

Galactic Plane Analysis

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- I've applied two methods to correct for signal events contaminating your background estimation
 - Region on Interest exclusion
 - How it works
 - Calculation of α for the IG region of the galactic plane
- Comparison of results from the 2 methods
- Simulation of each.
- Conclusions

Exclusion of ROI in direct integration

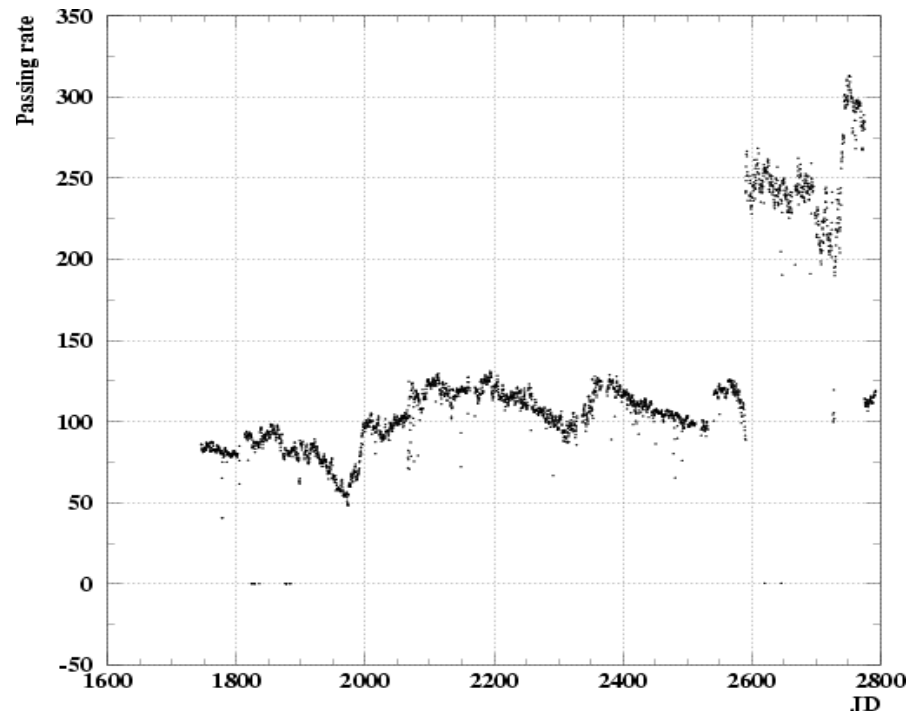
- With some suggestions from Gus, I've made some extensions to direct integration to exclude a ROI from the background calculation
- How it works:
 - Define a ROI.
 - Label the 0.1×0.1 degree bins that are in the ROI, here I'm using ± 5 degrees in galactic latitude, all longitude.
 - Fill 8 hour maps
 - All events passing cuts go into signal map, and nSider rate array, but only events outside ROI are put in bkg eff map.
 - At end of integration time, normalize map
 - Map is normalized by number of entries in signal map.

Method, cont...

- Correct the background efficiency map (ha,dec)
 - For each ha,dec location, consider all sidereal time, RA combinations that give that ha value ($ir=is-ih$) and count the total number entries that contribute to your background ($g_all[ih][id]$) and the number that would have come from the ROI $g_onsrc[ih][id]$
 - Correction factor to eff map:
 - $cor_fact = g_all[ih][id]/(g_all[ih][id]-g_onsrc[ih][id])$
- Calculate the bkg, for all ih,is combinations:
 - $bkg[ir][id] += nSider[is]*eff[ih][id]*cor_fact[ih][id]$
 - Discovered is,ih,id loop ordering important!

