

<http://amanda.uci.edu>

AMANDA

ANTARCTIC MUON AND NEUTRINO DETECTOR ARRAY

RECENT RESULTS - ADDENDUM

Andrea Silvestri

University of California, Irvine

UCIrvine

University of California, Irvine

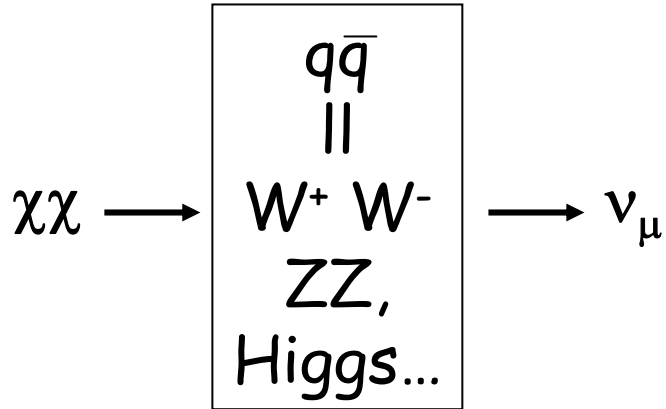
**International School on Cosmic Ray Astrophysics
14th Course: Neutrinos and Explosive Events in the Universe
July 10, 2004 Erice-Sicily**

WIMP ANNIHILATION in the EARTH

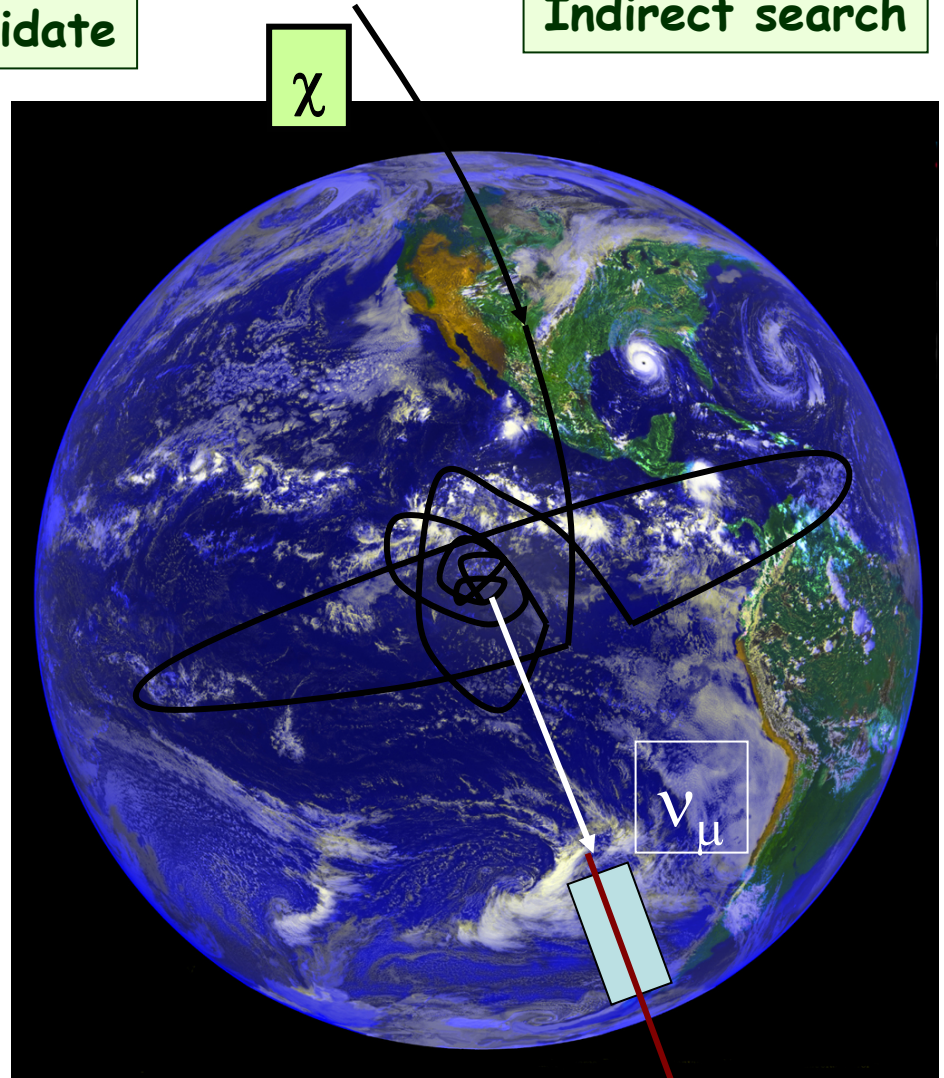
The WIMP is a Dark Matter candidate

Indirect search

AMANDA looks for muon neutrinos from annihilating **neutralinos** the **lightest** SUSY particle (MSSM)



