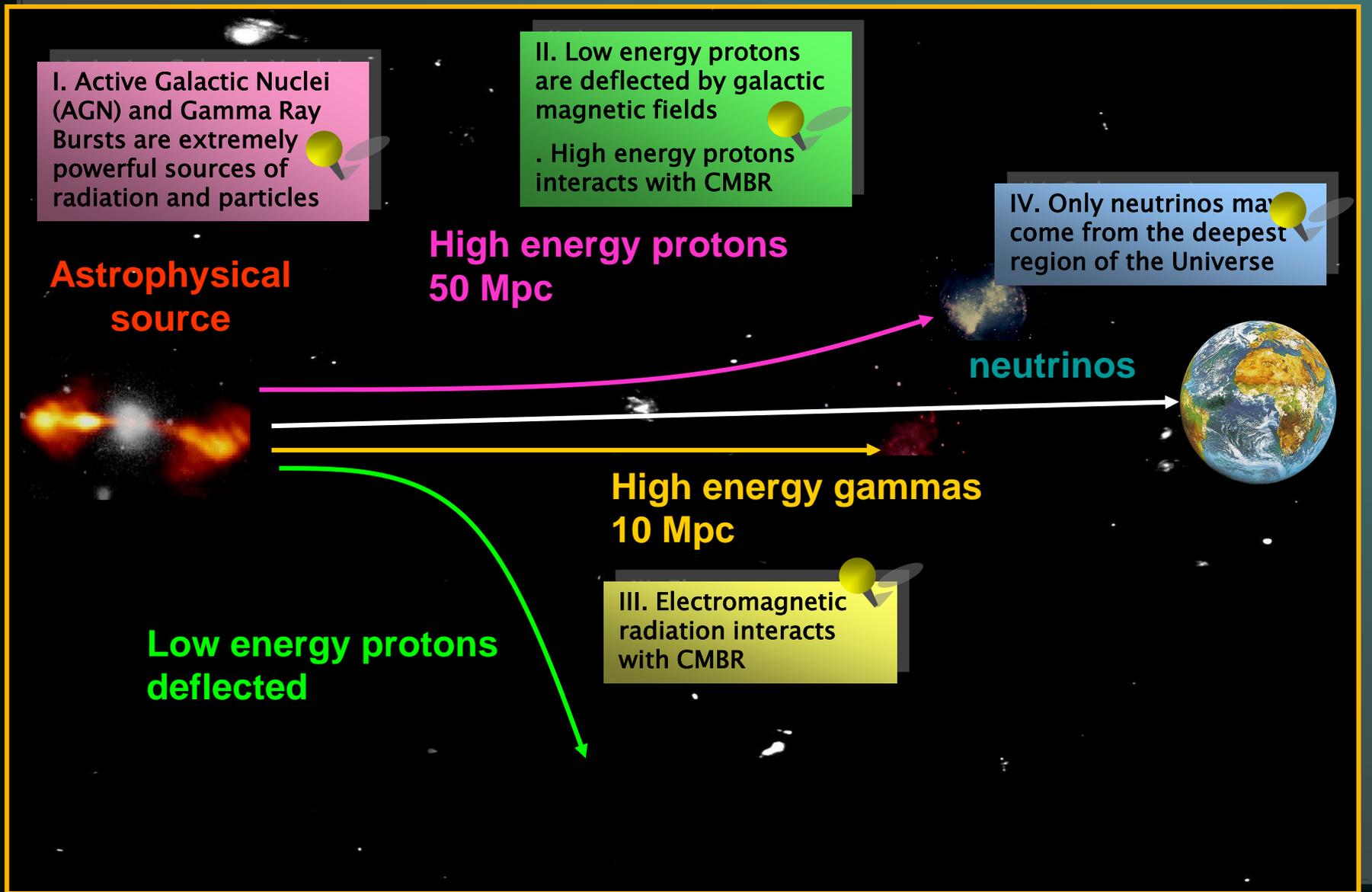


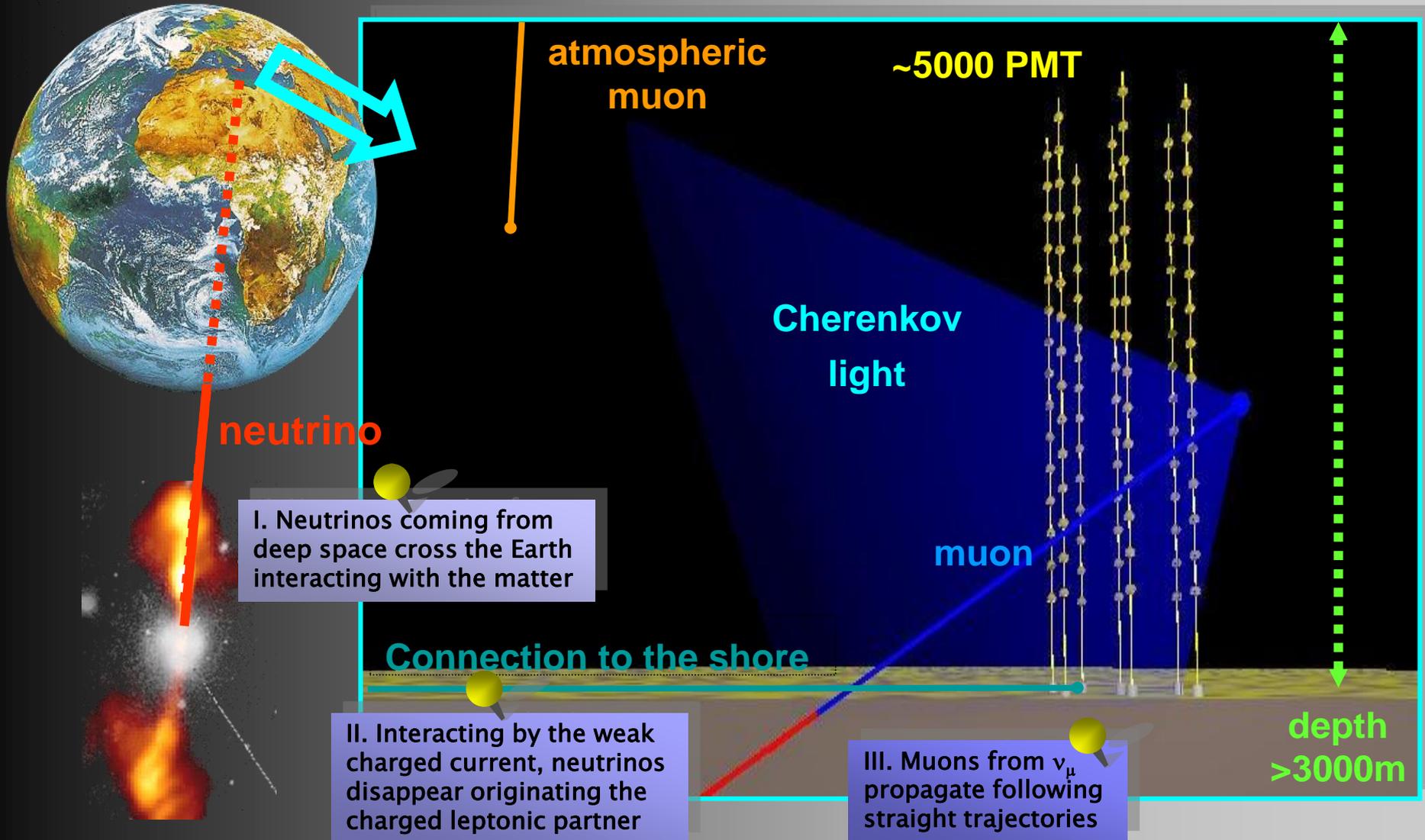
ANTARES results

Evgeny Shirokov
on behalf of the ANTARES collaboration