This is done, ran on ~3yr of data

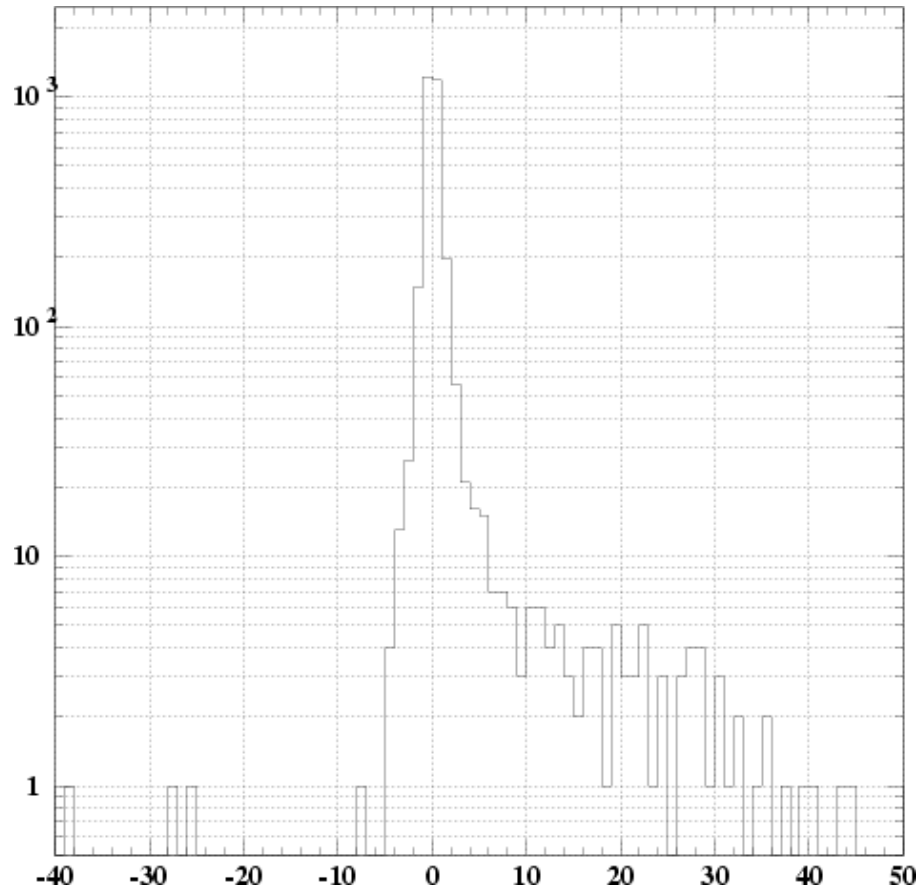
- 3 data sets considered
 - 14 month NYU data set JD: 1745-2163
 - 2.5 year data set, until new calibs, JD: 1745-2589
 - 3 year data set, thru May 31, 2003, JD: 1745-2792
- After new calibrations of Nov, 2002, save rate increases greatly
 - Save rate x 2.5
 - A problem?



Additional cuts to maps

- I stop my maps any time the detector stops taking data for more than a few seconds (run stops), or if 8hr integration time is reached.
- A map that is too short, will not have enough “off source” data to accurately estimate background.
 - Especially true at high DEC's where GP is parallel to RA
 - Cut maps that are shorter than 6 hours.
- If background is correct, number of events in entire sky signal and background maps should be ~equal. (Exact equality in direct integration.)

A few maps have bkg deficits.



$$\text{bkg_var} = (\text{nsig} - \text{nbkg}) / \sqrt{\text{nsig}}$$

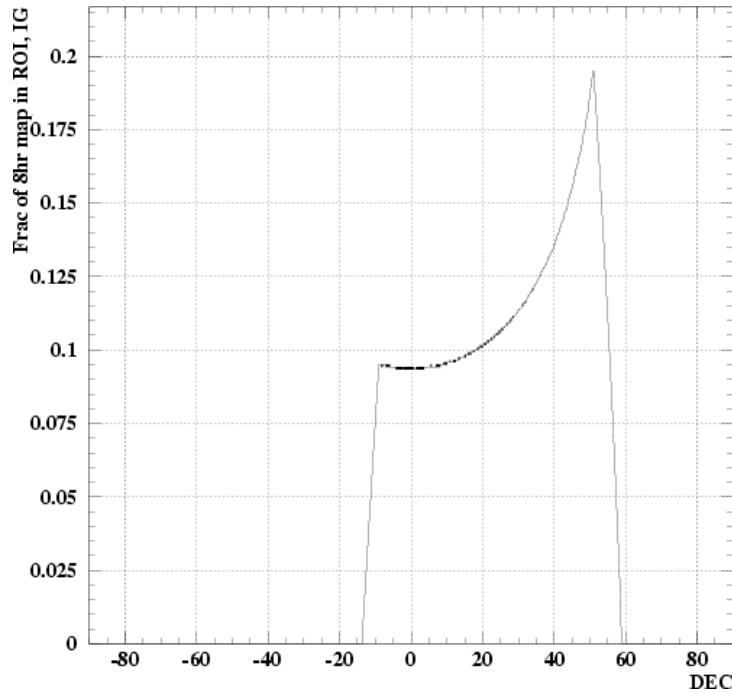
No time cut done here, but even after time cut, a few remain

If a map location has no “off source” data, then `cor_fact` is infinite, set to 1

Should tag map as troubled and drop them, but not done yet.

