

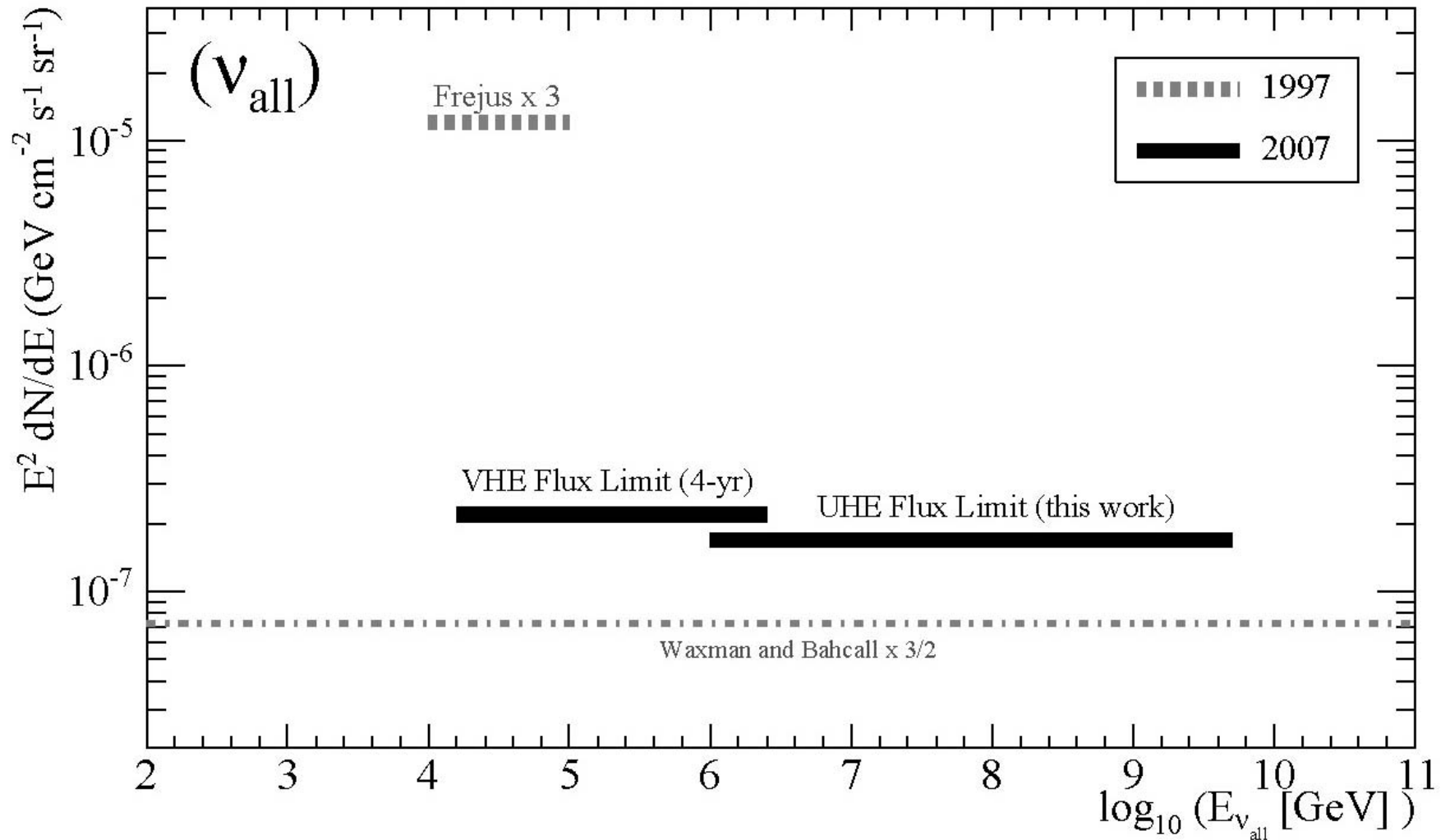
Limit on Ultra High Energy Neutrino Flux

