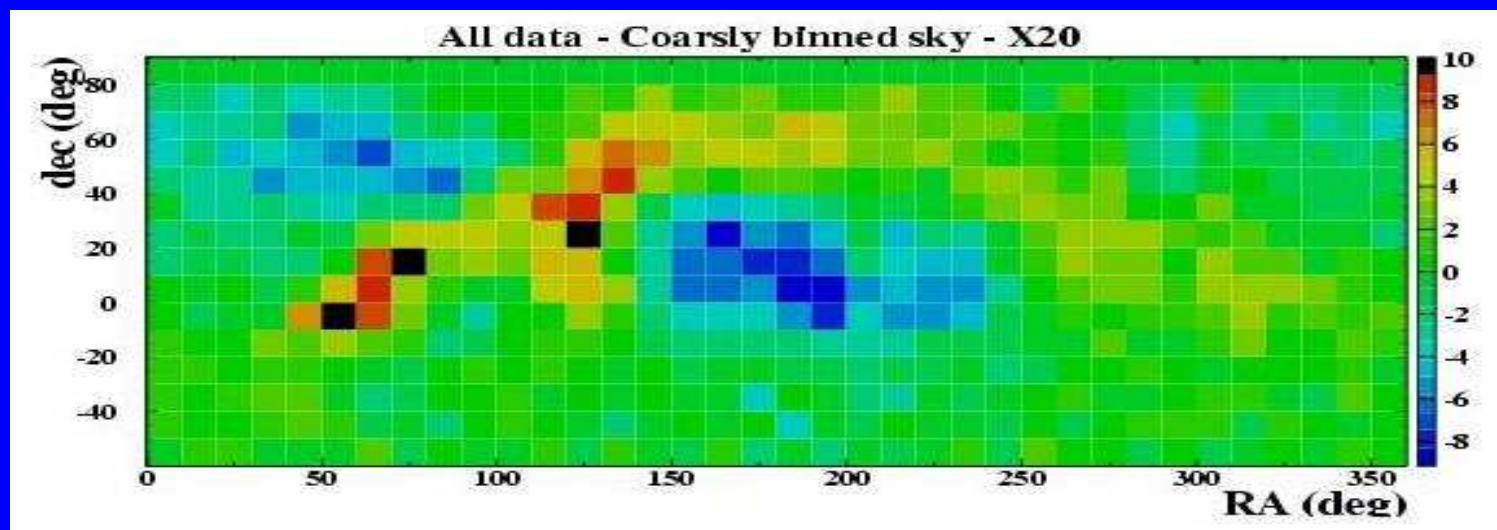# More on the Galactic Plane
Andy Smith – UMD

➔ Breathing Correction
➔ Optimal binsize for the plane search (From EGRET)
➔ Results of the search
➔ Relaxing the X2 cut
➔ Anomalies:
   ➔ J2000?
   ➔ The lack of systematic errors from binning.
   ➔ Solar wind shock termination and the heliopause.

All data - Coarsly binned sky - X20

"Breathing" Correction

The study of an extended source requires long integration periods so that the event sample from which the background is drawn is large compared to the number of signal events.

The fundamental assumption of our standard background subtraction is that the local coordinate distribution ([th,ph] or [HA,dec]) remain constant. Extending the integration period may strain this assumption.

One way to reconcile this is to modify the background subtraction method to account for changes in the theta distribution on a short time scale compared to the integration period.

"Breathing" Correction

Record the theta distribution for each of many 240s sidereal time bins within the time integration period.

At the end of the integration period, normalize the total theta distribution and the each of the binned distributions in ST.
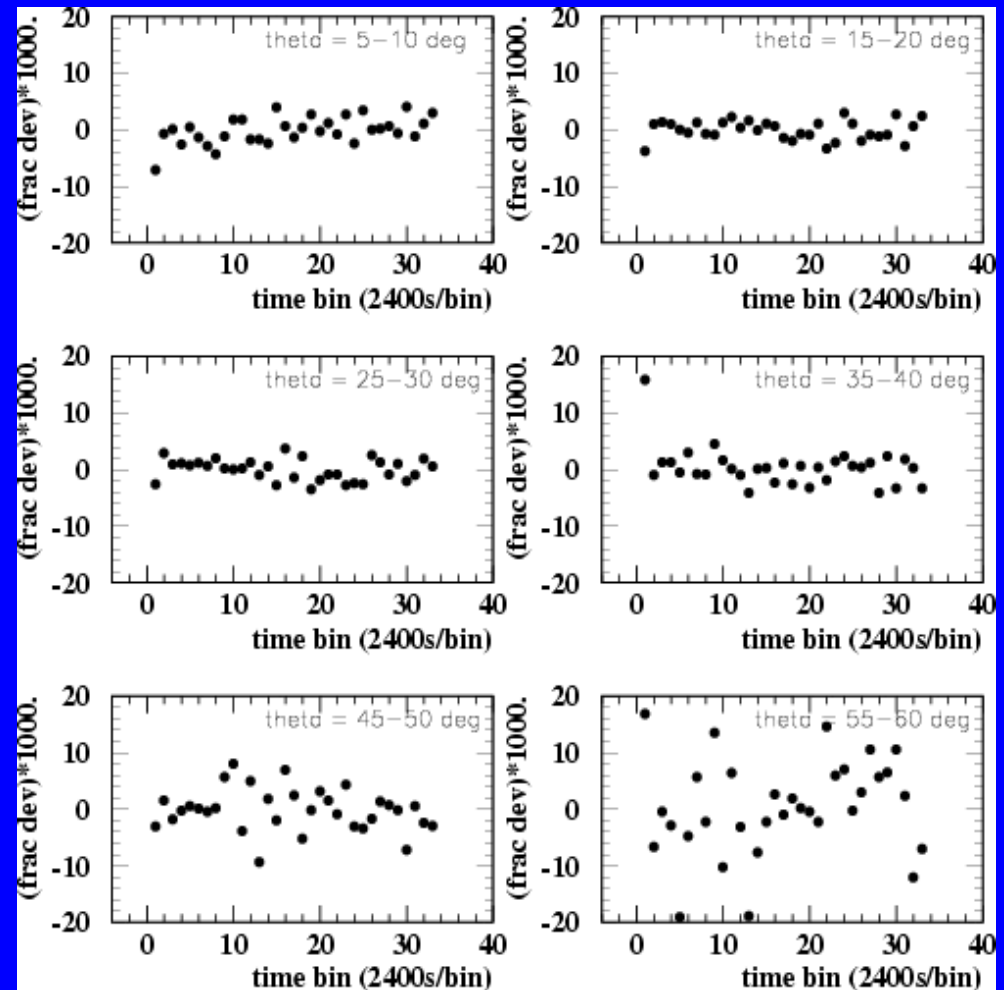
correction factor [ST,th] = norm_th_dist[ST,th]

/norm_th_dist_total[th]

Apply the correction factor when filling the background map.

