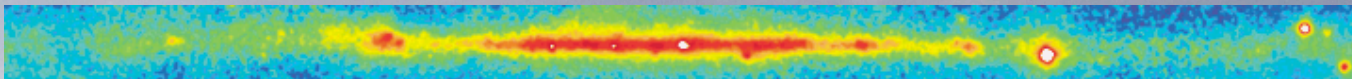
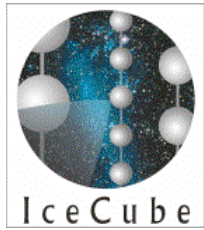


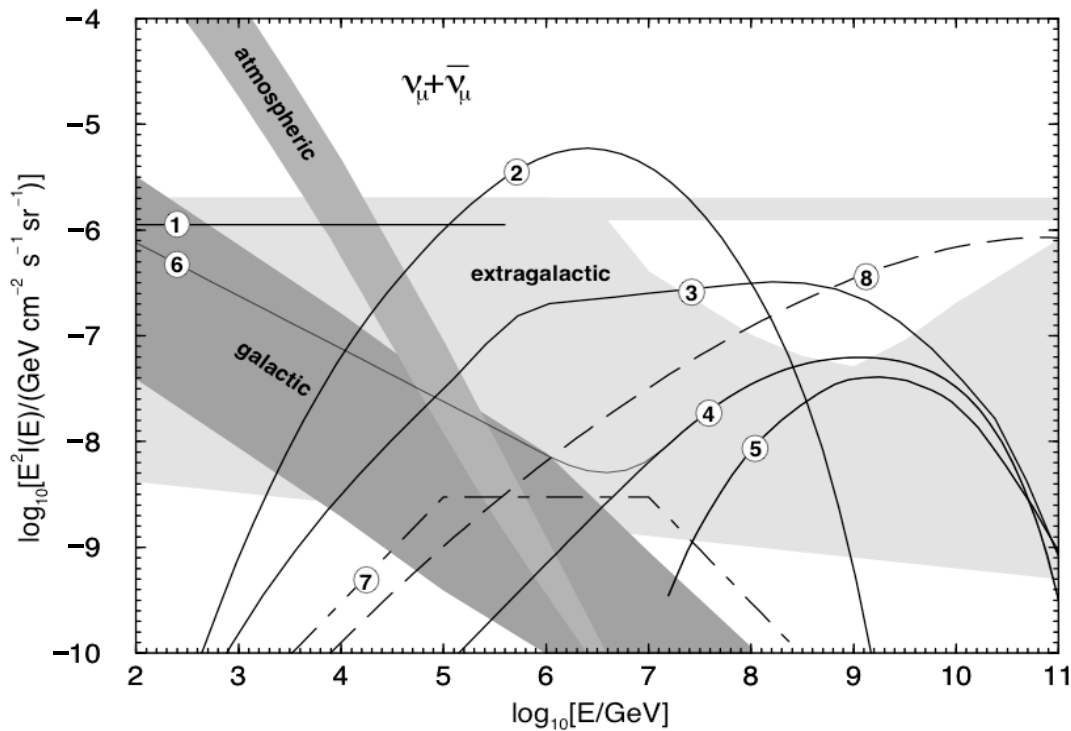
# A Search for High-Energy Muon Neutrinos from the Galactic Plane with AMANDA-II



John Kelley for the IceCube Collaboration  
University of Wisconsin — Madison, U.S.A.  
August 6, 2005