- Backgrounds:
- Atmospheric Muons
 - Atmospheric Neutrinos



DARK MATTER SEARCH IN THE EARTH



Look for vertically upgoing tracks

- NN optimized (on 20% data) to
 - remove misreconstructed atm. μ
 - suppress atmospheric ν
 - maximize sensitivity to WIMP signal

Combine 3 years: 1997-99

Total livetime (80%): 422 days

No WIMP signal detected!

Limit for "hardest" channel:

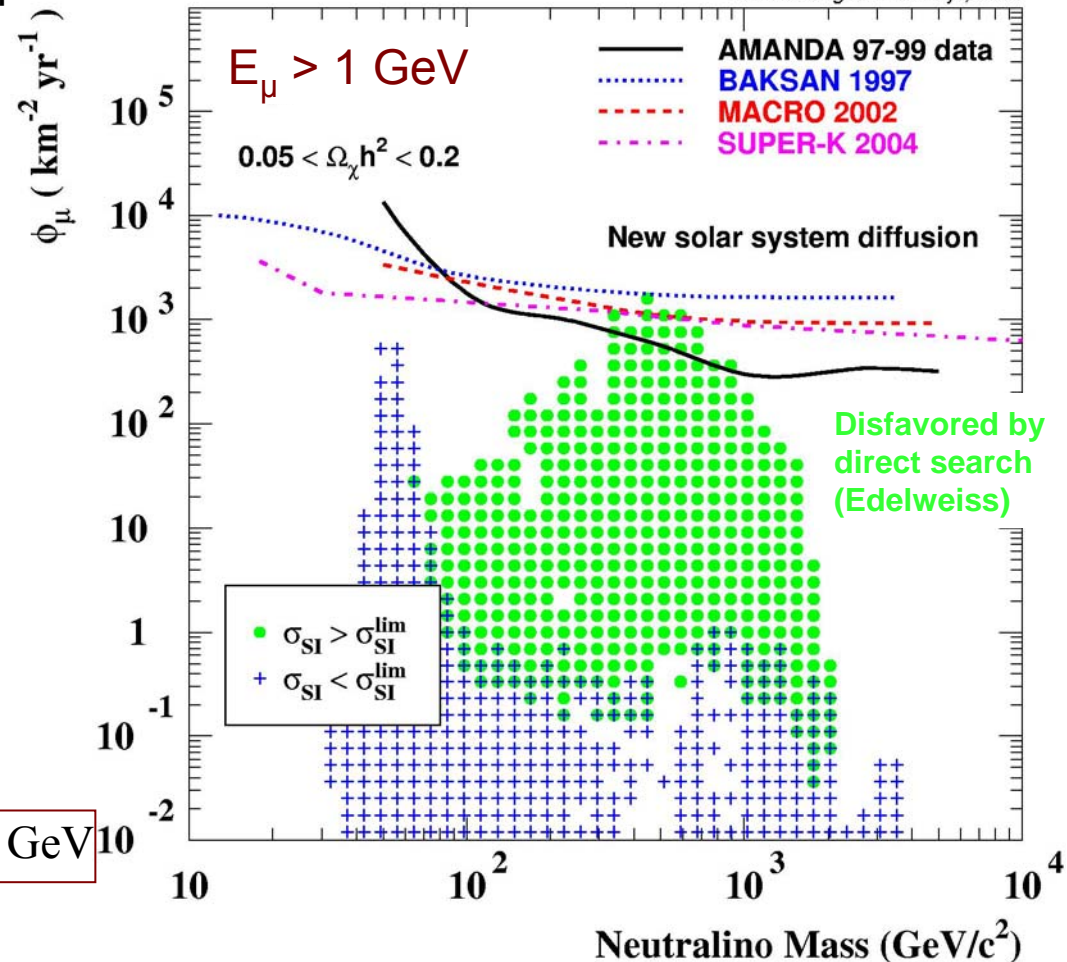
$$xx \rightarrow \tau^+ \tau^- \rightarrow \nu_\mu \quad M_x = 50 \text{ GeV}$$

$$xx \rightarrow W^+ W^- \rightarrow \nu_\mu \quad M_x = 100\text{-}5000 \text{ GeV}$$

