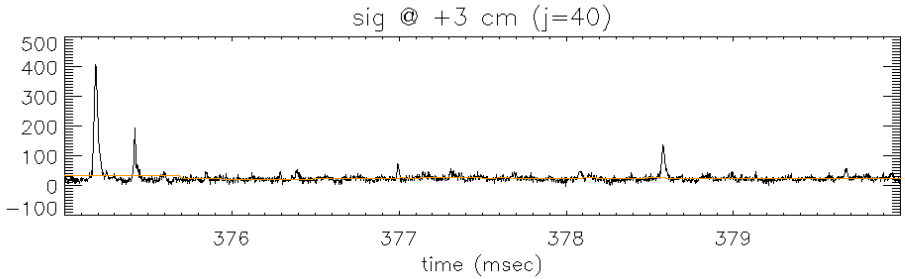


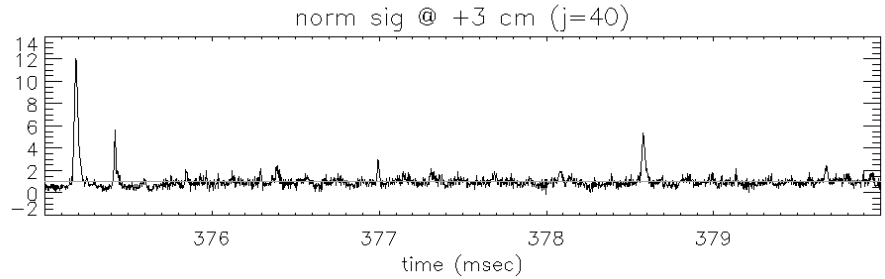




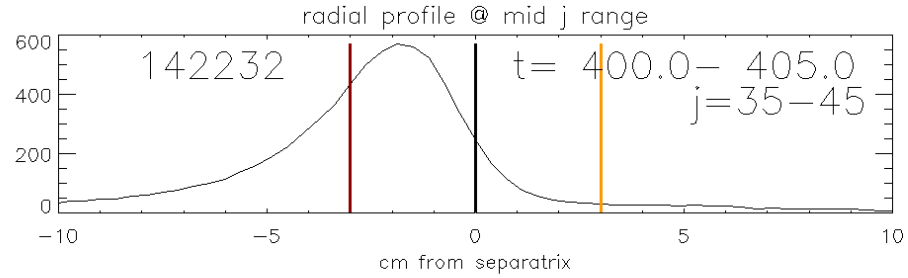


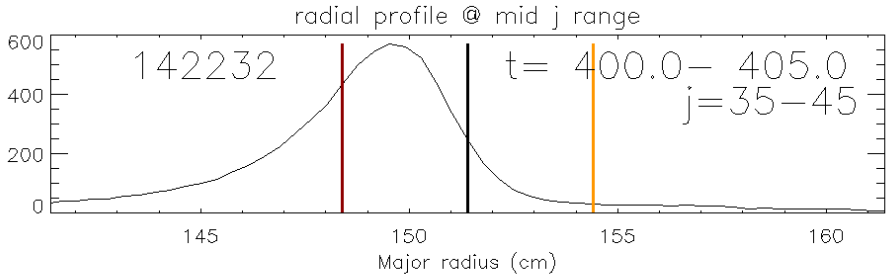


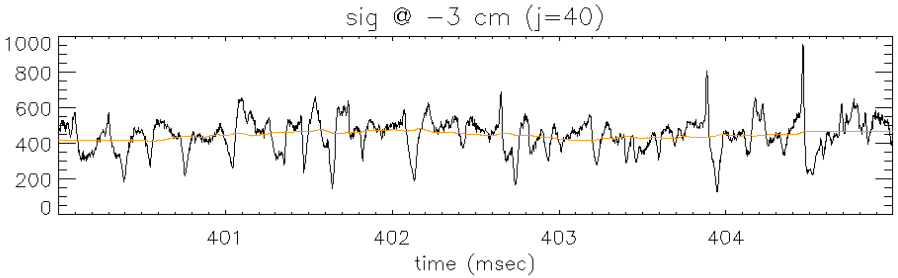


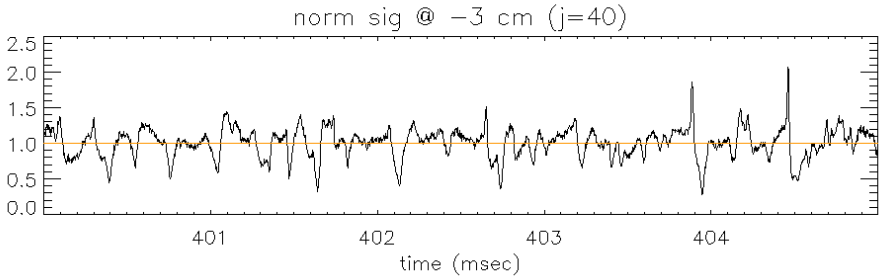


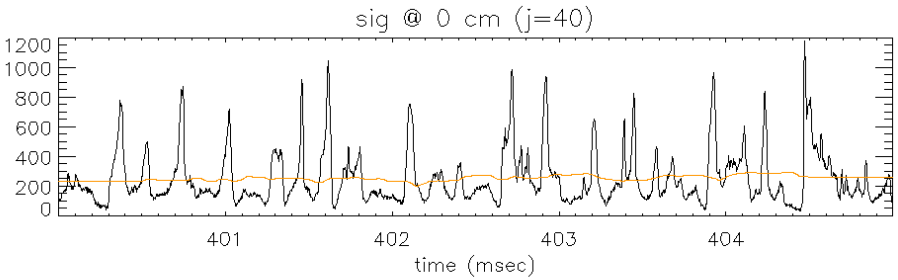
GPI vs. time at three pixels at different radii with respect to EFIT02 sep)- 142232