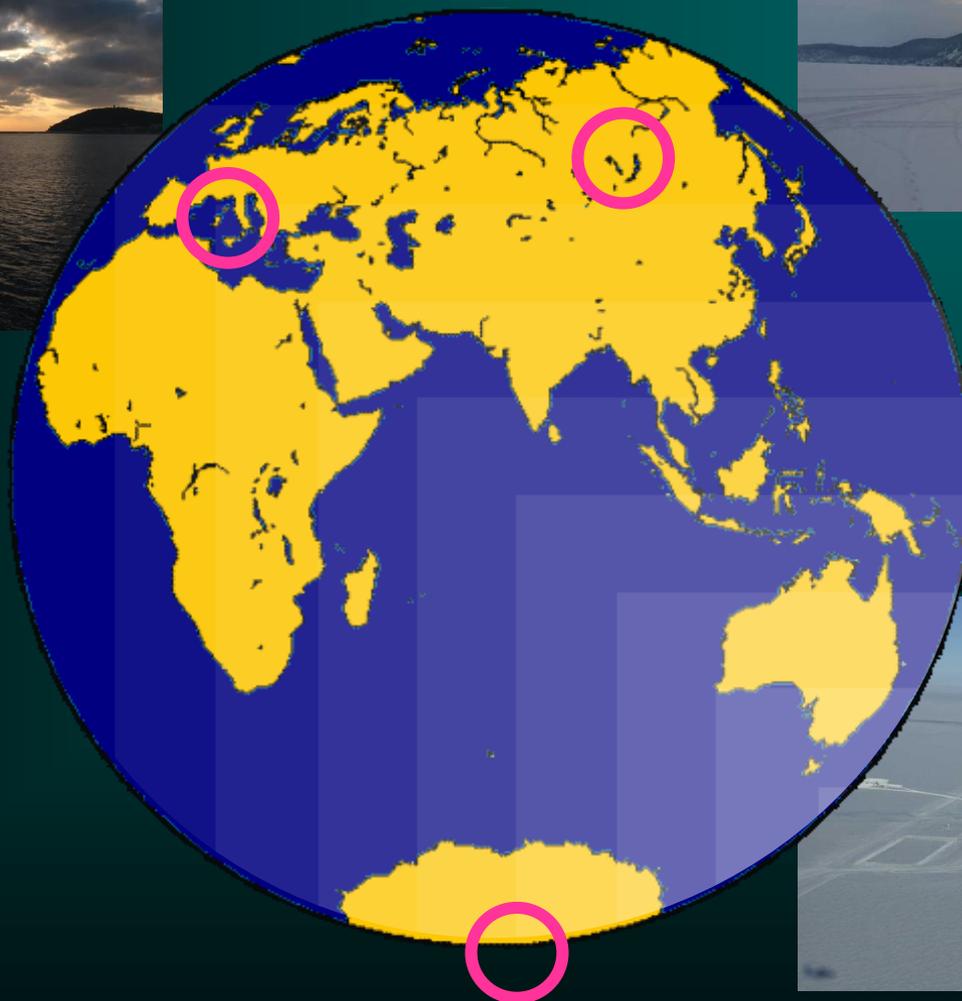
Limits of High Energy Astronomy

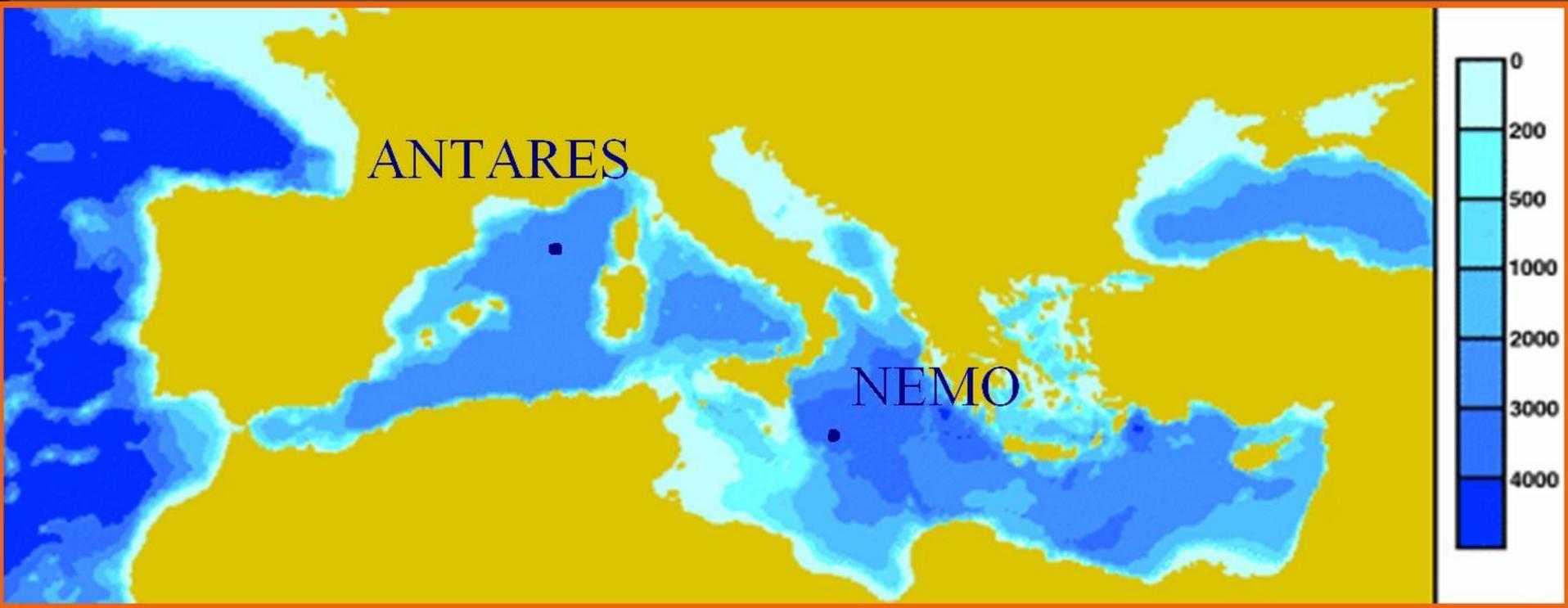


Neutrino Detection Principle

