On the implications of neutrino flux limits

Robbie George-UteCityPhoto.com

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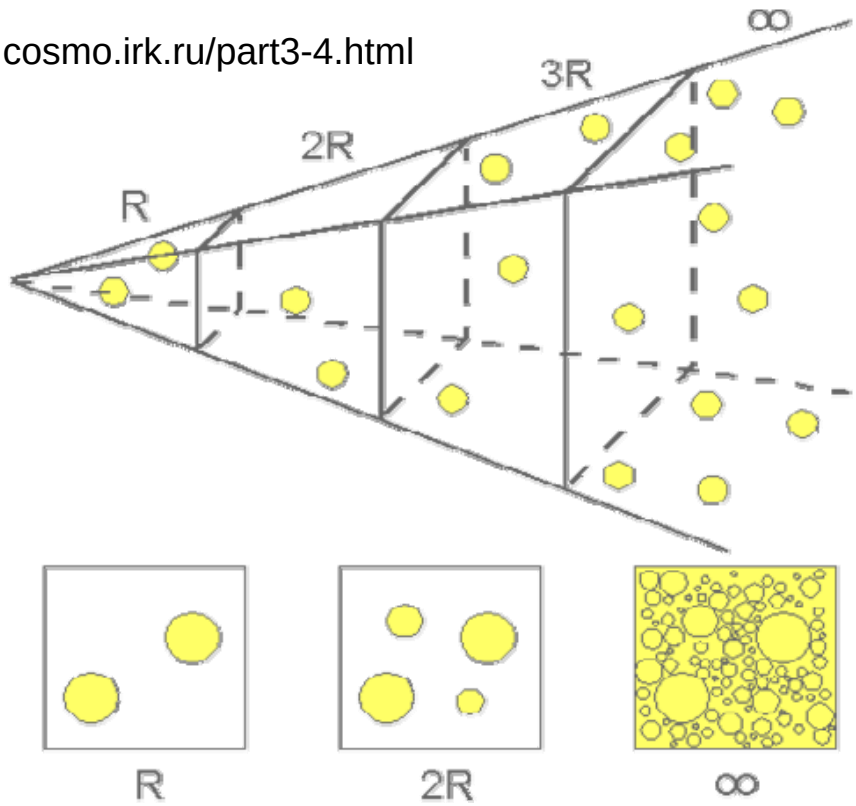

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In Collaboration with

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Contents

I. Short introduction

II. Stacking limits interpreted as diffuse limits

III. Implications for neutrino emission from different source classes (EGRET blazars, TeV blazars, ROSAT sources,...)

Neutrinoproduction

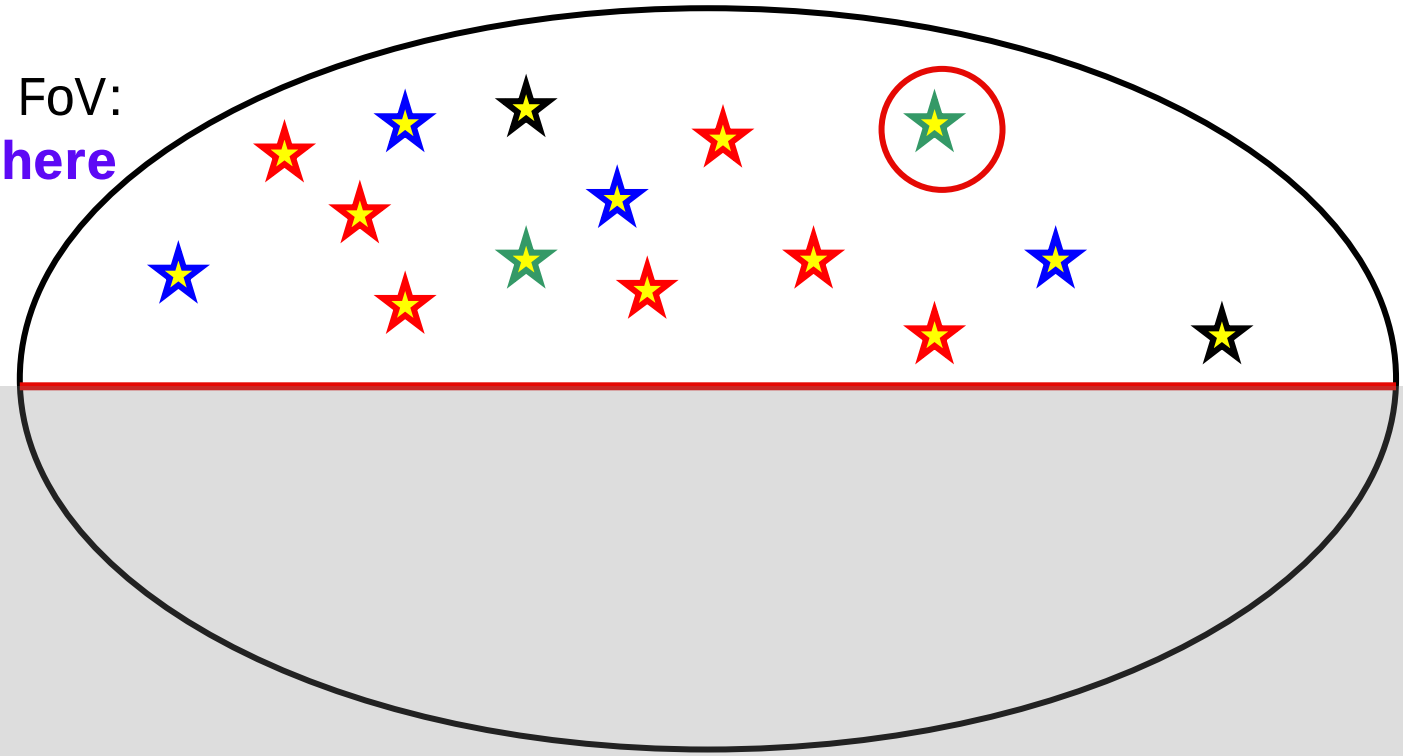

- $p\gamma \rightarrow \Delta^+ \rightarrow \pi^+ \; n/\pi^0 \; p$
  - $\pi^+ \rightarrow \mu^+ \; \nu_\mu \rightarrow e^+ \; \nu_e \; \nu_\mu$
  - $\pi^0 \rightarrow \gamma \; \gamma$ (E_γ~TeV)
  - **Pions**: Correlation between TeV **Photons and Neutrinos**
  - Optically thick medium: E_γ~keV-GeV
- Main assumption:
  - $L_\gamma \propto L_p \propto L_\nu$
  - Photonluminosity:
    sources can be selected
  - Protonluminosität ~ TeV emission

