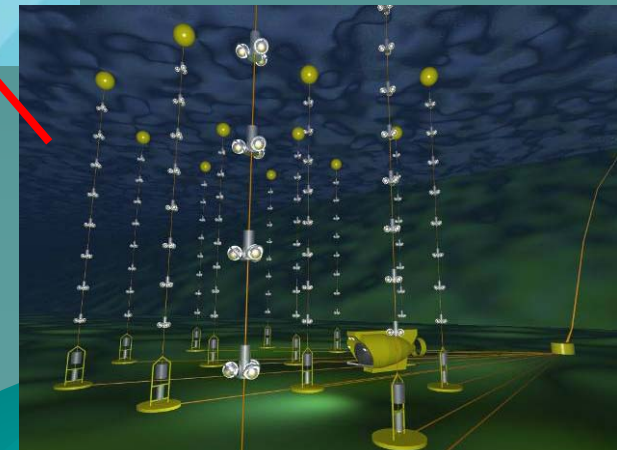


Data from the ANTARES Neutrino Telescope

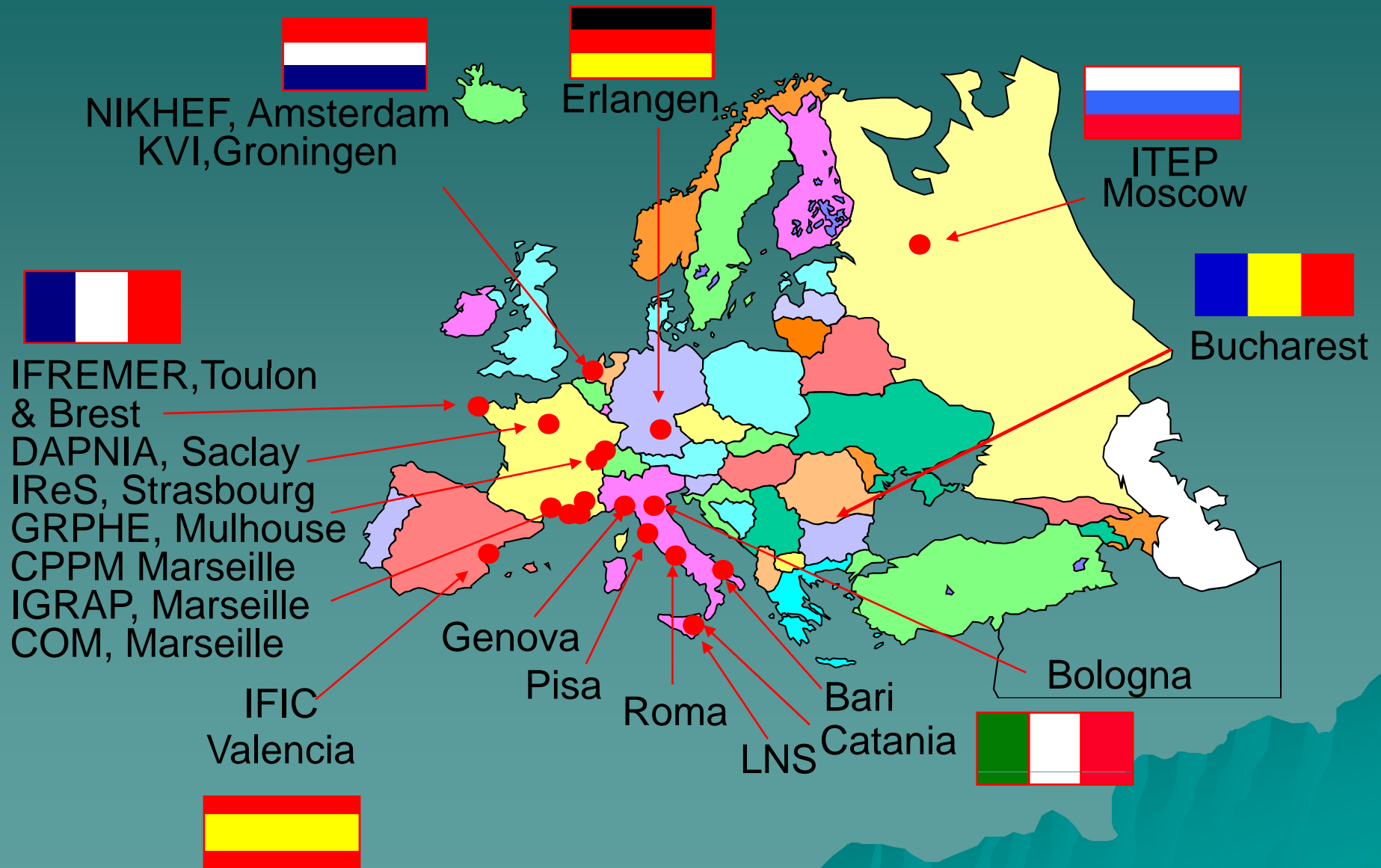
John CARR (Centre de Physique des Particules de Marseille / IN2P3 / CNRS)