"Breathing" Correction

Normal Day - Winter 1/24/03
No evidence of abrupt rate changes.

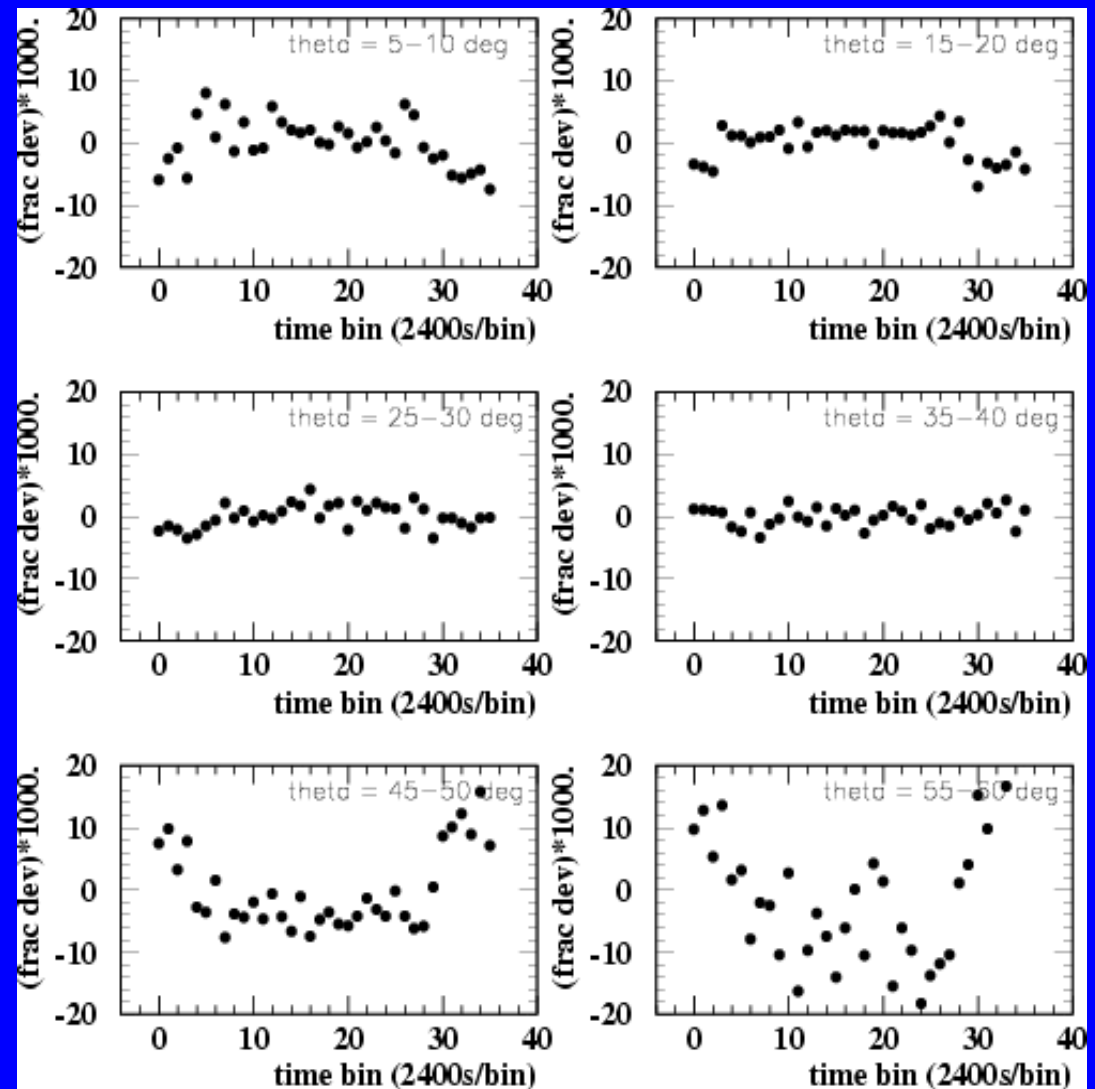Deviations = correction factor - 1.

"Breathing" Correction

Ice Day - Winter 1/29/02

Clear evidence of changes in the theta distribution.

Deviations = correction factor - 1.
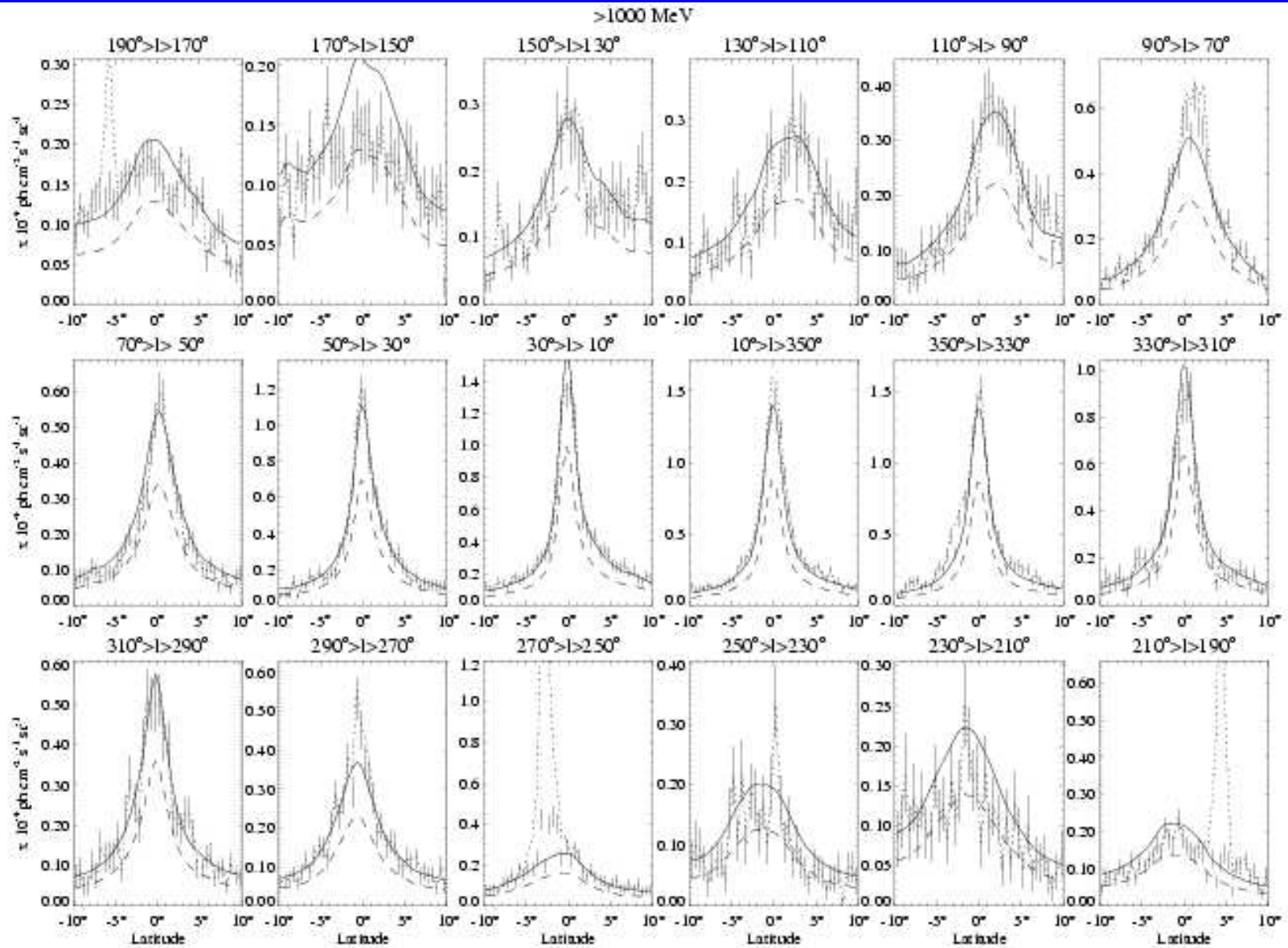
Optimal Bin Size Analysis

