Neutrino Point Sources in B10 Data

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IceCube Meeting
Wisconsin, April 2007

No Neutrino Point Sources in B10 Data

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Overview

- Introduction
- Neutrinos a-plenty
- Quality Cut Optimization
- 3-year Combination
- Result

Details: Wiki/B10_Point_Source_Search

Cut Method (Neyman-Pearson)

$\sigma_{paraboloid}$

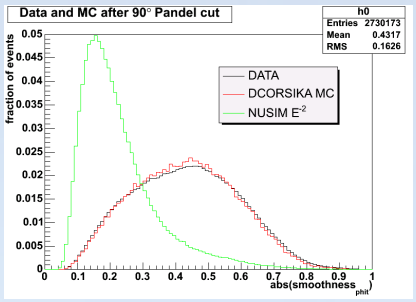
$smooth_{phit}$

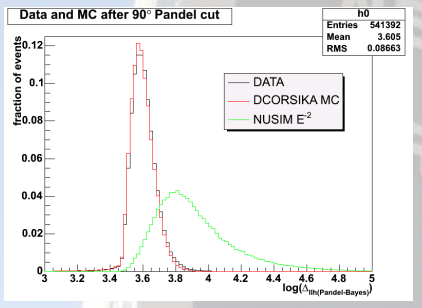
$\frac{L_{dir} * N_{dir}}{N_{om}}$

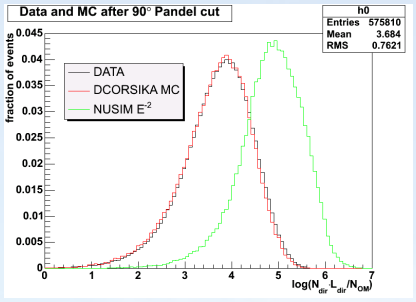
$\Delta_{llh,unred}$

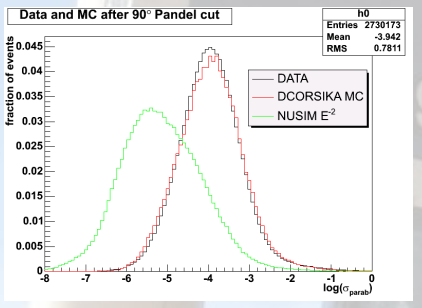
$$\Lambda(\vec{x}) = \frac{pdf(\vec{x}|S)}{pdf(\vec{x}|B)} \approx \prod_{i=1}^{N_{obs}} \frac{pdf(x_i|S)}{pdf(x_i|B)}$$

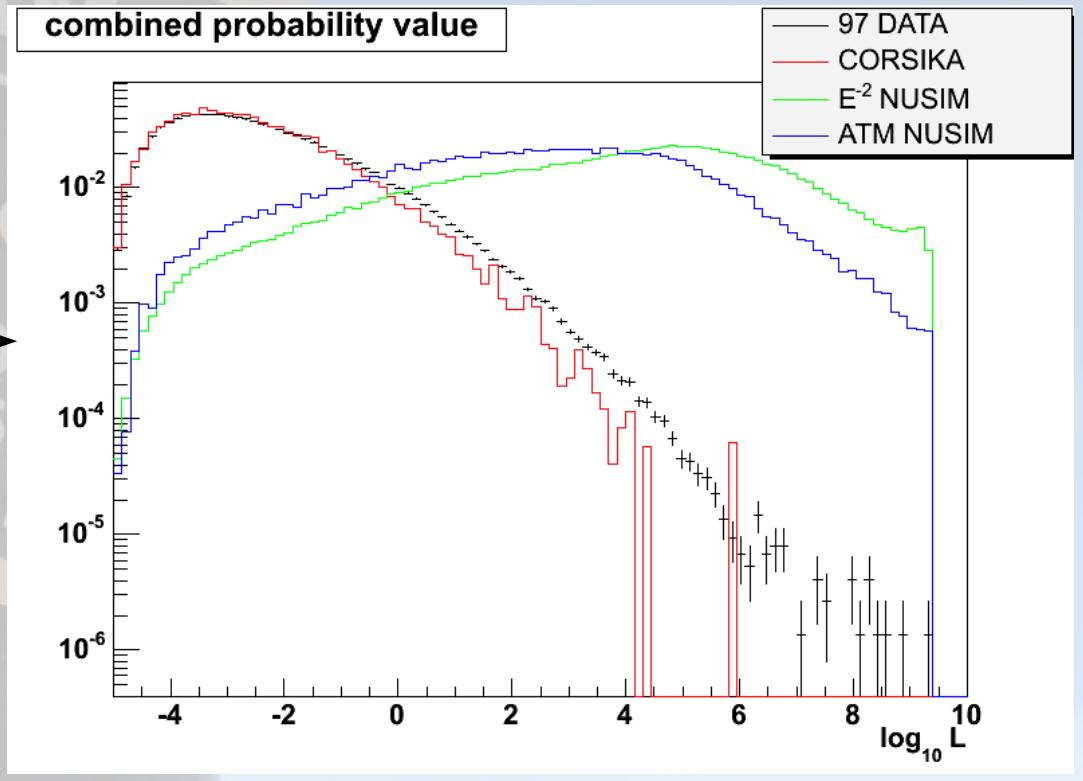
Cut Method


Data and MC after 90° Pandel cut
h0
Entries 2730173
Mean 0.4317
RMS 0.1626
DATA
DCORSIKA MC
NUSIM E-2
fraction of events
abs(smoothness)


Data and MC after 90° Pandel cut
h0
Entries 541392
Mean 3.605
RMS 0.8663
DATA
DCORSIKA MC
NUSIM E-2
fraction of events