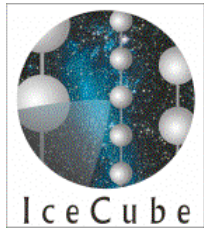


# Motivation

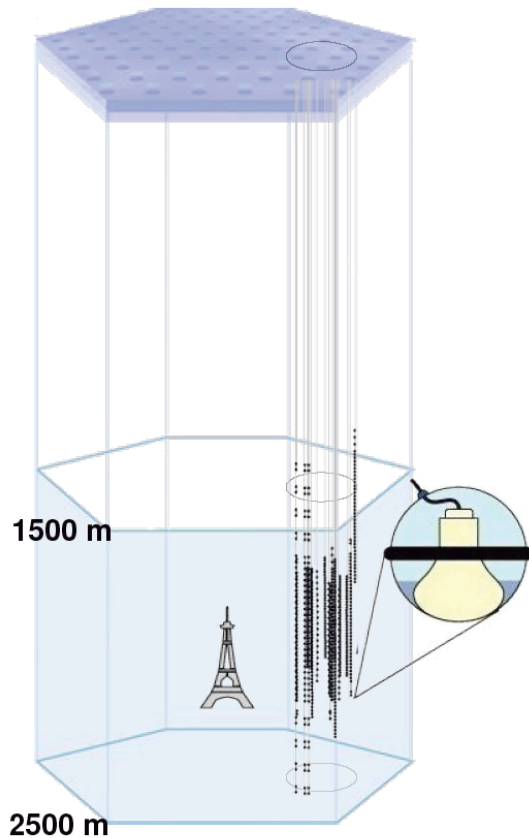


- Cosmic rays interact with galactic ISM, produce  $\gamma$ ,  $\nu$ , etc.
- Low density of ISM  $\Rightarrow$  spectrum follows CR primary spectrum,  $\sim E^{-2.7}$
- Most models predict flux proportional to ISM column density (highest toward GC)

Figure: Learned & Mannheim, Annu. Rev. Nucl. Part.Sci.2000.50  
Galactic flux model from Ingelman and Thunman, hep-ph/9604286



# AMANDA-II Subdetector



- Select “up-going” track-like events (from  $\nu_\mu$ )
- Sensitive to  $33^\circ < \text{gal. long.} < 213^\circ$
- Primary background: atmospheric  $\nu$

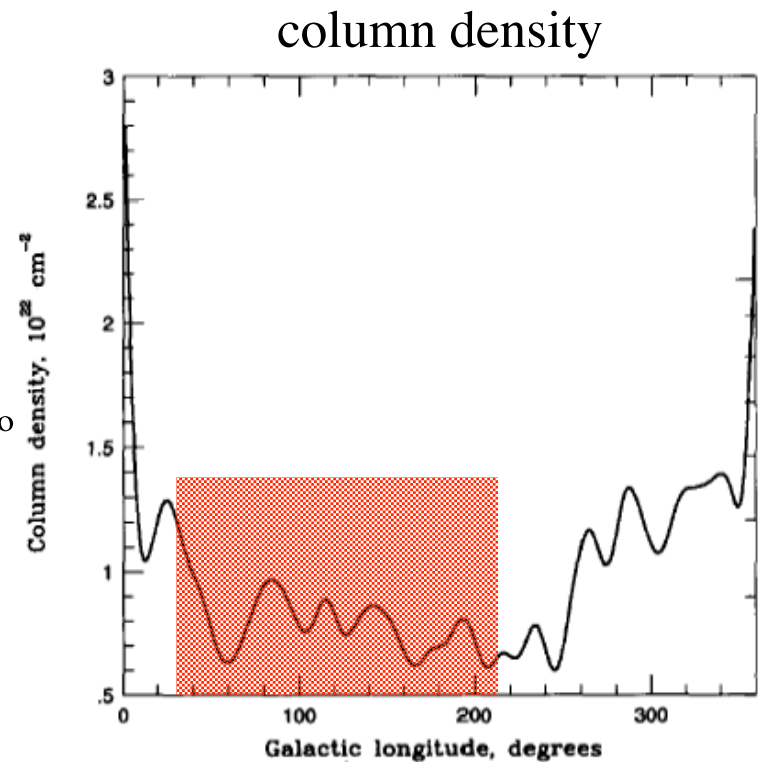
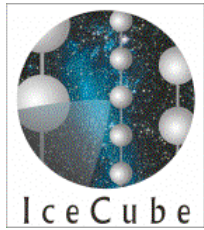