RICAP07
Rome
June 2007



ANTARES Collaboration





ANTARES project

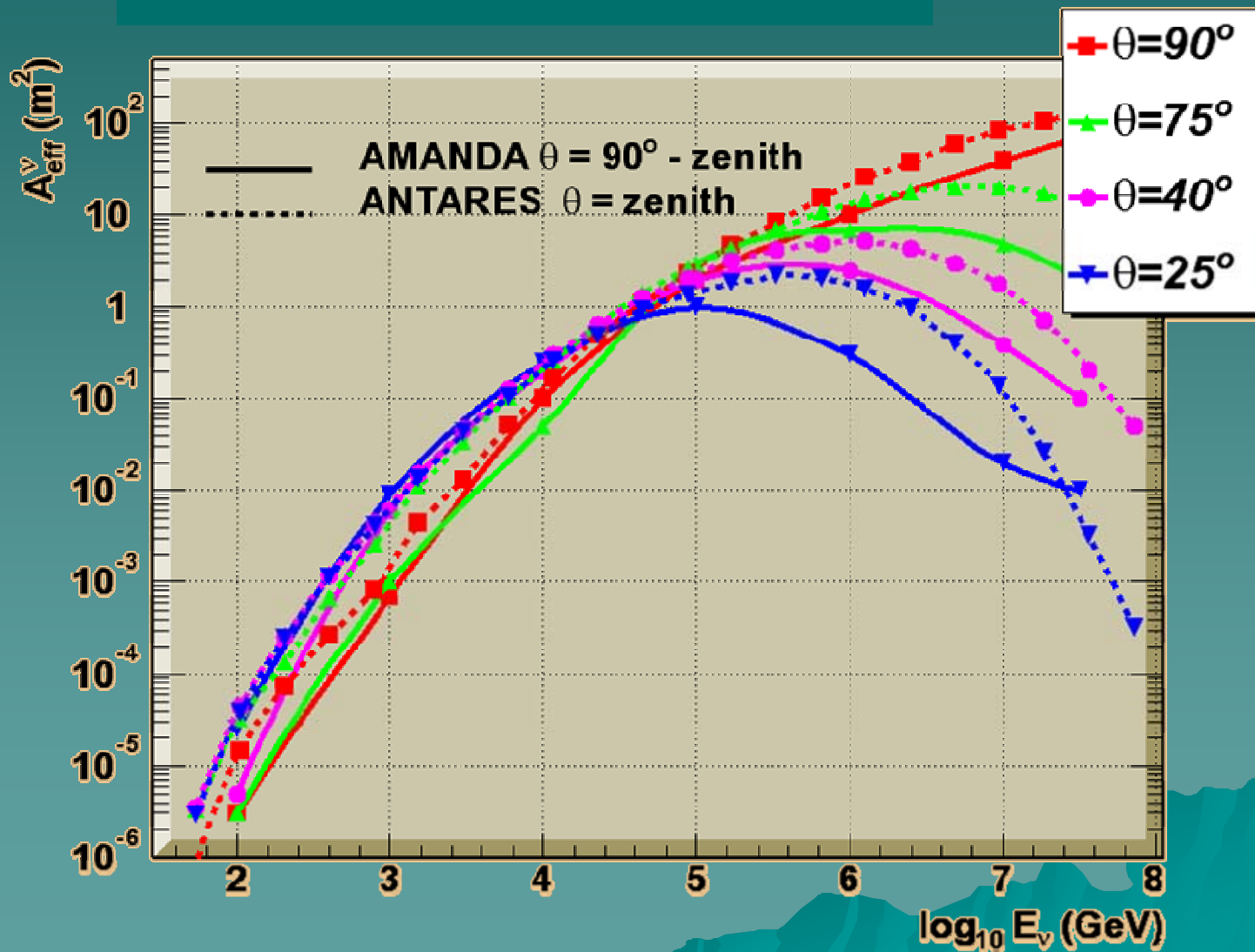


Fundamental research in "Astroparticle" physics
and interdisciplinary research
in oceanography, geology et biology

- ◆ 1996-2002
Site exploration and R&D
- ◆ 2002-2008
Construction of 12 lines
- ◆ 2008-2013...
Operation for science

**Since 29 January 2007, 5 lines in operation:
biggest neutrino telescope in northern hemisphere**

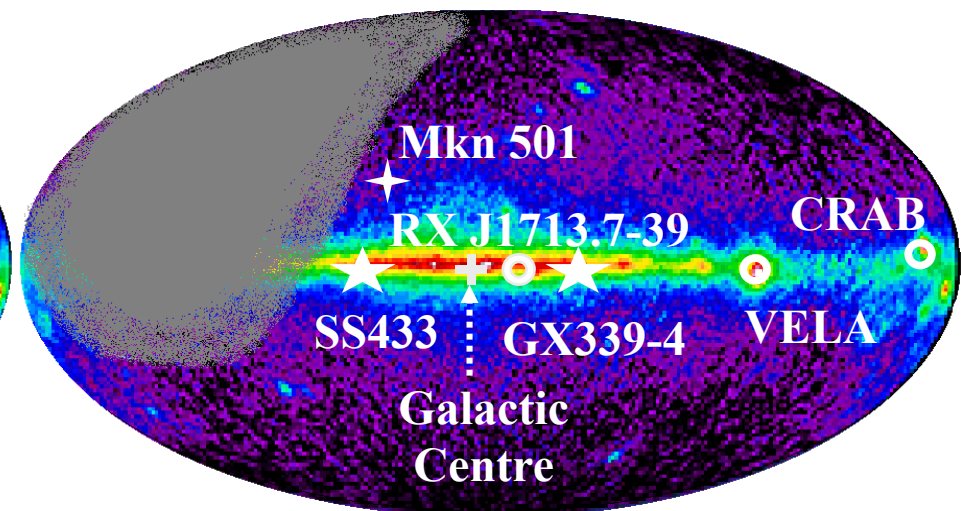
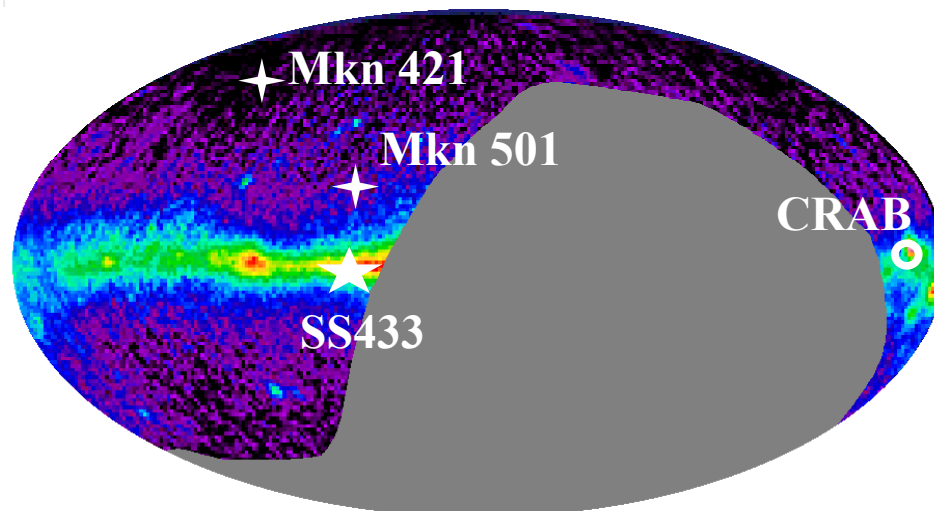
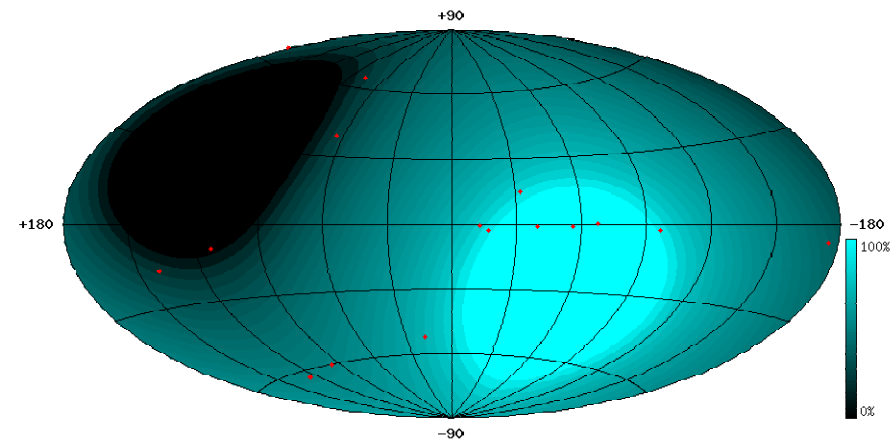
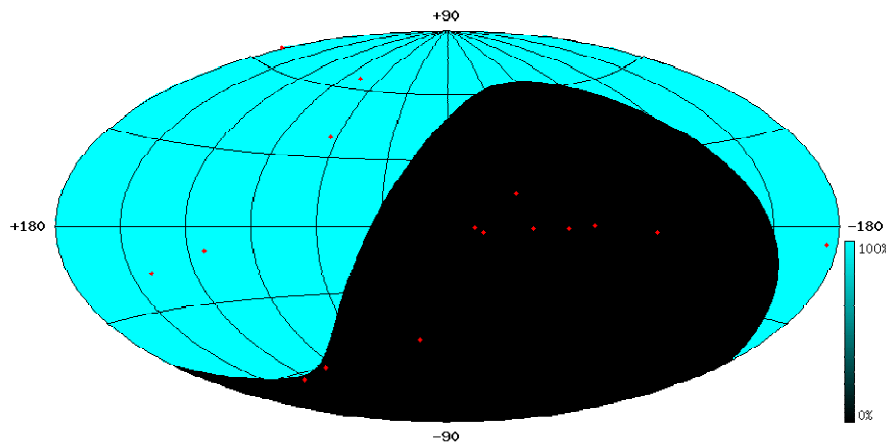
Effective Neutrino Area AMANDA / ANTARES