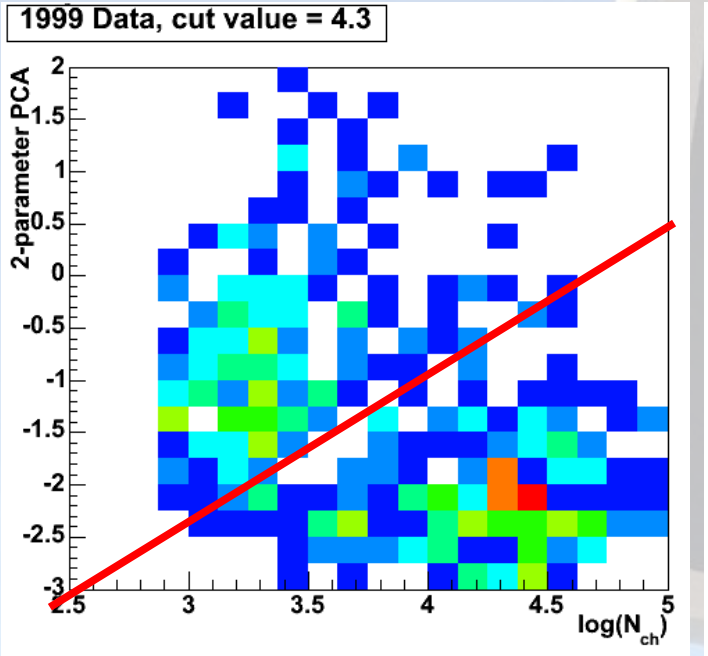

Data and MC after 90° Pandel cut
h0
Entries 575810
Mean 3.684
RMS 0.7621
DATA
DCORSIKA MC
NUSIM E-2
fraction of events

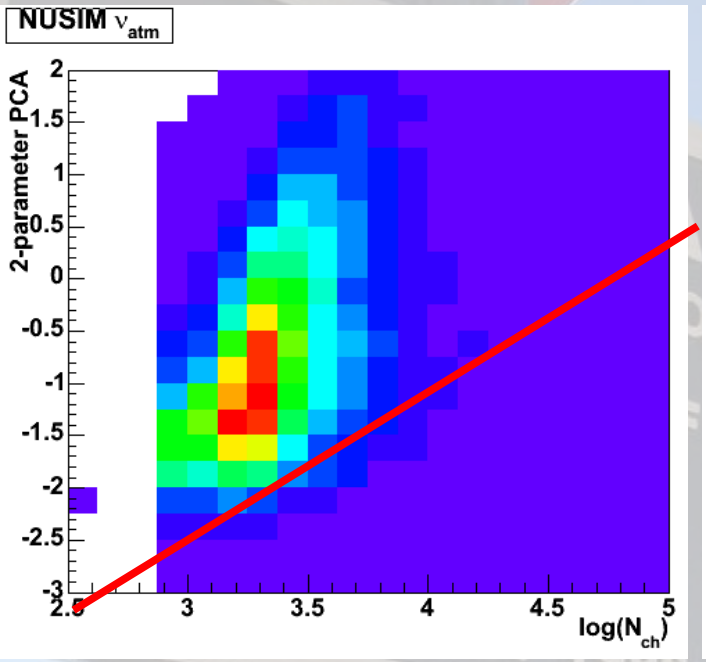

Data and MC after 90° Pandel cut
h0
Entries 2730173
Mean -3.942
RMS 0.7811
DATA
DCORSIKA MC
NUSIM E-2
fraction of events