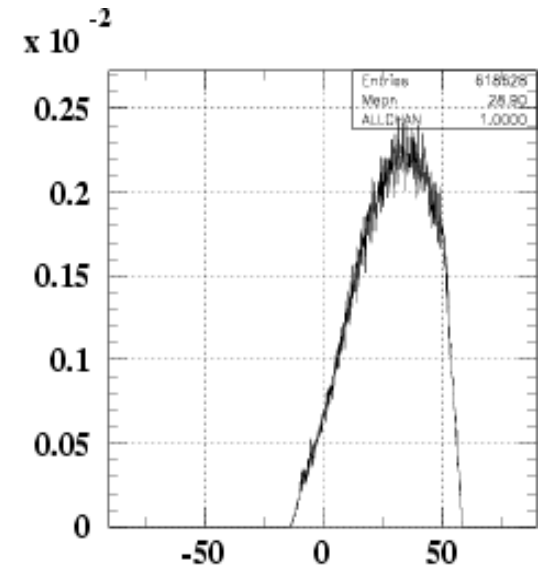
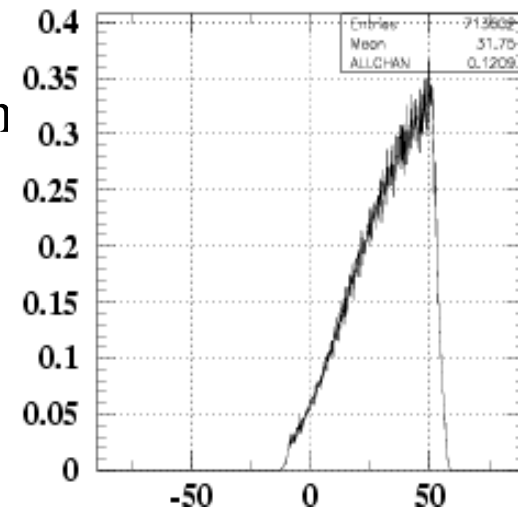
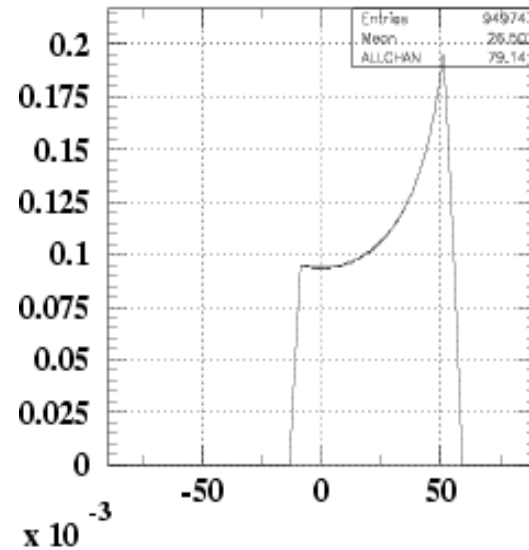
For now, cut maps $> 5\sigma$

Alternative, find α with no exclusion



For the IG region, fraction of an 8hr map that is in the ROI (from width of GP vs DEC)