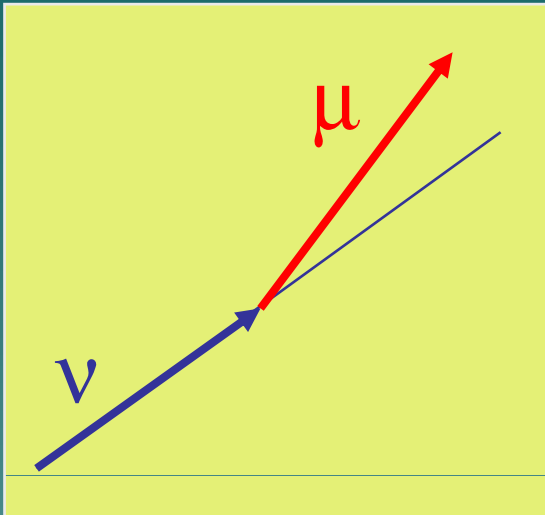
Region of sky observable by Neutrino Telescopes

AMANDA (South Pole)

ANTARES (43° North)



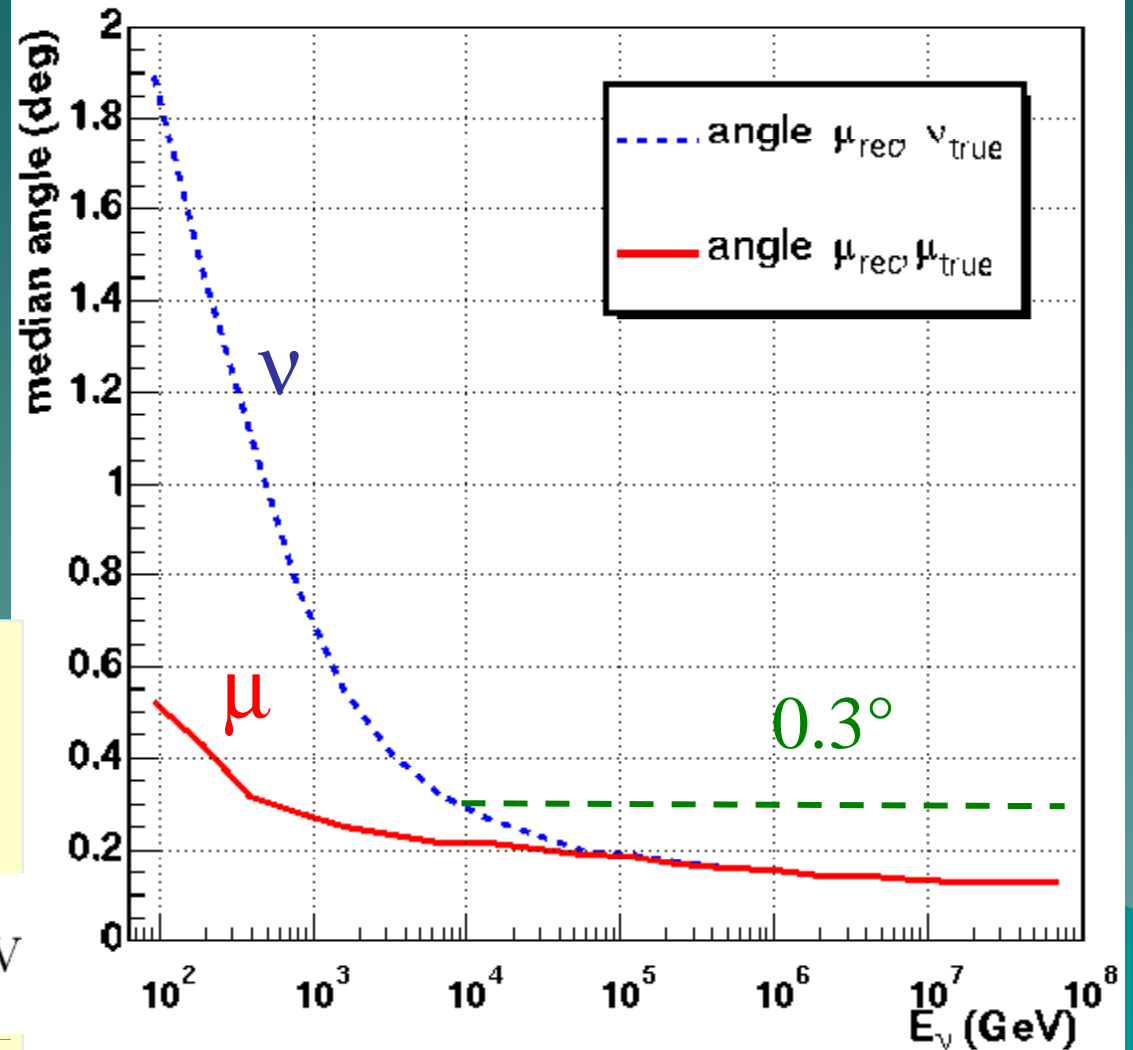
Angular Resolution



Deep inelastic scattering :