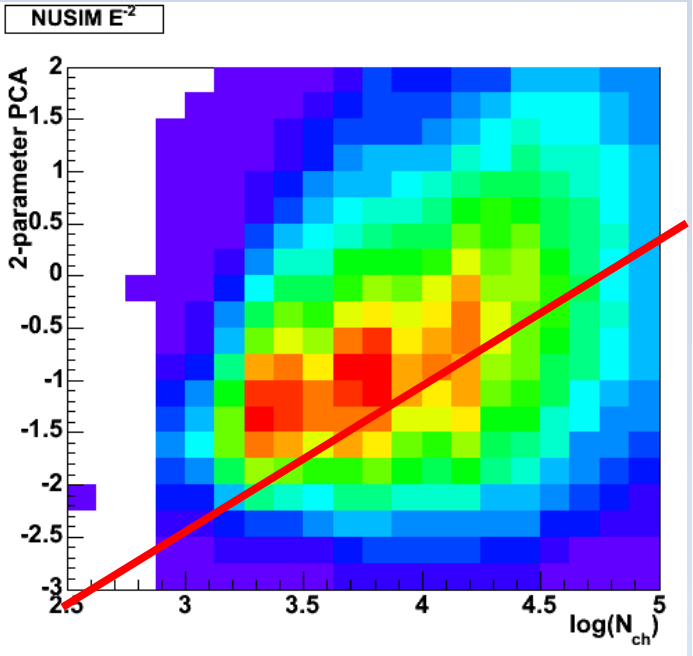

combined probability value
97 DATA
CORSIKA
E-2 NUSIM
ATM NUSIM
log10 L

Motion Picture

Example Neutrino Cuts

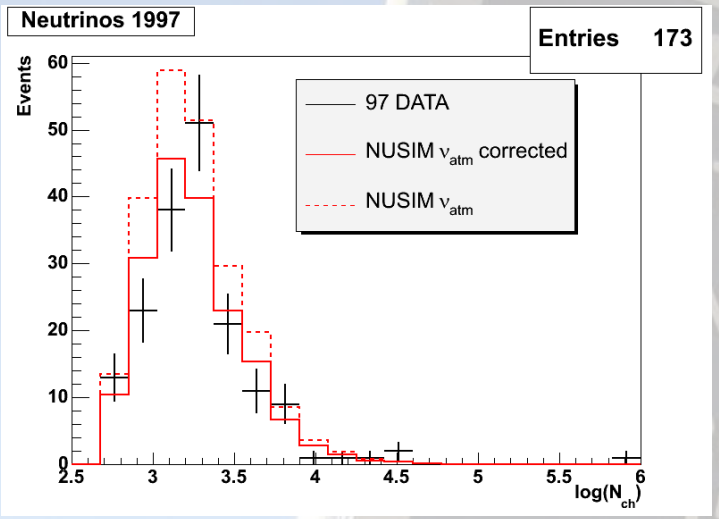


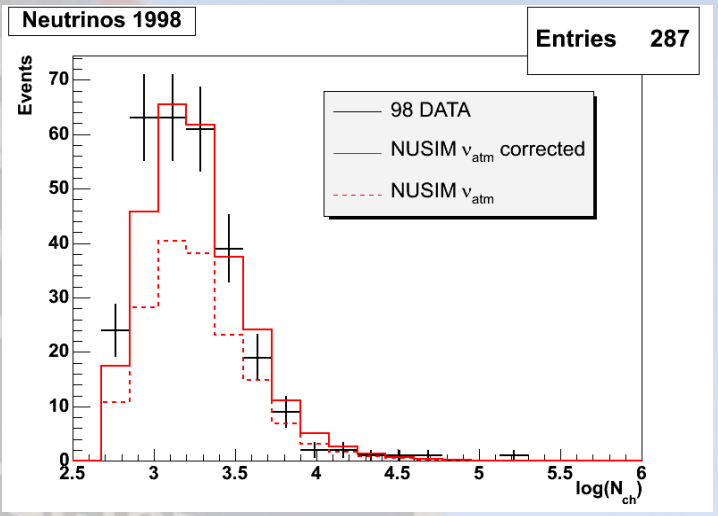


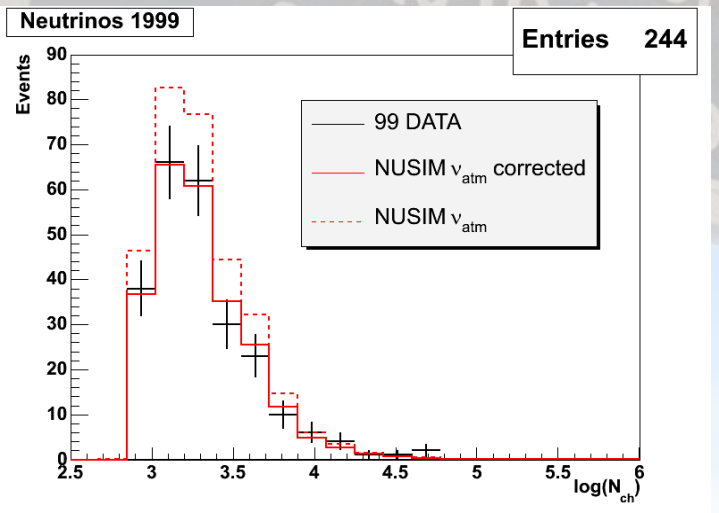


Cut NOT used for analysis

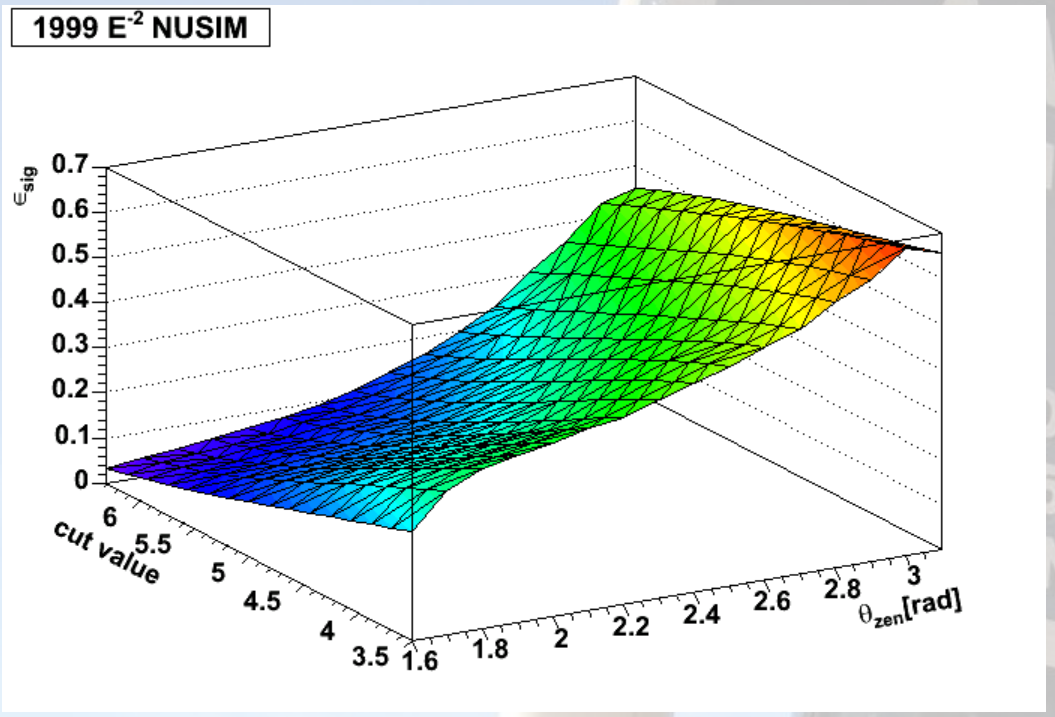
Example Neutrino Samples



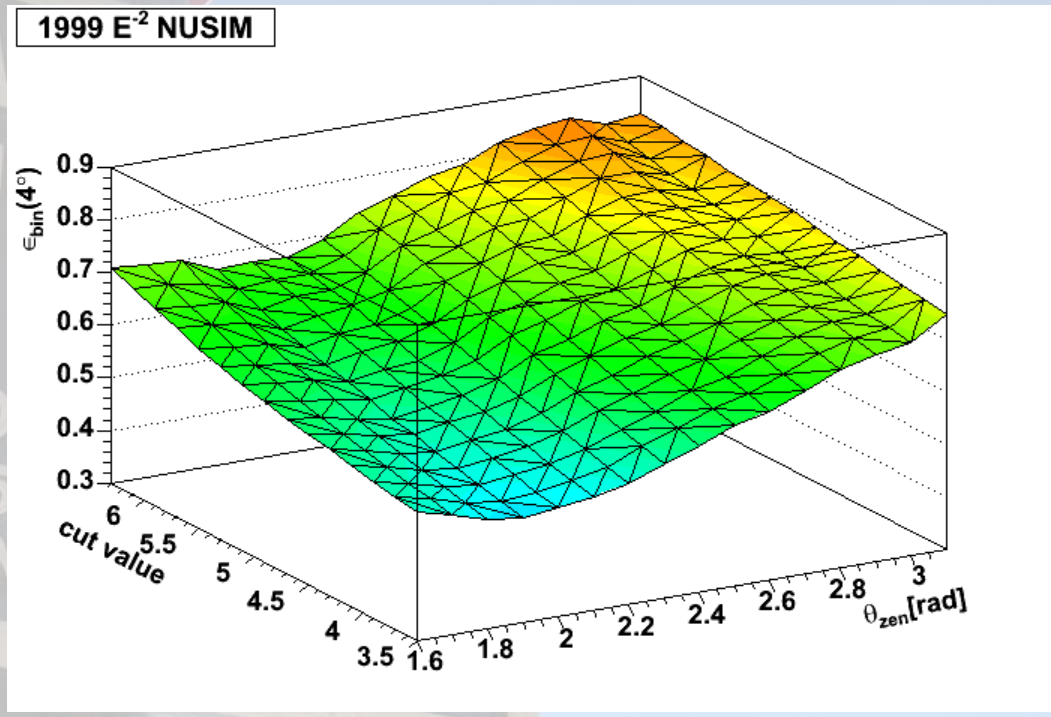




Cut Optimization (1 year)