Convolve this with the DEC distribution of events in the IG



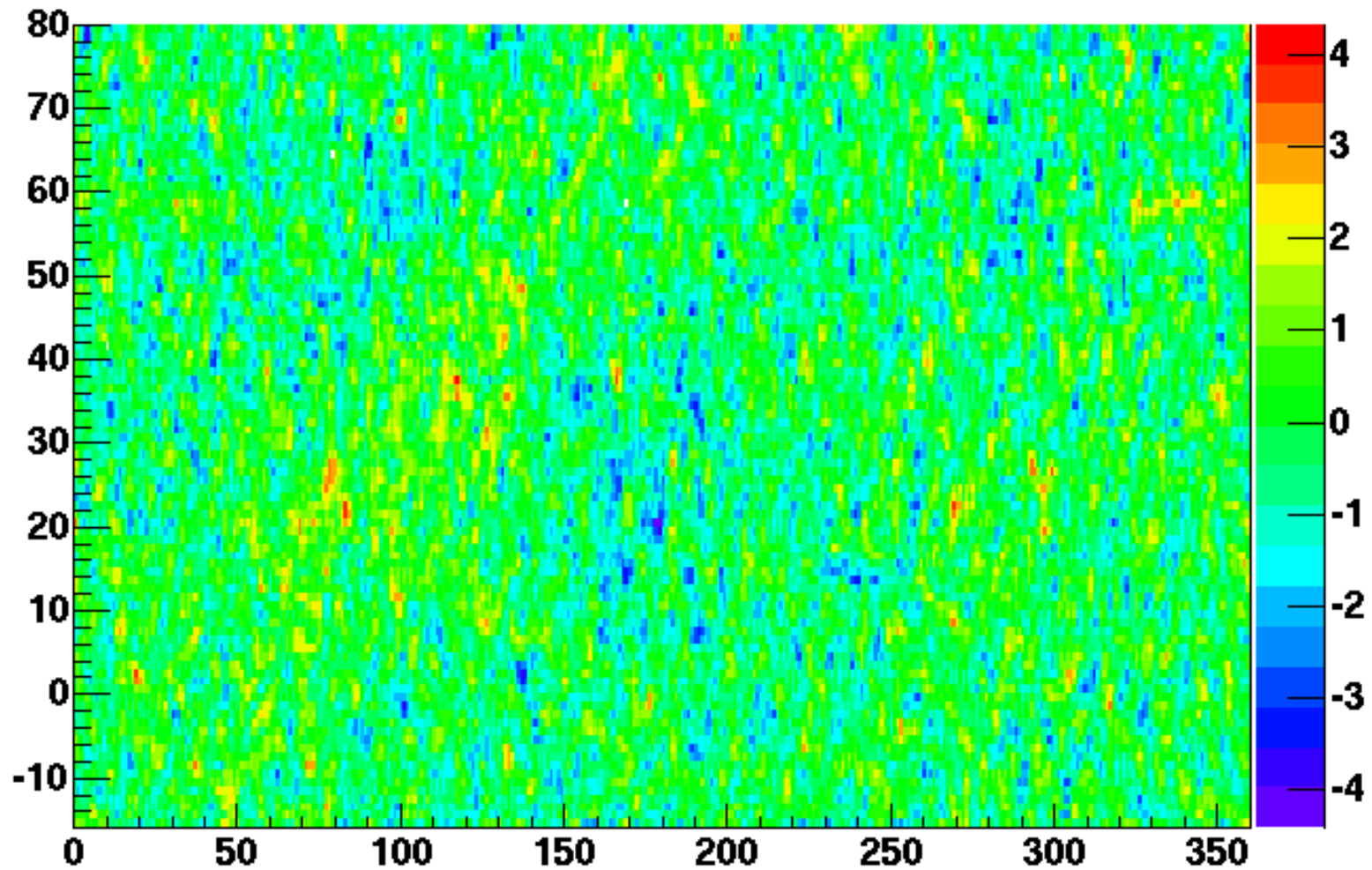
Found α is 12.1%

Compare my results with and without exclusion

- NYU results from the 14 month analysis +/-5 IG
 - No exclusion frac excess: 2.02 E-4
 - With exclusion frac excess: 3.40 E-4
 - Ratio is 1.68 (1.29 for +/-2 IG)
- I'll consider my results with and without exclusion, and look measure size of increase in frac excess.