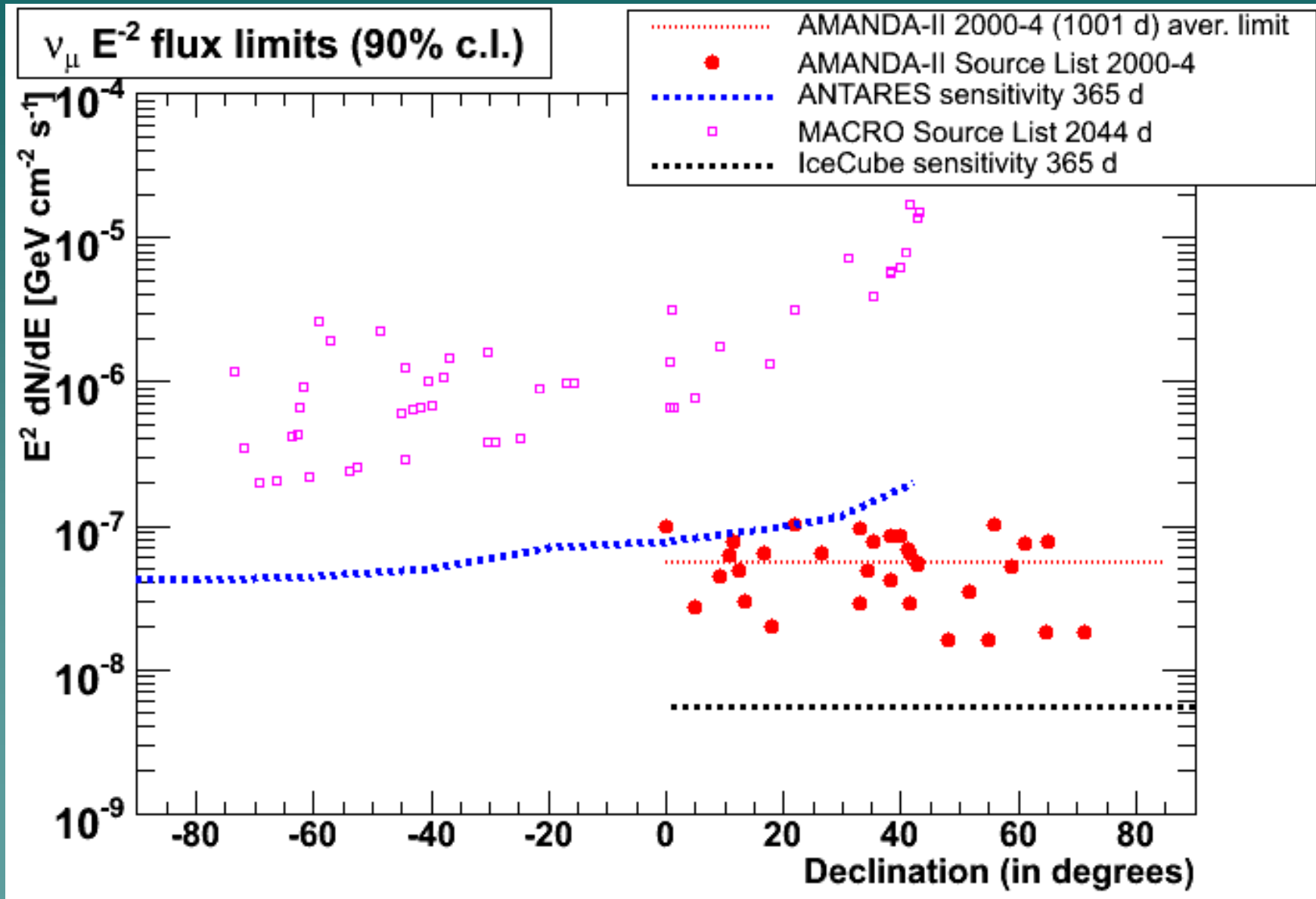
$$\sqrt{\langle \theta_{\mu\nu}^2 \rangle} \approx \sqrt{\frac{m_N}{E_\nu}}$$

$$\langle \theta_{\mu\nu} \rangle = \frac{0,64^\circ}{(E_\nu / \text{TeV})^{0,56}} \quad E_\nu > 10 \text{ TeV}$$