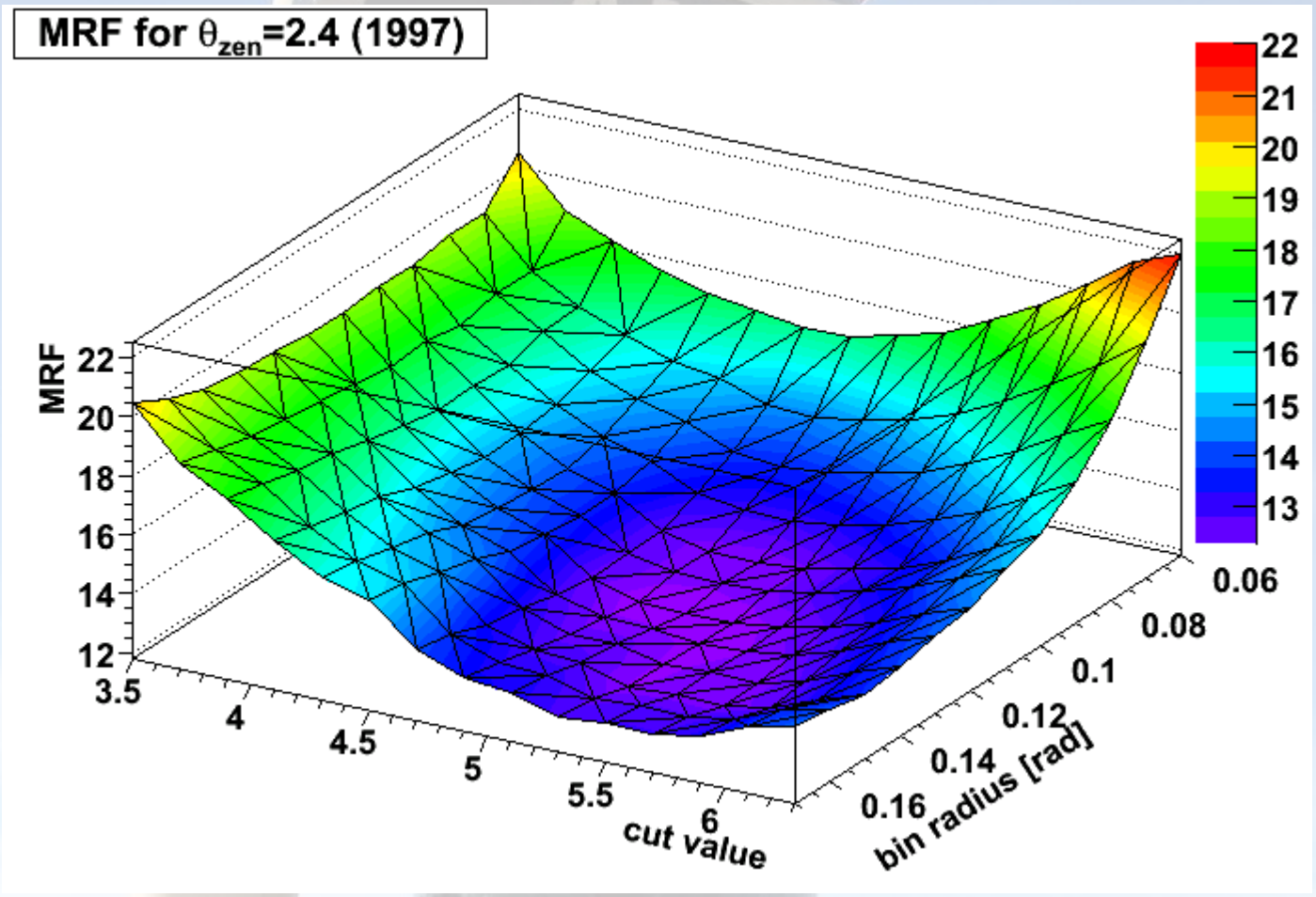


Signal Efficiency

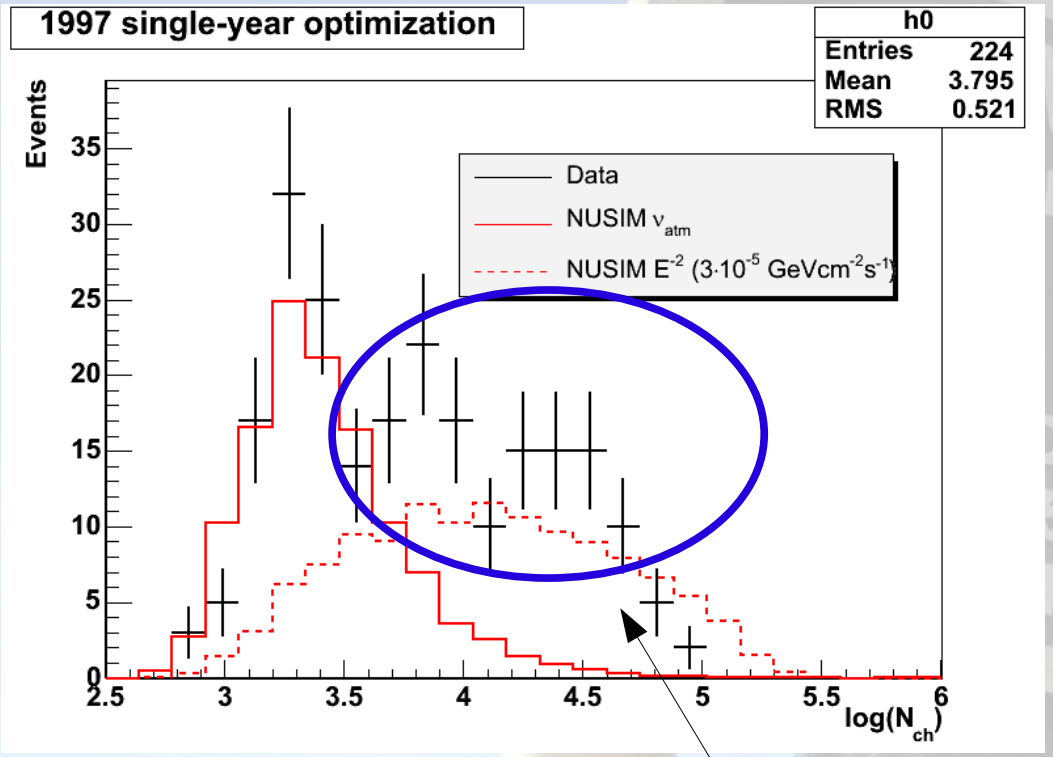


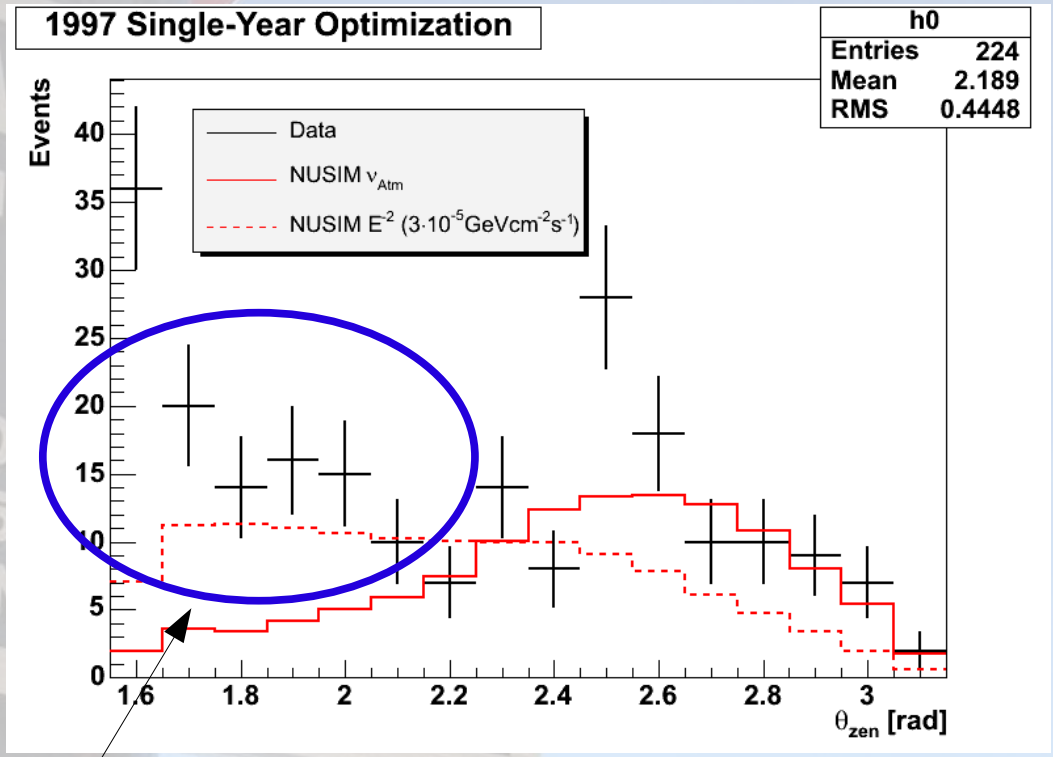
PSF

Cut Optimization (1 year)



1-Year Optimized Sample (1997)





Almost half of the events are atmospheric muons!