PRELIMINARY

Muon flux limits

J. Lundberg and J. Edsjö, 2004



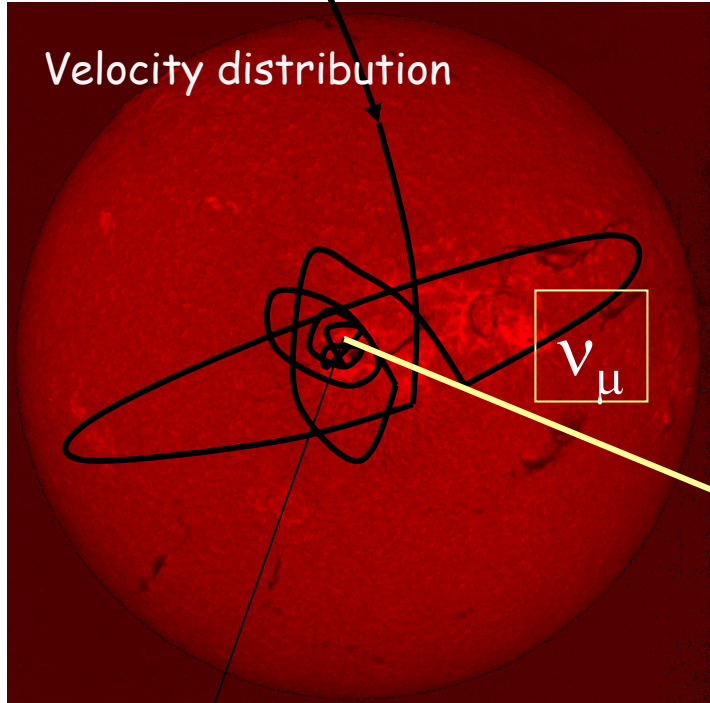
WIMP ANNIHILATION in the SUN

χ

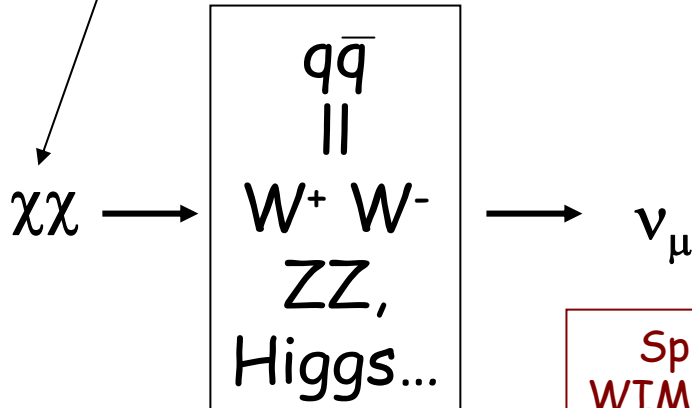
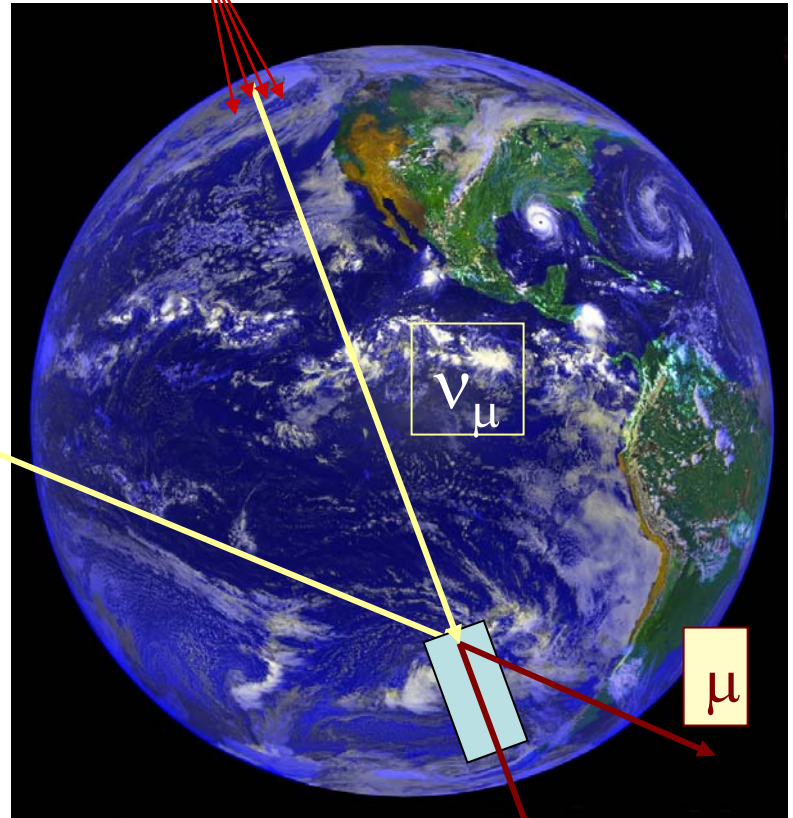
The Sun sinks maximally 23° below the horizon at the south pole