$< 0.3^\circ$ for $> 10 \text{ TeV}$: dominated by detector resolution

Expected limits for point-like sources



2400m

ANTARES Detector

12 lines
25 storeys / line
3 PMT / storey

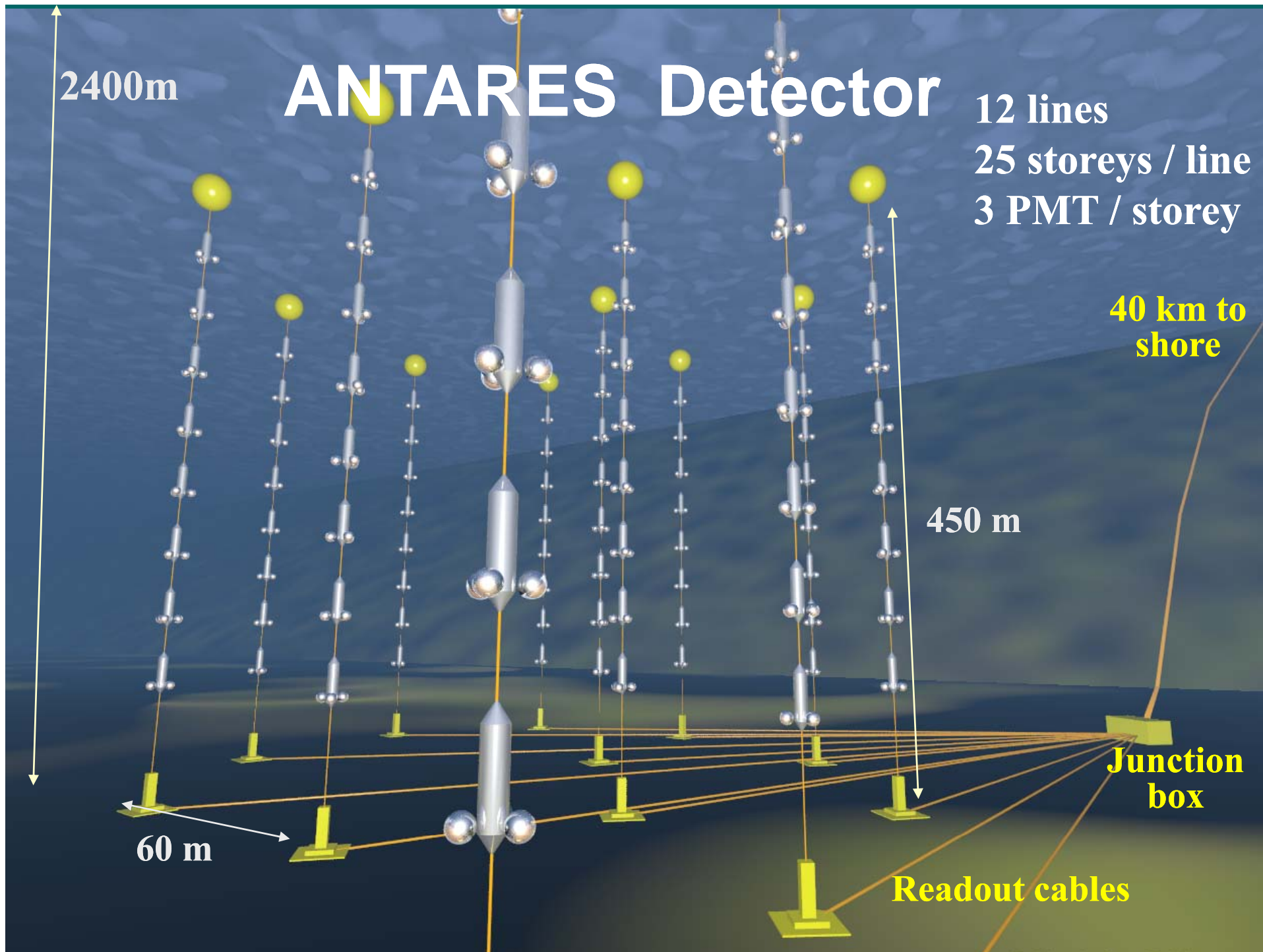
40 km to shore

450 m

60 m

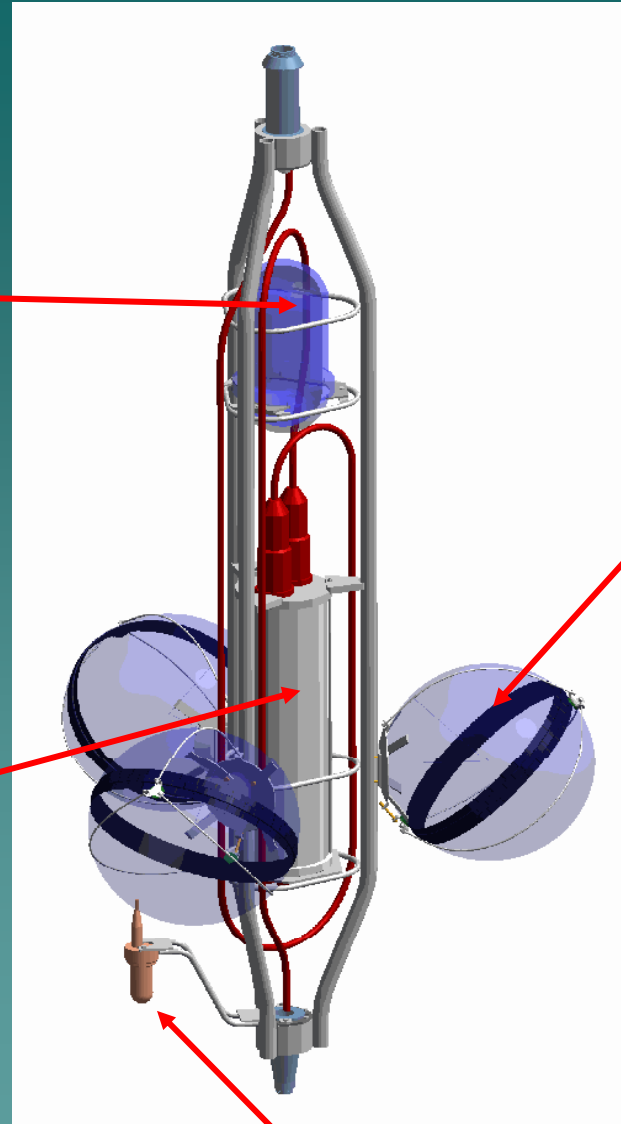
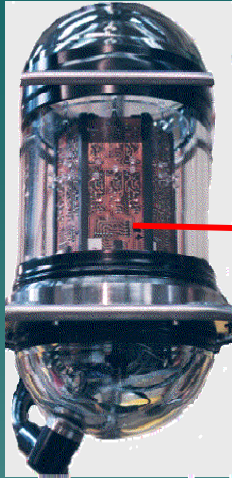