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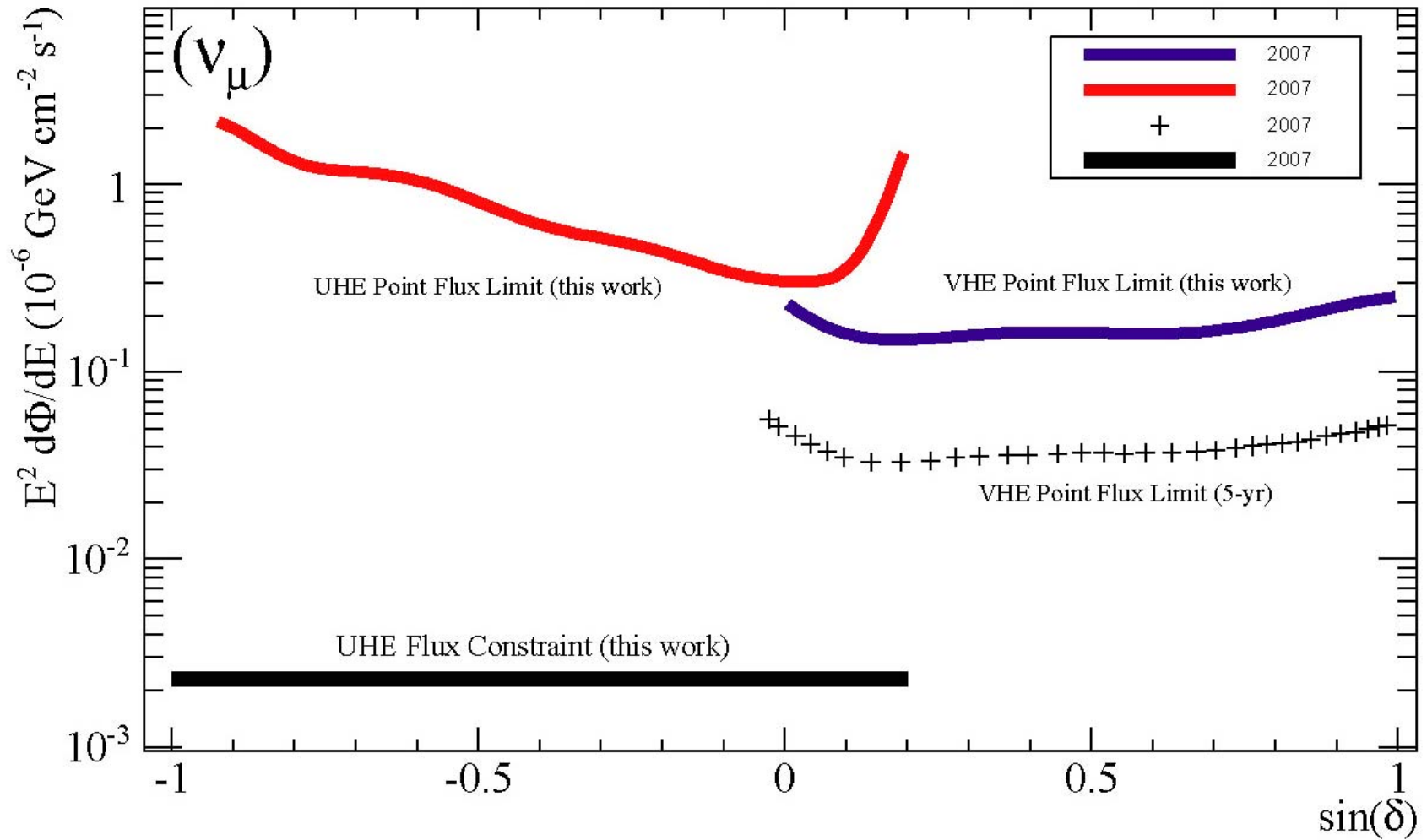
<http://www.ps.uci.edu/~silvestr/DISSERTATION/DISSERTATION.pdf>