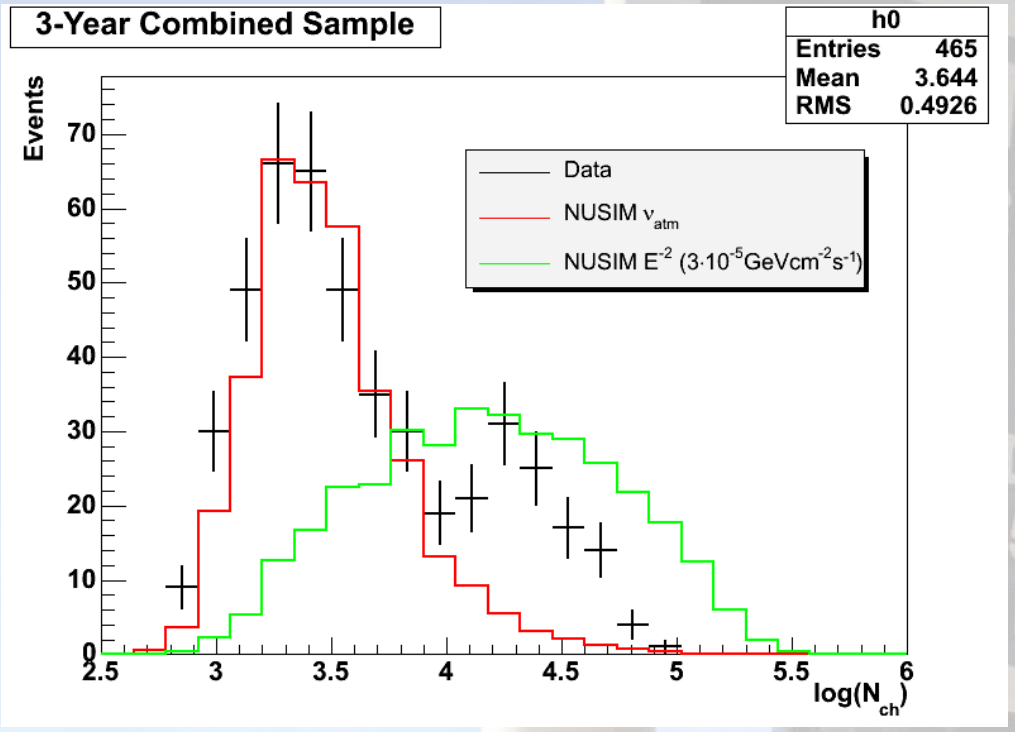
Three-Year Optimization

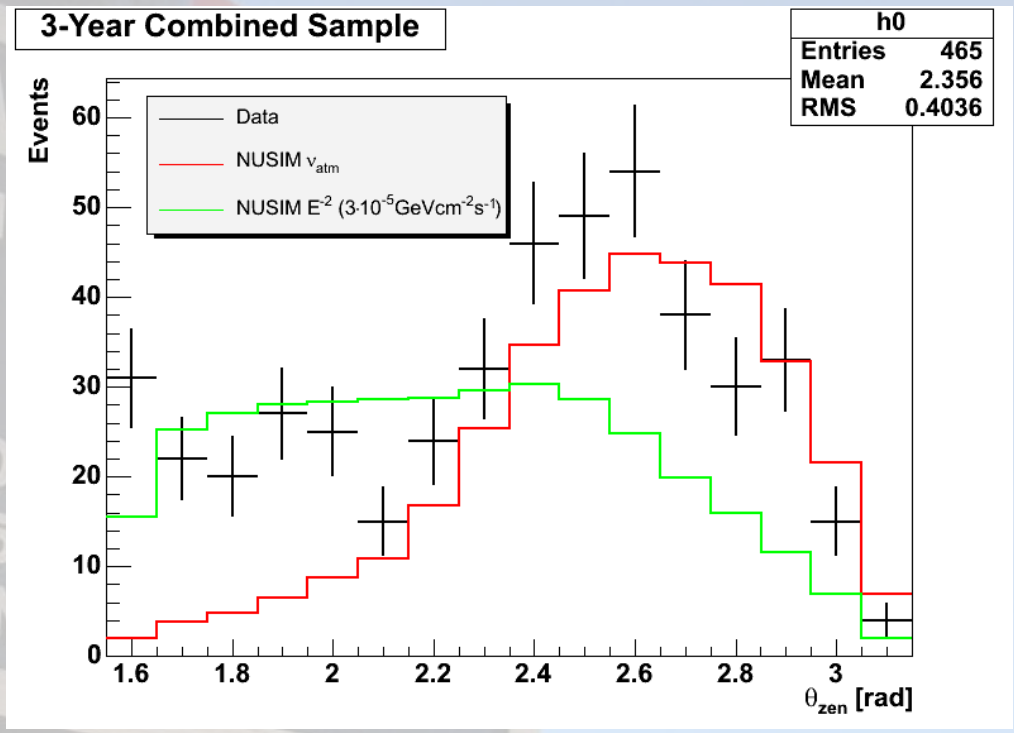
$$P(\vec{n}_{obs}|\Phi)=\prod P(n_{obs,i}|n_{bg,i},\frac{\Phi}{n_{sig,i}})$$

Construct combined confidence belt -> G. Hill

Three-year combination allows tightening of cuts, reduction of atmospheric muons in final event sample