Animation genatedt with povray

Detection strategies

Point source searches – significance map
identified photon sources

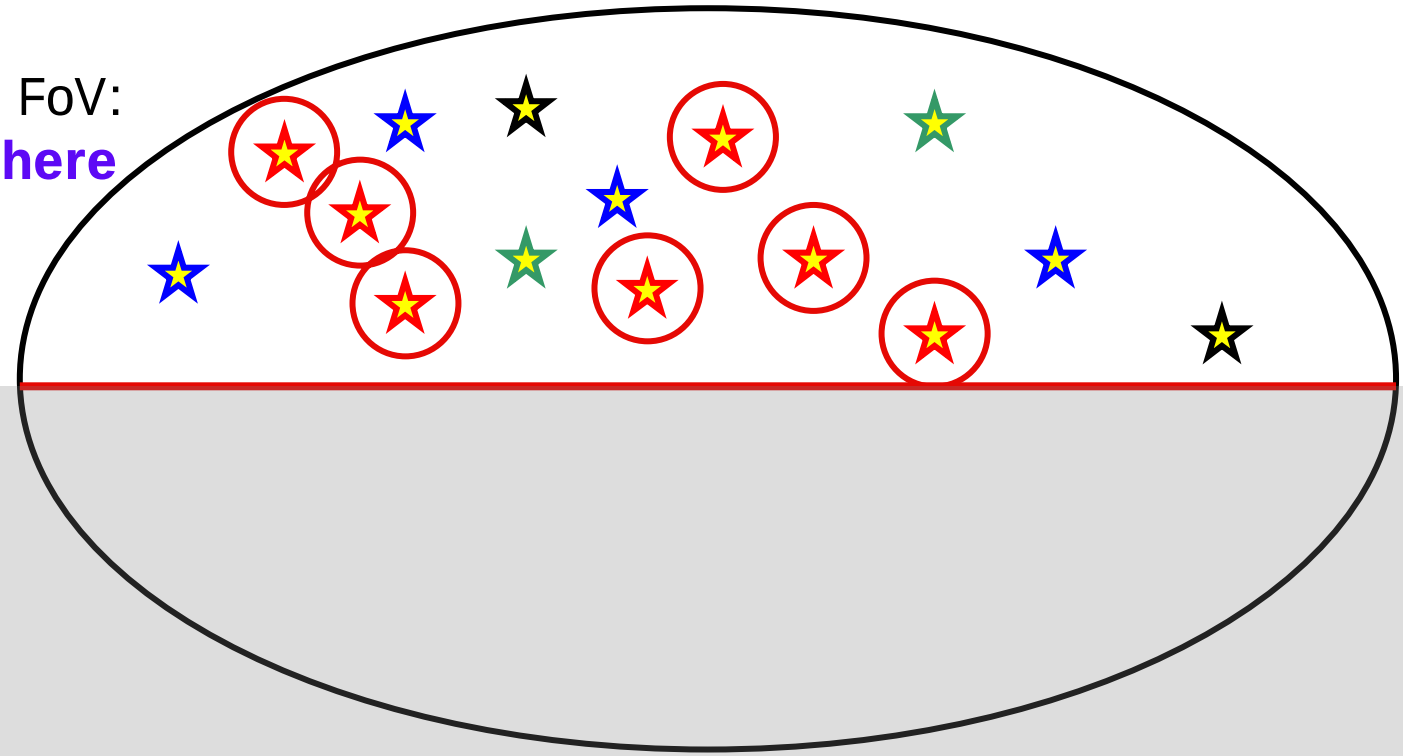
AMANDA/IceCube FoV:
northern hemisphere



Detection strategies

Stacking strategy – sum signal of point sources of same source class

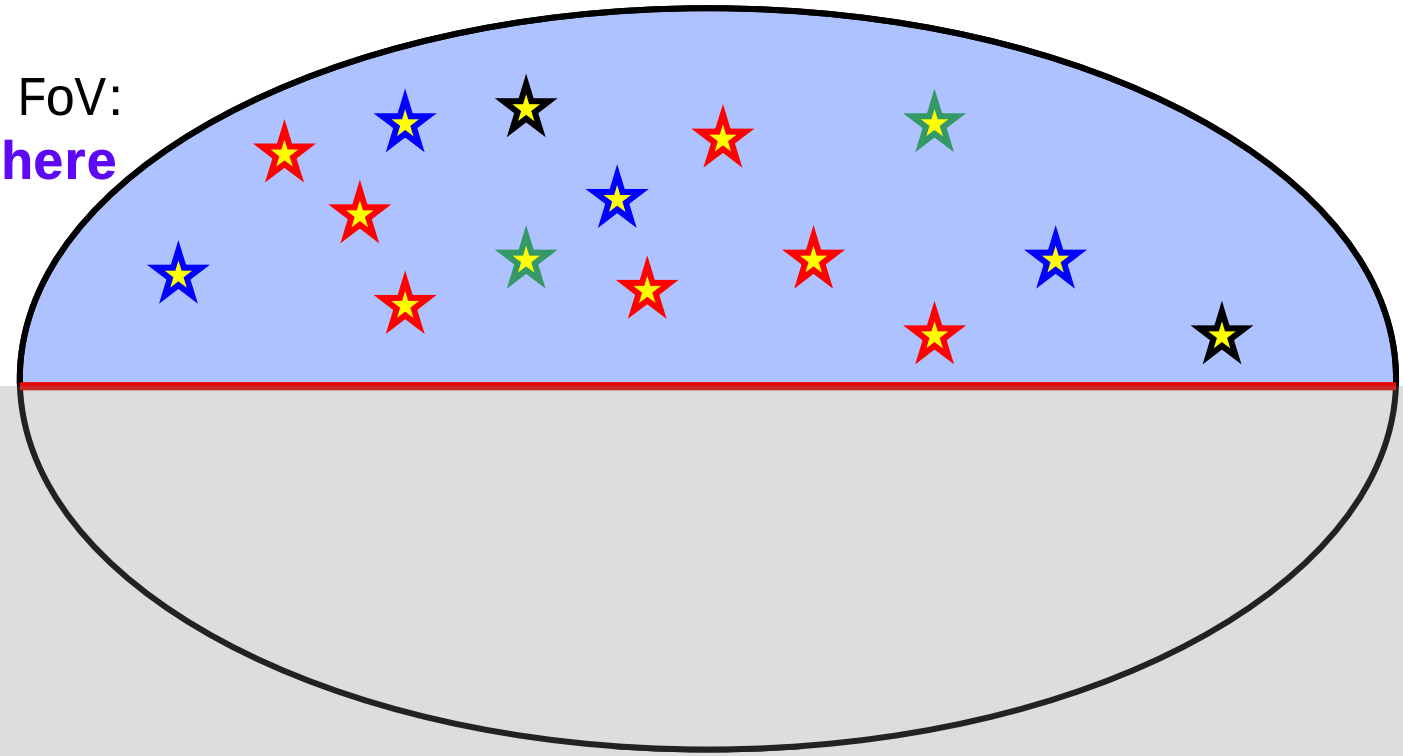
AMANDA/IceCube FoV:
northern hemisphere



Detection strategies

Search for a diffuse signal: use complete northern hemisphere

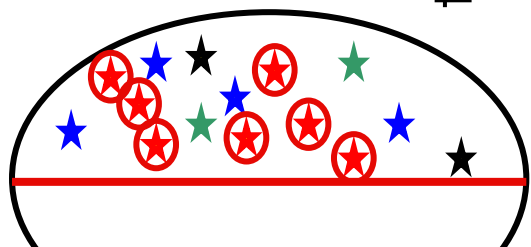
AMANDA/IceCube FoV:
northern hemisphere



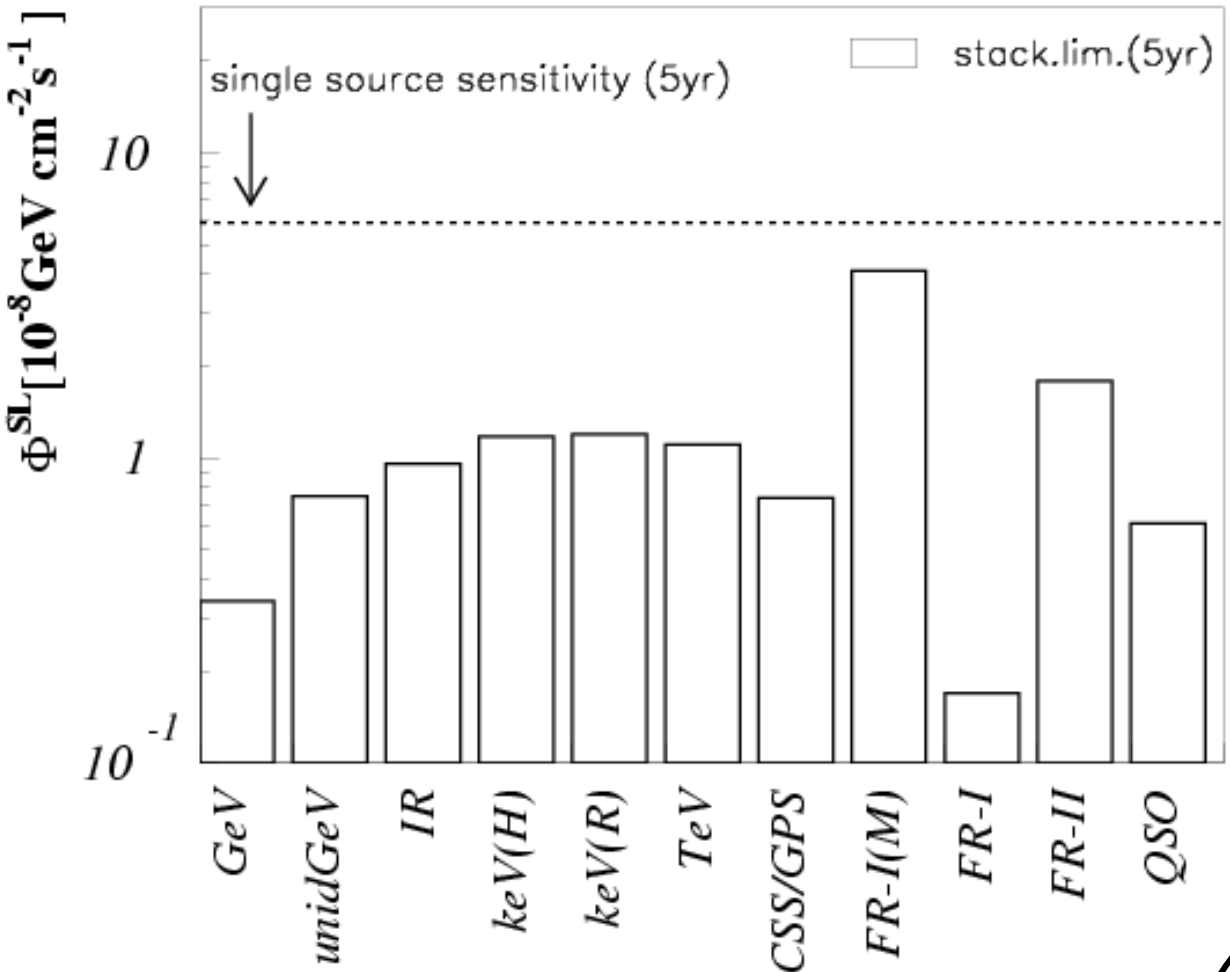
Stacking of AGN in AMANDA

- GeV blazars (**EGRET**) – *GeV*
- **Unidentified EGRET** sources – *unidGeV*
- **Infrared** sources – *IR*
- HAEO-A-detected **keV** sources – *keV(H)*
- ROSAT-detected **keV** sources – *keV(R)*
- **TeV** blazars - *TeV*
- **Compact Steep** Spectrum and **Giga-Hertz** peaked sources – *CSS/GpS*
- **FR-I** galaxies including **M87** – *FR-I(M)*
- **FR-I** galaxies without M87 – *FR-I*
- **FR-II** galaxies – *FR-II*
- Radio-weak **quasars** – *QSO*