May 3, 2008 | IceCube Collaboration Meeting | Madison WI

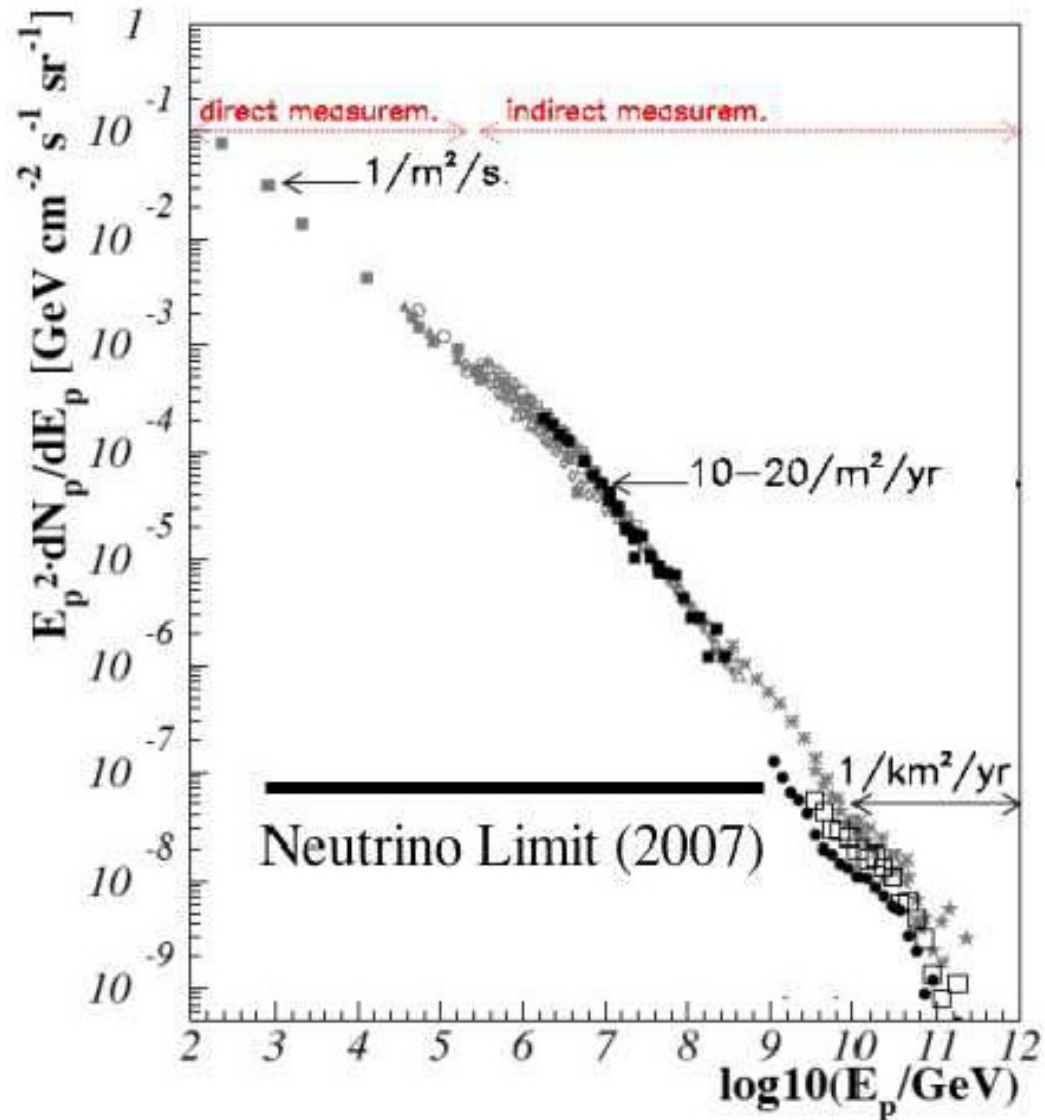
10 Years of Diffuse ν -Search



10 Years of Point ν -Search



ν -Fluxes well below CR-Fluxes



Search for **Diffuse** UHE ν 's ($E_\nu > 1\text{PeV}$)

- Analysis Strategies:
 - NN1: directional info θ , energy cuts
 - NN2: timing fluctuation $\sigma_{\text{tot}} \longrightarrow$ better energy estimate
- Limit on ν -flux:

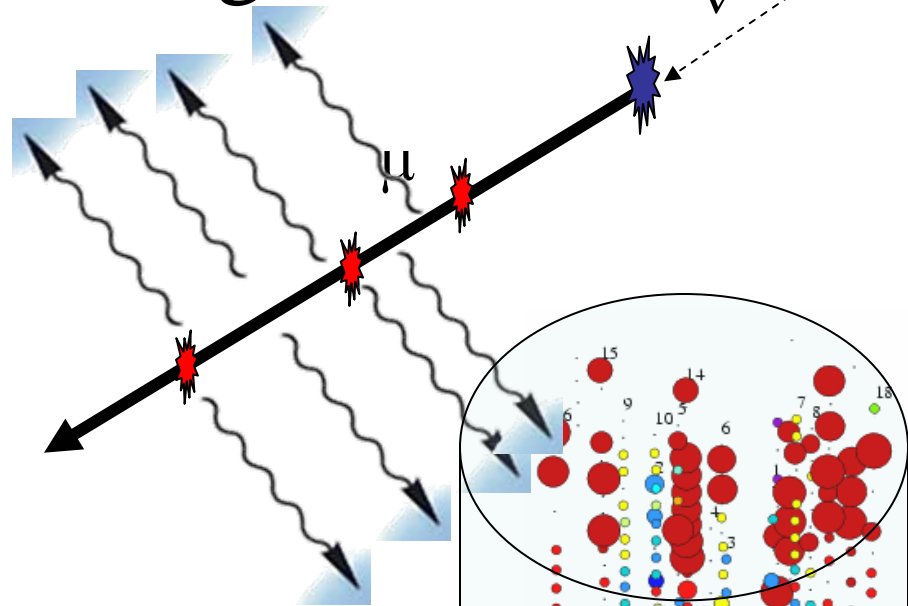
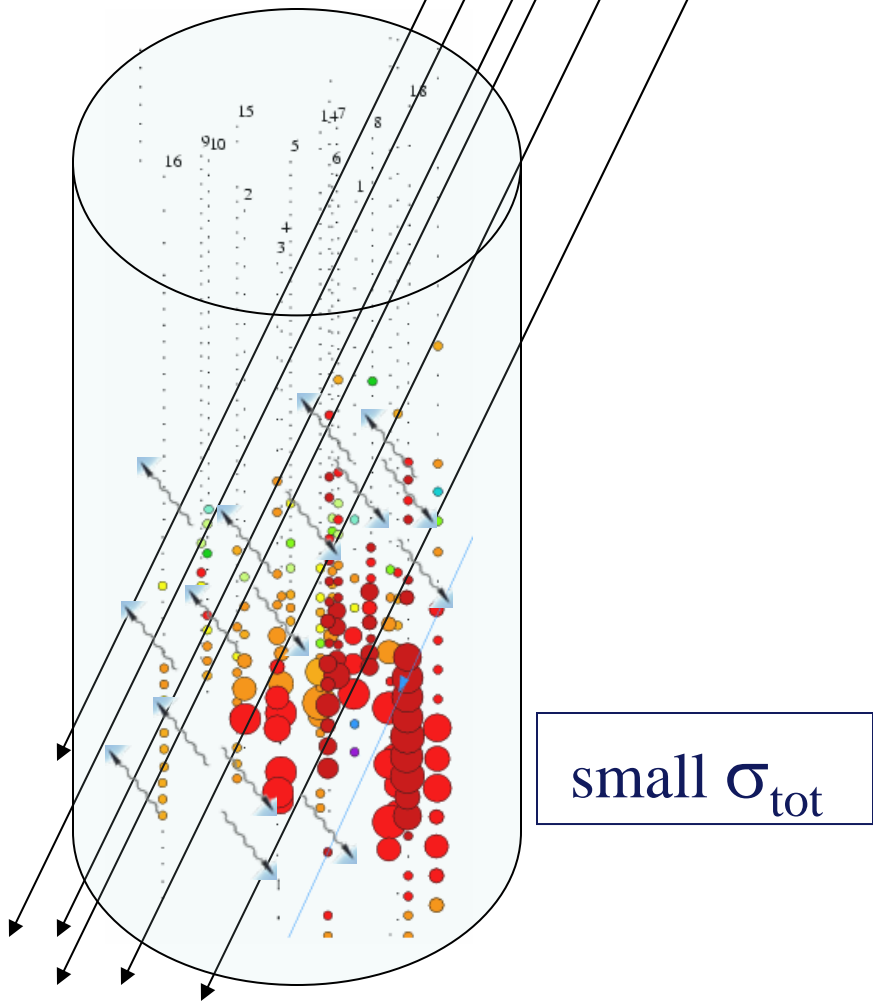
$$E^{-2}\Phi_\nu < 1.69 \times 10^{-7} \text{ GeV cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$$