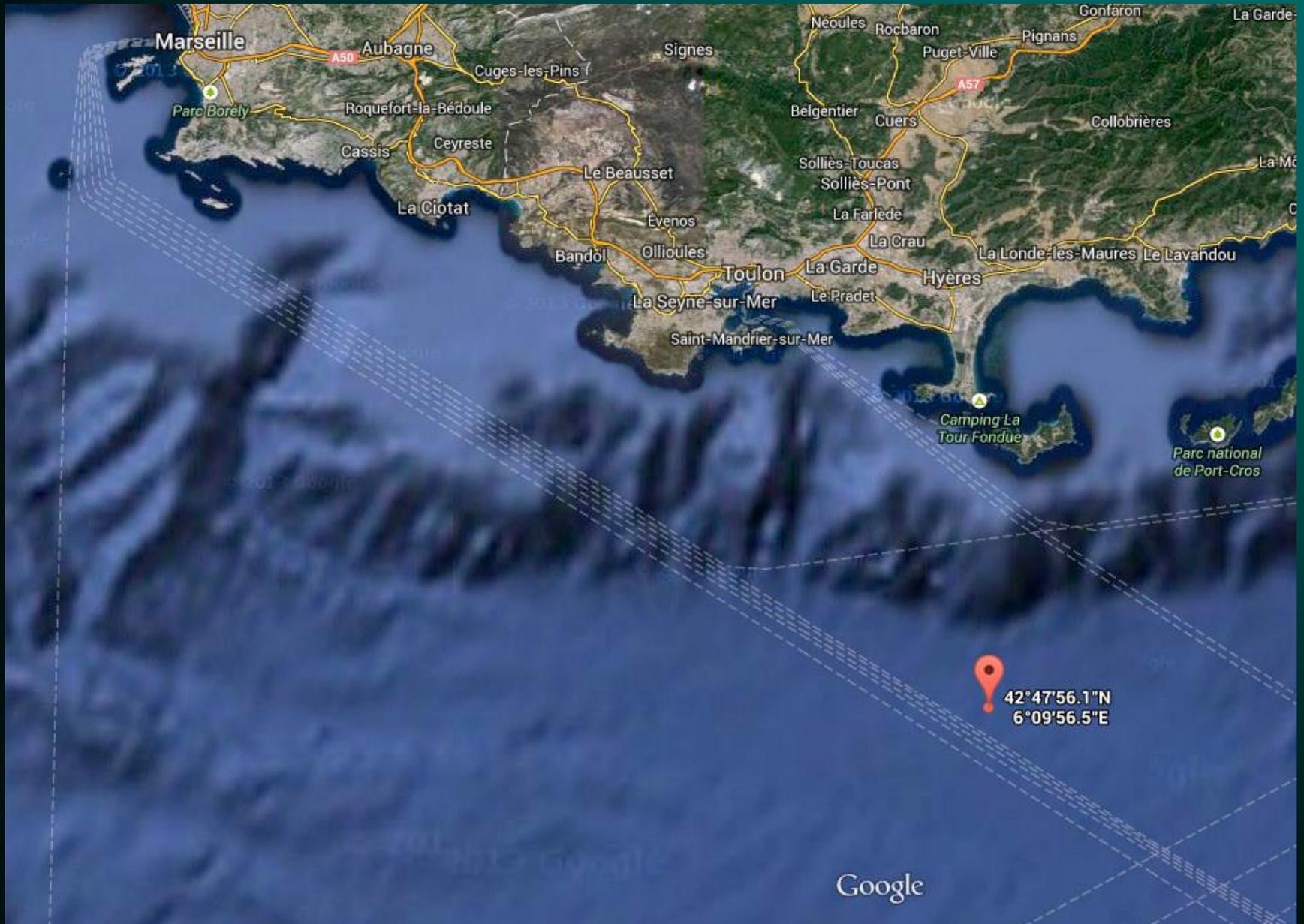


HE ν telescopes



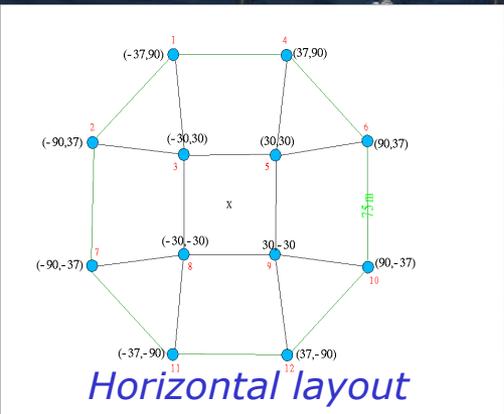


The ANTARES site



ANTARES detector (artist's view)