IceCube&P.Biermann, astro-ph/0609534



Stacking of AGN in AMANDA



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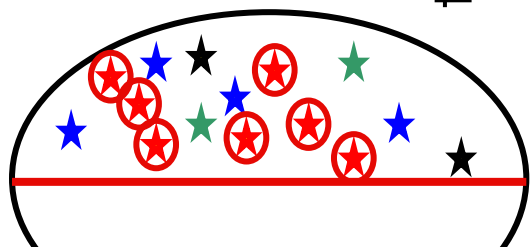


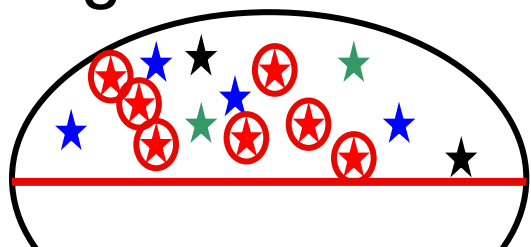
Stacking → Stacking diffuse

$$\Phi^{SDL} = \frac{\varepsilon \cdot \xi}{2 \cdot \pi \cdot sr} \cdot \Phi^{SL}$$

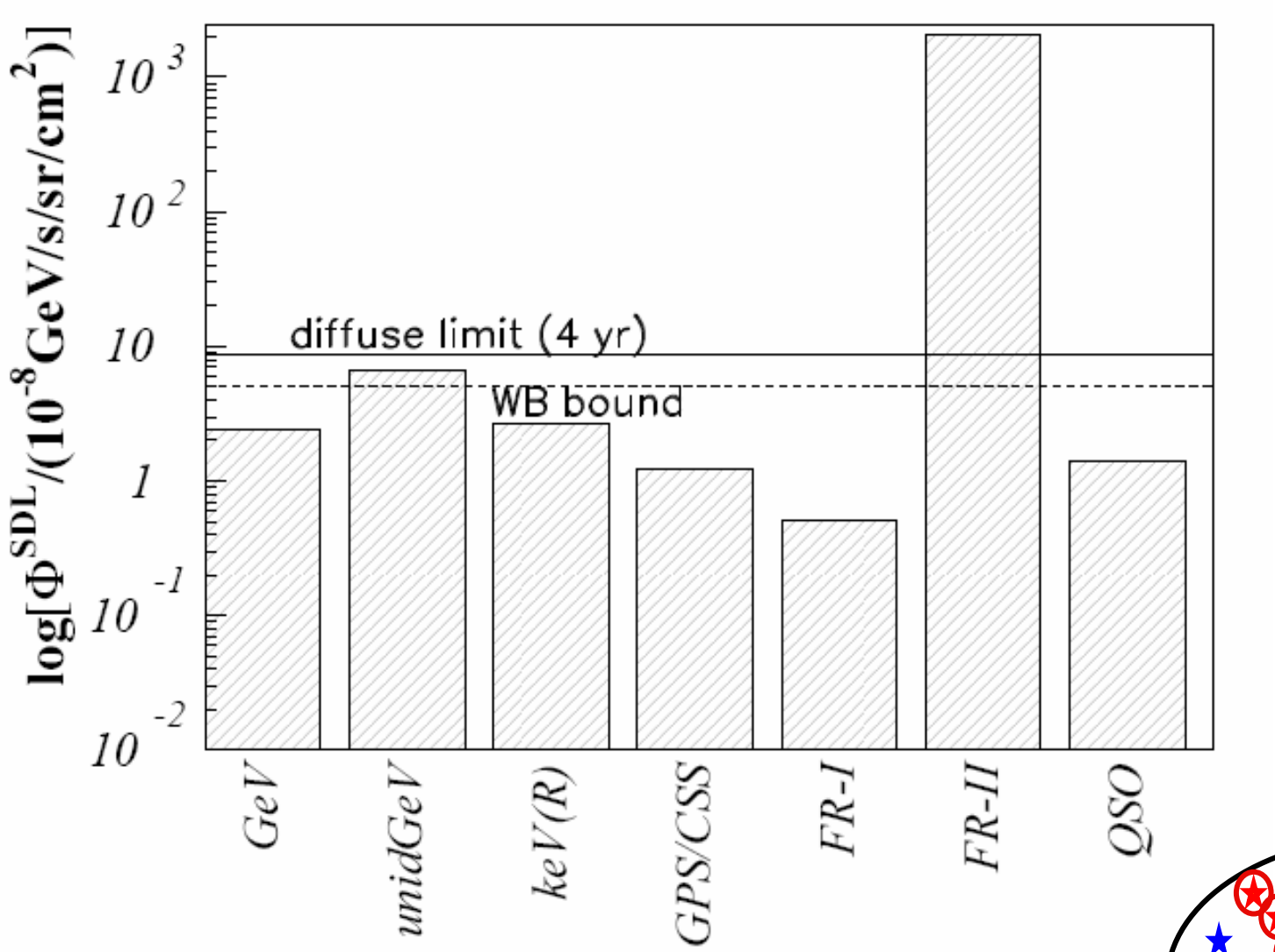
Stacking diffuse limit

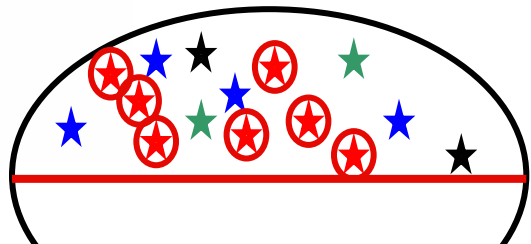
Stacking limit

- ε: „**stacking factor**“ → include weaker, identified sources
- ξ: „**diffusive factor**“ → diffuse background of the corresponding source class