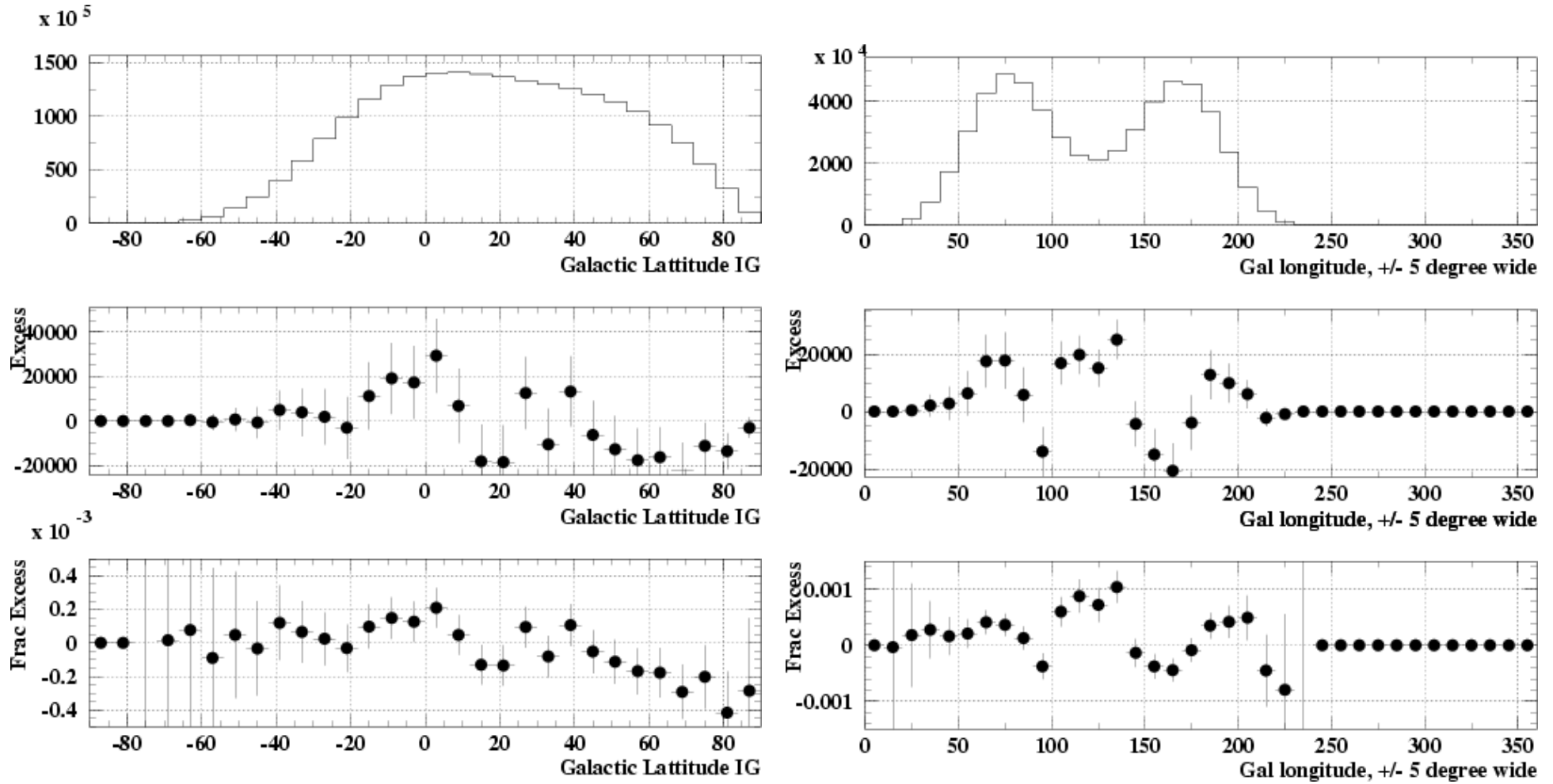
Skymap still shows anisotropy

Significance Map2



2.5 year data with exclusion

Distributions from data



Tabulation of results IG +/- 5 deg

	No Exclusion	With Exclusion	Ratio
14 month, NYU sample			
On	112534035	108172561	
Off	112514125.6	108152705.6	
Excess	19909.4	19855.4	
Frac Ex	1.77E-004	1.84E-004	1.04
Sigma	1.87	1.91	1.02
Exposure time	385.0 days	363.5 days	0.94
2.5 year sample			
On	244172583	231162786	
Off	244134469.2	231123940.3	
Excess	38113.8	38845.6	
Frac Ex	1.56E-004	1.68E-004	1.08
Sigma	2.44	2.56	1.05
Exposure time	749.6 days	699.3 days	0.93
3 year sample (includes higher rate)			
On	384645301	359053386	
Off	384576973	358975510.1	
Excess	68328	77875.9	
Frac Ex	1.78E-004	2.17E-004	1.22
Sigma	3.48	4.11	1.18
Exposure time	934.3 days	870.9 days	0.93