12 lines (about 900 PMTs)
25 storeys / line
3 PMTs/storey



14.5 m

a storey

350 m

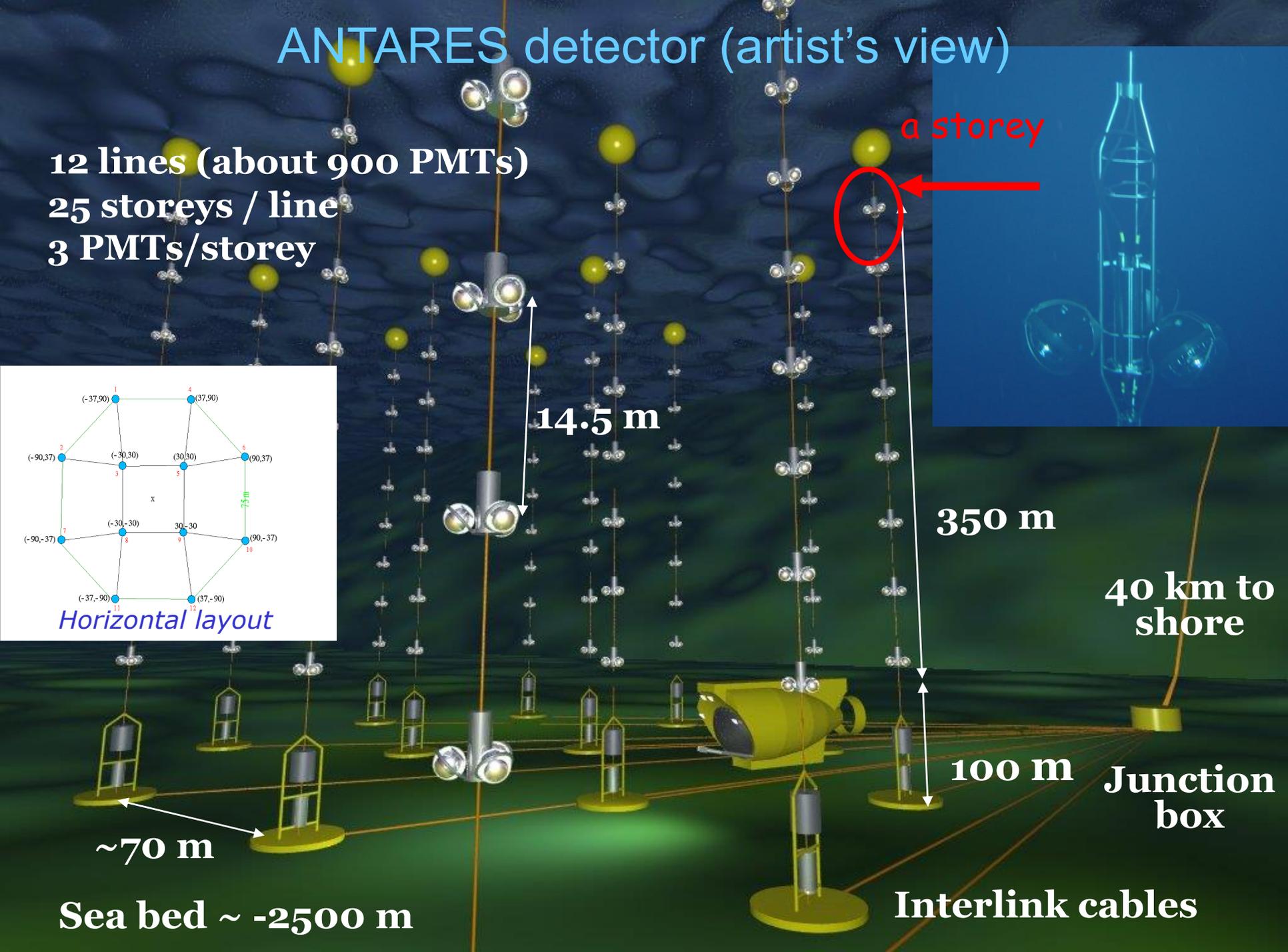
40 km to shore

100 m

Junction box

Interlink cables

Sea bed ~ -2500 m







The collaboration



Physics results

- Diffuse flux
- Neutrino point source search
- Fermi bubbles research
- Multi-messenger search
- GRB results
- Flaring sources
- Gravitational waves
- Conclusion and perspective

Diffuse flux

Theory

- ν_μ from unresolved sources
- Flux from UHECRs and γ -rays

Search with the 2008-2011 data (855 days)