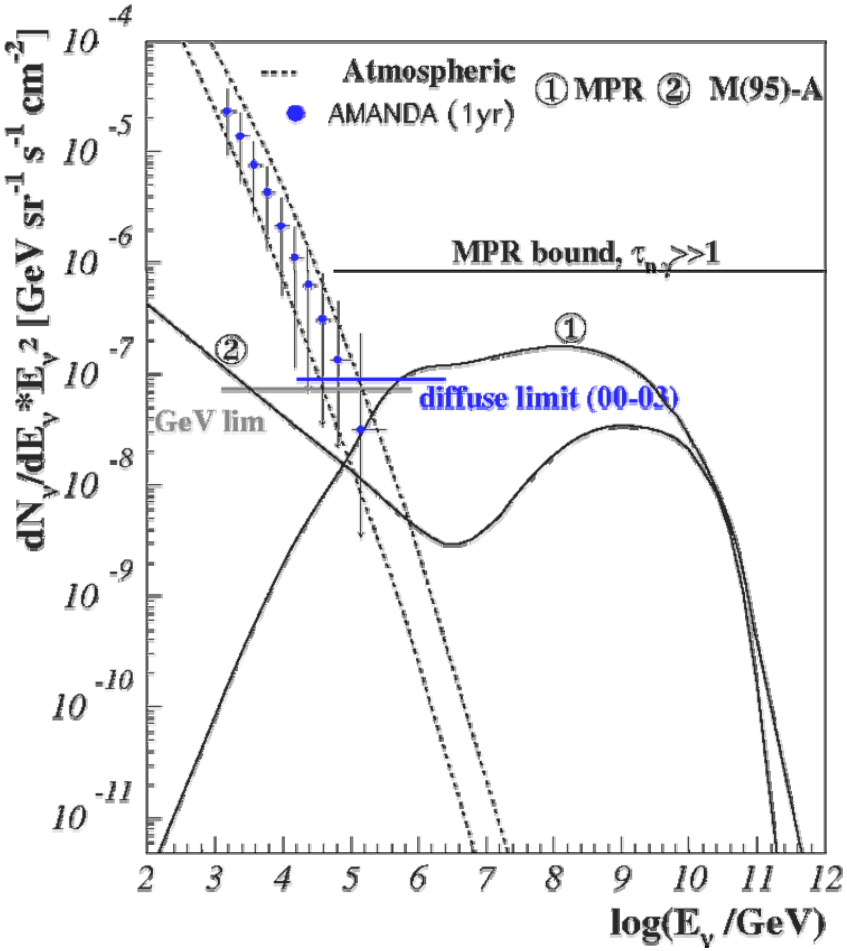
Stacking diffuse limits

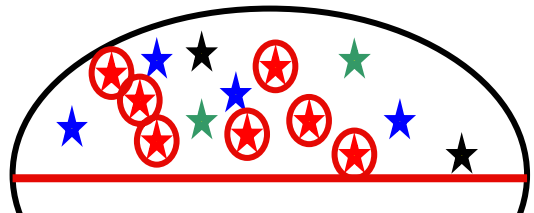




EGRET-sources

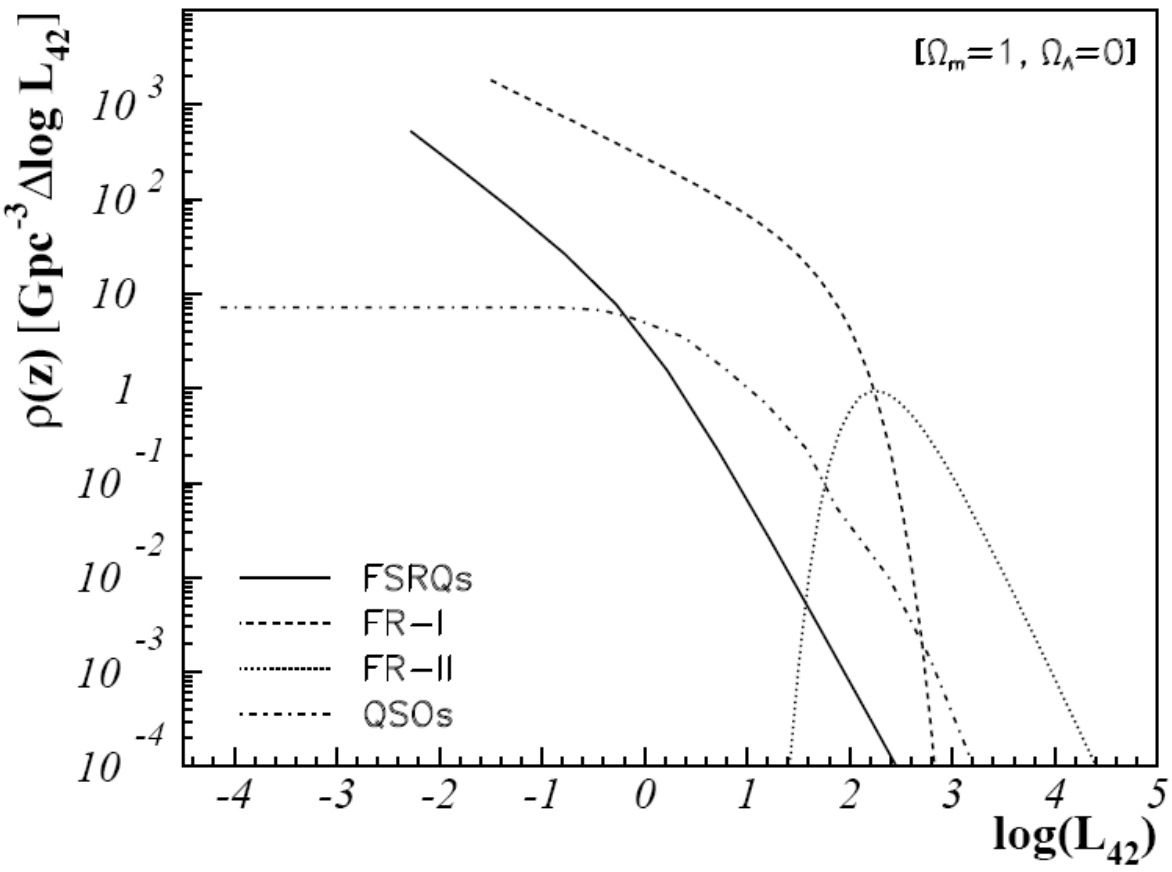
- AGN of GeV Emission
- Fluxmodels normalized to the extragalactic background as determined by EGRET
- GeV limit: stacking diffuse
  - Limit starts to restrict models
  - Limit far below atmospheric background!