for $10^{15} \text{ eV} < E_\nu < 10^{18.7} \text{ eV}$ at 90% C.L.

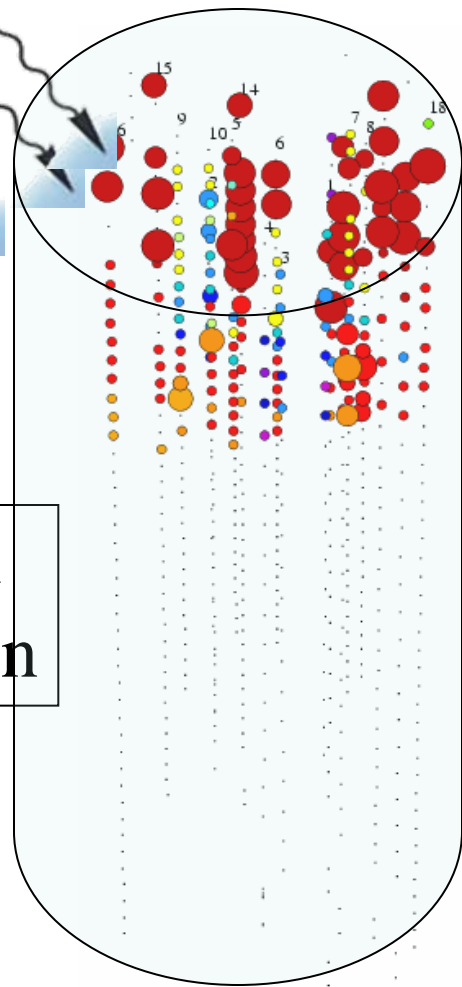
- A factor ~ 4 better/year compared to previous UHE analysis [Gerhardt, Ph.D. 2007, ApJ]
- Most stringent limit placed to date

BG & SIG Event Signature

BG Event
Muon Bundle



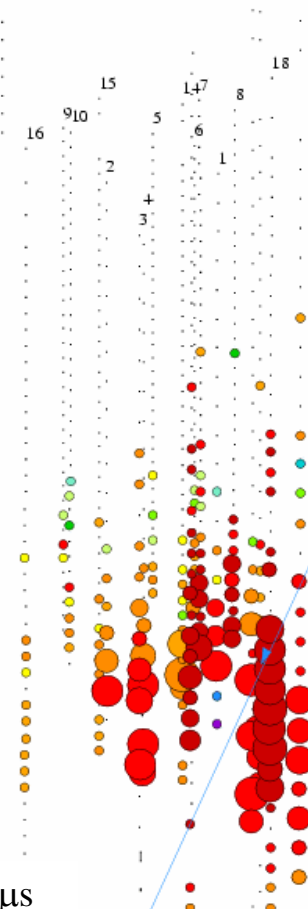
SIG Event
Single Muon



BG & SIG Timing Fluctuation

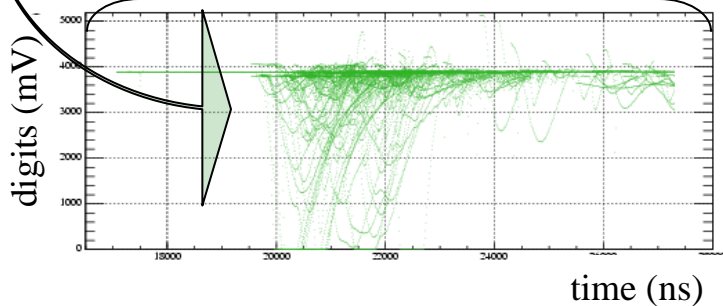
No external geometry file is opened.
 Detector: amanda-b-10, 20 strings, 681 modules
 Data file: e_1001943.f2L.def
 File contains 1 event.
 Displaying data event 1001943 from run 7306
 Recorded yr/dy: 2003/263
 6751.8318200 seconds past midnight.
 Before cuts: 186 hits, 186 CMs
 After cut: 186 hits, 186 CMs
 12 Antineutrino

Vertex : (50.7, 57.4, -171.6) m
 Direction : (-0.74180, -0.11646, -0.66043)
 Length : 149.803000 m
 Energy : ? GeV
 Time : 19991.700000 ns
 Zenith : 48.7°
 Azimuth : 8.9°
 rdmc-jk = -1
 id = 7.354410
 rch2 = -1
 prob = -1
 sigth = -1
 covmin = -1
 covmax = -1
 cutoffbg = 1331.150000