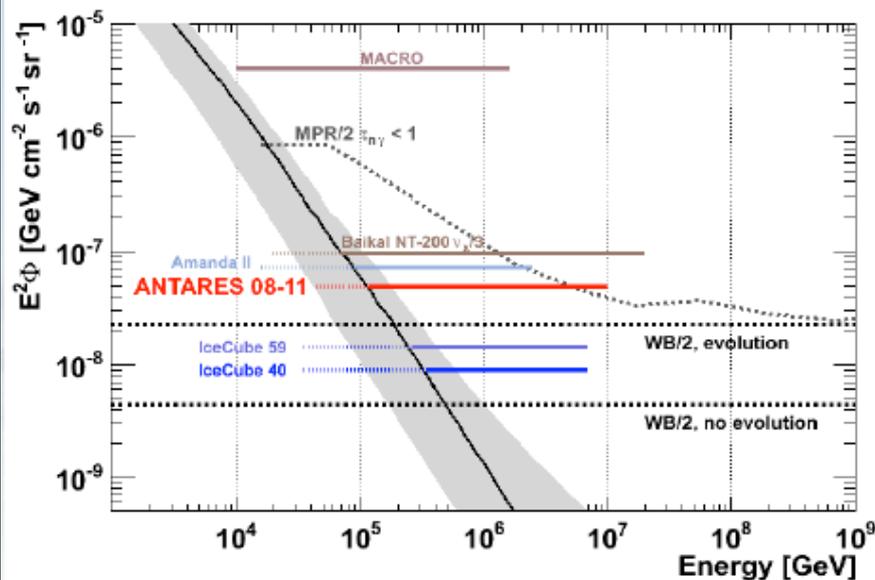
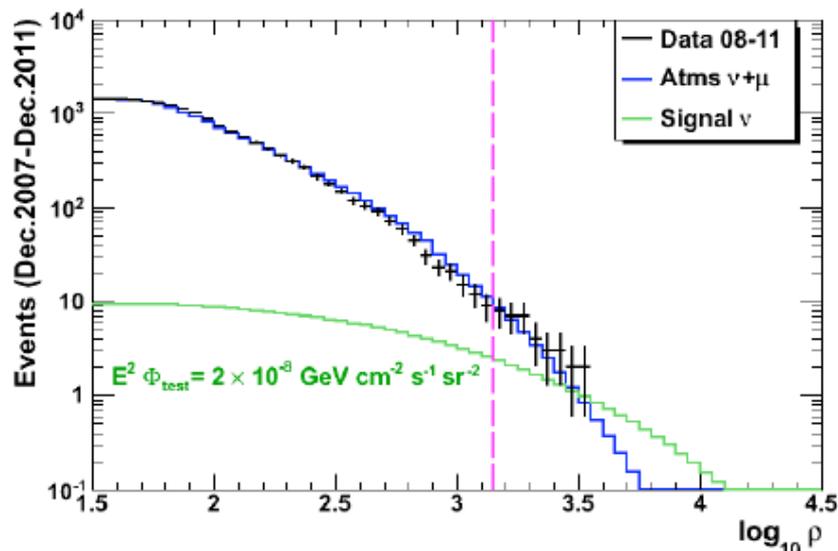
- dE/dx (hits repetitions) as energy estimator
- Negligible muon contamination
- Sensitivity:

$$E^2 \Phi = 4.7 \times 10^{-8} \text{ GeV cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$$

- Unblinded results (45 TeV to 10 PeV):

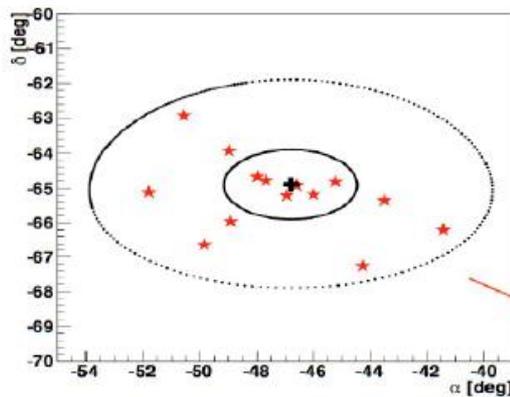
$$E^2 \Phi_{90\%} = 4.8 \times 10^{-8} \text{ GeV cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$$

$$N_{\text{obs}} = 8, N_{\text{bkg}} = 8.4, N_{\text{sig}} = 2.3$$

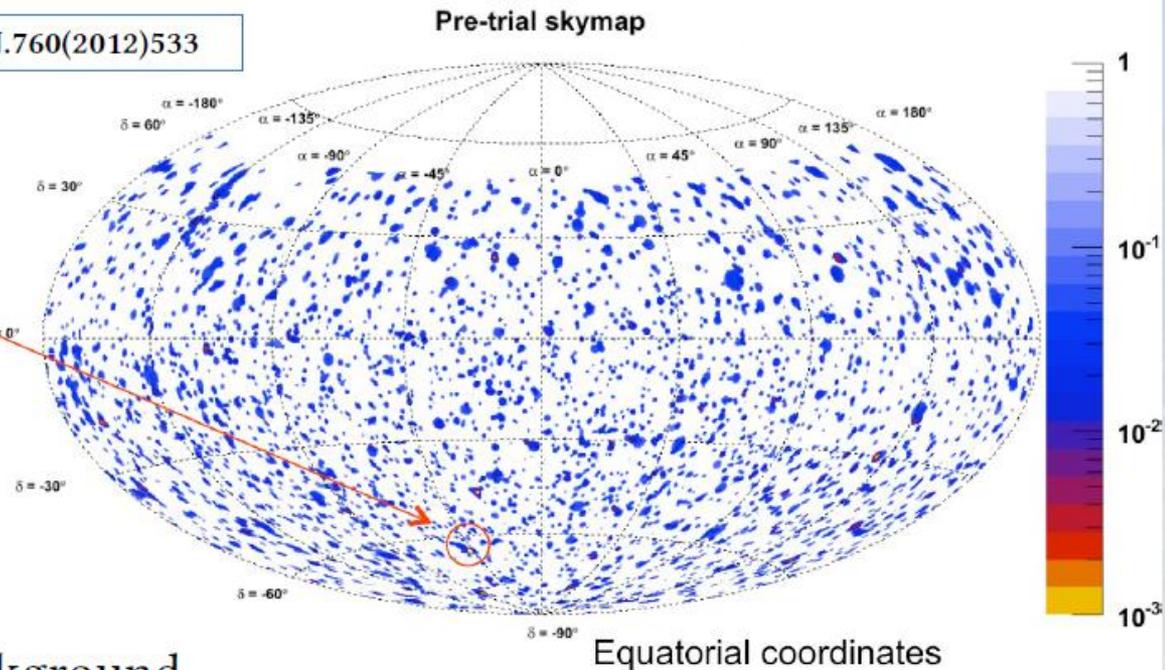


Neutrino point source search

- 1340 days of data (2007-2012)
- 5516 neutrino candidates and **no significant excess**