Difficulty: distant, faint sources

- Typically many faint sources in a sample
- Exception: FR-II galaxies
- Faint sources need to be accounted for



Contribution of faint sources

- Sources which are not cataloged because too faint:

$$S_{tot}^{add} = \int \frac{dN}{dS} S \, dS < S_{weak} \cdot N_{add} \qquad N_{add} = N_{tot} - N_{cat}$$

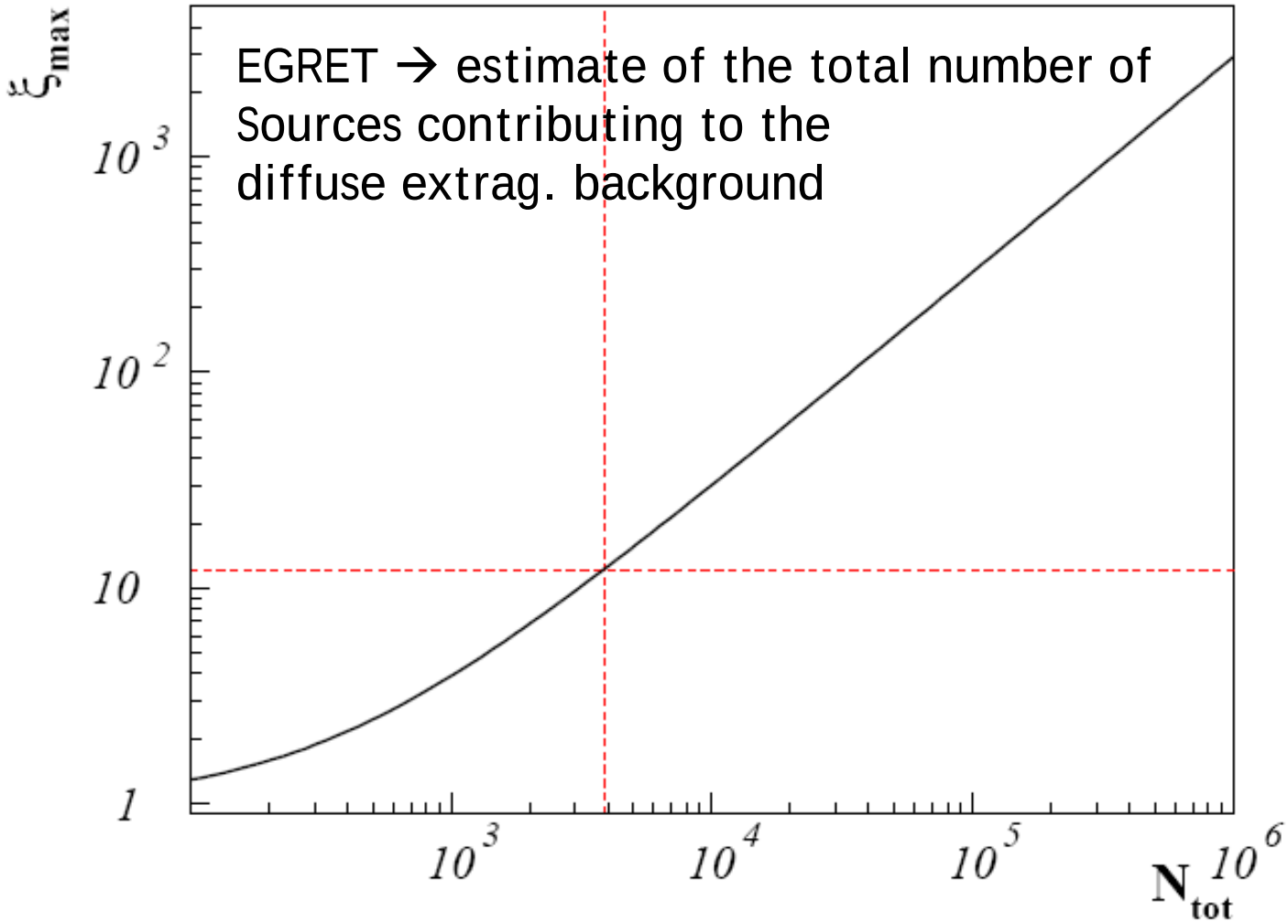
- Diffusive factor: fraction of flux not in the source catalog →