Horizontal events are very important!!



Cosmic Rays: $\mu, \gamma, \pi, K, \dots$

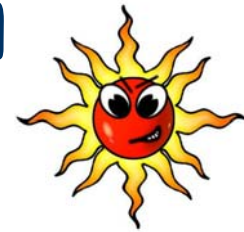


Spin-dependent WIMP-Hydrogen int.

Indirect search

μ

DARK MATTER SEARCH IN THE SUN



WIMPs from Sun vs Earth:

- + larger mass \rightarrow deeper gravitational well
- + increased capture rate due to addition of spin-dependent processes

- further away

Sun is maximally 23° below horizon

Search with AMANDA-II possible thanks to improved reconstruction capabilities for horizontal tracks

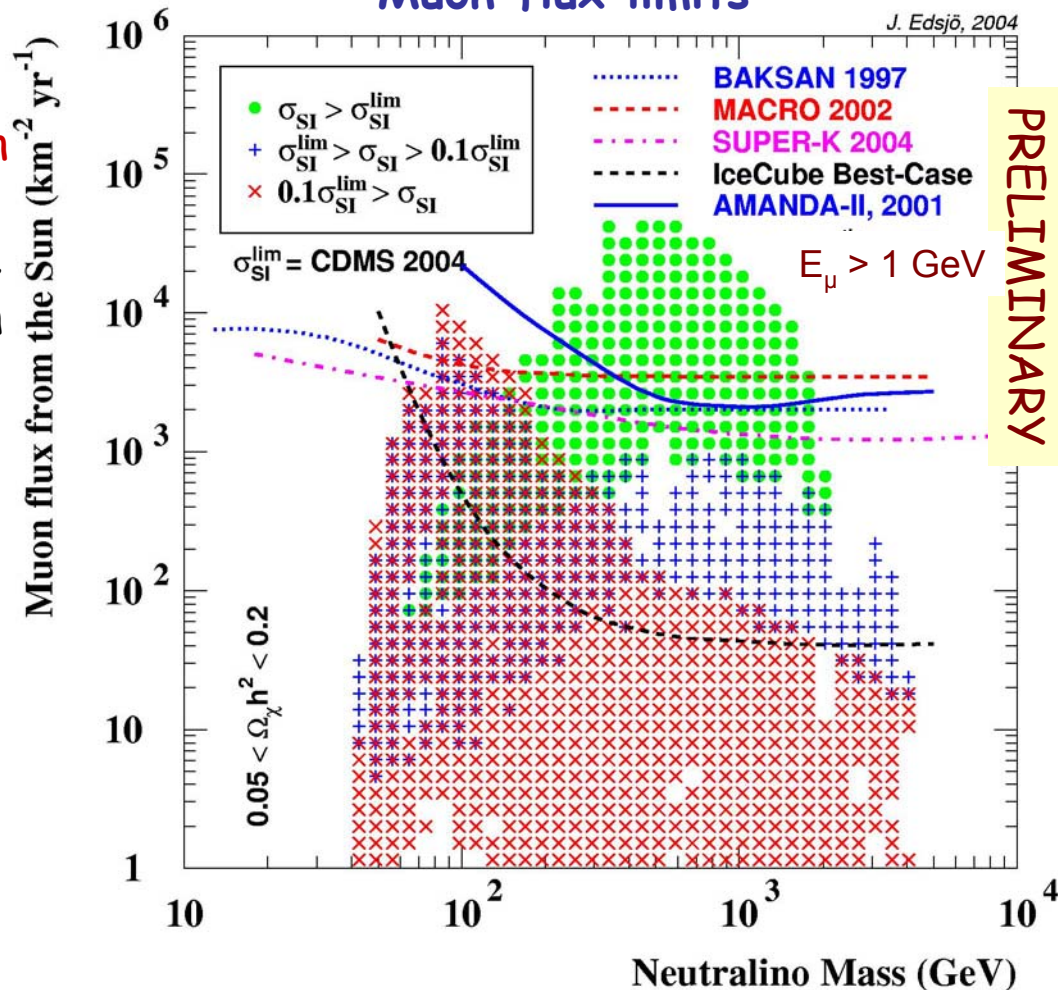
Exclusion sensitivity from analyzing off-source bins