ApJ.760(2012)533

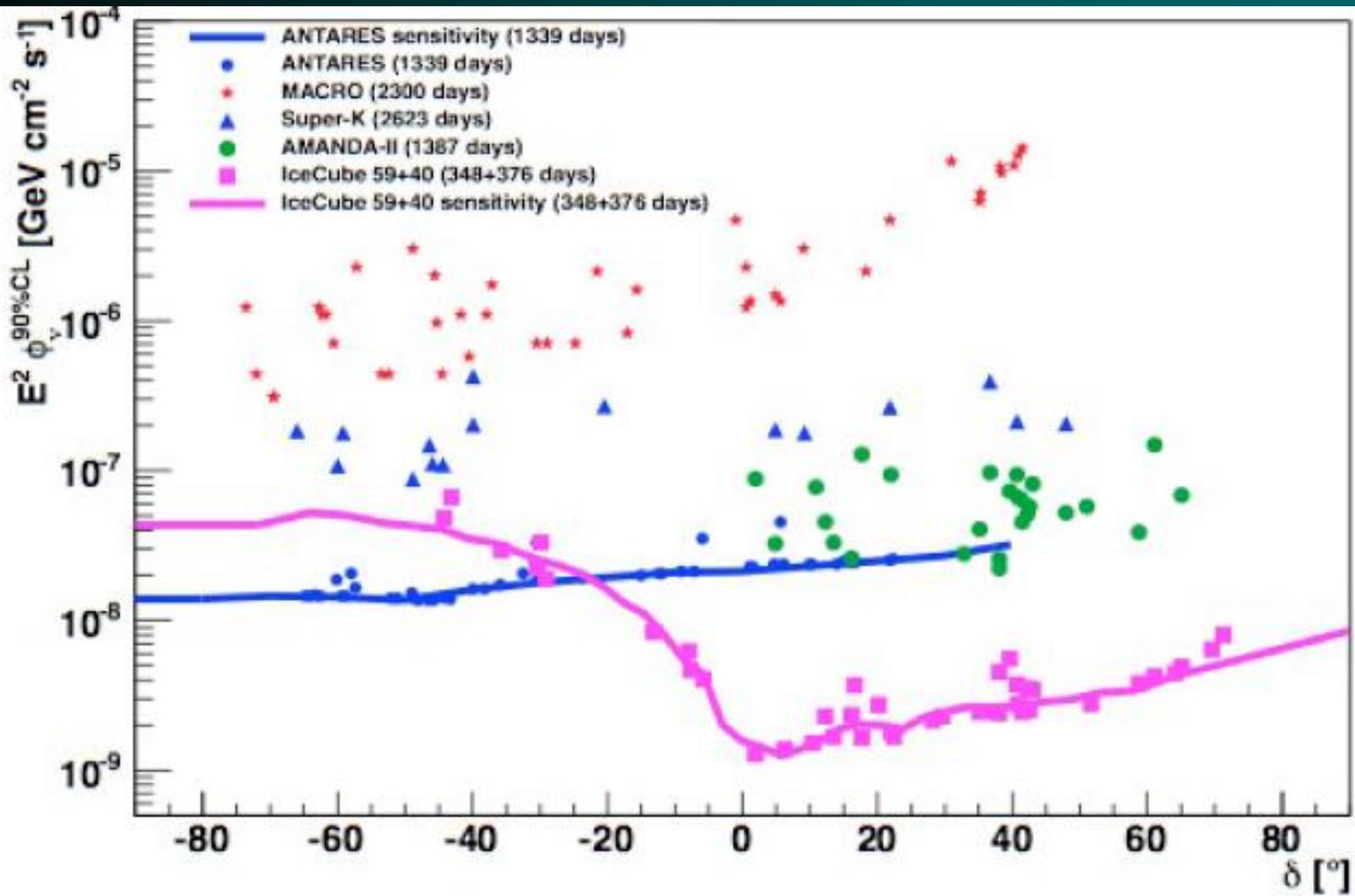


Most significant cluster, 14 events

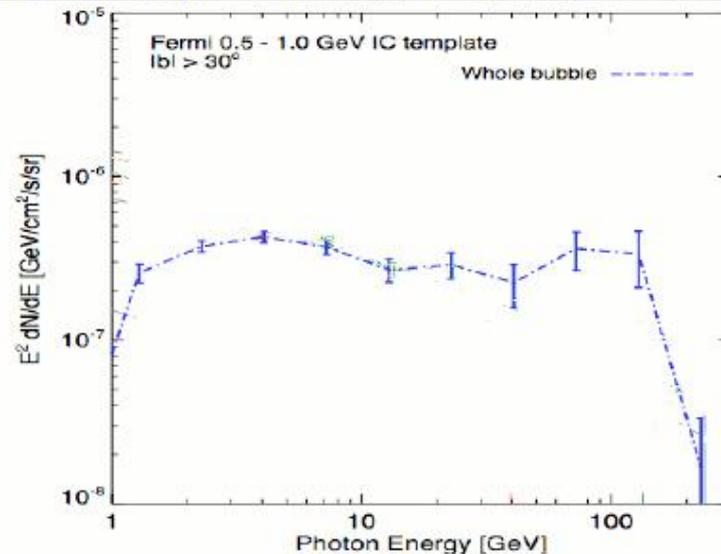
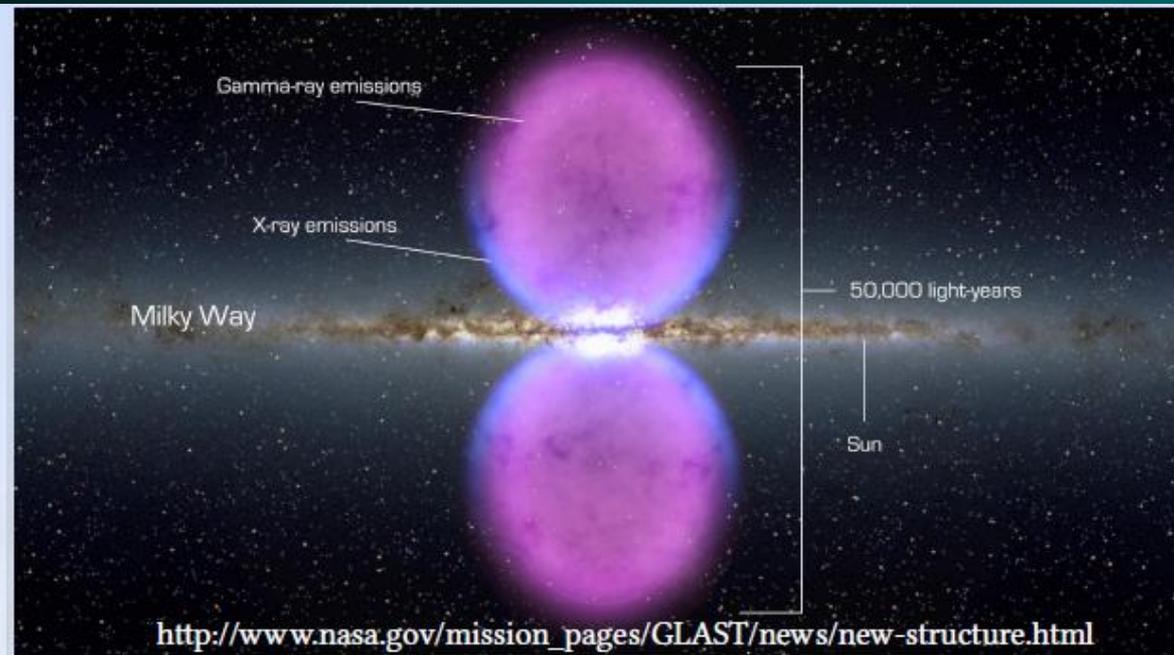
P-value of 2.1% ($\sim 2 \sigma$)

→ compatible with the background

Neutrino point search



Fermi Bubbles research