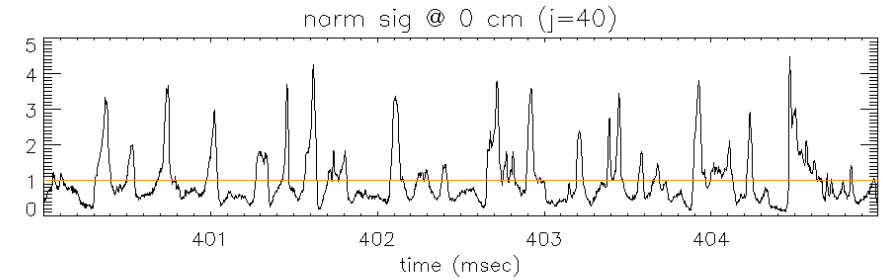


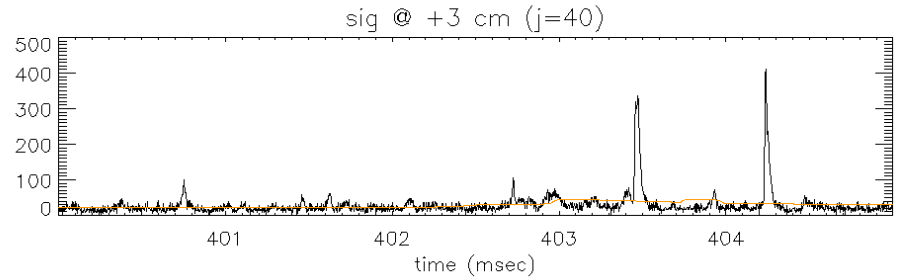


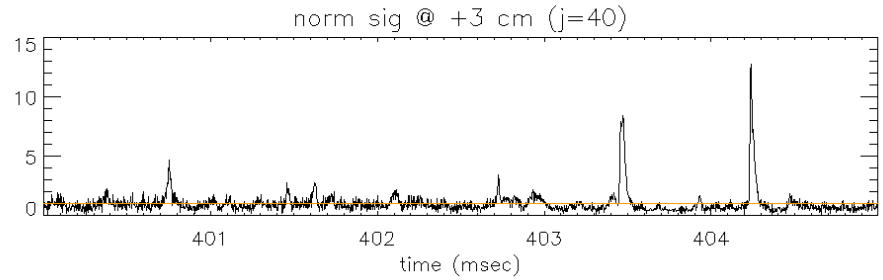




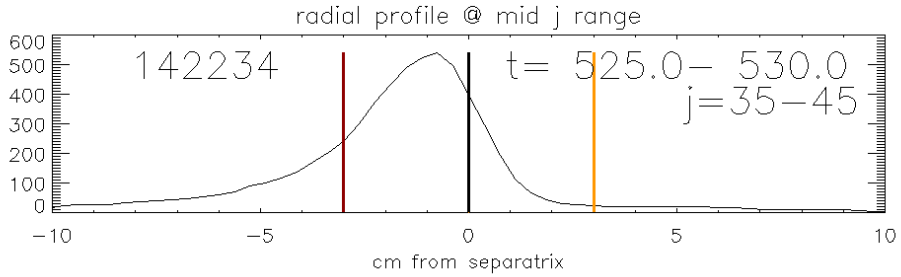


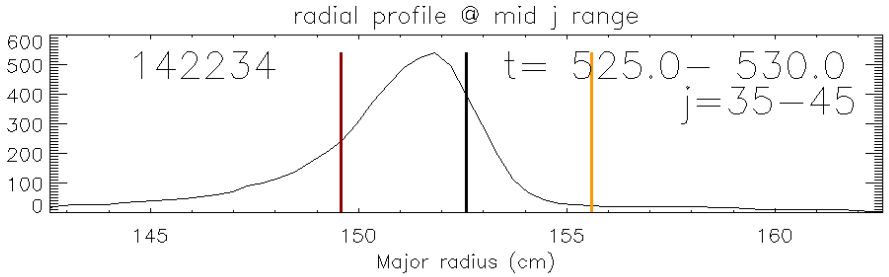


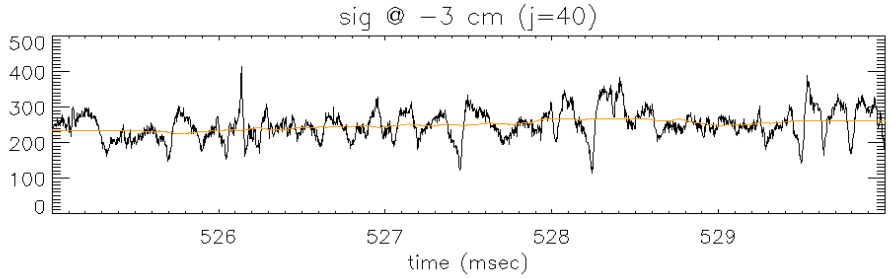


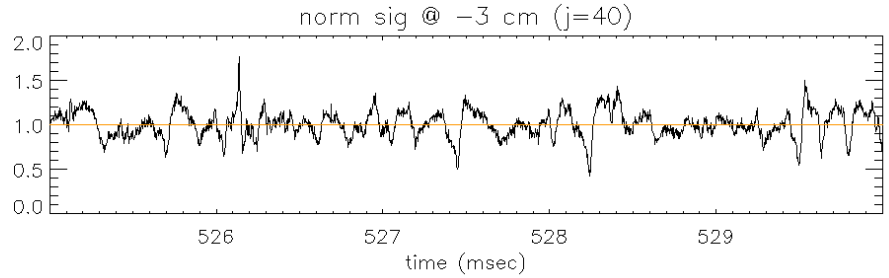


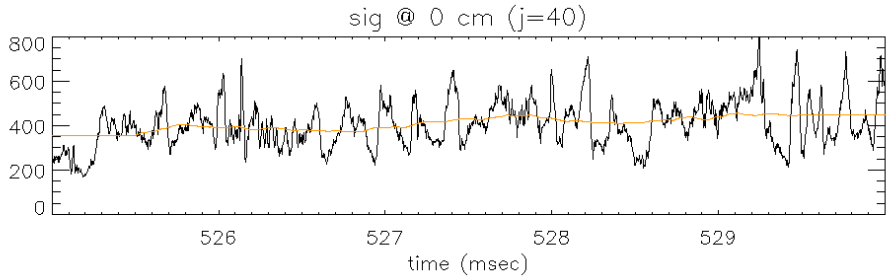
GPI vs. time at three pixels at different radii with respect to EFIT02 sep)- 142234