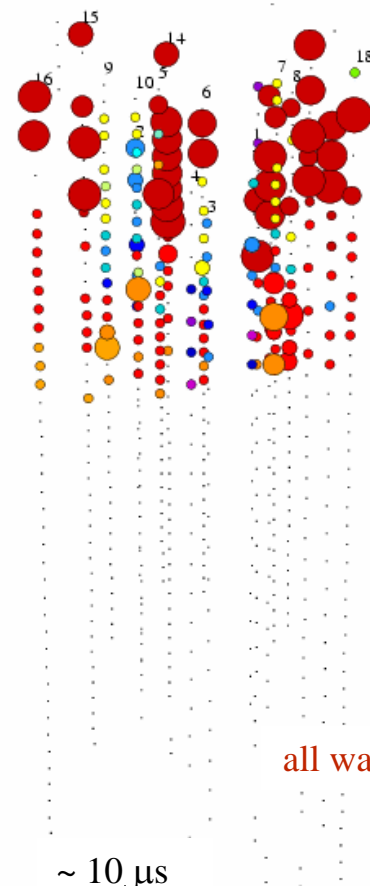
all waveforms

~ 10 μ s



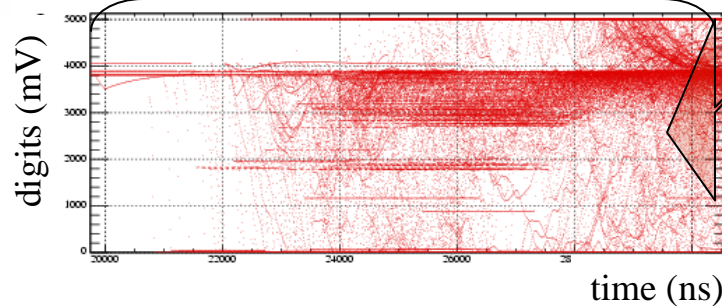
No external geometry file is opened.
 Detector: amanda-b-10, 19 strings, 680 modules
 Data file: e_1776.f2L
 File contains 1 event.
 Displaying MC event 1776 from run 1
 Created yr/dy: 1970/1
 Before cuts: 185 hits, 185 CMs
 After cut: 185 hits, 185 CMs
 3 Hadronic Cascade (1)

Vertex : (-28.6, 83.3, 441.2) m
 Direction : (0.16447, 0.07408, -0.98360)
 Energy : 648.56800000 GeV
 Time : 40678 ns
 Zenith : 10.4°
 Azimuth : 204.2°

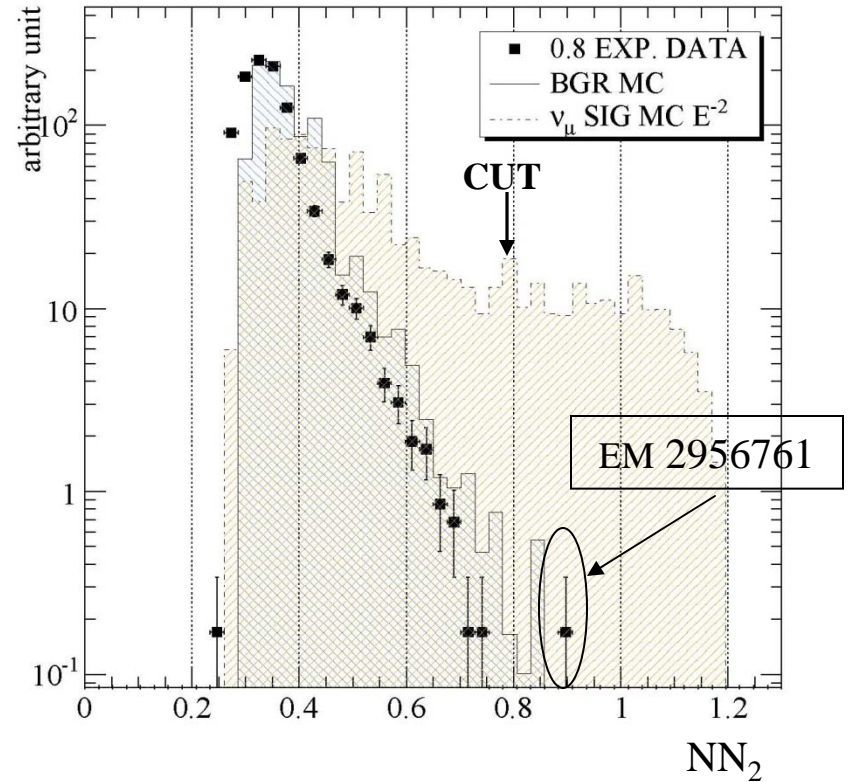
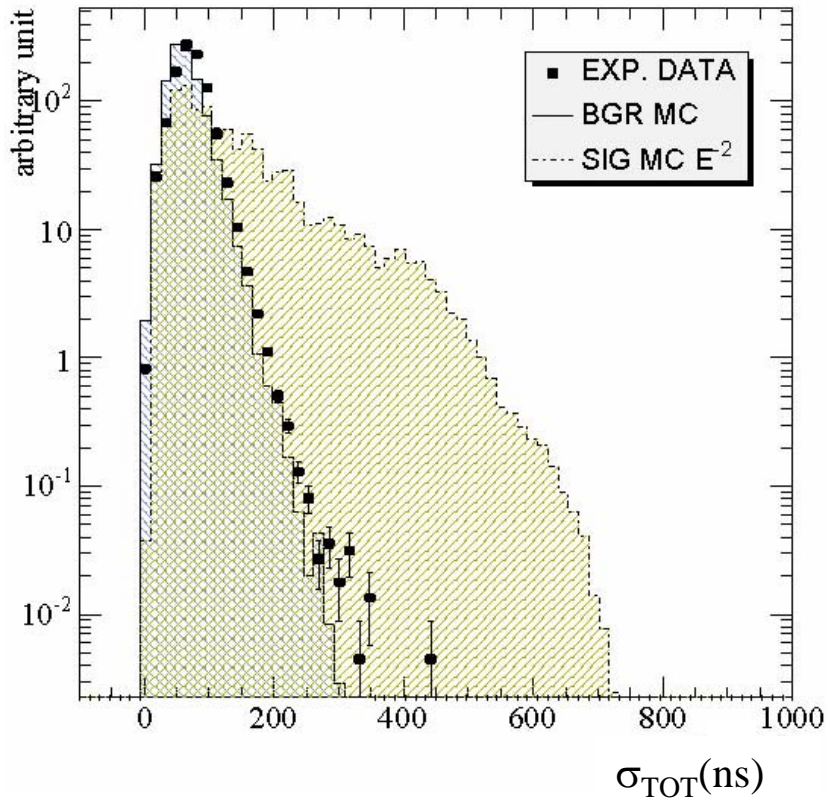