3 yr sample excess seems consistent with number of signal events

Tabulation of other results

	No Exclusion	With Exclusion	Ratio
2.5 year sample, OG +/-5			
On	260813591	240270312	
Off	260855547.6	240287530.2	
Excess	-41956.6	-17218.2	
Frac Ex	-1.61E-004	-7.17E-005	0.44
Sigma	-2.59	-1.11	0.43
Exposure time	749.6 days	699.3 days	
2.5 year sample, IG +/-2			
On	97938851	92723203	
Off	97910972	92696930.6	
Excess	27879	26272.4	
Frac Ex	2.85E-004	2.83E-004	0.99
Sigma	2.82	2.73	0.97
Exposure time	749.6 days	699.3 days	
3 year sample, IG +/-5			
	No bkg_var cut	bkg_var cut at 3 sigma	
On	360492902	351358434	
Off	360410729	351285290.3	
Excess	82173	73143.7	
Frac Ex	2.28E-004	2.08E-004	
Sigma	4.32	3.9	
Exposure time	877.5 days	859.6 days	

bkg_var cut doesn't seem to make a large difference

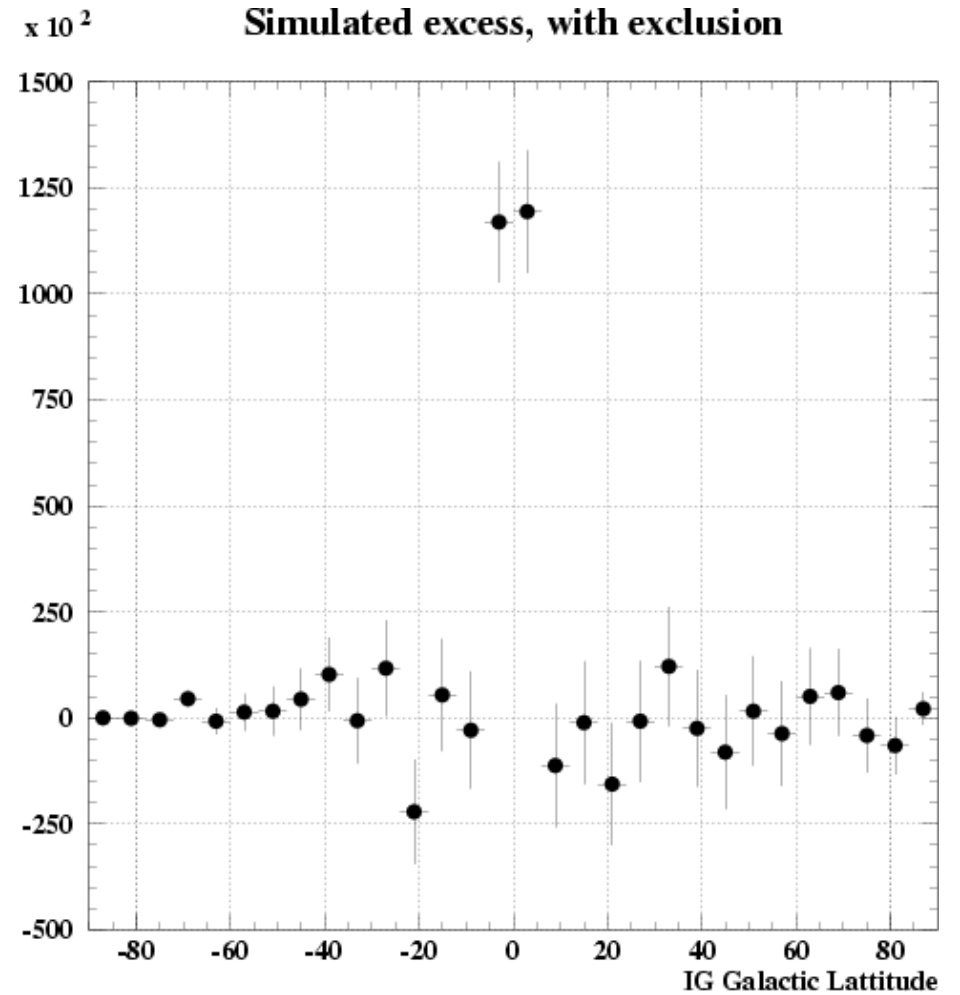
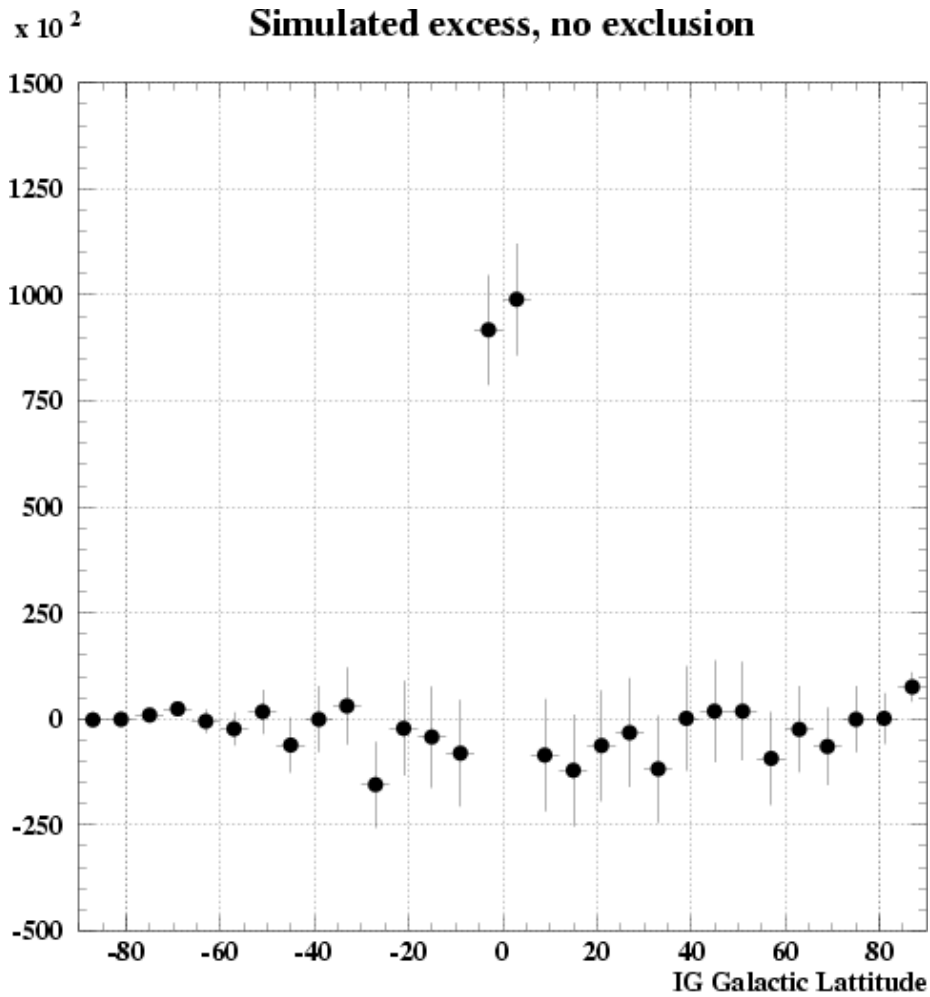
Time for some simulation

- Simulation that generates fake data
 - Generates data from a fixed zenith angle distribution
 - Picks a random map start time during a simulated yr.
 - Simulates 8hr of data with a fixed event rate from data
- Insert GP events at a known rate- 2 different ones
 - All in +/- 5 degree IG region
 - Large: 1.4 E-3 fractional excess
 - Moderate: 3.6 E-4 fractional excess
- Simulated both mapping methods, with and without exclusion.

Results from simulation +/- 5 IG

	No Exclusion	Exclusion
Large input		
Input	202216	246369
Output	189285	235744
Ratio	1.07	1.05
Small Input		
Input	68969	67452
Output	62631	78518
Ratio	1.1	0.86

Comparing simulations...



Don't find any sharp deficits in excess near plane

Conclusions

- Exclusion method developed and applied to GP analysis
- Results from exclusion and no exclusion show similar results for excesses from the IG region
 - In contrast to NYU's 14 month results
- Need to understand rate increase in Nov 2002 and how to account for it
- Continue to resolve background estimation differences with NYU.