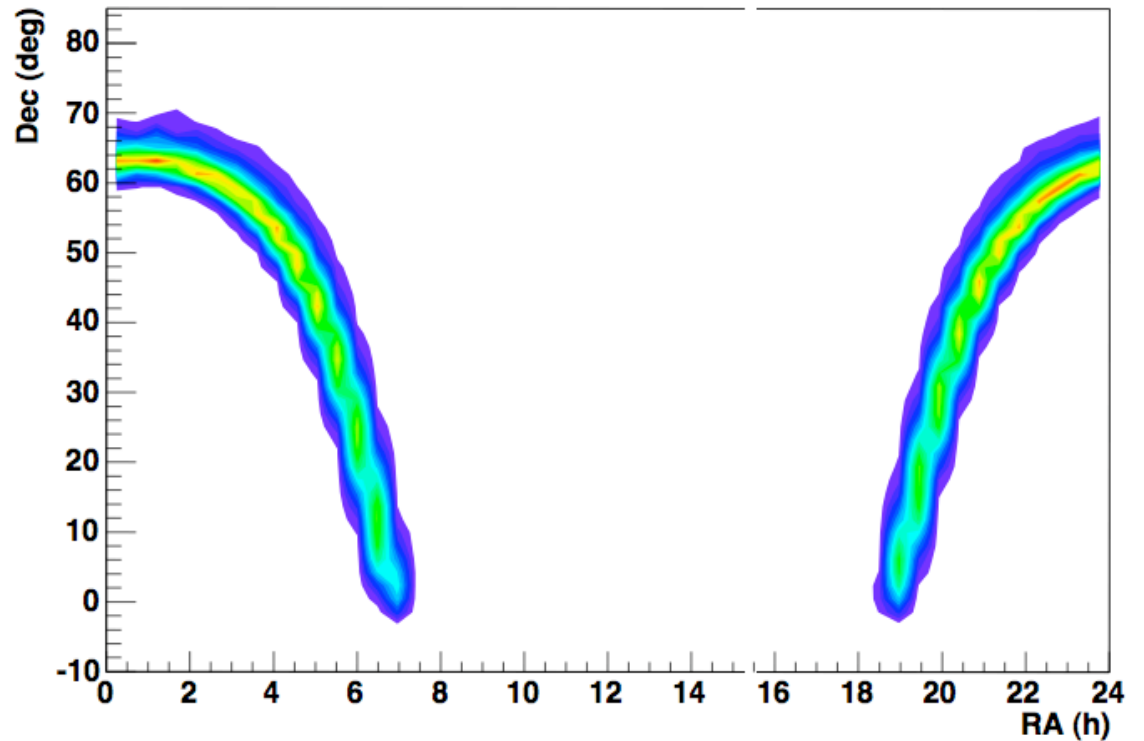
Figure: adapted from Berezhinsky *et al.* *Astropart. Phys.* 1, 281 (1993). Orig. from Bloemen.

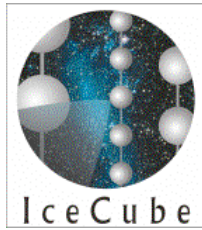


# Signal Hypothesis



- Line source of neutrinos from galactic equator
- Isotropic in galactic longitude
- Spectrum of  $E^{-2.7}$   
(other models considered)