Combined Optimized Sample

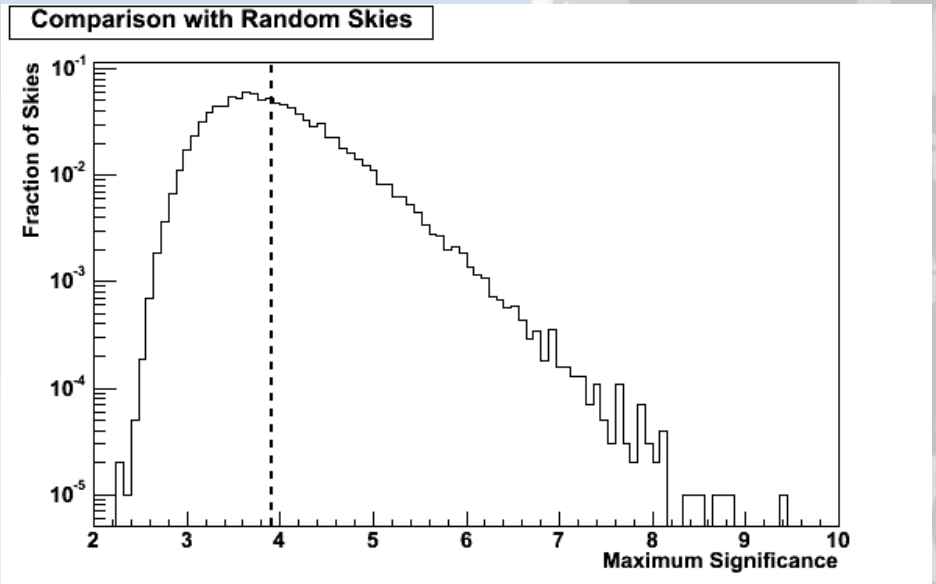


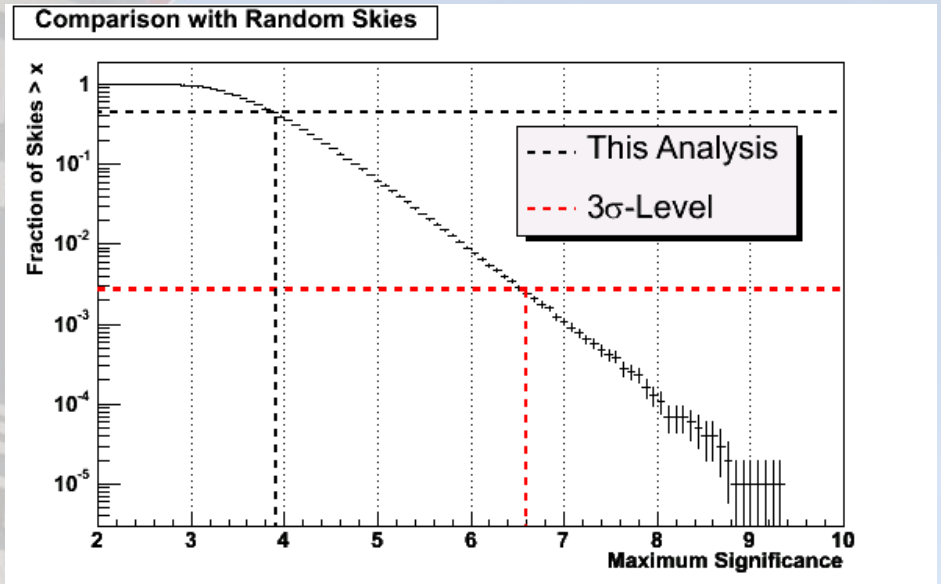


1997	128 events
1998	166 events
1999	171 events

Atmospheric Muon Background reduced to about 25%

Result:Significance



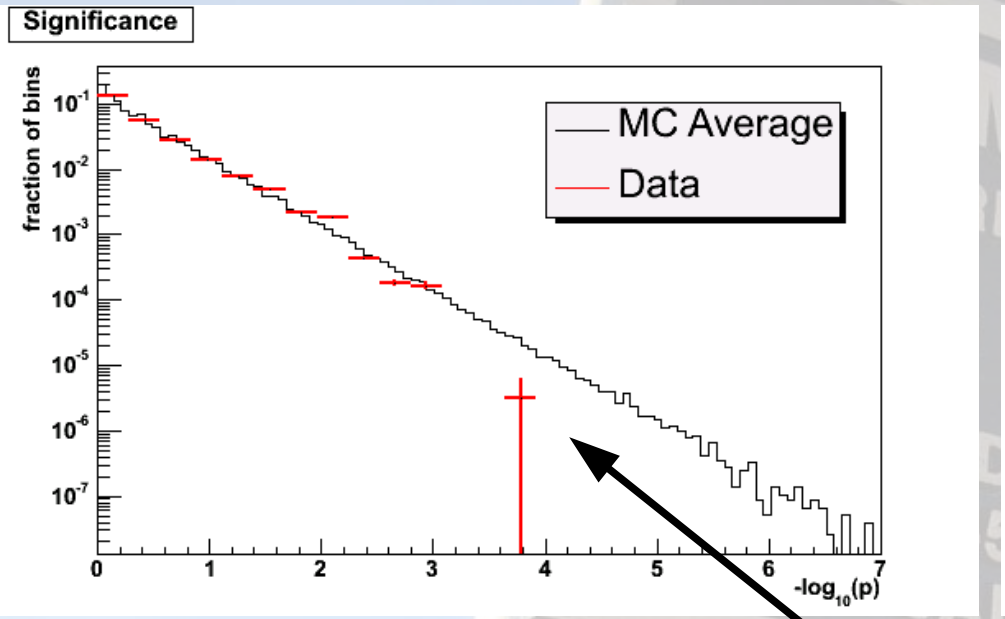


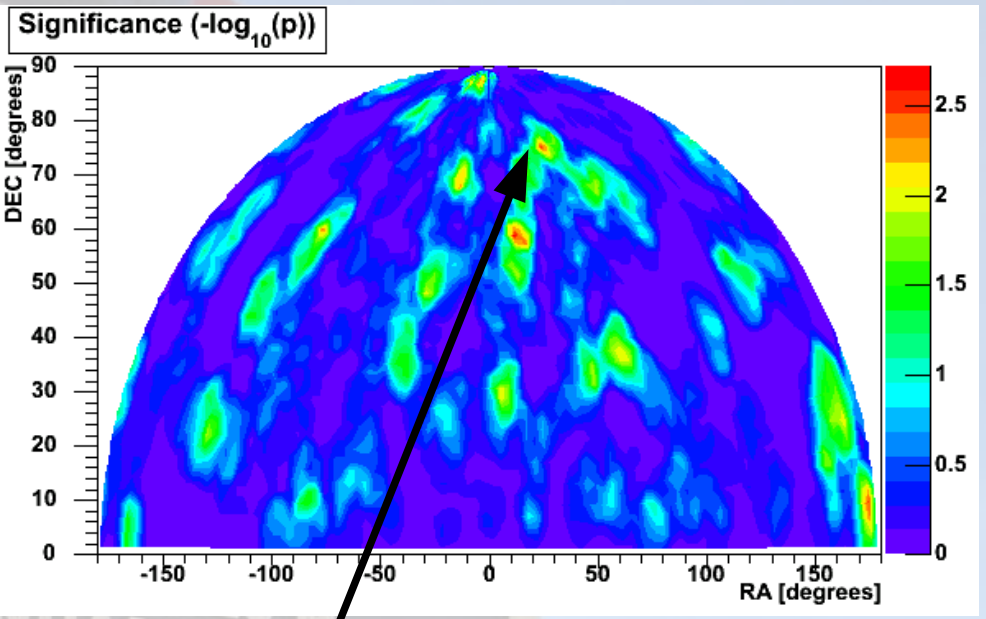
$$sig \equiv -\log_{10} P$$

Binning on grid with 0.5 degree spacing, 78000 grid points