Fig. 3d

➡ EGRET – Hunter et al
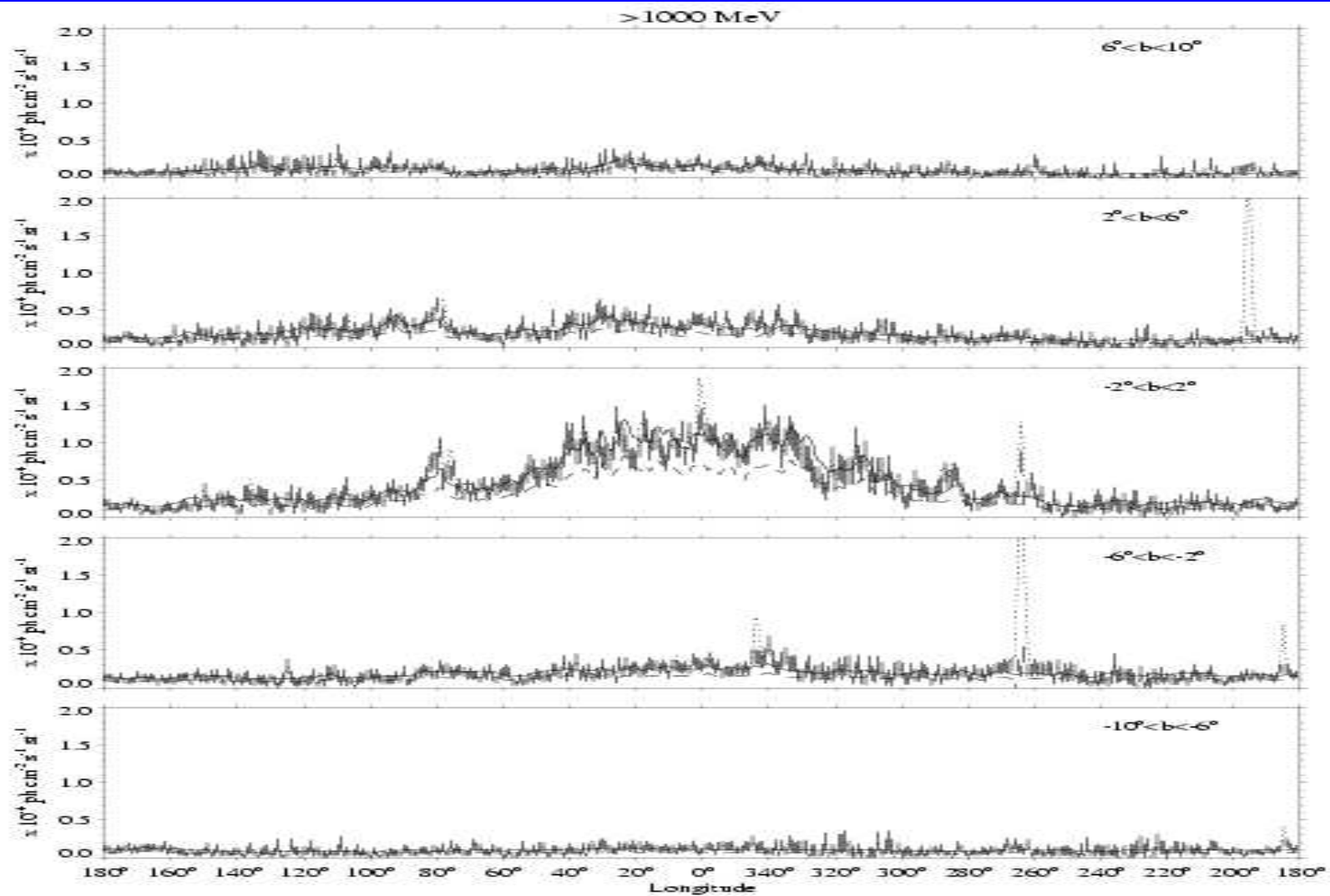
Optimal Bin Size Analysis