# Spatial Profile

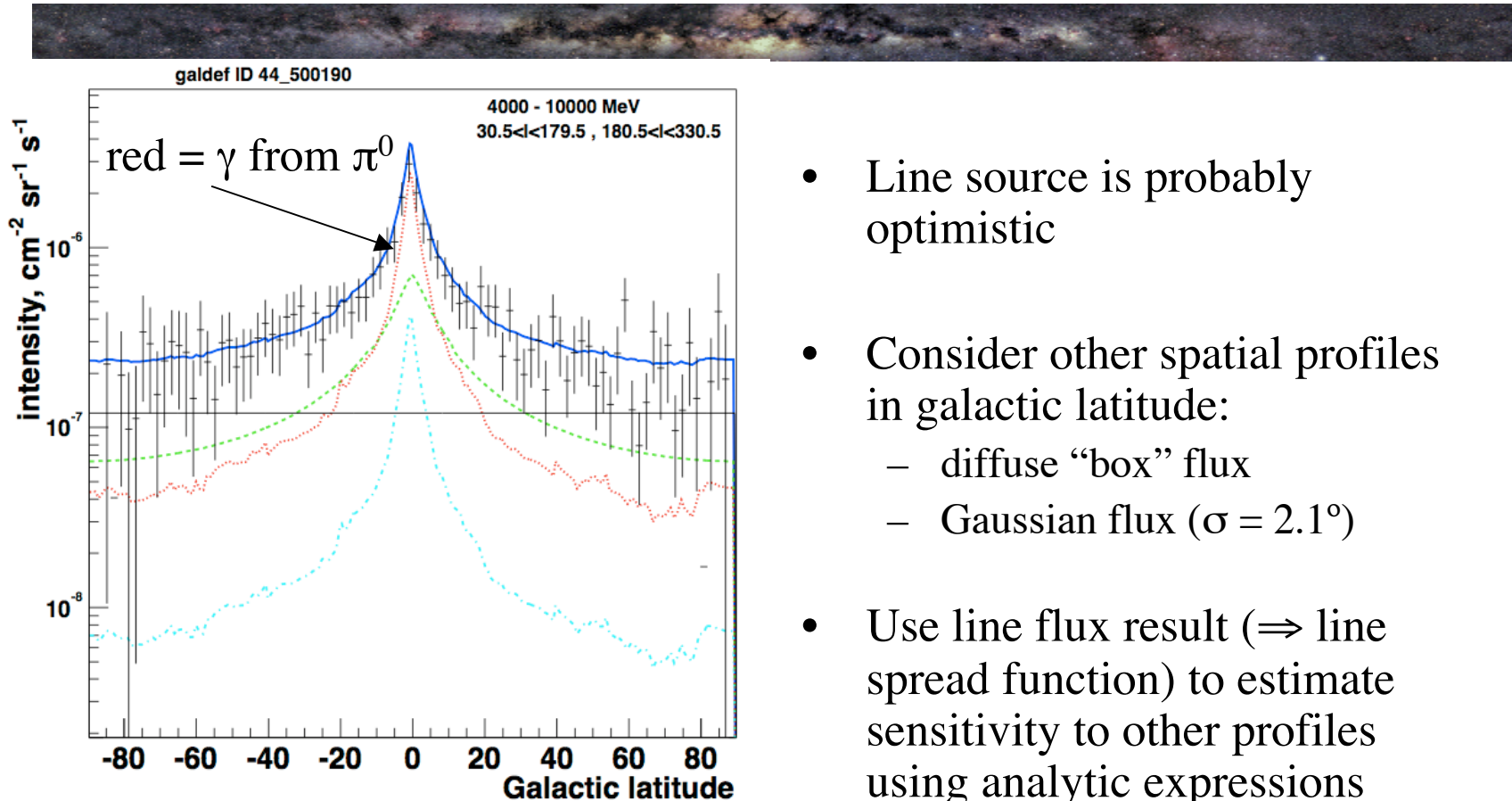
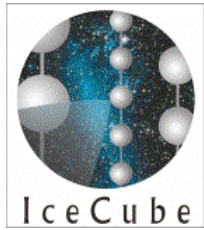
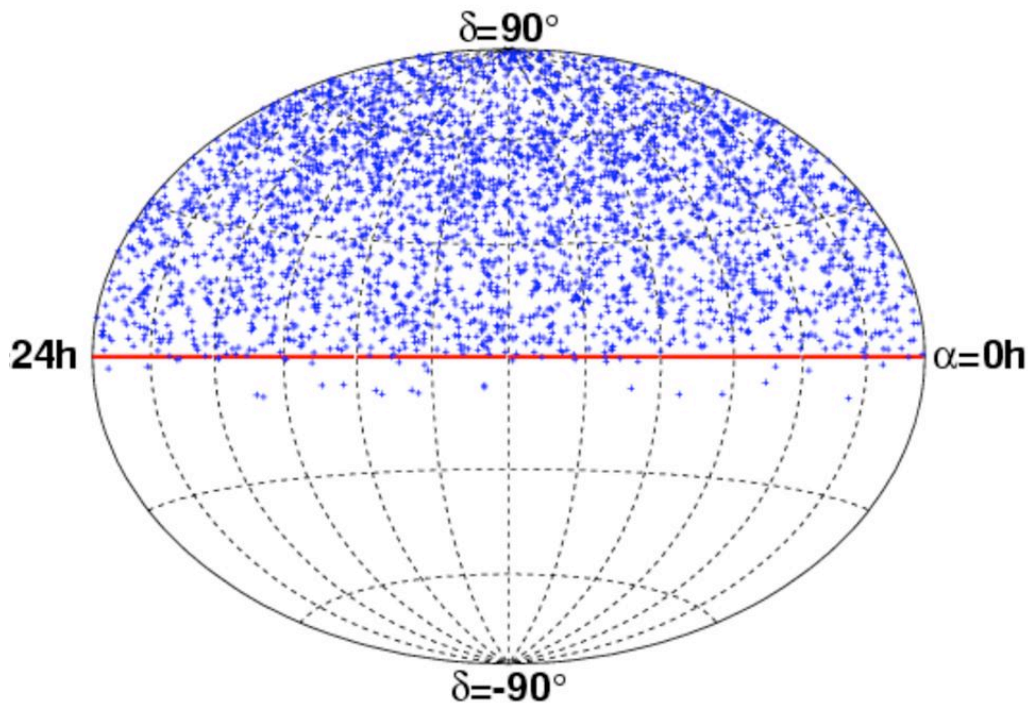