Junction box

Readout cables

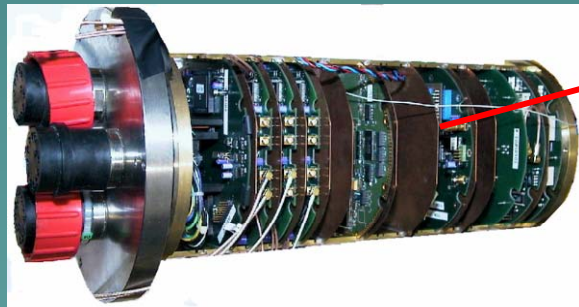
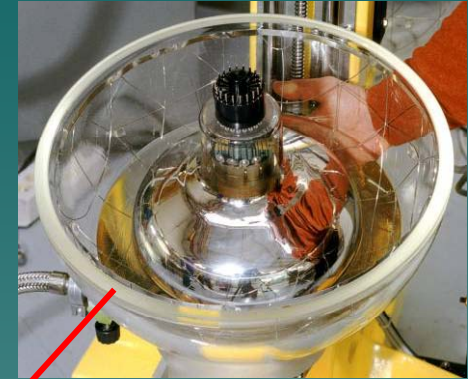


Basic detector element: storey

Optical Beacon
for timing
calibration
(blue LEDs)
1/4 floors



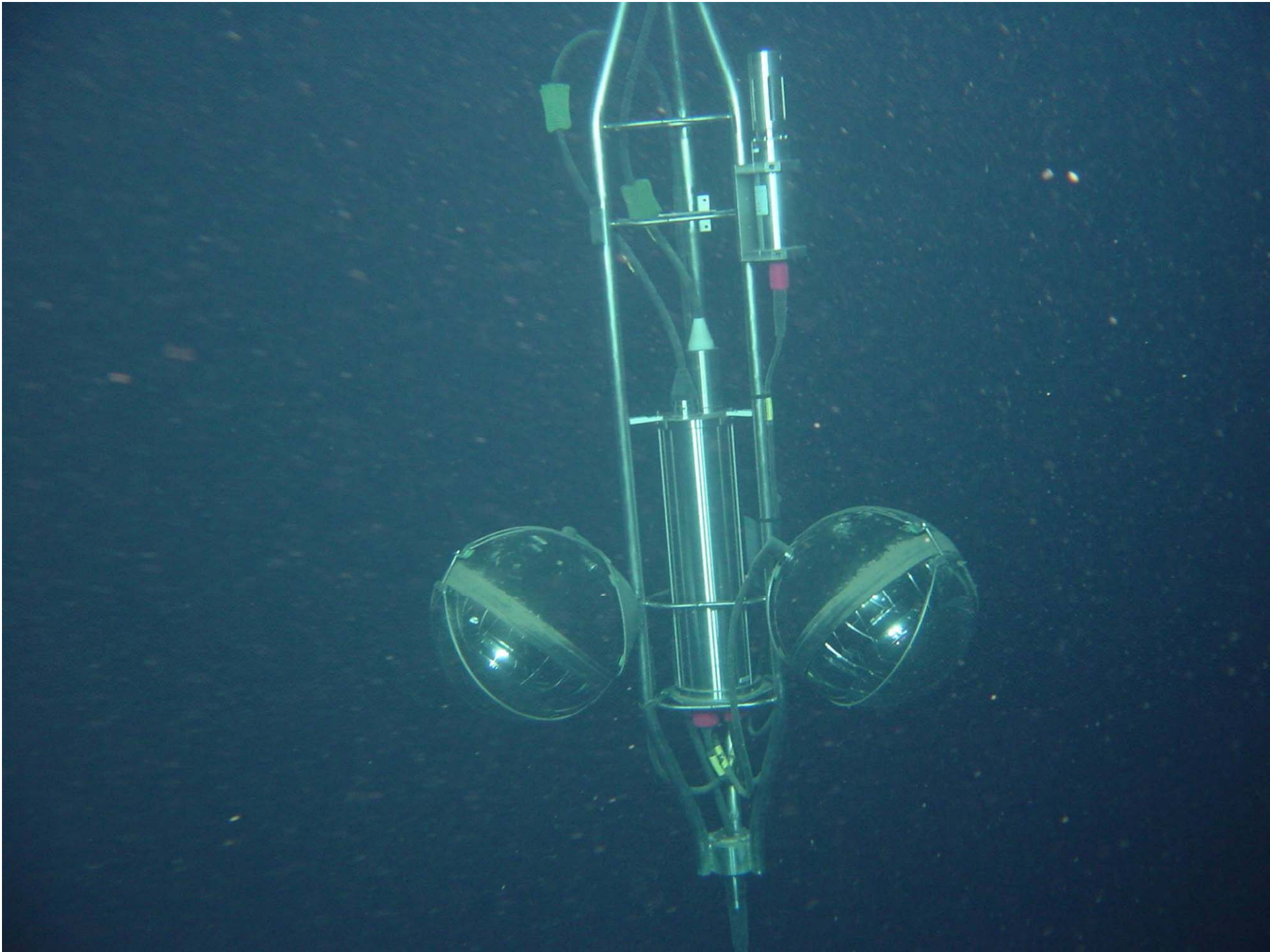
17" glass sphere
10" PMT Ham. R7081-20
14 stages