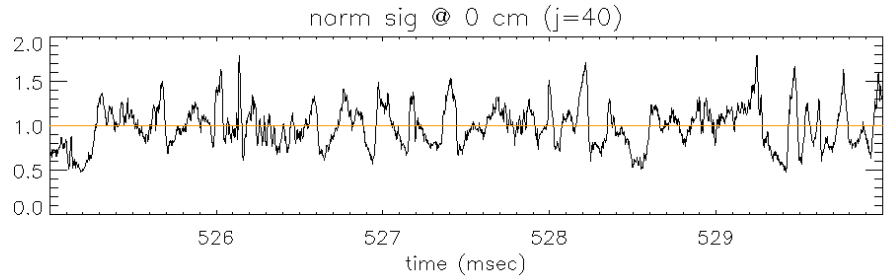


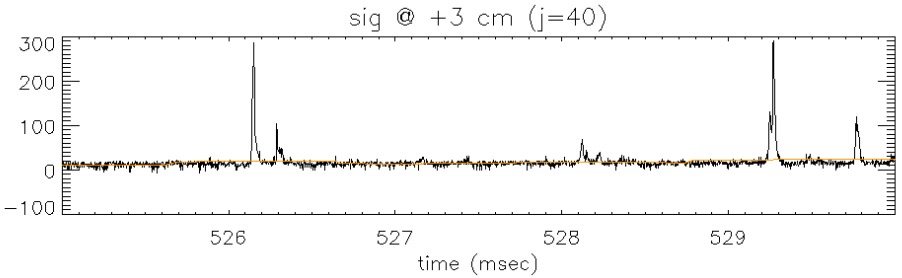


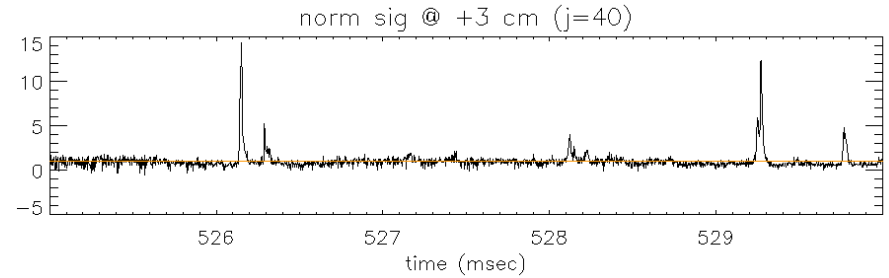




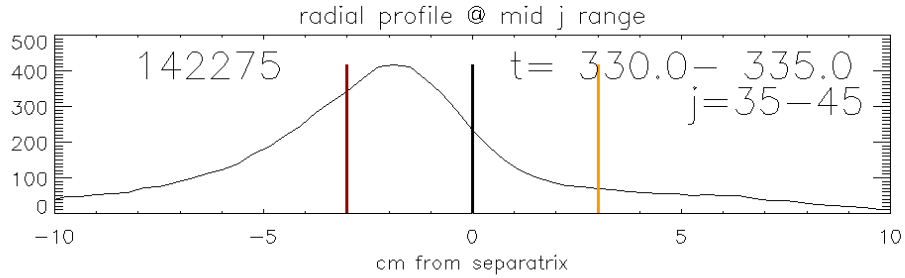


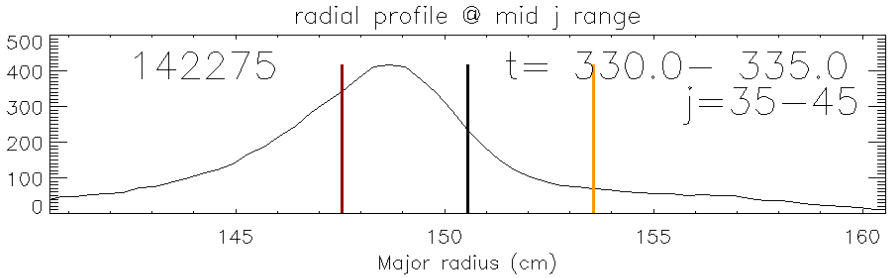


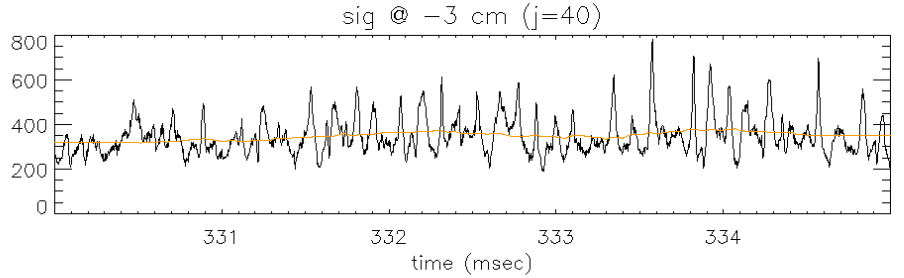


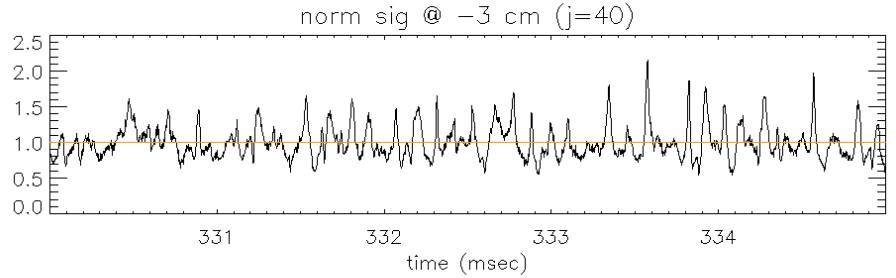


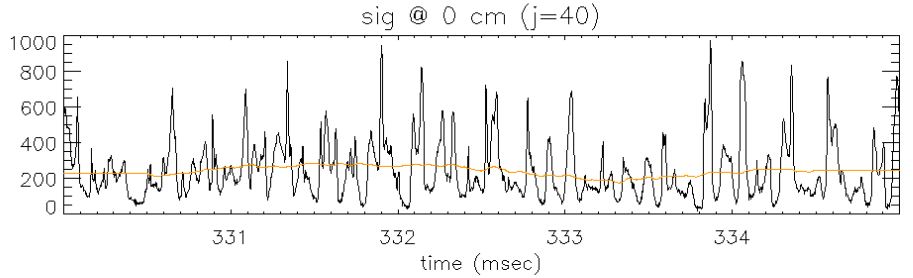
GPI vs. time at three pixels at different radii with respect to EFIT02 sep)- 142275