Figure: Strong, Moskalenko, and Reimer, astro-ph/0406254

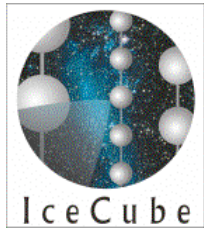
- Line source is probably optimistic
- Consider other spatial profiles in galactic latitude:
  - diffuse “box” flux
  - Gaussian flux ( $\sigma = 2.1^\circ$ )
- Use line flux result ( $\Rightarrow$  line spread function) to estimate sensitivity to other profiles using analytic expressions



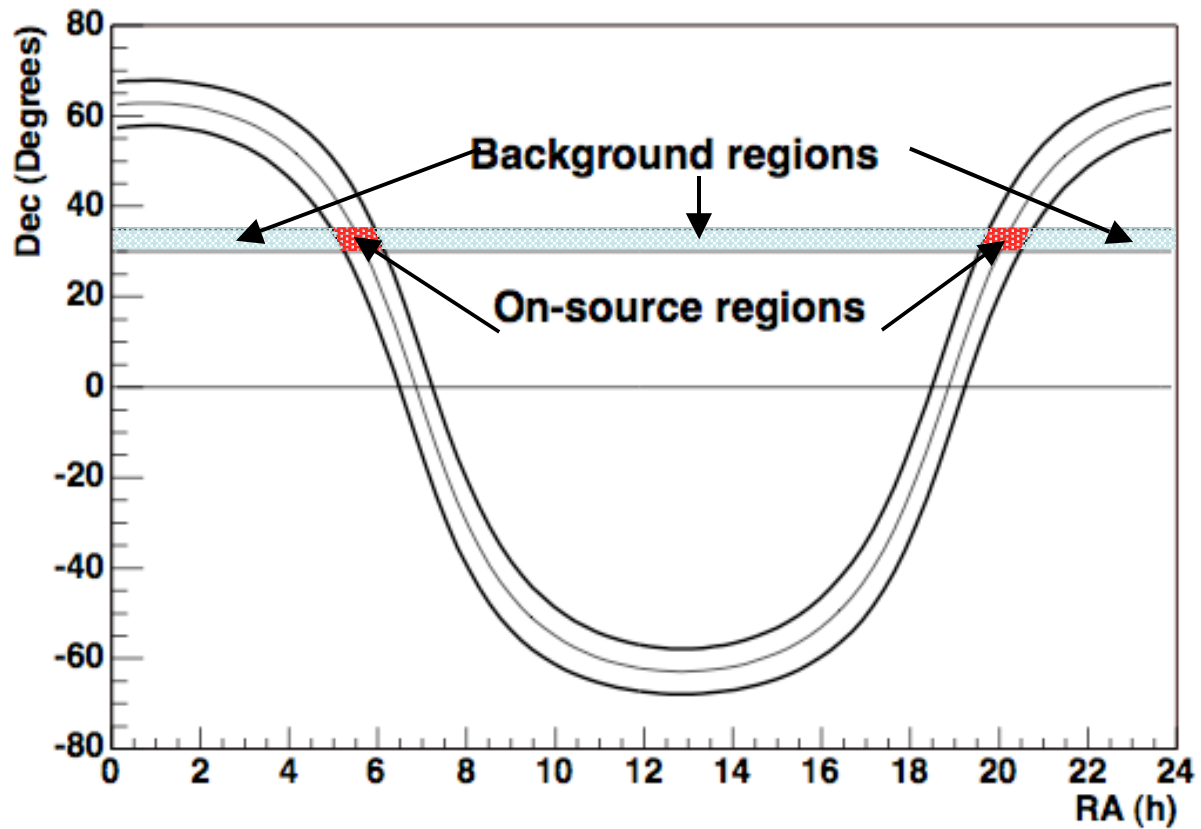
# Data Sample



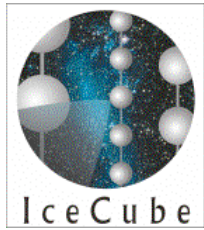
- Data collected from 2000-2003
- 807 days of livetime
- 3329 candidate events below horizon
- RA scrambled for blindness during analysis