EGRET – Hunter et al
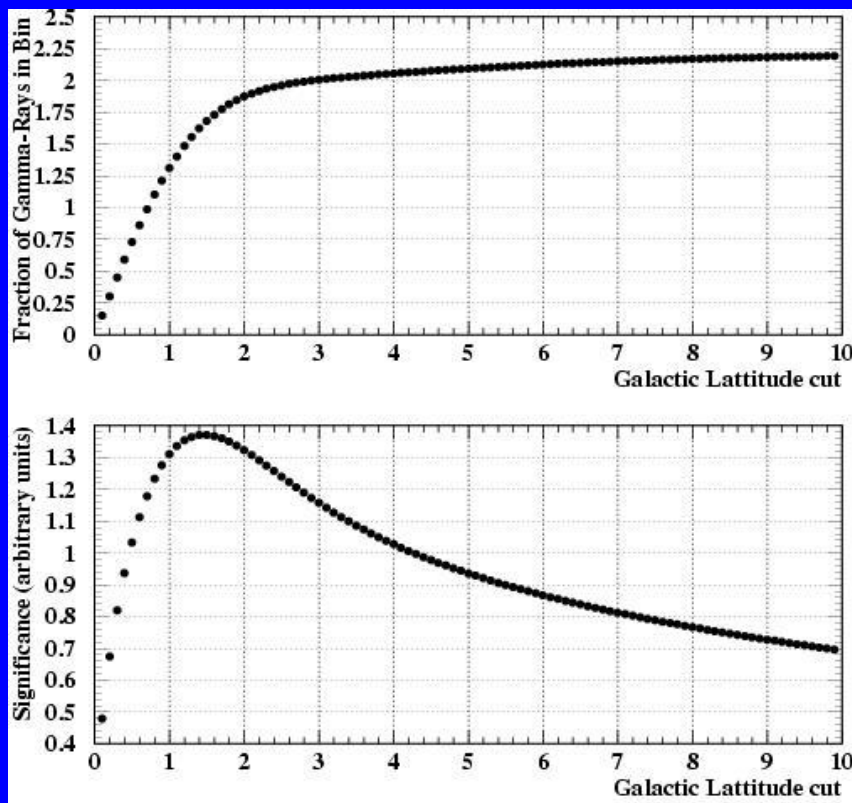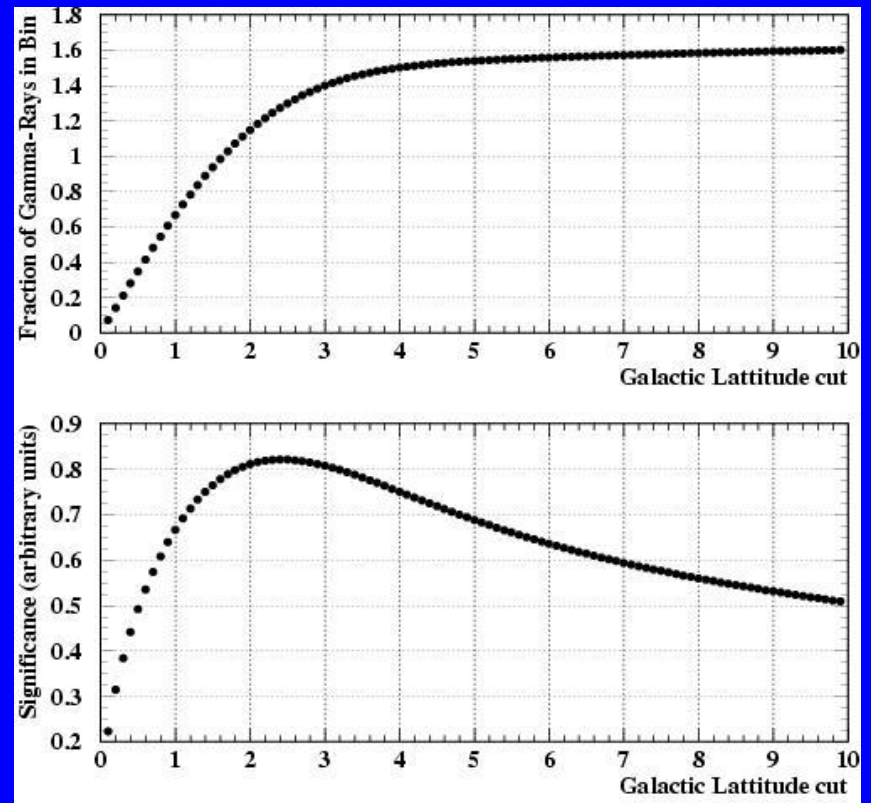
Optimal Bin Size Analysis