Local Control Module
(in the Ti-cylinder)



Hydrophone RX



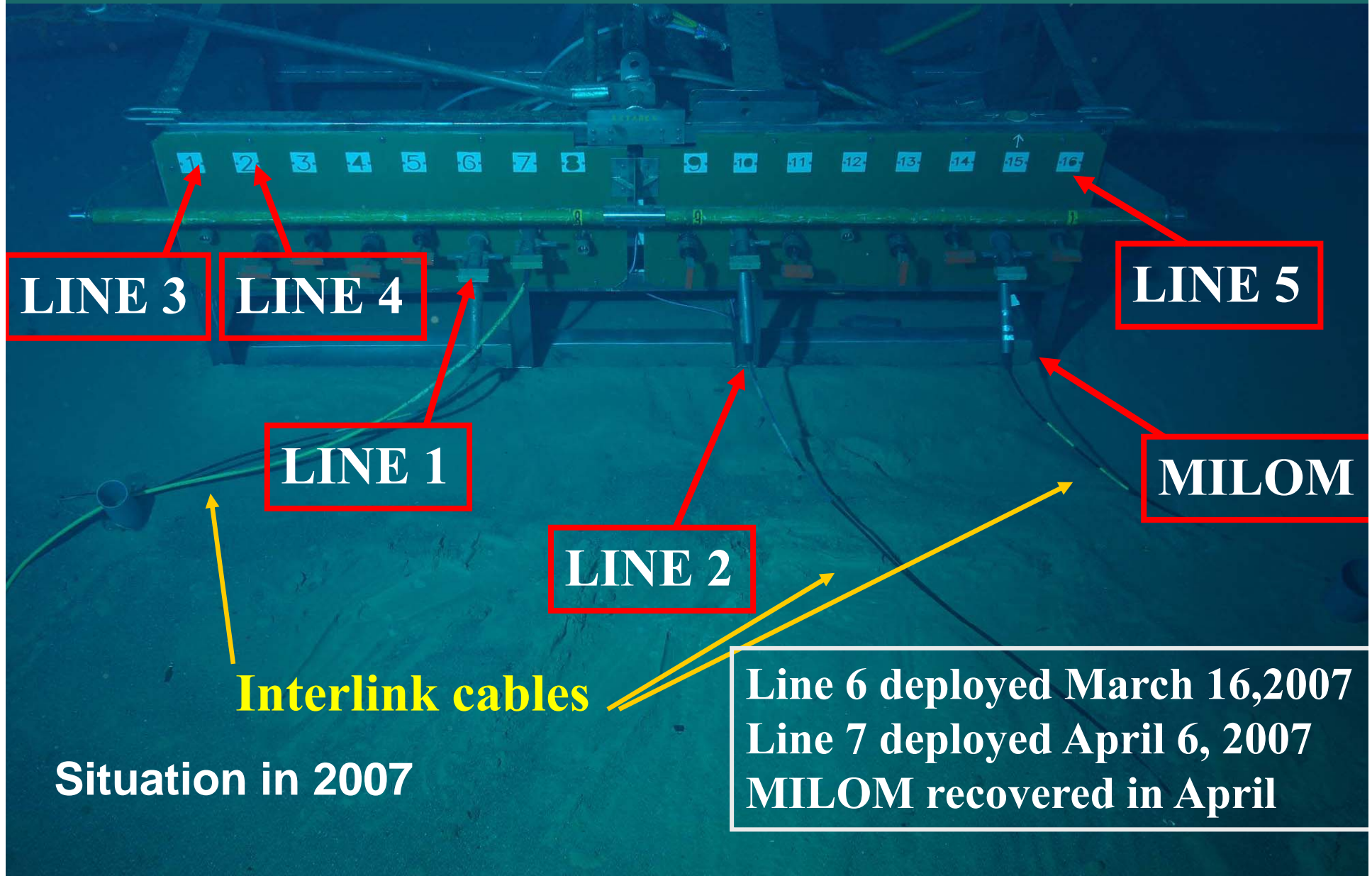
Deployment of Sea Cable



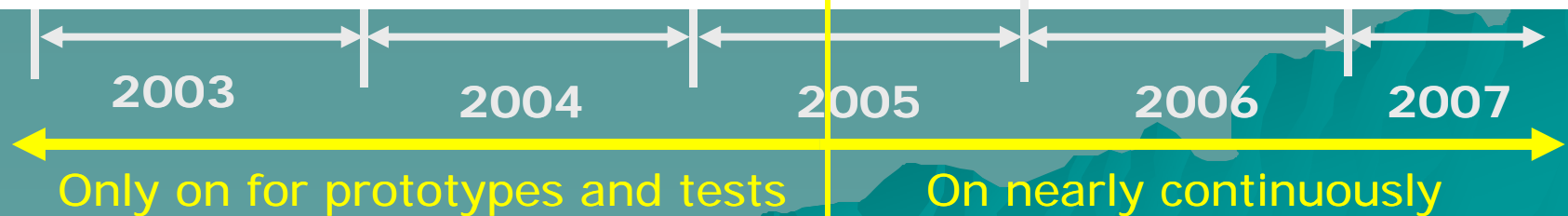
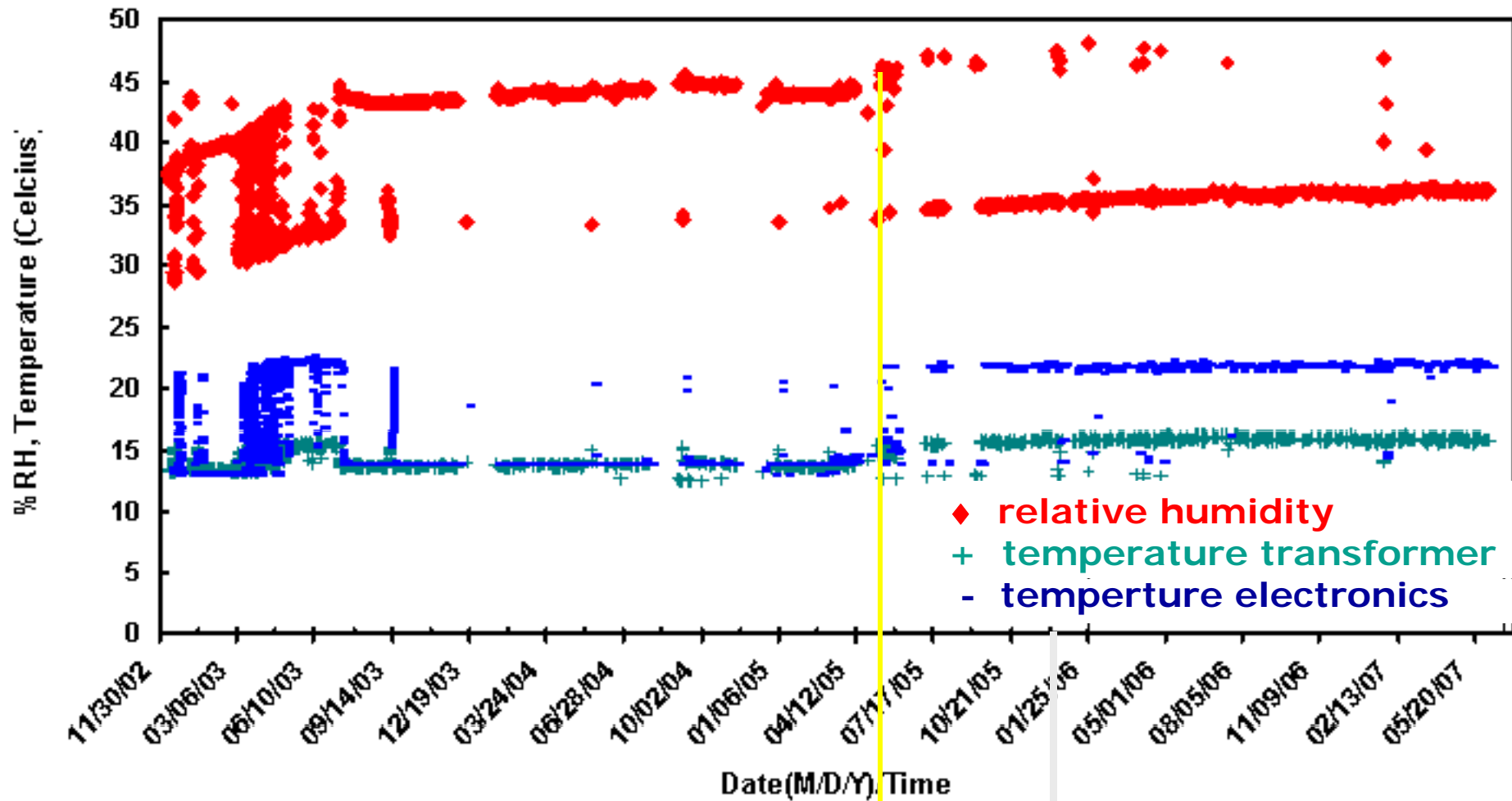
Deployment of Junction Box