# Background Estimation and Event Counting



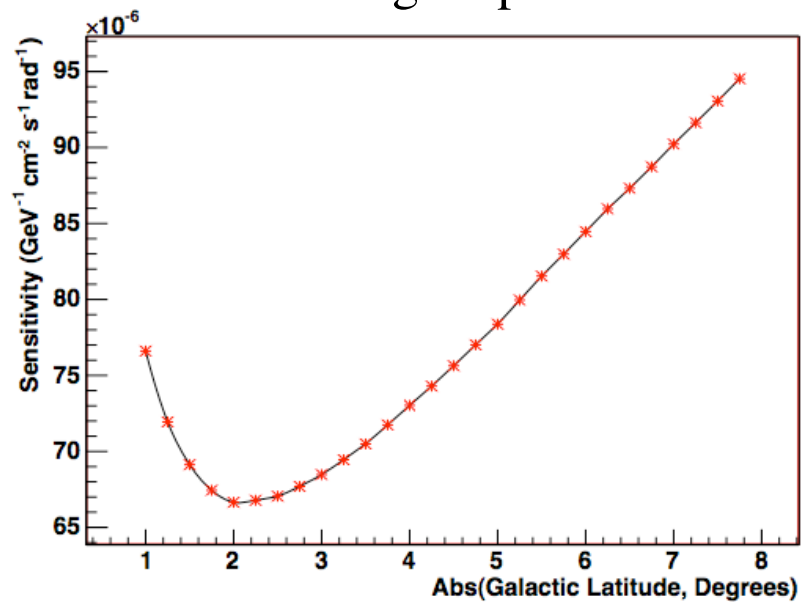
- Source is extended; background is declination-dependent
- Chop plane into  $5^\circ$  slices at a given declination
- Define on-source region around galactic equator
- Background estimated from off-source region