all waveforms

~ 10 μ s



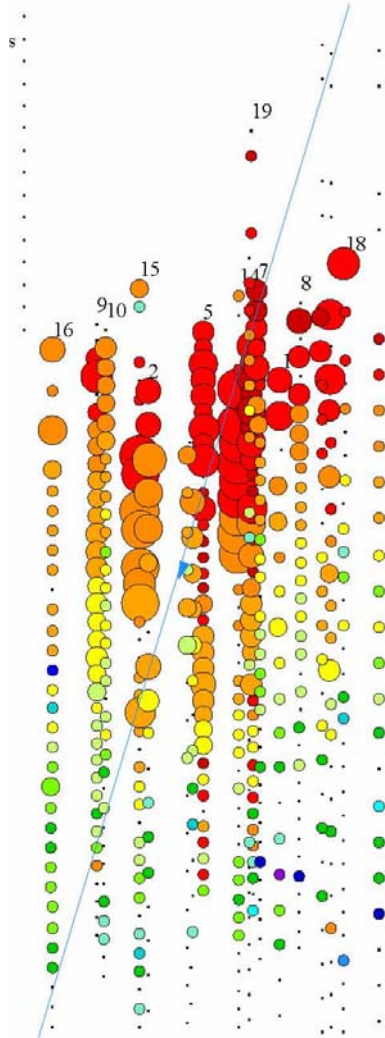
UHE Results



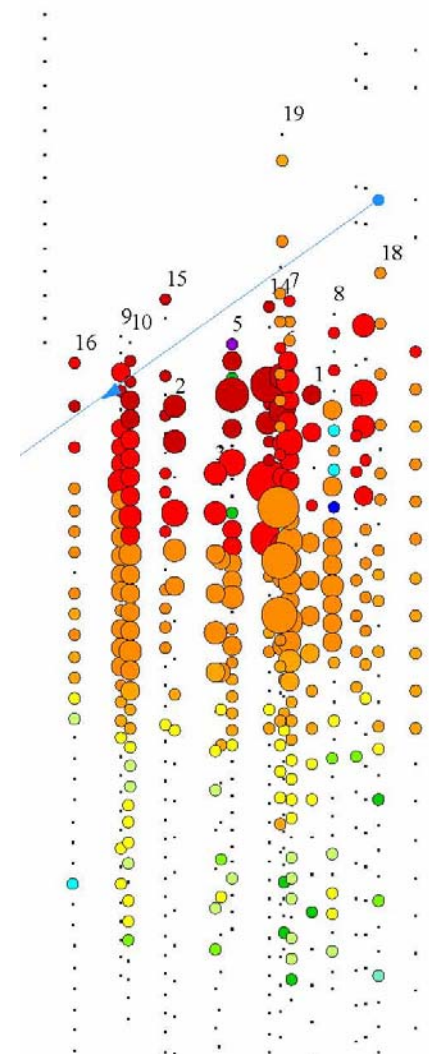
- Signal generates a large timing fluctuation, information incorporated in the σ_{TOT}
- One event survives the cut $NN_2 > 0.78$, consistent with BG expectation