Latitude profiles digitized and fit to sum of 2 gaussians
Optimal bin size deduced from integration of profile.
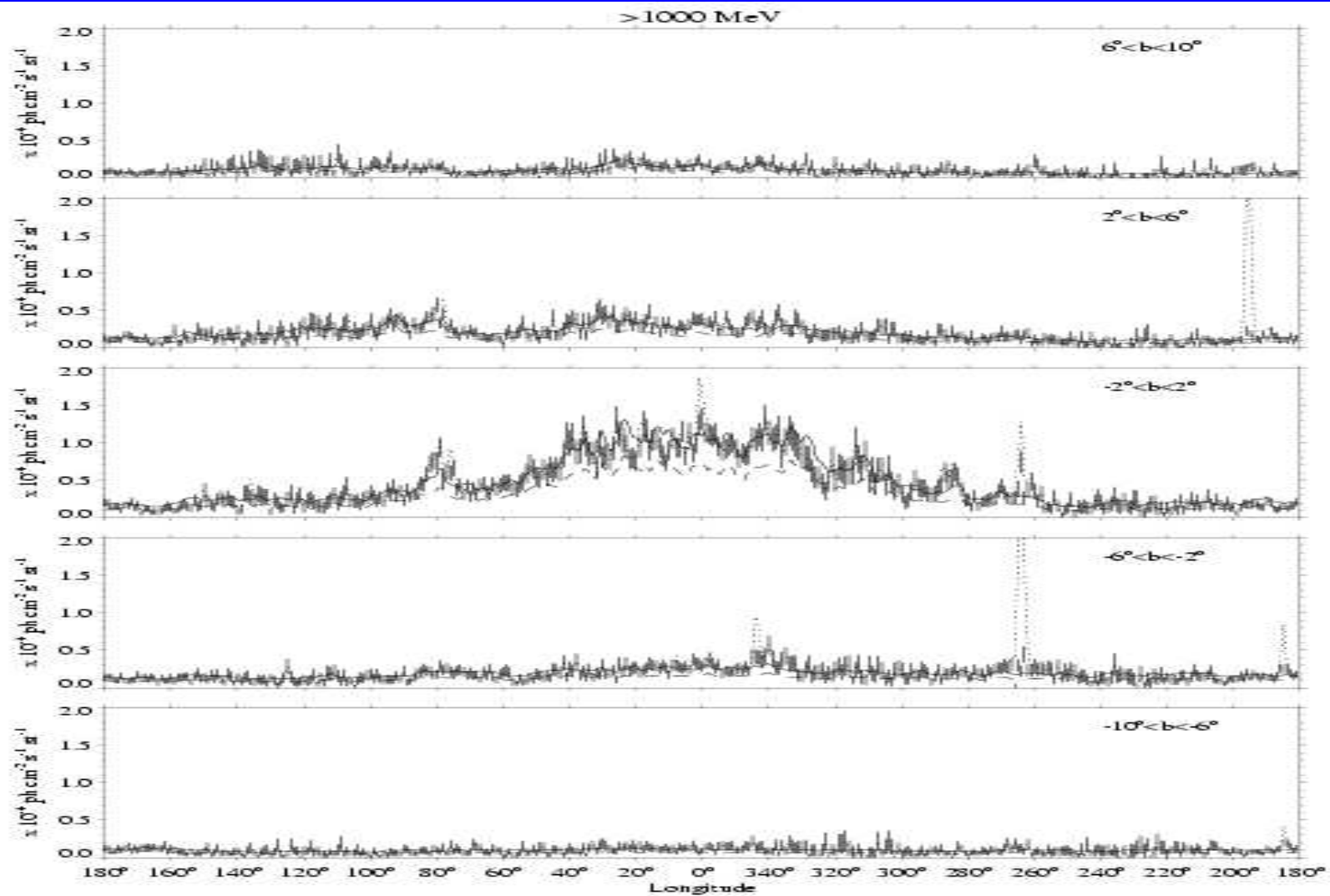
Lat = 30-50
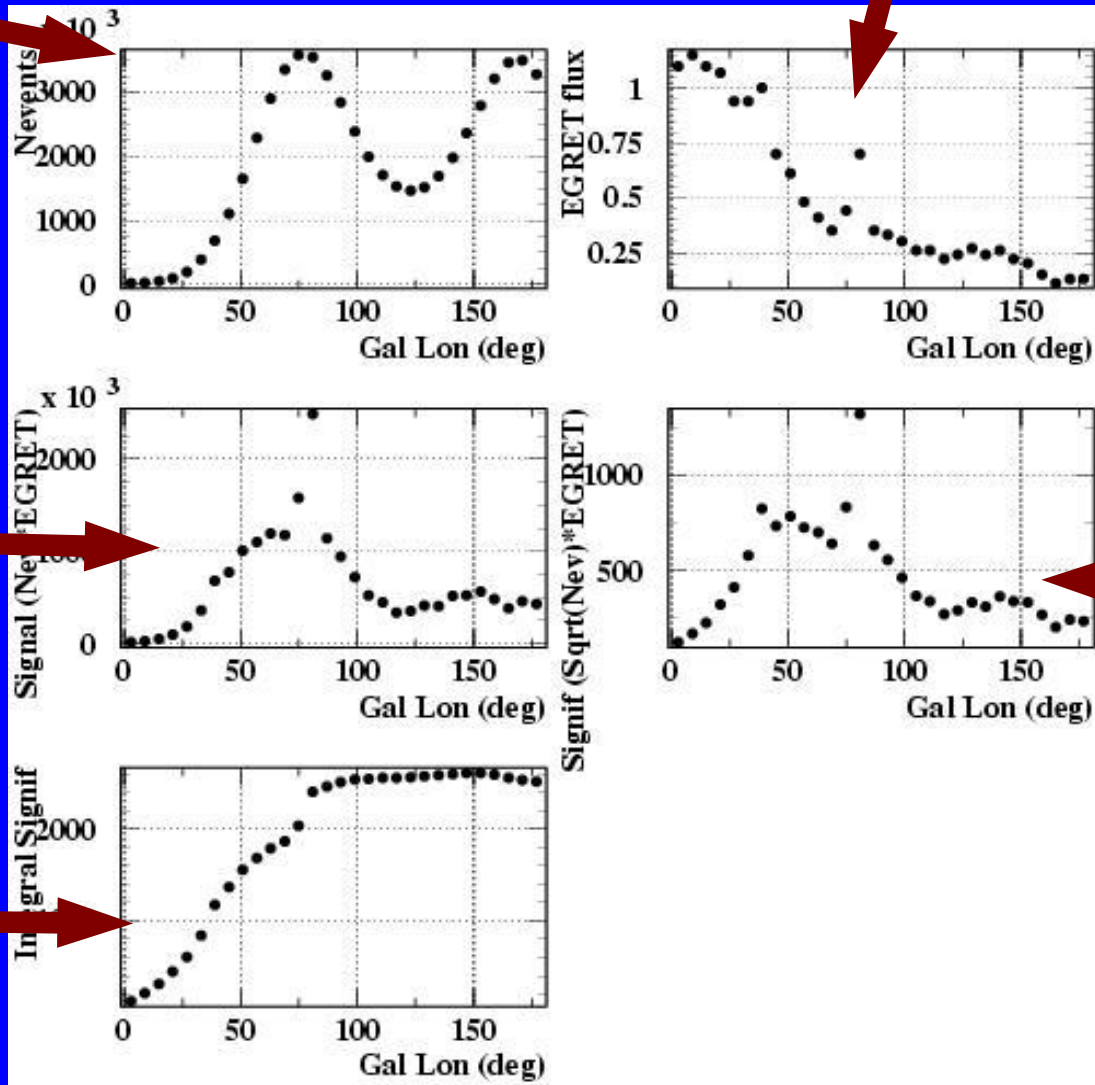
Lat = 50-70

Optimal Bin Size Analysis

EGRET – Hunter et al

Optimal Bin Size Analysis

Events Collected in a day

EGRET flux

Events collected in Milagro

Signif of each bin

Integral Signif

Results of Galactic Plane Search

Table 4: Table of AS galactic plane results - 1 year X2$\geq$2.5

Region	ON	OFF	Excess	Significance
IG ±2°	44178905	44175818.9	3086.1	0.5
IG ±5°	110102668	110096249.1	6418.9	0.6
IG ±10°	218196081	218198260.4	-2179.4	-0.1
OG ±2°	47958347	47962932.6	-4585.6	-0.7
OG ±5°	119615937	119629573.2	-13636.2	-1.2
OG ±10°	237074387	237104401.5	-30014.5	-1.9

Table 5: Table of AS galactic plane results - 2.3 year X2$\geq$2.5

Region	ON	OFF	Excess	Significance
IG ±2°	125268199	125243615.0	24584.0	2.2
IG ±5°	312148653	312111787.3	36865.7	2.1
IG ±10°	618507210	618460768.2	46441.8	1.9
OG ±2°	134217254	134224376.1	-7122.1	-0.6
OG ±5°	334772373	334797199.2	-24826.2	-1.4
OG ±10°	663563932	663614344.4	-50412.4	-2.0
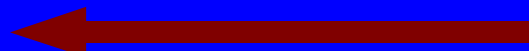
Table 6: Table of AS galactic plane results - 2.3 year No X2 cut

| Region	ON	OFF	Excess	Significance
IG ±2°	1131395269	1131301659	93609	2.8
IG ±5°	2820572018	2820380919	191099	3.6
IG ±10°	5595799060	5595567172	231888	3.1
OG ±2°	1216614503	1216700223	-85720	-2.5
OG ±5°	3034744265	3034994141	-249876	-4.5
OG ±10°	6018242199	6018714643	-472444	-6.1

8 hr time sloshing.
Breathing correction.
Removed a bunch of bad/corrupt data
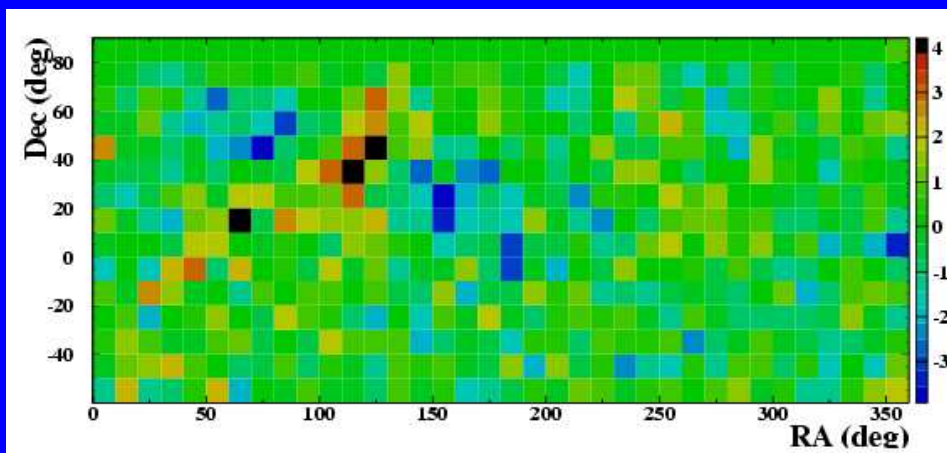Dealt with clock errors.