2001 data
0.39 years livetime

No WIMP signal detected!

IceCube is just sensitivities and not limits

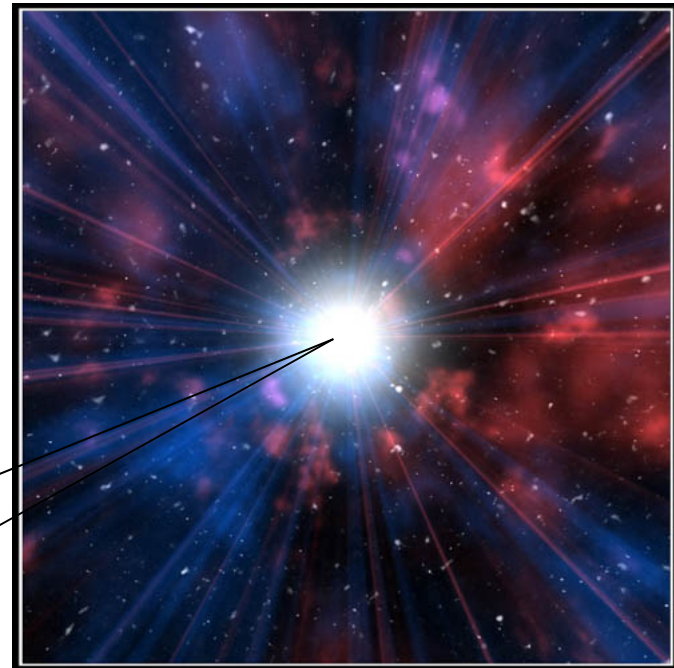
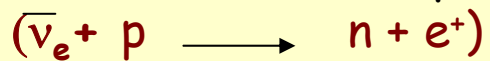
Muon flux limits