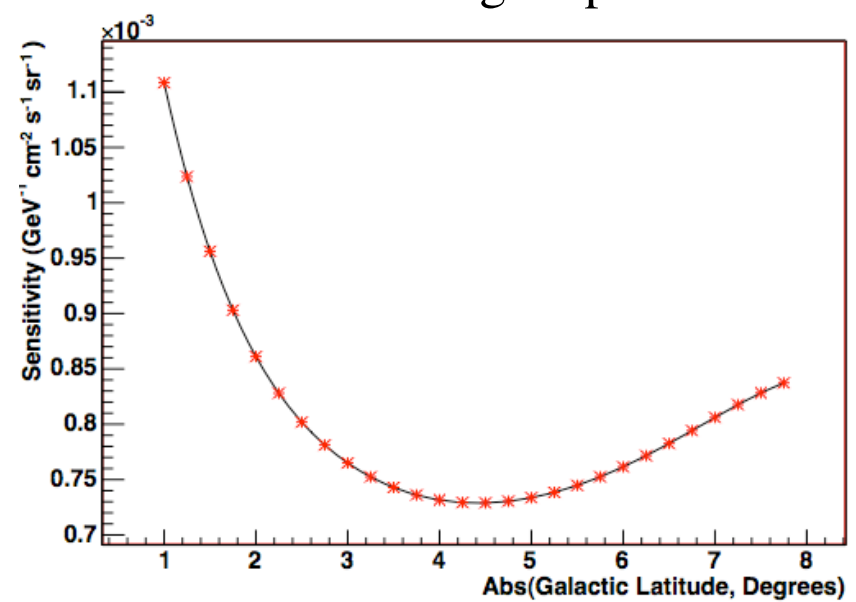
# Optimization



linear signal profile

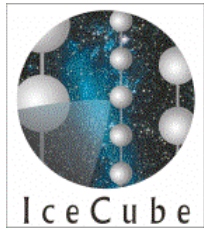


Gaussian signal profile

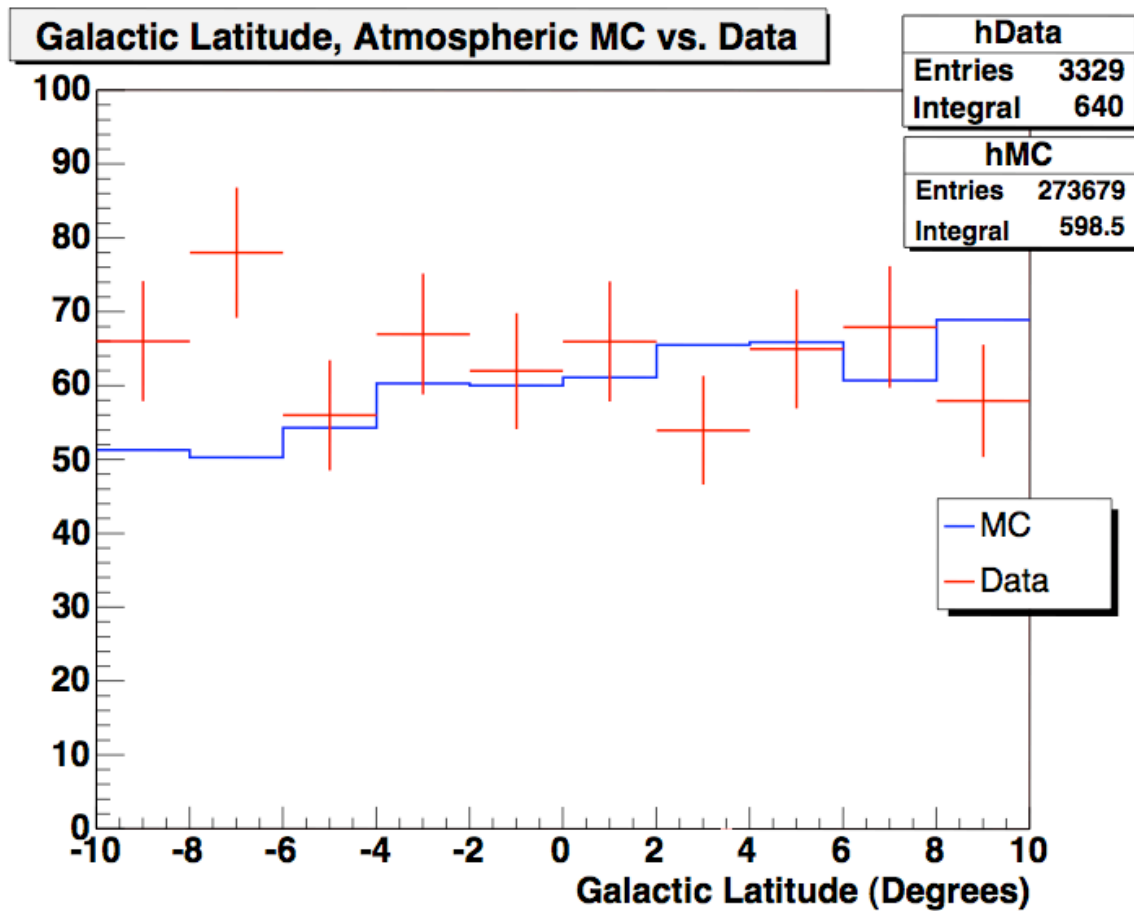


Optimal on-source region:  $\pm 2.0^\circ$  (line source) and  $\pm 4.4^\circ$  (Gaussian)