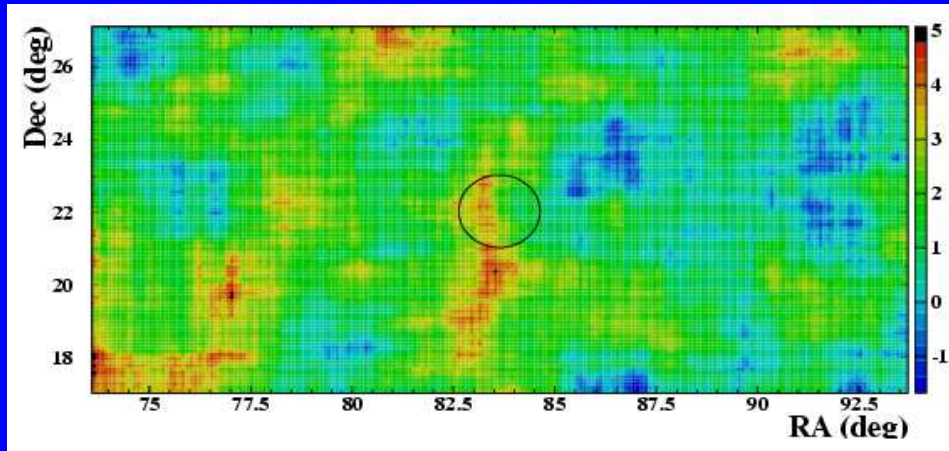# Sky map for ~2.3 years of data $X_2 > 2.5$
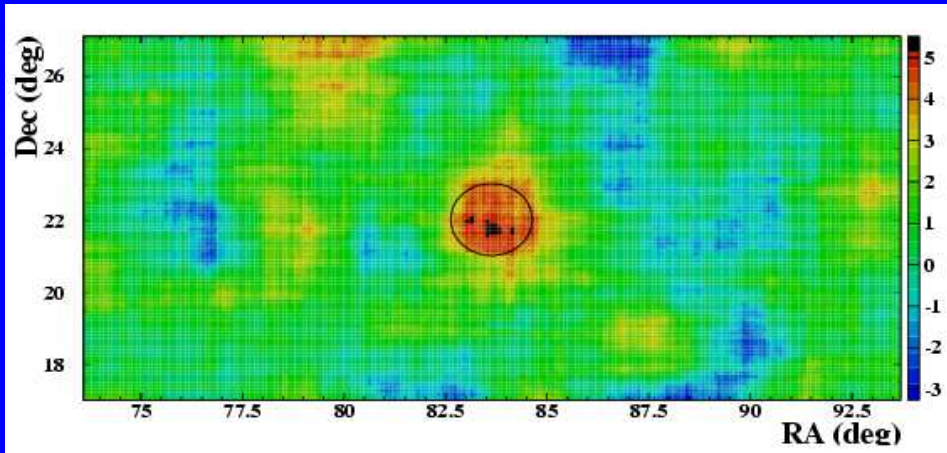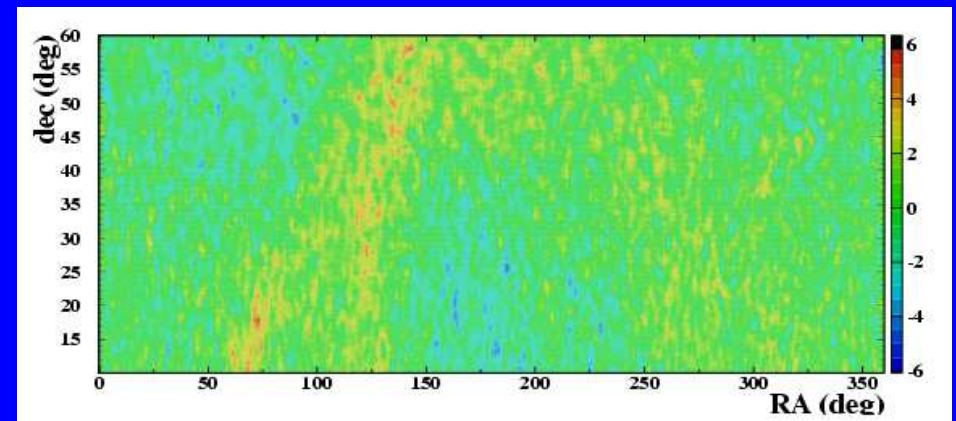