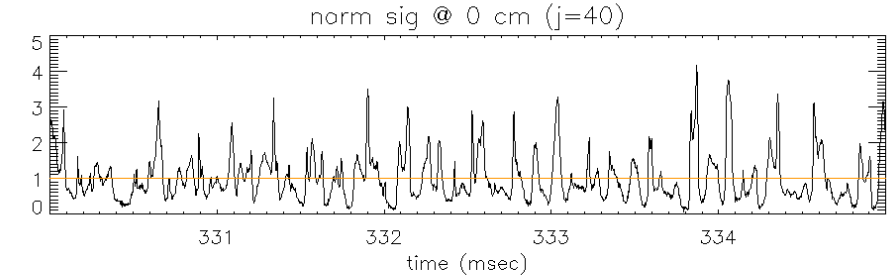


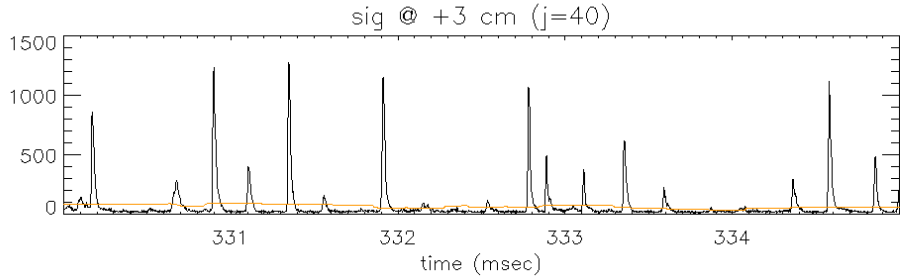


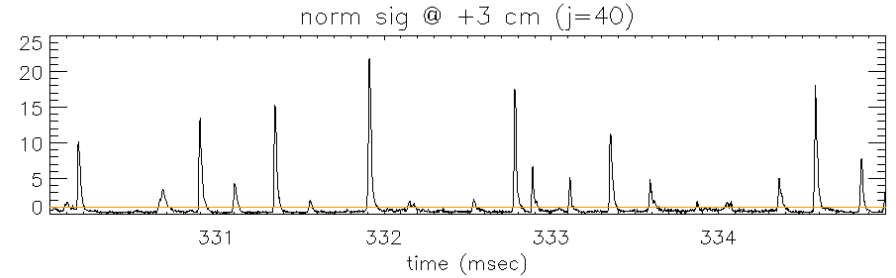




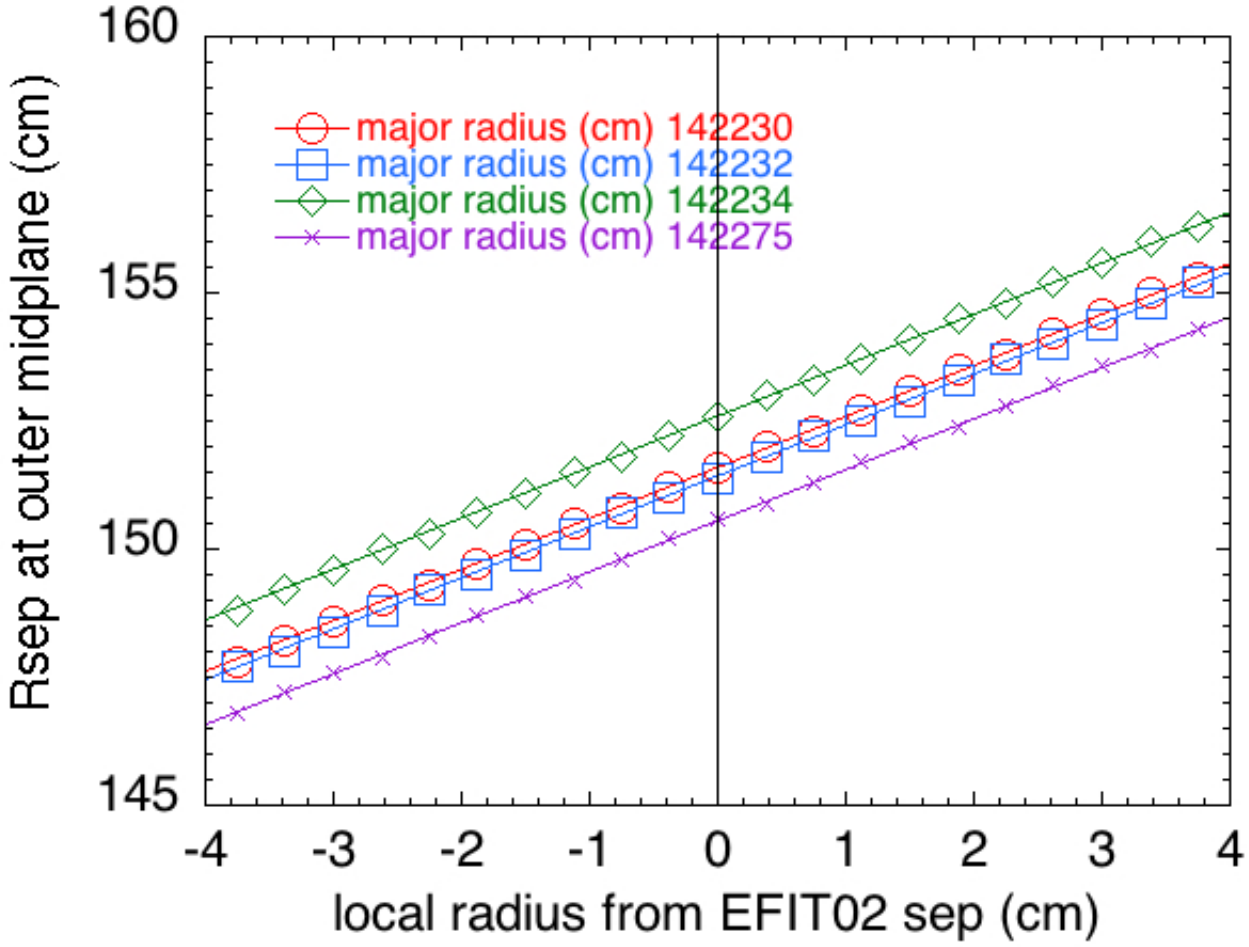






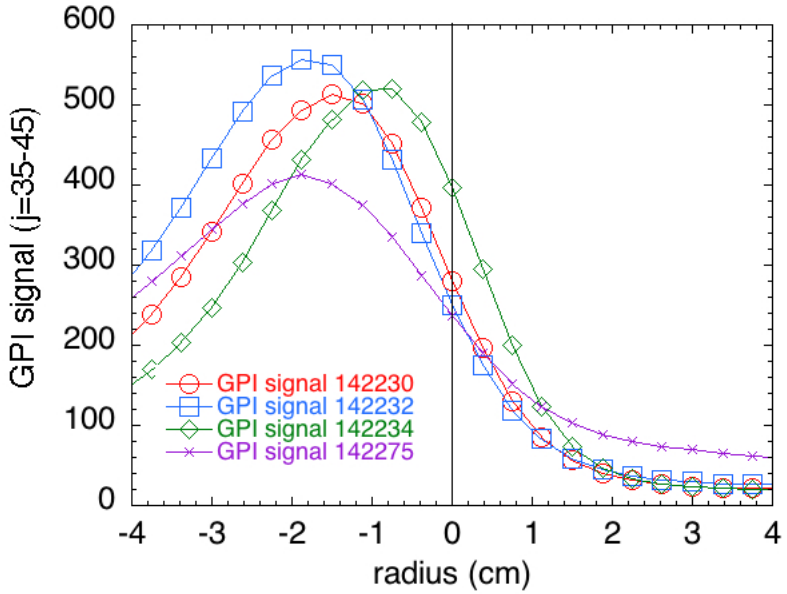


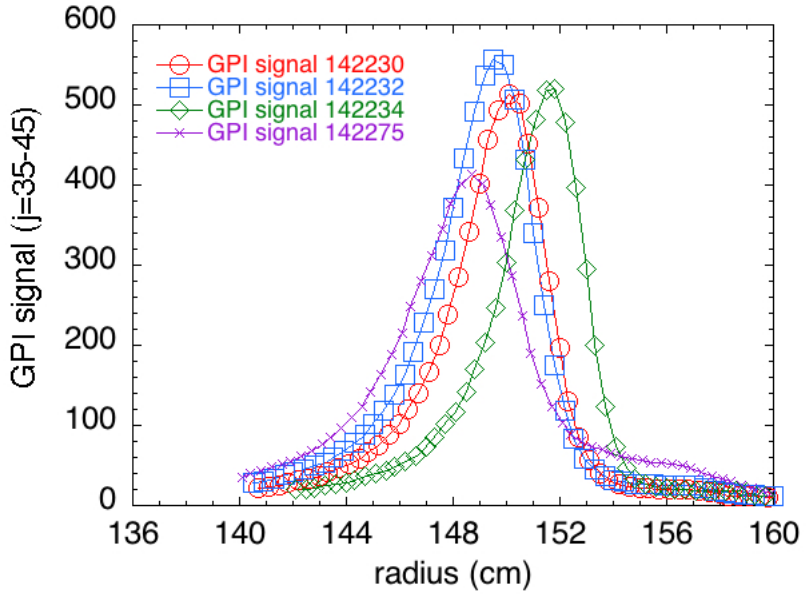
Outer midplane separatrix position in cm vs. distance to EFIT02 local separatrix (assuming distance between flux surfaces at GPI is same as at outer midplane)