45% of all random skies have higher maximum significance than data

Result: Significance



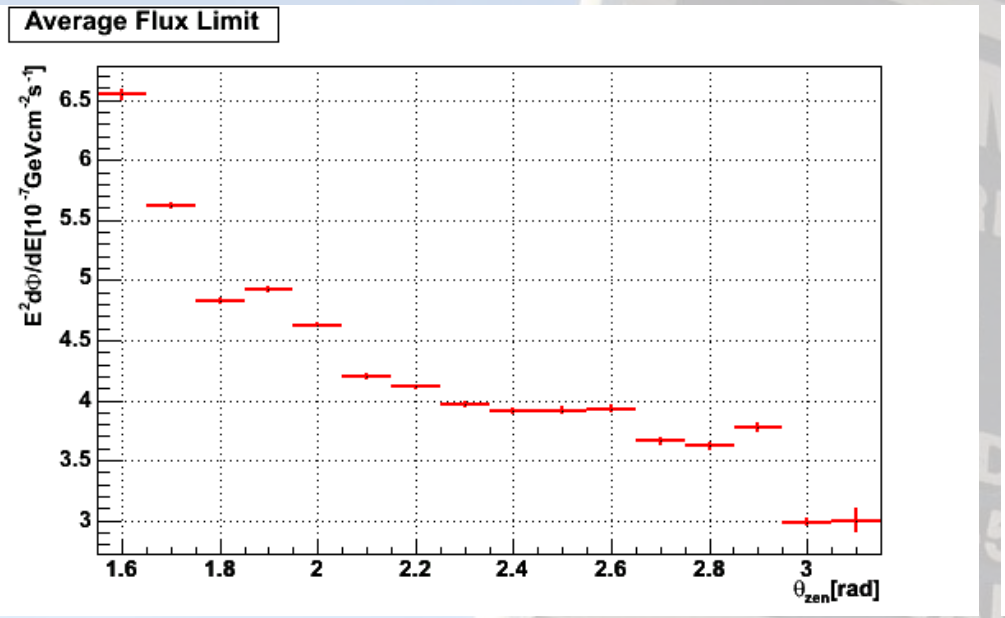


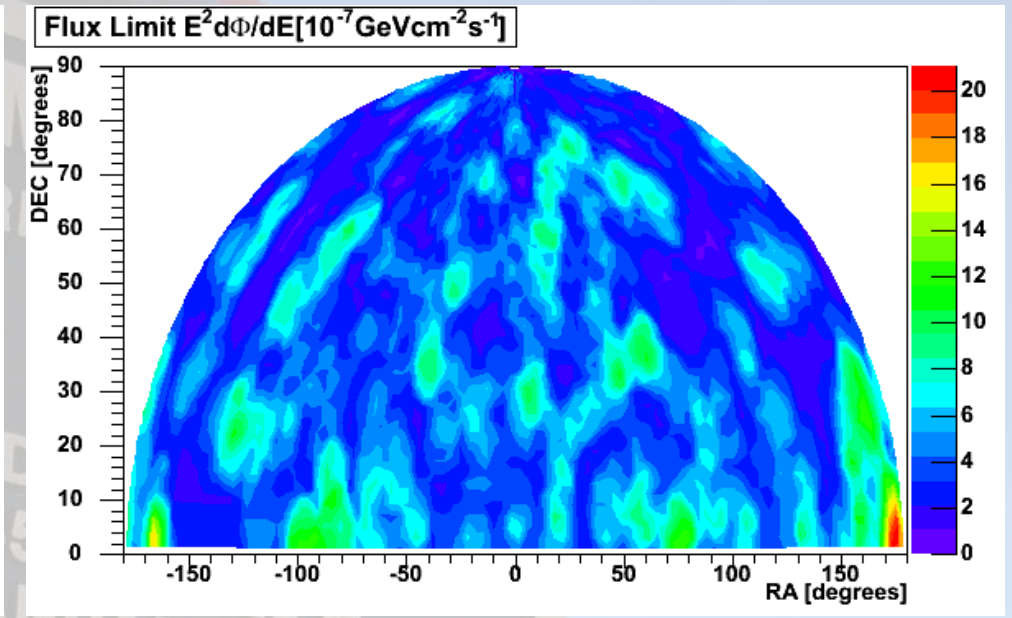
DEC: +71.16deg RA: 3h 44min

Hot spots not coincident with any (Amanda-II) candidate sources

Unusually smooth event distribution

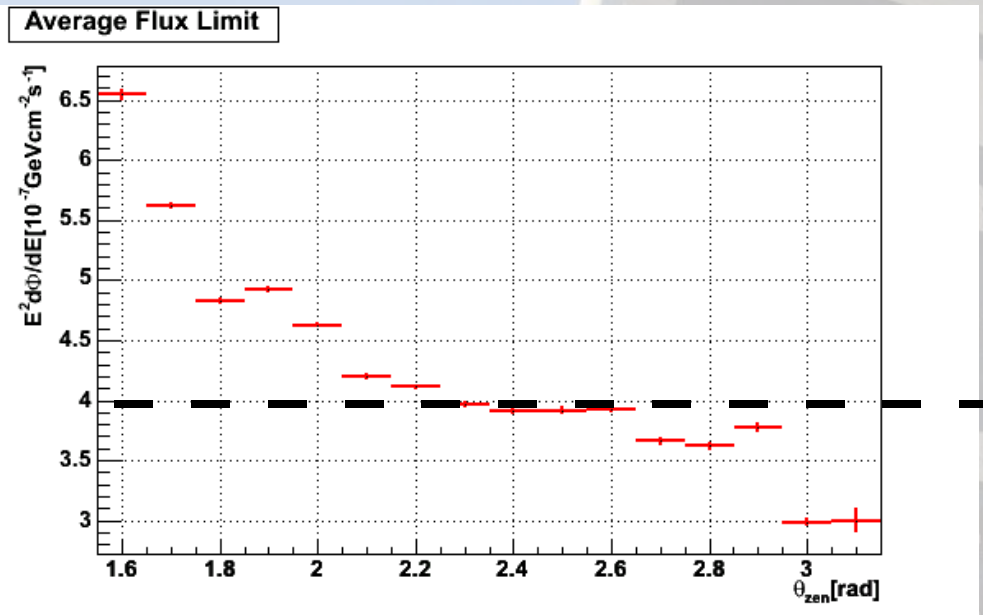