Crab in rec data

Fine Skymap
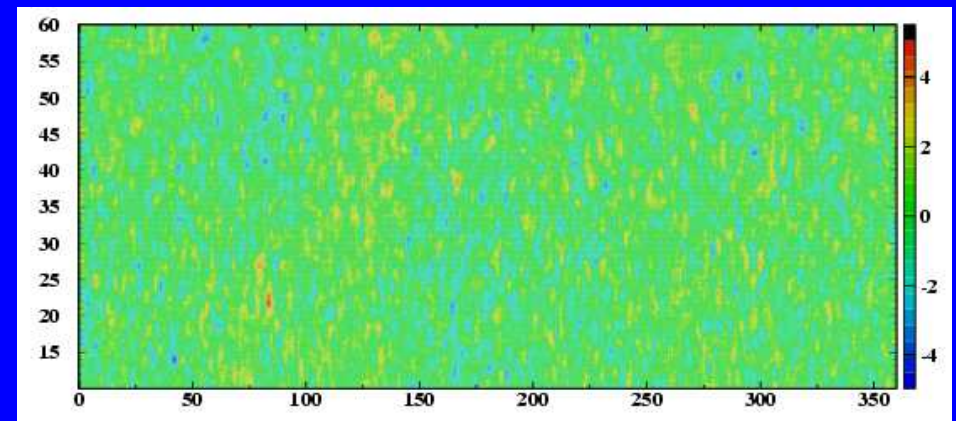
Coarse Skymap

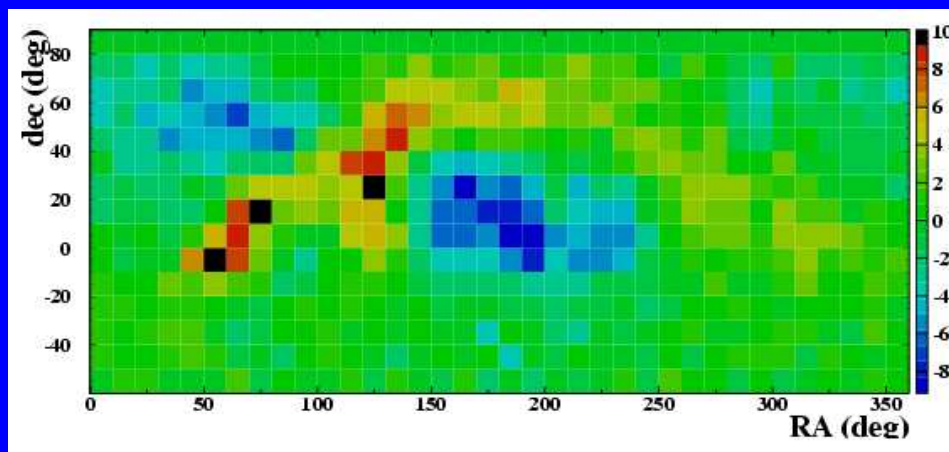# Sky map for ~2.3 years of data $X_2 > 0.0$

Crab in rec data

Fine Skymap

Coarse Skymap

Anisotropy due to J2000 Coordinate System?

(RA,dec) defined wrt rotation axis of the earth.

We use this in the background subtraction (time sloshing/direct int) by assuming that changing the time at which an event is collected only changes the RA.
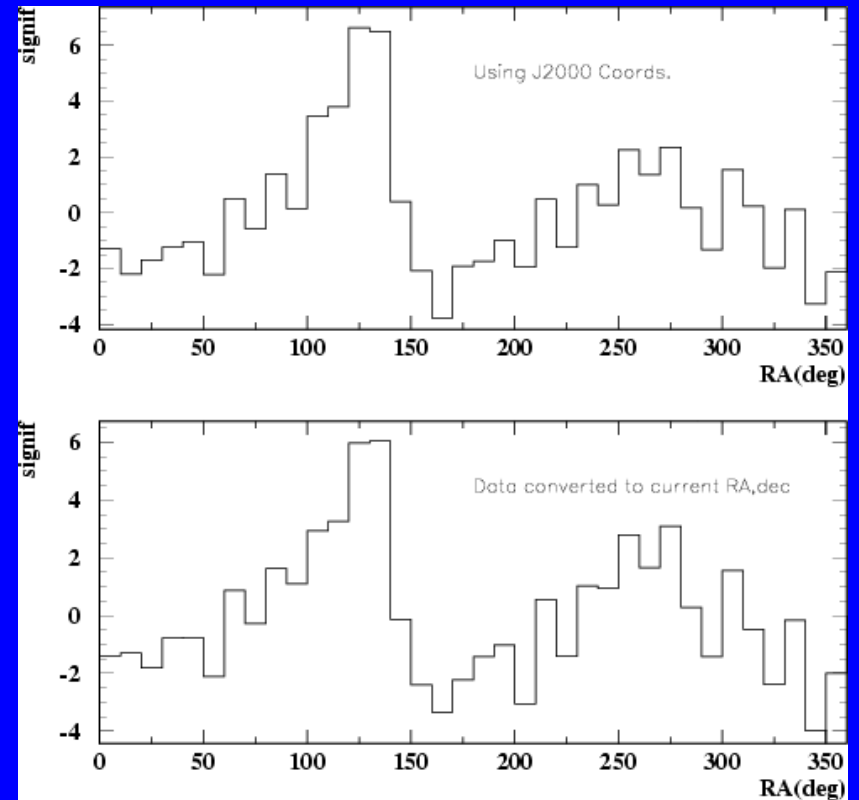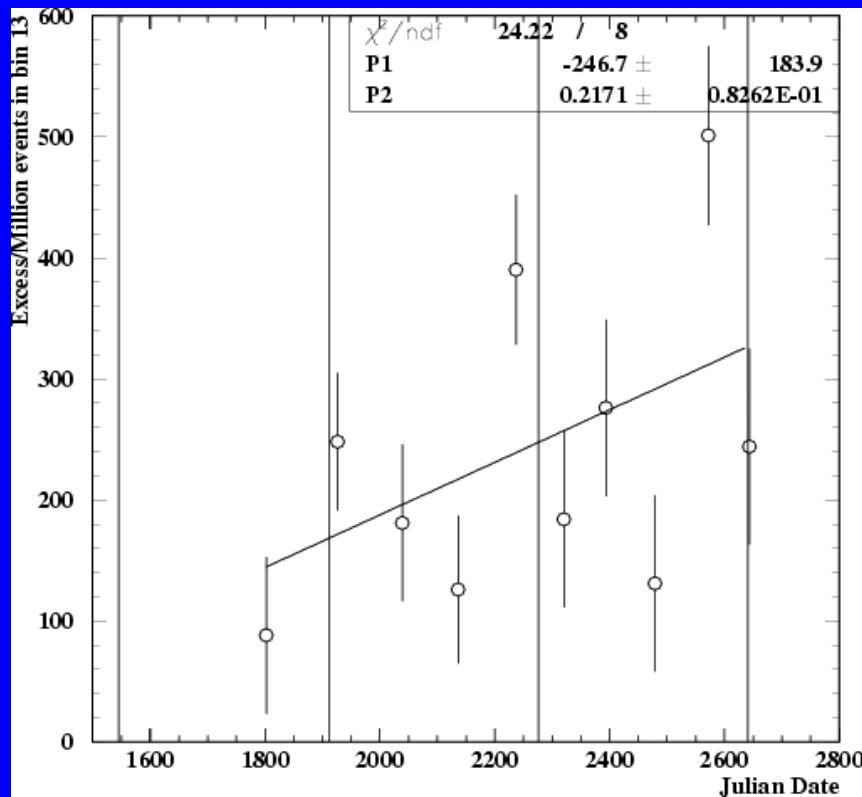
We don't record (RA,dec) in the data. We record (RA2000,dec2000)! The rotation axis of the earth is NOT exactly aligned with the event coordinate system.
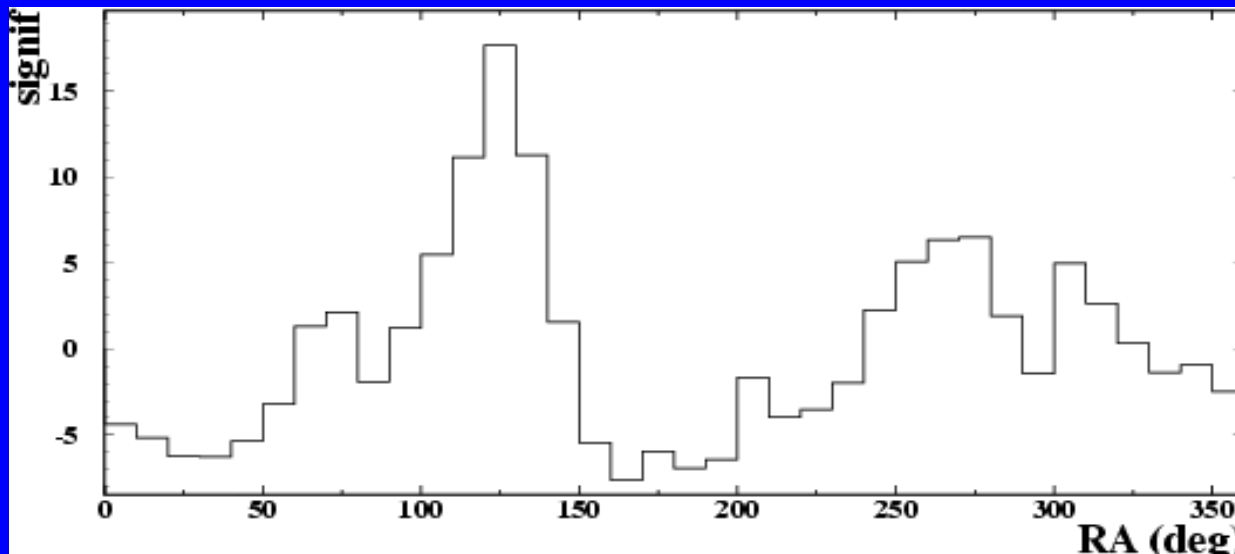
# Anisotropy due to J2000 Coordinate System?