UHE Results: Event EM 2956761

EXP.
EM 2956761

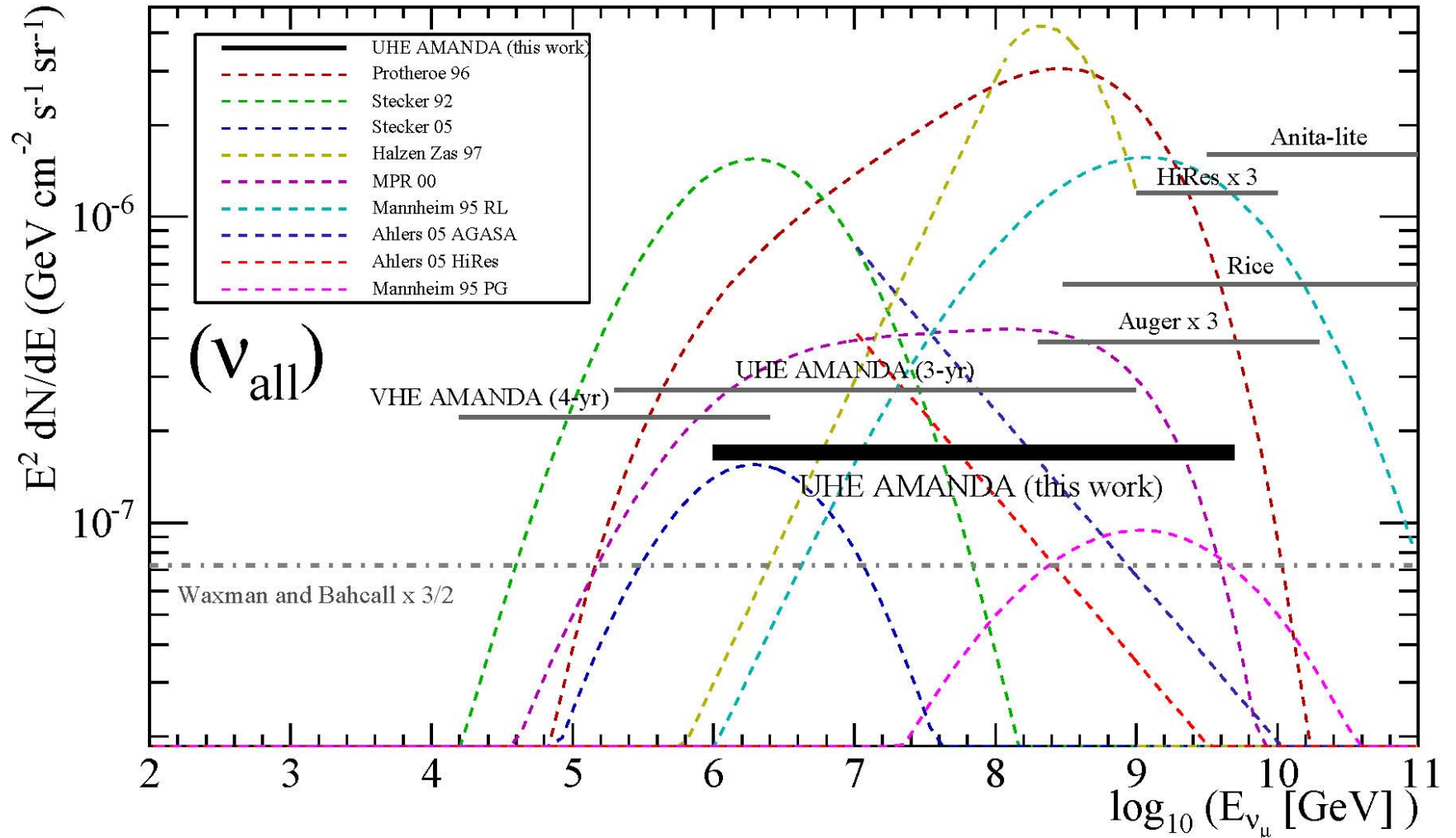


BGR-MC
EM 1739



- Appears to be bright source in upper part of detector
- Other analysis variables compatible with BG characteristics