Result: Flux Limit

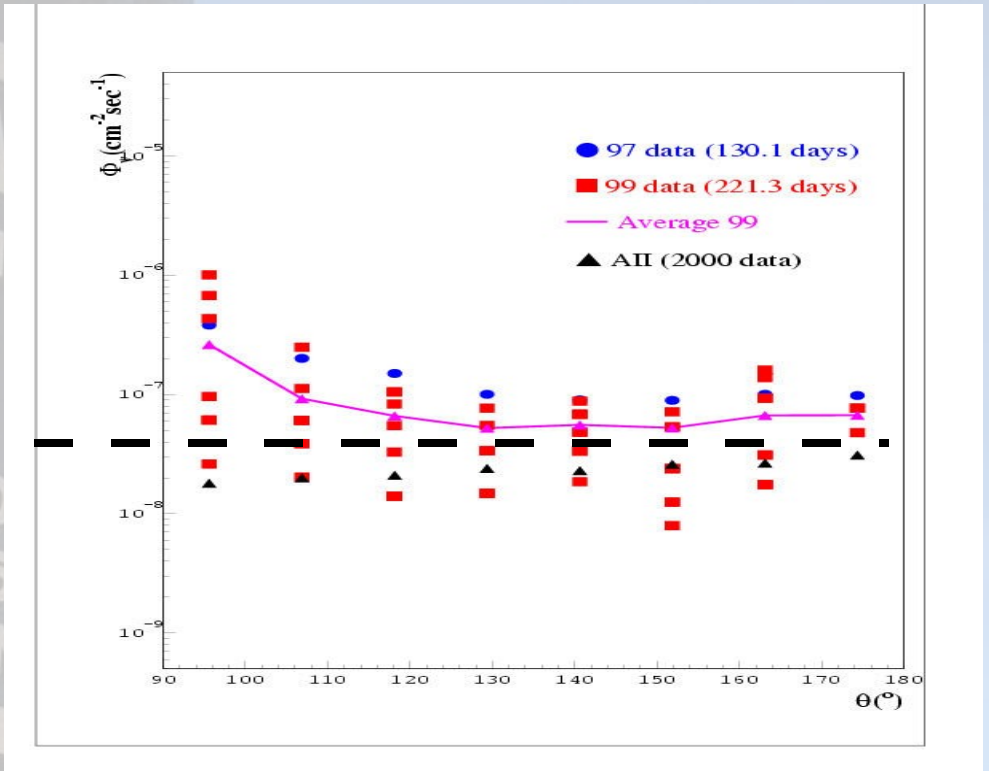




$$E^2 \frac{d\,\Phi}{d\,E} = 3 - 5 \cdot 10^{-7}\, GeV\, cm^{-2}\, s^{-1}$$

Result: Flux Limit





Best B10 limit yet

Not quite one A2 year

Conclusion

- Best B10 Point-Source Limit
- First PS analysis using 1998 data
- First Use of Neyman-Pearson Parameter
- LR combination of event samples
- No Sources Found