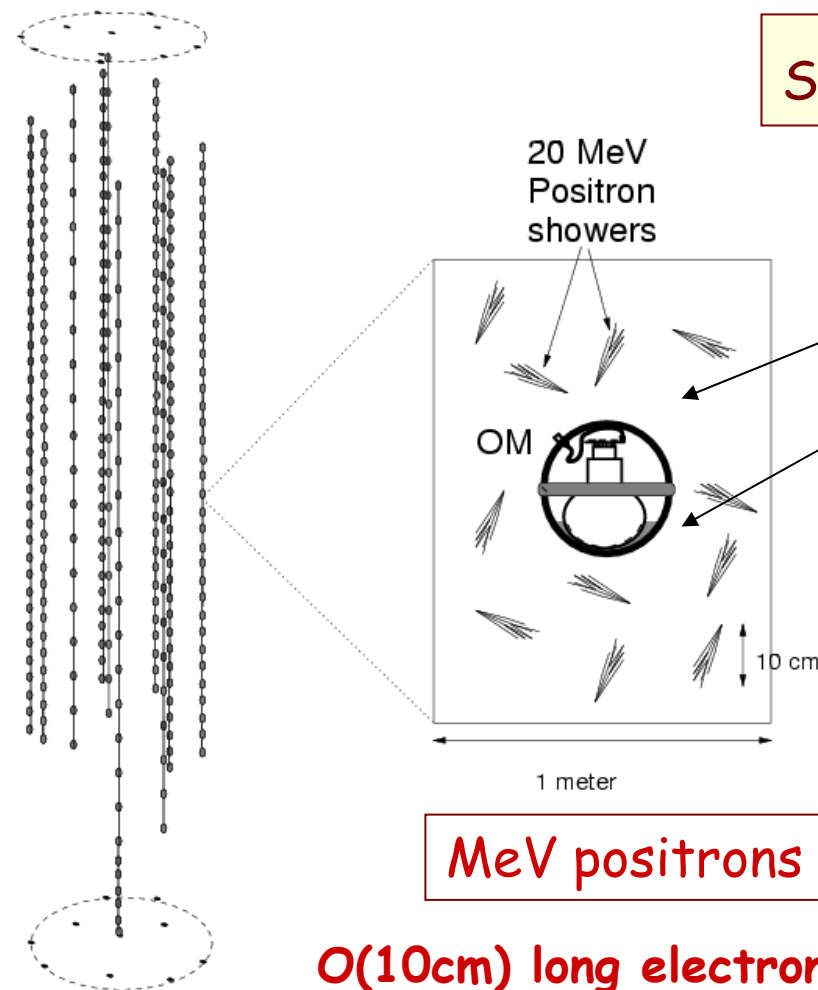
PRELIMINARY

SN NEUTRINO SEARCH

Burst of low energy (MeV) ν_e from SN.
Antineutrino absorption:



AMANDA-B10



SN $\bar{\nu}_e$ Event

$\bar{\nu}_e$

$\bar{\nu}_e$

NO Event Reconstruction



Collective Rate increase
On top of dark noise

SUPERNOVA SEARCH '97 + '98

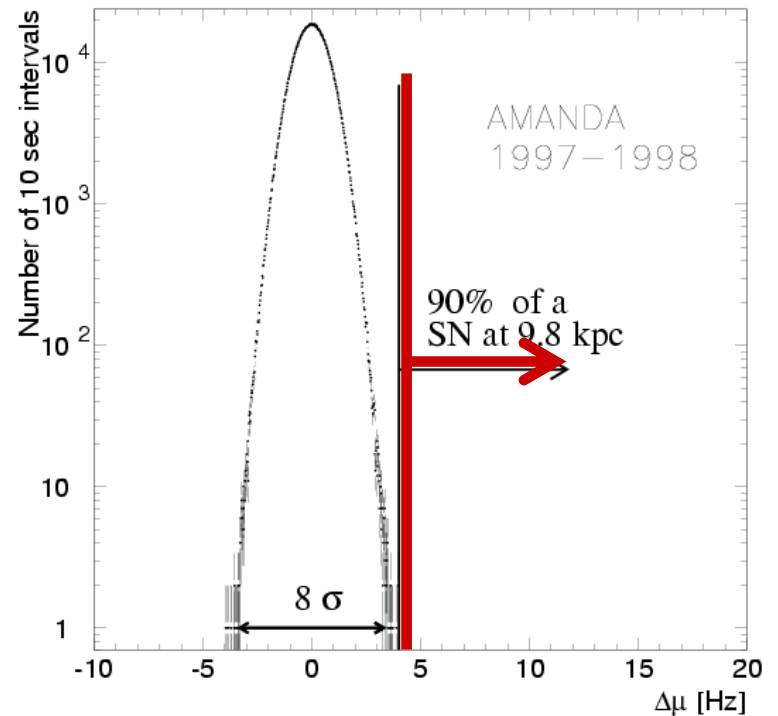
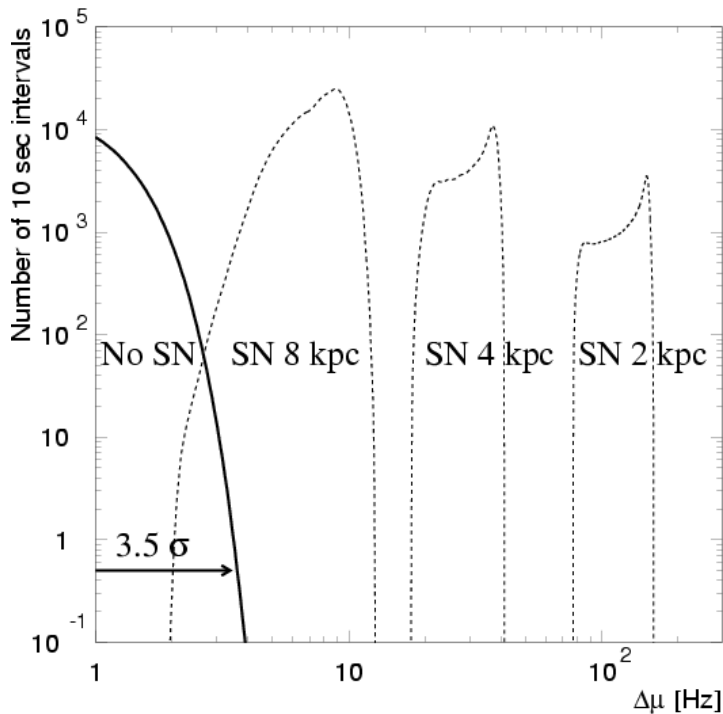
AMANDA-B10 with 302 OMs
Selection of very stable OMs