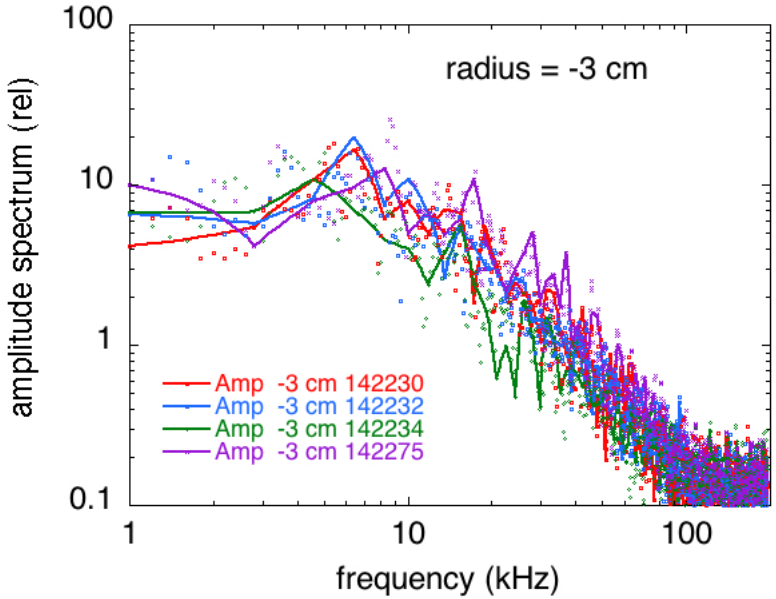
GPI signal vs. local radius from EFIT02 and major radius mapped to midplane

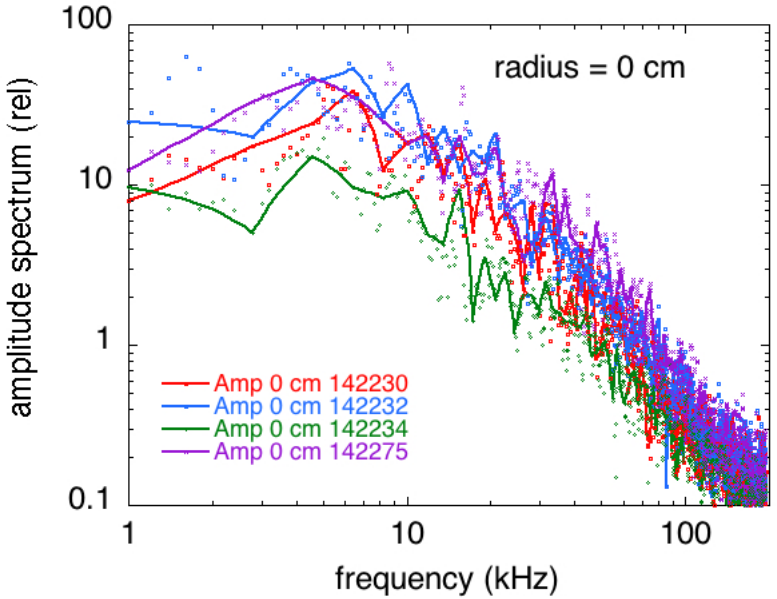
averaged over vertical pixels j=35-45 over time of interest

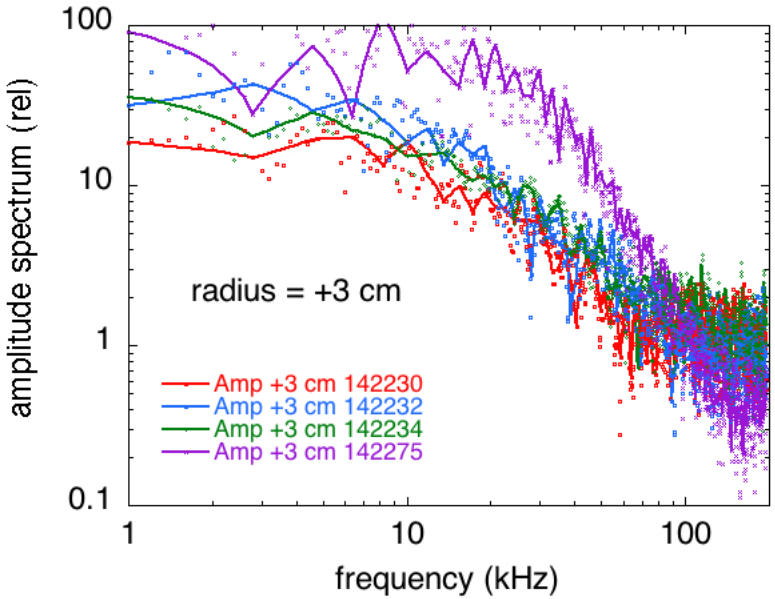




Typical GPI frequency spectra (amplitude not power) at single pixel j=40 at three radii