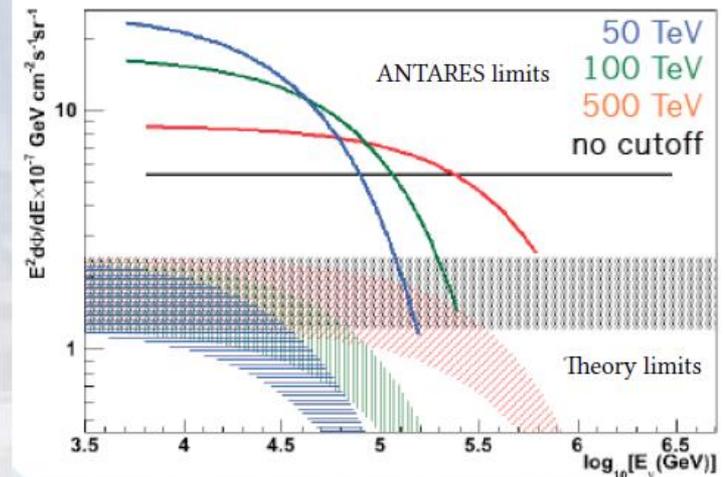
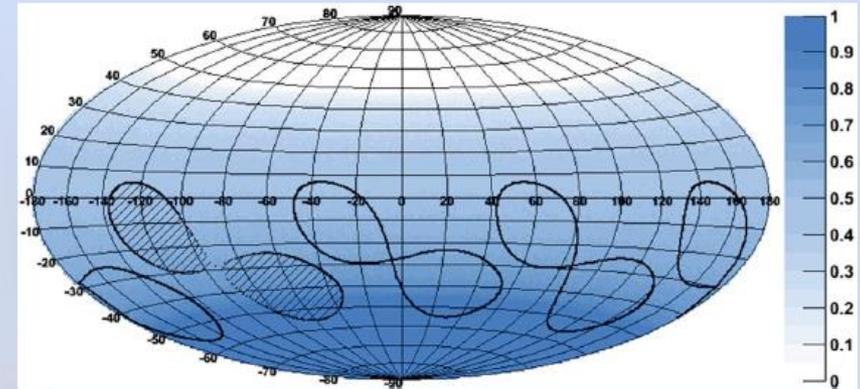
Fermi Bubbles

- Excess of gamma and x-rays above and below the galactic center
- Homogeneous flux in $1/E^2$
- The galactic wind is possible origin
- An energy cut-off is probable
- The hadronic scenario is privileged