3 Checks:

1) Effect should be proportional to days since Jan 1,2000.
2) Remove J2000 correction after the fact.
3) Simulate effect.

Rec Data Simulation

I wrote a simple simulation that generates a cos(th)**5
zenith angle distribution, and simulates event times as well.

The code is incorporated within MilagroEvent() so it can
be call by the code used to do any analysis.
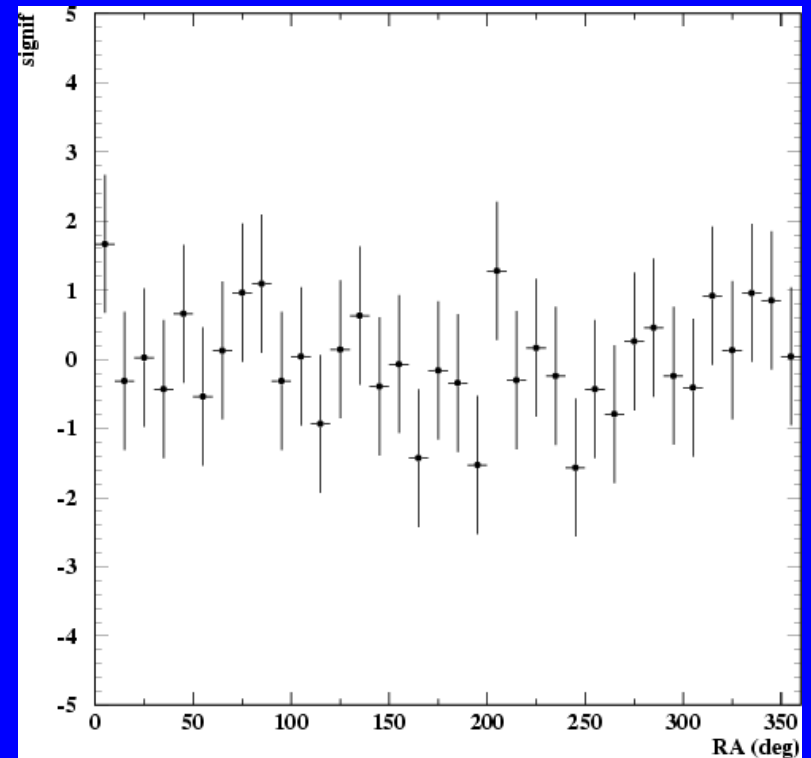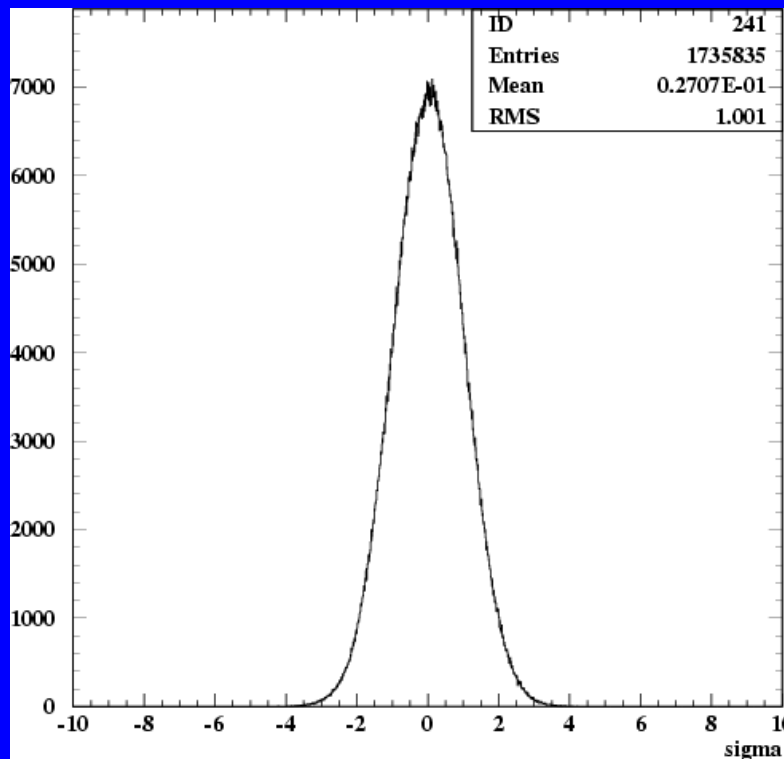
Results from 60 Billion Simulated Events

Interpretation

This anomaly is:

1) Not an artifact of the analysis.

2) Present during all epochs of the experiment

3) Present during all seasons

4) Signal proportional to number of events (ie behaves
   like background when X2 cut applied)

Conclude: This is evidence of a substantial anisotropy in the
cosmic ray flux.

People predict such anisotropies, but the predictions are complex
and energy dependent. There may be loads of cosmic ray physics
in this data independent of the galactic plane.