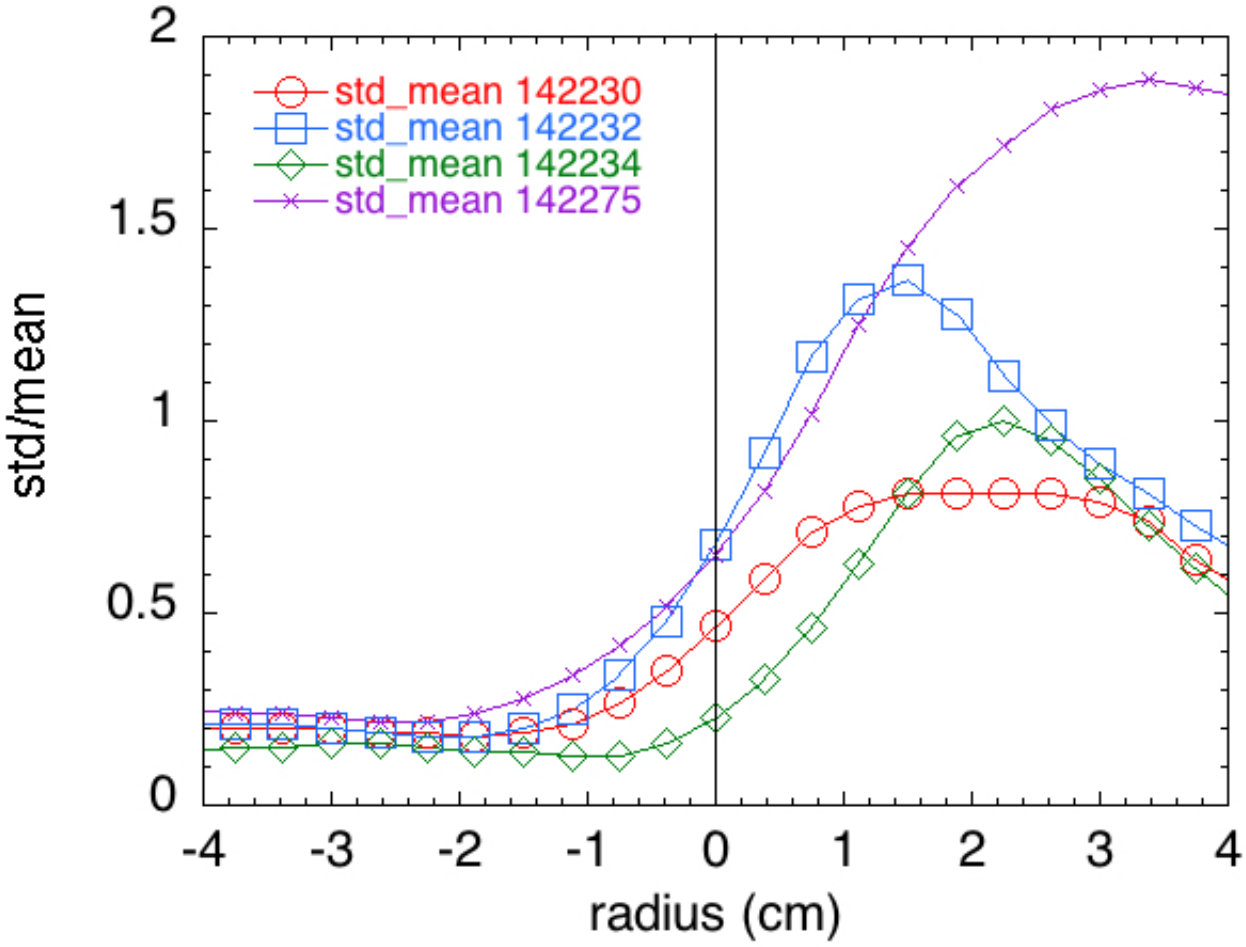






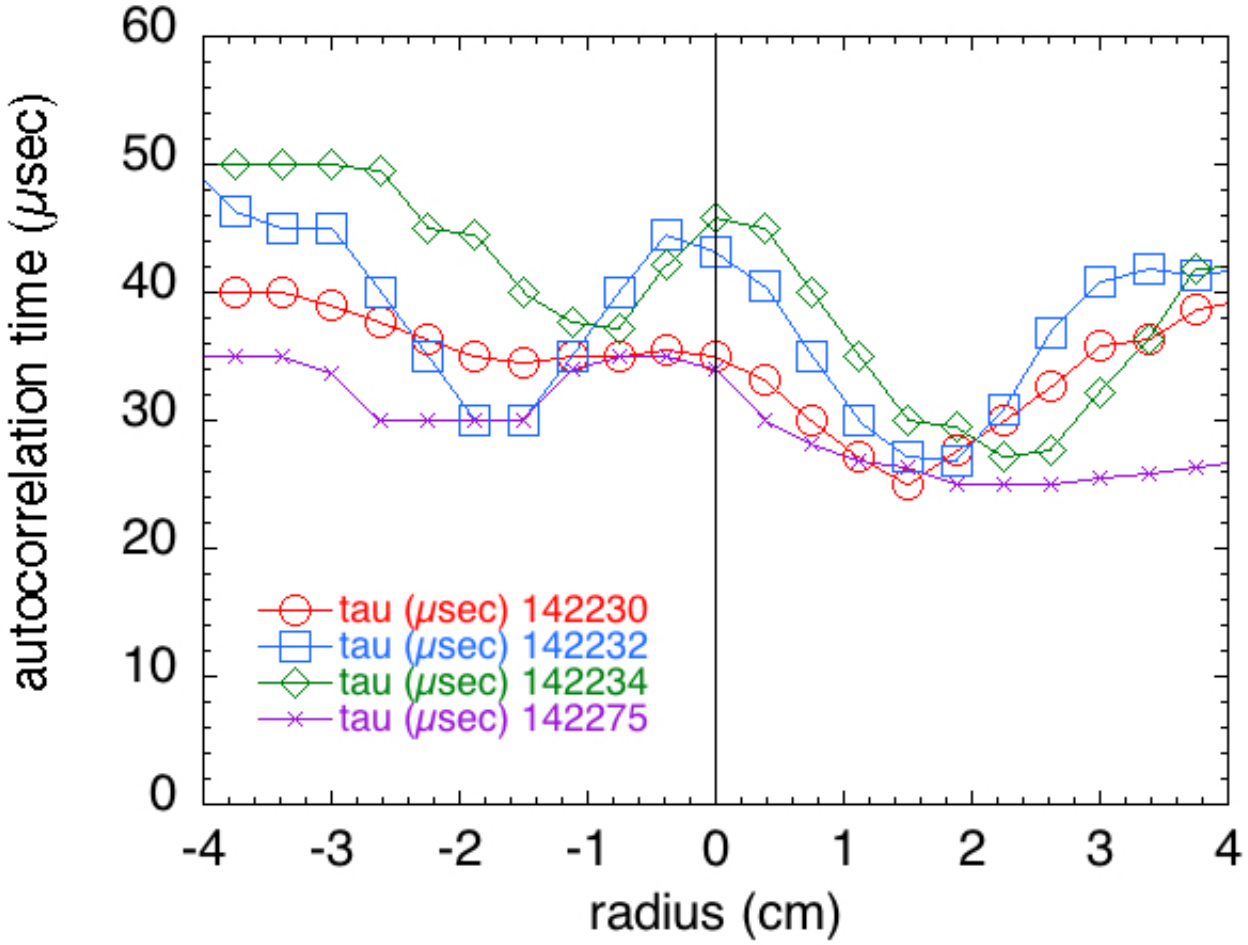
Relative GPI fluctuation level (standard deviation over mean) vs. local radius

- each pixel in raw data is first smoothed by 3x3 adjacent pixels (~ 1 cm x 1 cm)
- then data for each pixel normalized by the running time average over 1 msec
- thus f≥ 1 kHz only in this plot, up to Nyquist frequency of 200 kHz
- std/mean is then averaged over time of interest for each shot



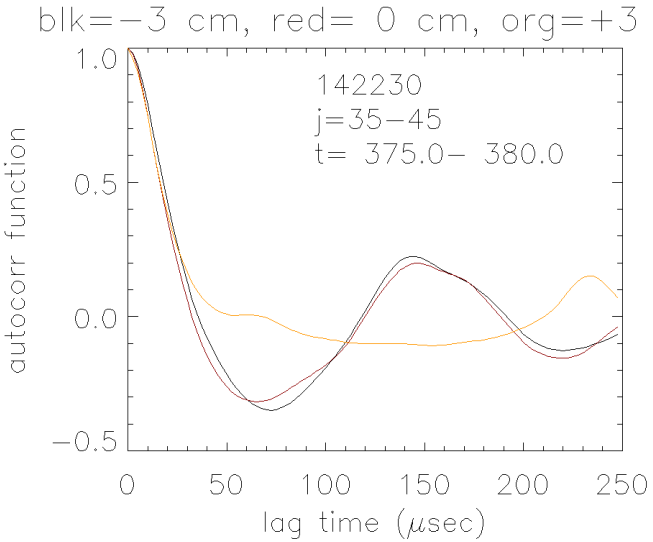
Autocorrelation time (FWHM) vs. local radius

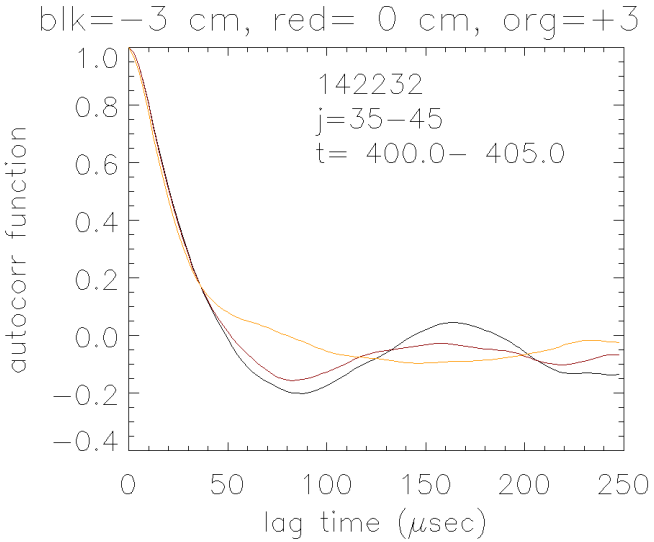
- each pixel in raw data is first smoothed by 3x3 adjacent pixels (~ 1 cm x 1 cm)
- then data for each pixel normalized by the running time average over 1 msec
- time for autocorrelation function to fall to 0.5 x 2 (FWHM) evaluated for each pixel
- results are averaged over j=35-45 and plotted vs. column as local radius