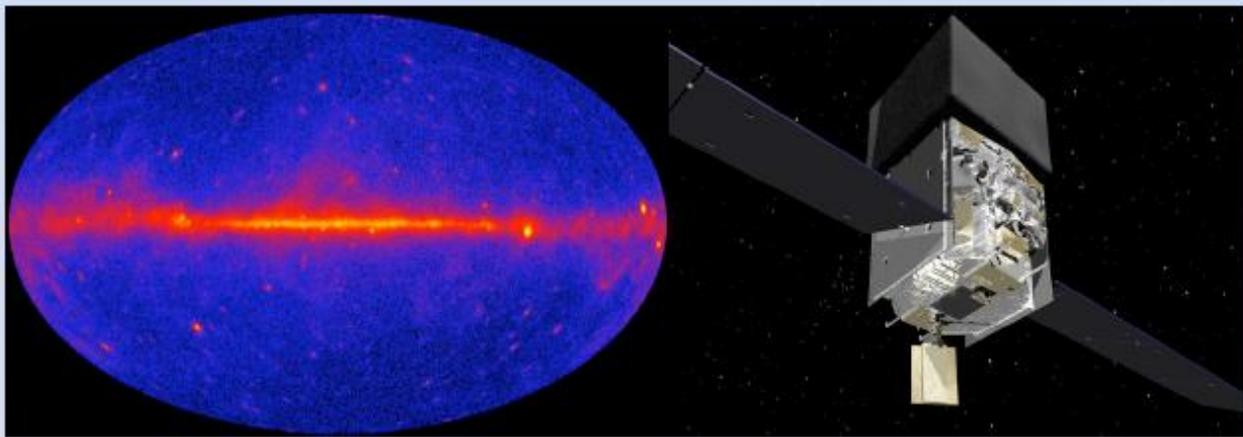
Fermi Bubbles research

- 3 off zone to evaluate the background
- 806 days of data (2008 to 2011)
- Neural network for the energy estimation
- $N_{\text{obs}} = 16$, $N_{\text{bg}} = 11$
→ 1.2σ , no significant excess

EPJ C 1434-6044(2014)



GRB sources

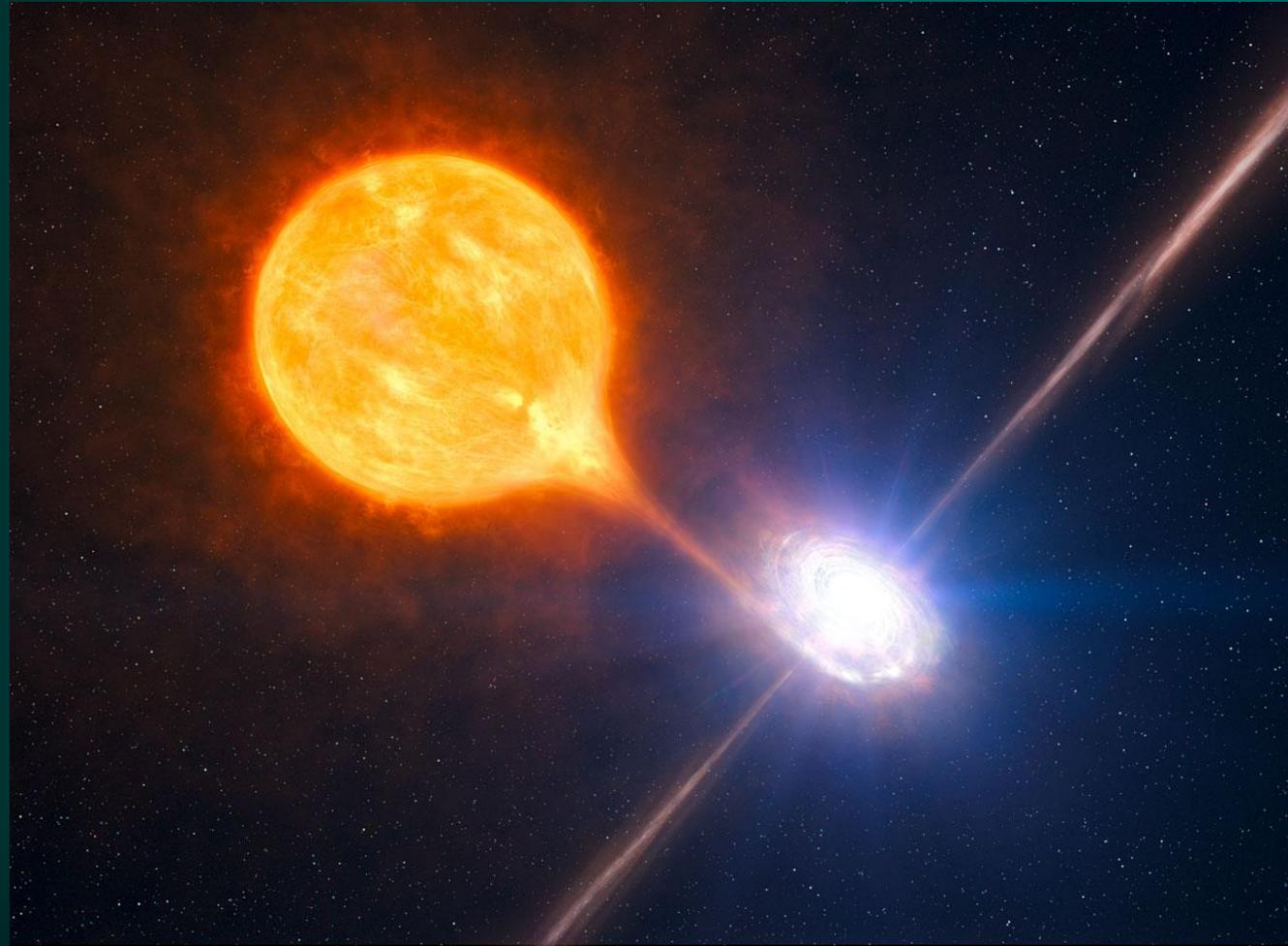


GCN provides time a coordinates of the GRBs from the Swift and Fermi satellites

- Neutrino in coincidence with GRB
- Better background rejection
- Better sensitivity

A&A 559, A9 (2013)

Flaring sources



10 blazars (2008)
1 event in coincidence
41 blazars (2008-2011)
2 events in coincidence
6 microquasars

(AP 36 (2012) 204-210)

Gravitational waves

- Visible sources-GRBs (short, long low luminosity)
- Invisible sources-failed GRBs
- HE neutrino used as a trigger

- NO coincidence found

Conclusions

- ANTARES is the current largest neutrino telescope in the Northern Hemisphere
- Technically, it is a great success
- It has competitive physics results
- The potential of the data analysis is still big (shower, catalogs, statistics, analysis method improvement..)

The perspectives

The future is in preparation with KM3NeT:

- Aim to be the largest neutrino telescope on Earth
- A sensitivity largely improved
- A wider field of physics studies will be open (e.g. neutrino oscillations with the ORCA project)

Thank for your attention!