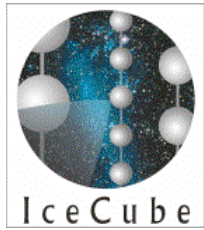




# Preliminary Results

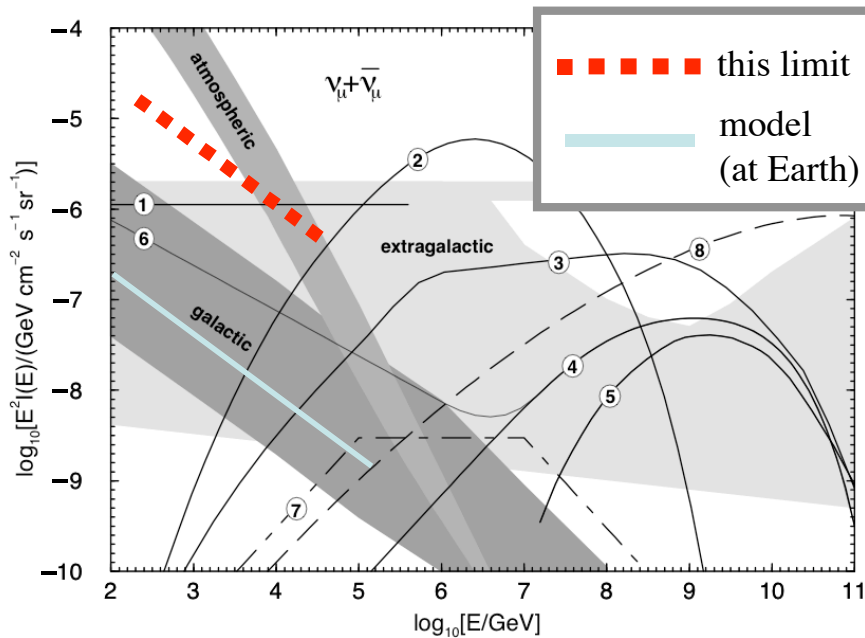


No excess observed



# Preliminary Limits

On-source region	On-source events	Expected background	90% event upper limit	Line source limit	Diffuse limit	Gaussian limit
$\pm 2.0^\circ$	<b>128</b>	129.4	19.8	$6.3 \times 10^{-5}$	$6.6 \times 10^{-4}$	—
$\pm 4.4^\circ$	<b>272</b>	283.3	20.0	—	—	$4.8 \times 10^{-4}$

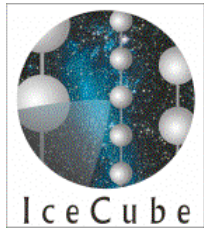


$\text{GeV}^{-1} \text{cm}^{-2} \text{s}^{-1} \text{rad}^{-1}$

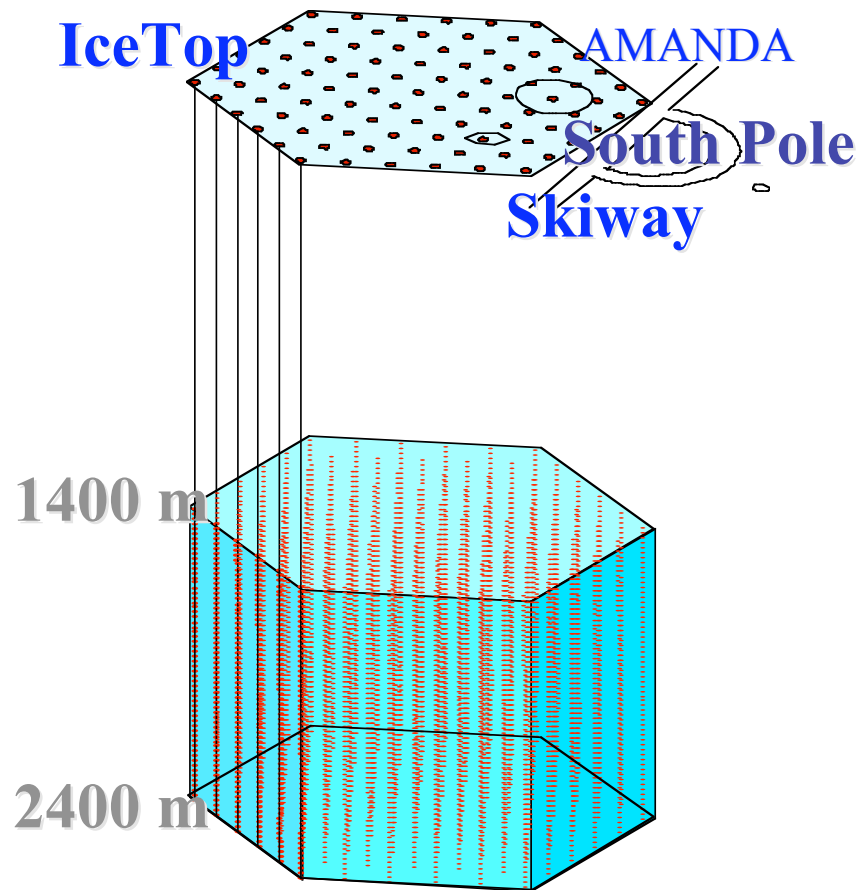
$\text{GeV}^{-1} \text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1}$

Limits include systematic uncertainty of 30% on atm.  $\nu$  flux

Energy range: 0.2 to 40 TeV



# Conclusions and Outlook



- Limits are  $\sim 2$  orders of magnitude above predictions
- Five years of IceCube data give  $\sim 1$  order of magnitude improvement
- Other approaches — cascades from GC, overdensities in plane