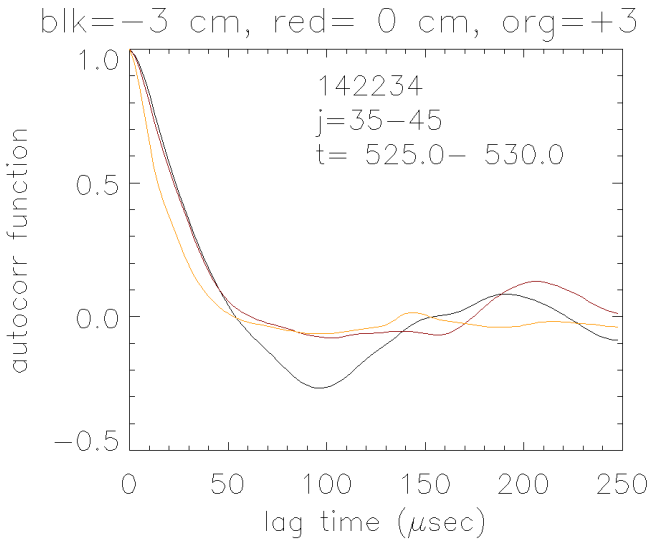


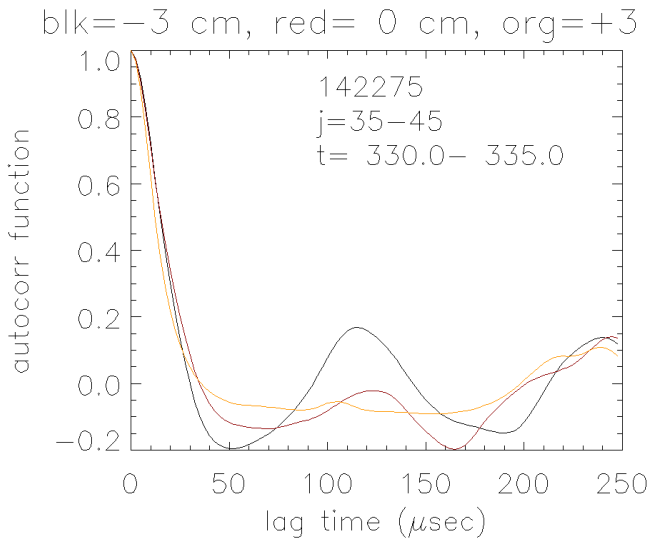
autocorrelation functions for selected radii

- seems to be some significant component of coherent modes at ~ 5-10 kHz





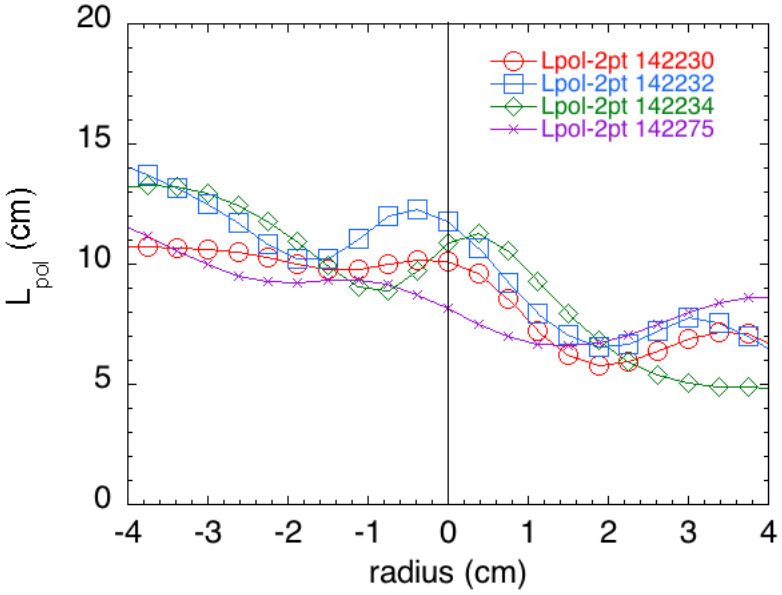




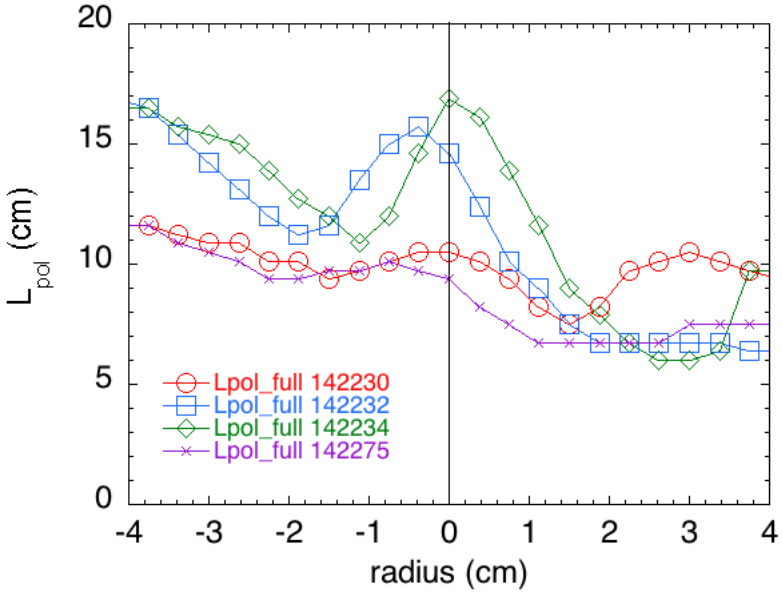
Poloidal correlation length (FWHM) vs. local radius

- each pixel in raw data is first smoothed by 3x3 adjacent pixels (~ 1 cm x 1 cm)
- then data for each pixel normalized by the running time average over 1 msec
- Lpol_2pt (FWHM) using 2-point method assuming Gaussian correlation function, with poloidal separation = 6 pixels (~2 cm) using average of j=37,40, and 43 rows
- Lpol_full (FWHM) using full poloidal correlation function for j=40 row only
- fairly good agreement between these two (Lpol_full slightly larger than Lpol_2pt)