UHE Flux Limit



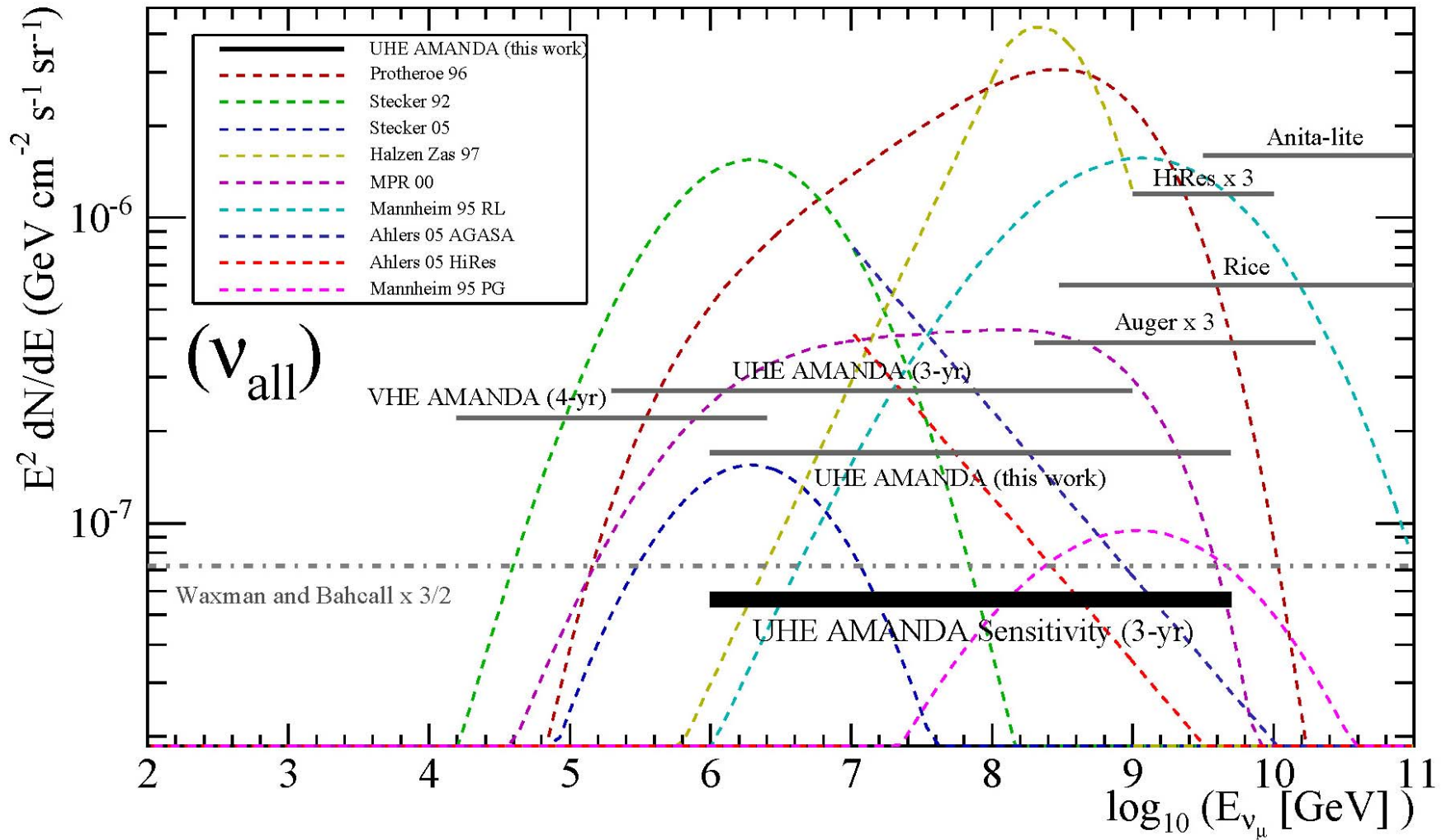
Rejected Model Predictions

Model	Source Type	Emission Type	Process	Normalization	Reference
radio-quiet AGN [†]	Seyfert/Quasar	core	$p\gamma$	x-ray diffuse	[Stecker et al., 1991]
radio-quiet AGN [†]	Seyfert/Quasar	core	pp	x-ray diffuse	[Nellen et al., 1993]
radio-loud AGN (B) [†]	Blazars	jets	$p\gamma$	1 MeV γ -ray diffuse	[Mannheim, 1995]
γ -ray loud AGN [†]	Blazars	jets	$p\gamma$	GeV γ -ray source	[Protheroe, 1996]
AGN [†]	Blazars	jets	$p\gamma$	100 MeV γ -ray source	[Stecker and Salamon, 1996]
γ -ray loud AGN [†]	Blazars	jets	$p\gamma$	GeV γ -ray source	[Halzen and Zas, 1997]
AGN [†]	Blazars	jets	$p\gamma$	100 MeV γ -ray source	[Mannheim et al., 2001]
AGN [†]	Blazars	jets	$p\gamma$	CR's spectrum	[Mannheim et al., 2001]
radio-loud AGN [†]	FSRQ	jets	$p\gamma$	radio source	[Becker et al., 2005]
radio-loud AGN (A)	Blazars	jets	$p\gamma$	100 MeV γ -ray diffuse	[Mannheim, 1995]
AGN-LBL	Blazars	jets	$p\gamma$	TeV γ -ray source	[Mücke et al., 2003]
AGN-HBL	Blazars	jets	$p\gamma$	CR's spectrum	[Mücke et al., 2003]
radio-quiet AGN	Seyfert/Quasar	core	pp and $p\gamma$	UV/x-ray source	[Alvarez-Muniz et al., 2004]
radio-loud AGN	FR-I	core	pp	TeV γ -ray source	[Anchordoqui et al., 2004]
radio-quiet AGN	Seyfert/Quasar	core	$p\gamma$	MeV γ -ray diffuse	[Stecker, 2005]
radio-loud AGN	FR-II	jets	$p\gamma$	radio source	[Becker et al., 2005]
radio-loud AGN	FR-I	core	pp	TeV γ -ray source	[Halzen and O'Murchadha, 2008]

Table 2.1: Summary of AGN models which predict ν -fluxes comparable to sensitivities of current generation of neutrino telescopes. Models are summarized according to their source and emission types. In particular AGN models are commonly differentiated by *core* or *jet* emission, if particles are emitted from the deep core or from the jets of the AGN. Models can also further classified according to their normalization used to calculate the associated ν -flux. Model predictions denoted with (†) are rejected by this work at 90% C.L.

Blazars + jets + $p\gamma$ = a possible excluded physics (?)

UHE 3-yr Sensitivity



Conclusions and Outlook

- Most stringent UHE flux limit to date
- 3-year of data (2003-2005) will improve:
 - Diffuse flux limit by a factor 3, below the WB bound (full evolution)
- First AMANDA point-source flux limit in the Southern sky (Cen A)
- Diffuse flux strongly constrains EG point flux under general assumptions. (see constraints talk)

What's Next

- Assessment of systematics by using Photonics
- Full 2004/2005 raw data set (~ 60TB) imported on online disks (SDSC).
- First look analysis – merging, calibration, processing and filtering – started.
- Assuming Photonics + opt5 = agreement in results:
 1. New un-blinding proposal for 04/05 will be submitted
 2. A first draft of 3-yr UHE paper by next collaboration meeting