CRUCIAL = LOW NOISE

SN Signal and Background In AMANDA

215 Days live time; 90% = 9.8 kpc



Astropart.Phys. 16 (2002) 345

70% of Galaxy coverage

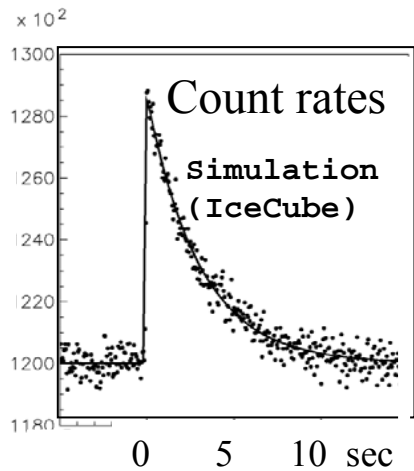
Upper Limits on SN Rate in the Galaxy

$$\Phi_{\text{SN}} < 4.3 \text{ Event yr}^{-1}$$

SUPERNOVA SEARCH '00

SN Signal proportional
To number of OMs !

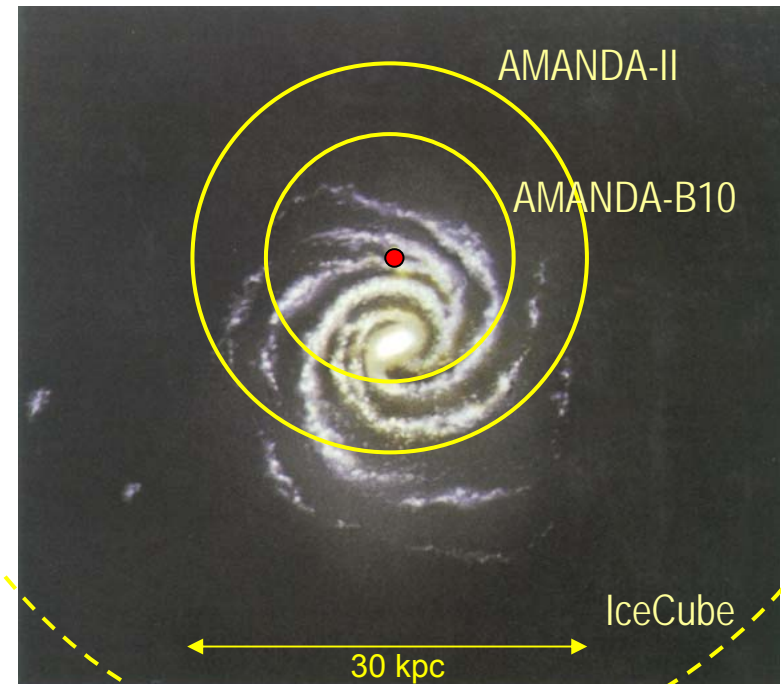
AMANDA-II with 677 OMs



Since 2003: SN DAQ includes all
AMANDA-II channels

Recent online analysis software upgraded
- Can detect 90% of SN within 9.4 kpc
- less than 15 fakes/year

Joining SNEWS (SuperNova Early Warning System)
[with Super-K, SNO, Kamland, LVD, Boone]



COVERAGE:

- B-10: 70% of Galaxy
- A-II: 95% of Galaxy
- IceCube: up to LMC

Analysis of 200x data in progress

SUMMARY - ADDENDUM

AMANDA hasn't seen ν sources yet,
But "she" has produced a lot of Physics!!

- Indirect search for neutralino Dark Matter inside the **Earth**
- Indirect search for neutralino Dark Matter inside the **Sun**
- Search for SN neutrinos
- SNDAQ upgrade → contribute to **SNEWS**