Lpol_2pt



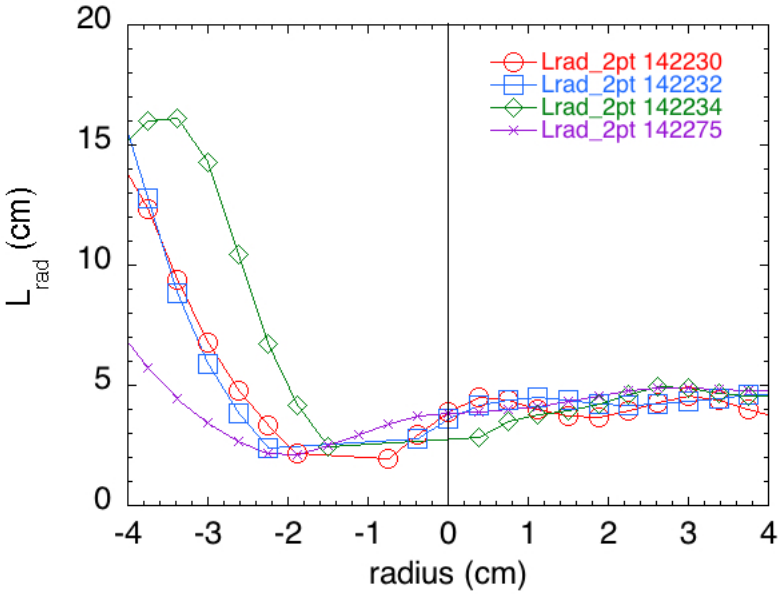
Lpol_full



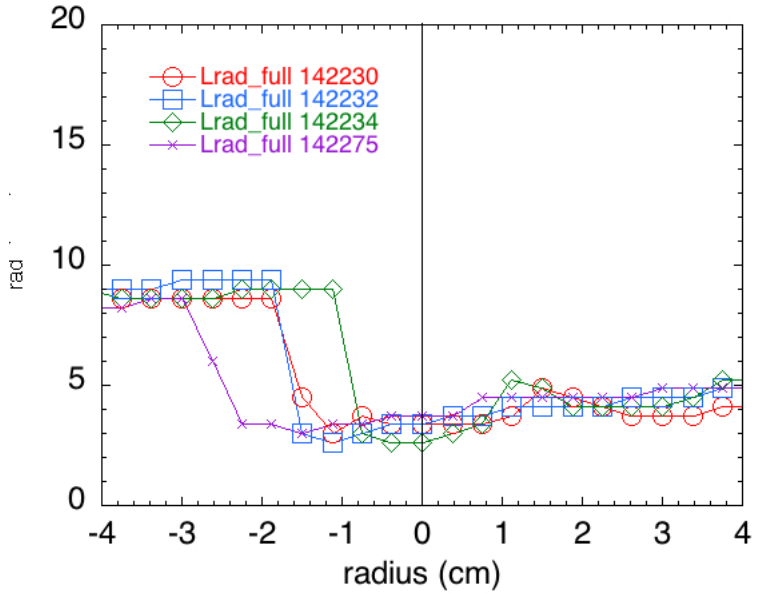
Radial correlation length (FWHM) vs. local radius

- each pixel in raw data is first smoothed by 3x3 adjacent pixels (~ 1 cm x 1 cm)
- then data for each pixel normalized by the running time average over 1 msec
- Lrad_2pt (FWHM) using 2-point method assuming Gaussian correlation function, with radial separation = 6 pixels (~2 cm) using average of j=37,40, and 43 rows
- Lrad_full (FWHM) using full radial correlation function for j=40 row only
- Lrad_full and Lrad_2pt are similar for radii outside the separatrix
- Lrad_full and Lrad_2pt both increase inside -2 cm, but not in the same way
- note missing points in Lrad_2pt near -1 cm – these had negative cross-correlations

Lrad_2pt

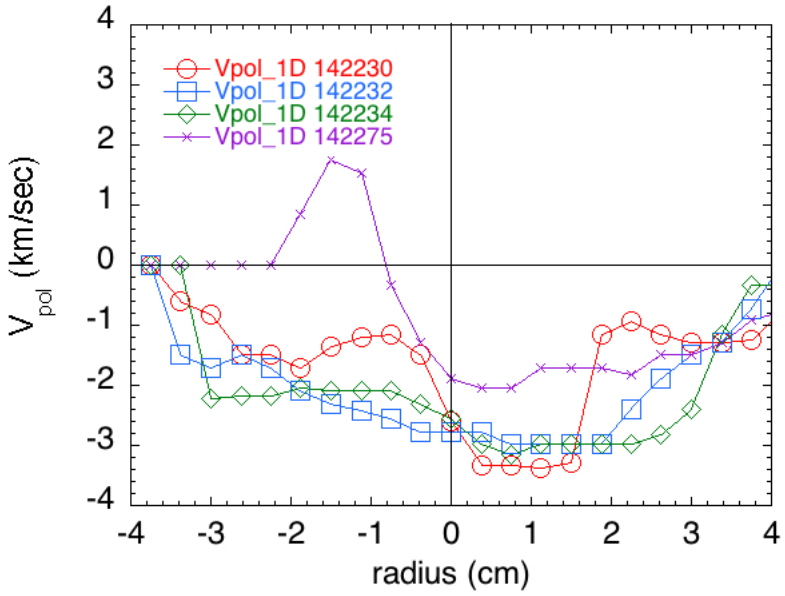


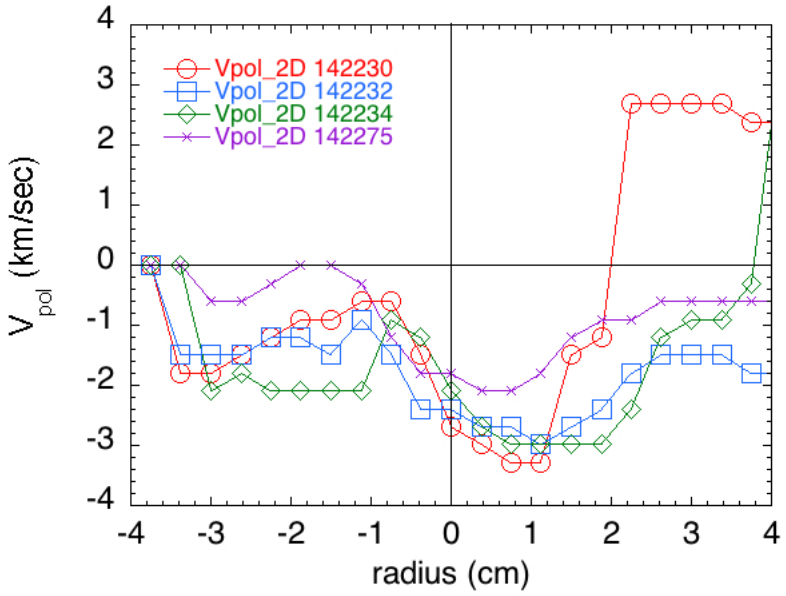
Lrad_full



Poloidal velocity vs. local radius

- each pixel in raw data is first smoothed by 3x3 adjacent pixels (~ 1 cm x 1 cm)
- then data for each pixel normalized by the running time average over 1 msec
- analyses done for j=40 row only
- Vpol_1D from fit of 1D poloidal correlations with 0-5 frame lags (≤12.5 μsec)
- Vpol_2D from location of maximum correlation in 2D at 5 frame lag (12.5 μsec)
- Vpol_1D similar to Vpol_2D except for 142275 @ -1 to -2 cm





Radial velocity vs. local radius

- each pixel in raw data is first smoothed by 3x3 adjacent pixels (~ 1 cm x 1 cm)
- then data for each pixel normalized by the running time average over 1 msec
- analyses done for j=40 row only
- Vrad_1D from fit of 1D radial correlations with 0-5 frame lags (≤12.5 µsec)
- Vrad_2D from location of maximum correlation in 2D at 5 frame lag (12.5 µsec)
- Vrad_1D similar to Vpol_2D except for -2 to -3 cm for 142232