$$\xi = \frac{S_{tot}^{cat} + S_{tot}^{add}}{S_{tot}^{cat}}$$

- Estimate by using the weakest source in the catalog

$$\xi_{\max} = \frac{S_{tot}^{cat} + S_{weak} \cdot N_{add}}{S_{tot}^{cat}}$$

Contribution of faint sources

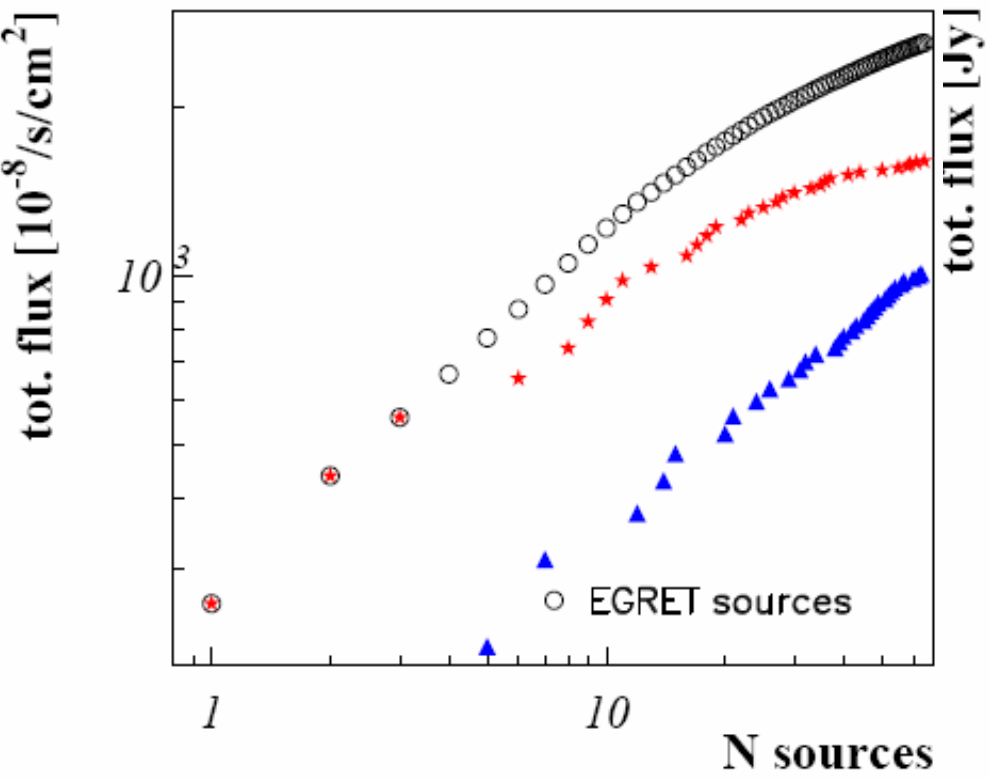


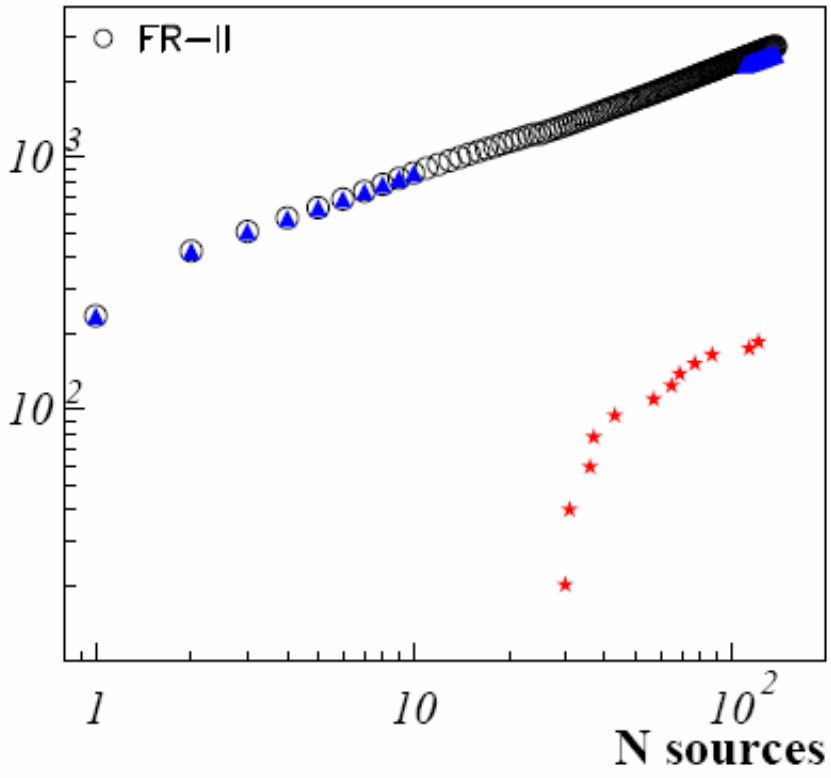
Comparison of north/south capabilities (I)

astro-ph/0607427

EGRET: south!

FR-II: north!





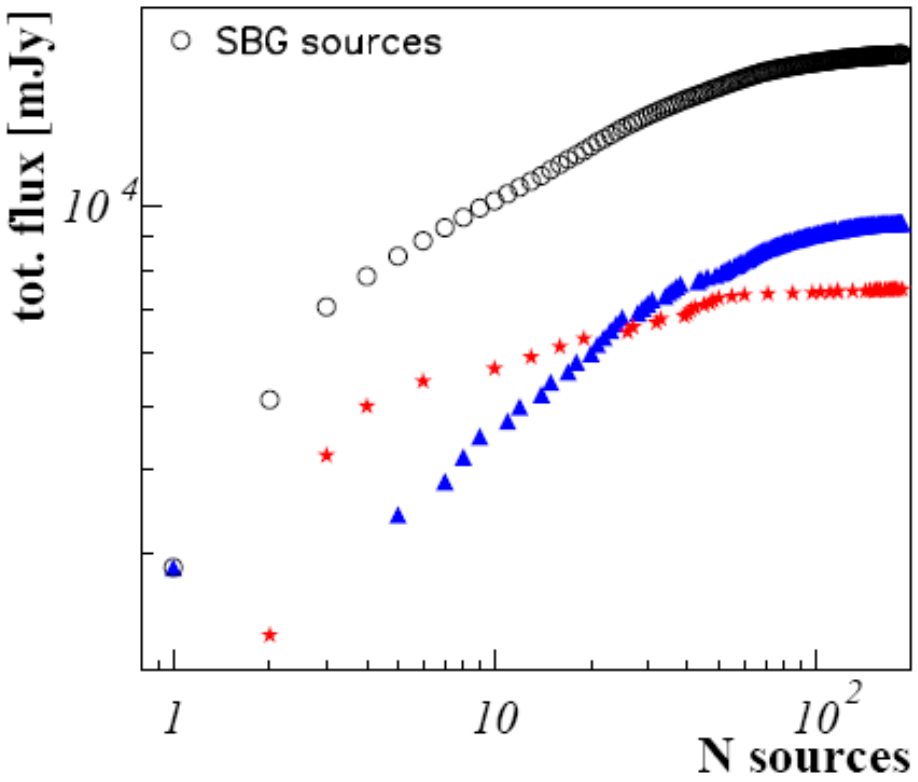
▲ northern sources
★ southern sources

Starbursts - north/south

astro-ph/0607427

- Loeb & Waxman: High neutrino flux from SBs
- Stecker: not as they calculate it → too optimistic assumptions (loss limit instead of diffusion limit etc)
- But: High rate of Sne in SBs → high rate of long GRBs → neutrinos
- Strongest source north, but next 3 strongest sources south

Starbursts



Olbers Paradox (1826)

- Infinit universe → **infinitely bright?**
- Simple observation „by eye“: **No!**
- Physics conclusions:
  - **Finite age of the universe**
  - **Finite radiation of stars**
  - **No thermal equilibrium**
- **Neutrinos**: so far no extrag. ν → **physics conclusions**

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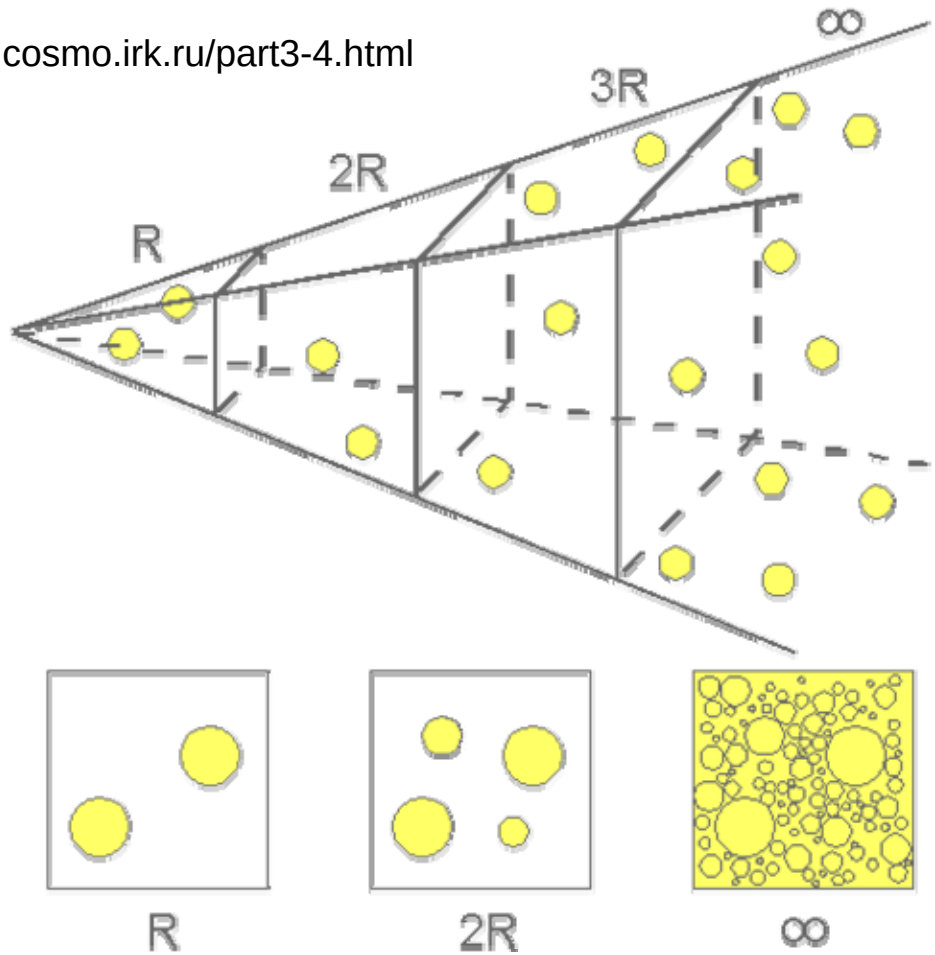
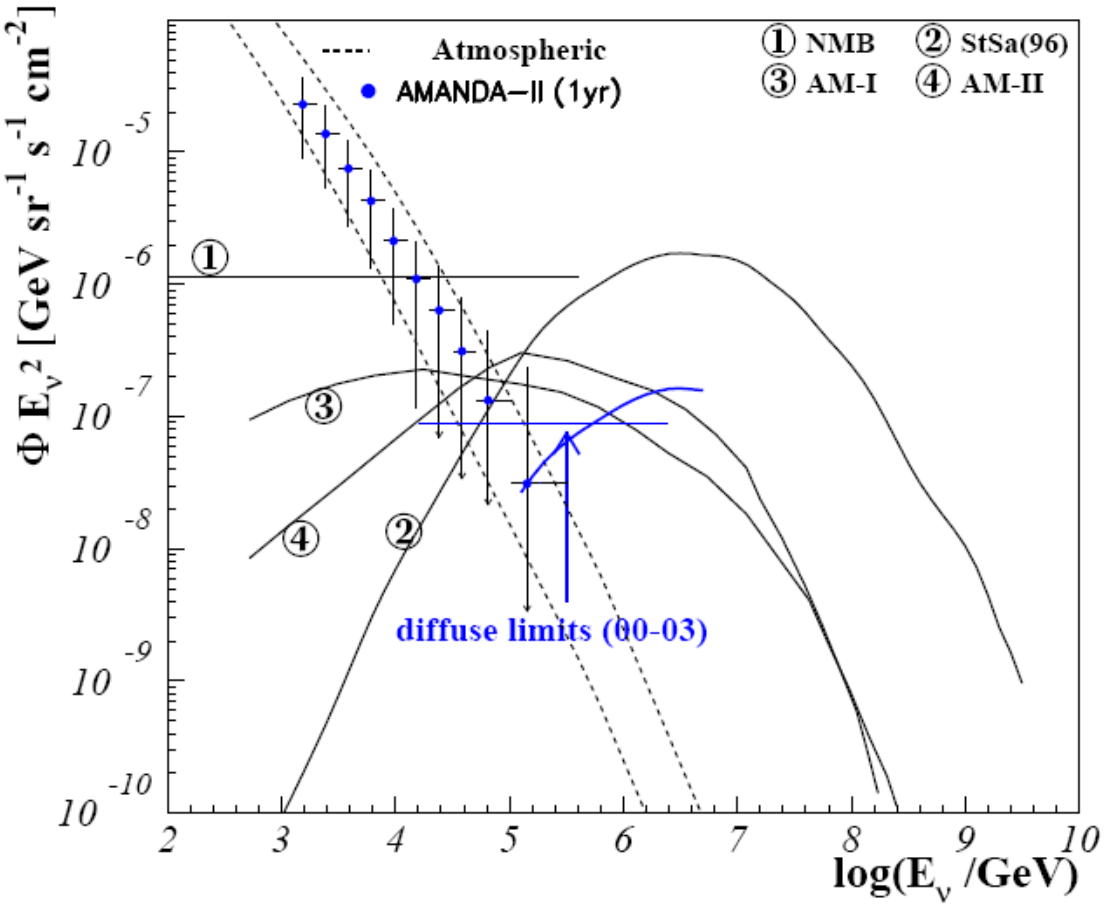


X-ray AGN

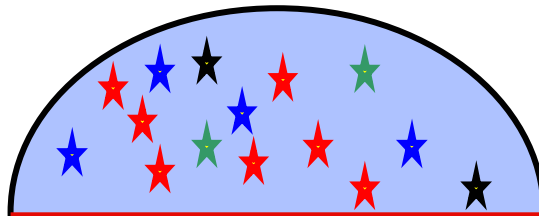
Nellen,Mannheim&Biermann
Phys.Rev.D (1993)

Stecker&Salamon
Space Science Rev. (1996)

Limits&IceCube sensitivity
Hill et al., Neutrino 2006



Limit adjusted to model
→1 order of magnitude below flux



Summary

- Method of **interpreting stacking as diffuse limits** for a given source class
- Applied to **8 source classes** with stacking limits given by AMANDA
- **EGRET sources**: limit starts to restrict flux models
- Difficulty for most source classes: determination of contribution from **faint sources**
- **Olbers paradox for neutrinos**: physics conclusions from non-detection
- X-ray emission not connected to neutrino emission

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