Junction Box at present time



Junction Box environment history



Line 1

Operational since March 2006

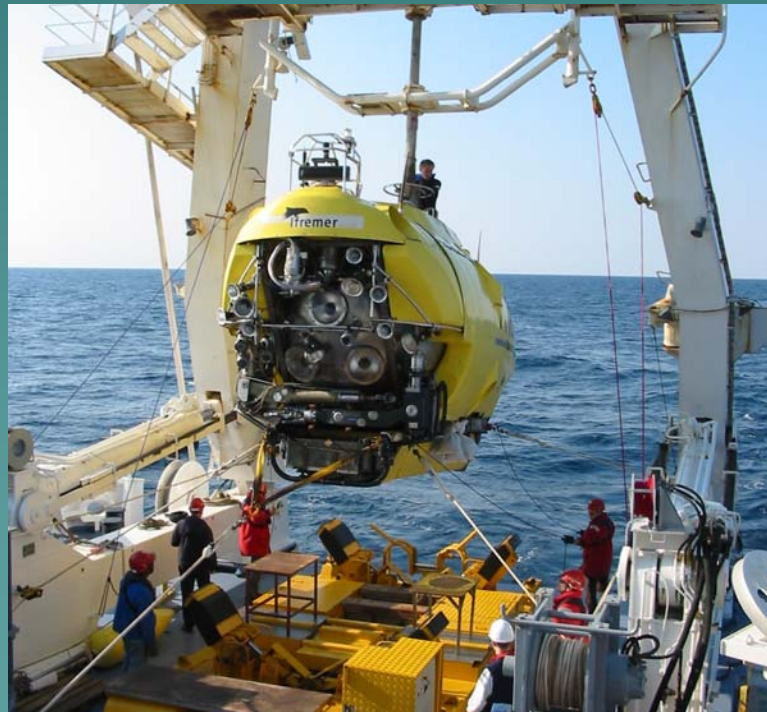


Line deployment with CASTOR



Connections with IFREMER submersibles

Manned submersible
Nautilie



Robot
VICTOR



P= 4.4 T=-2.8

GAP =206.6
206.7

09:36:56

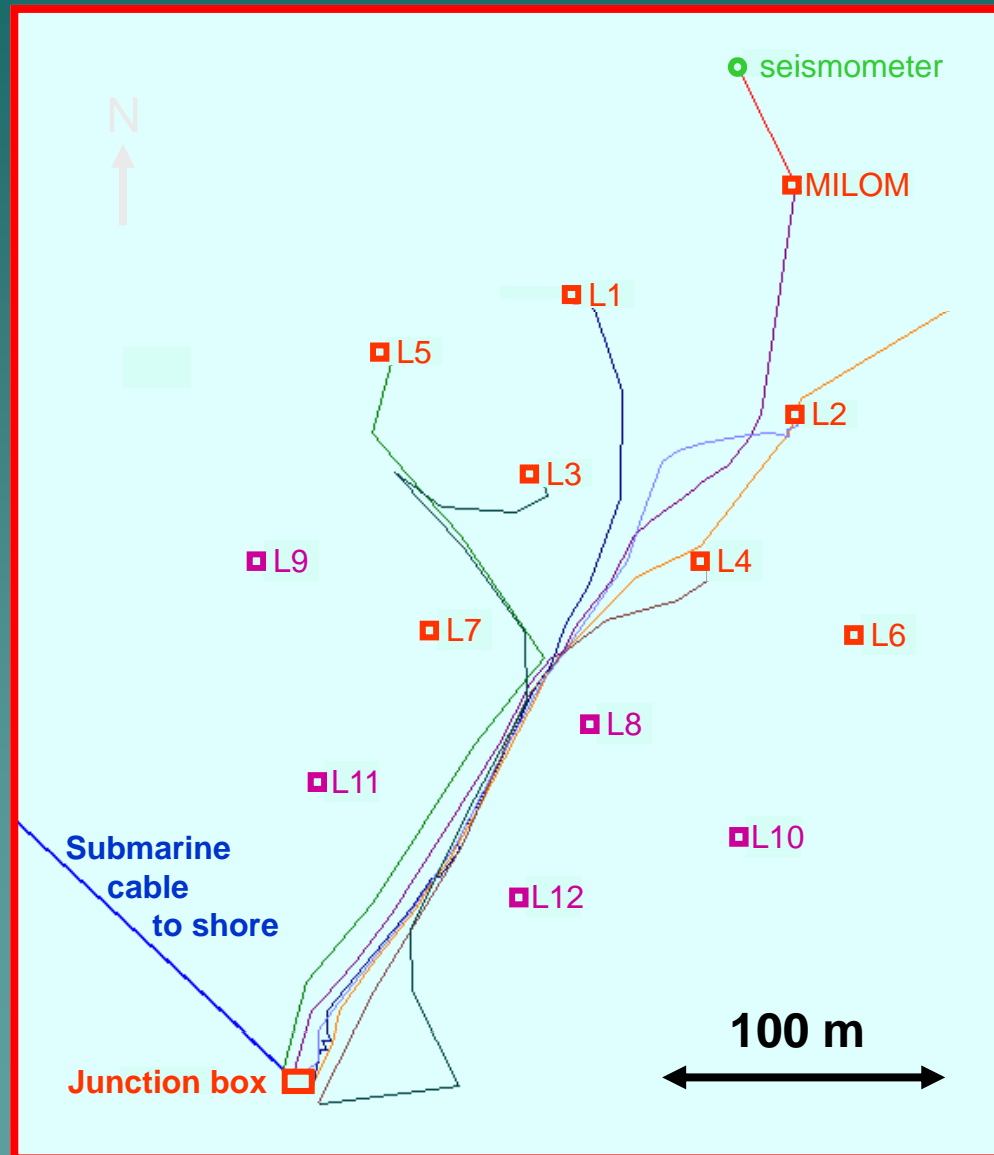
IMM =2480.2 vL =

ALT = 0.8

RDI = 0.0

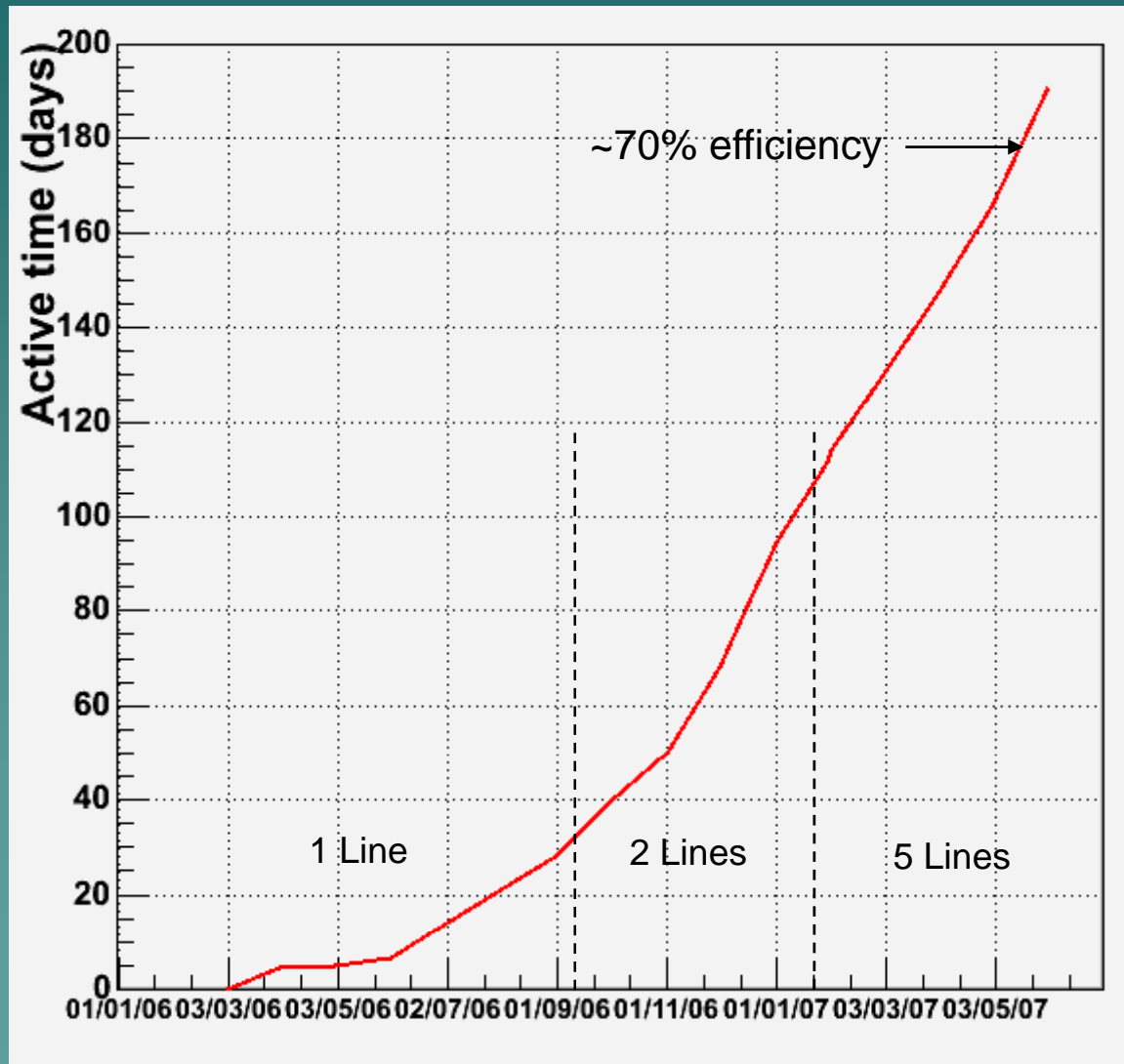
vt =

7 lines in sea, 5 in operation

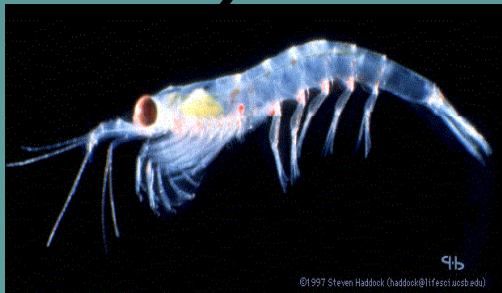
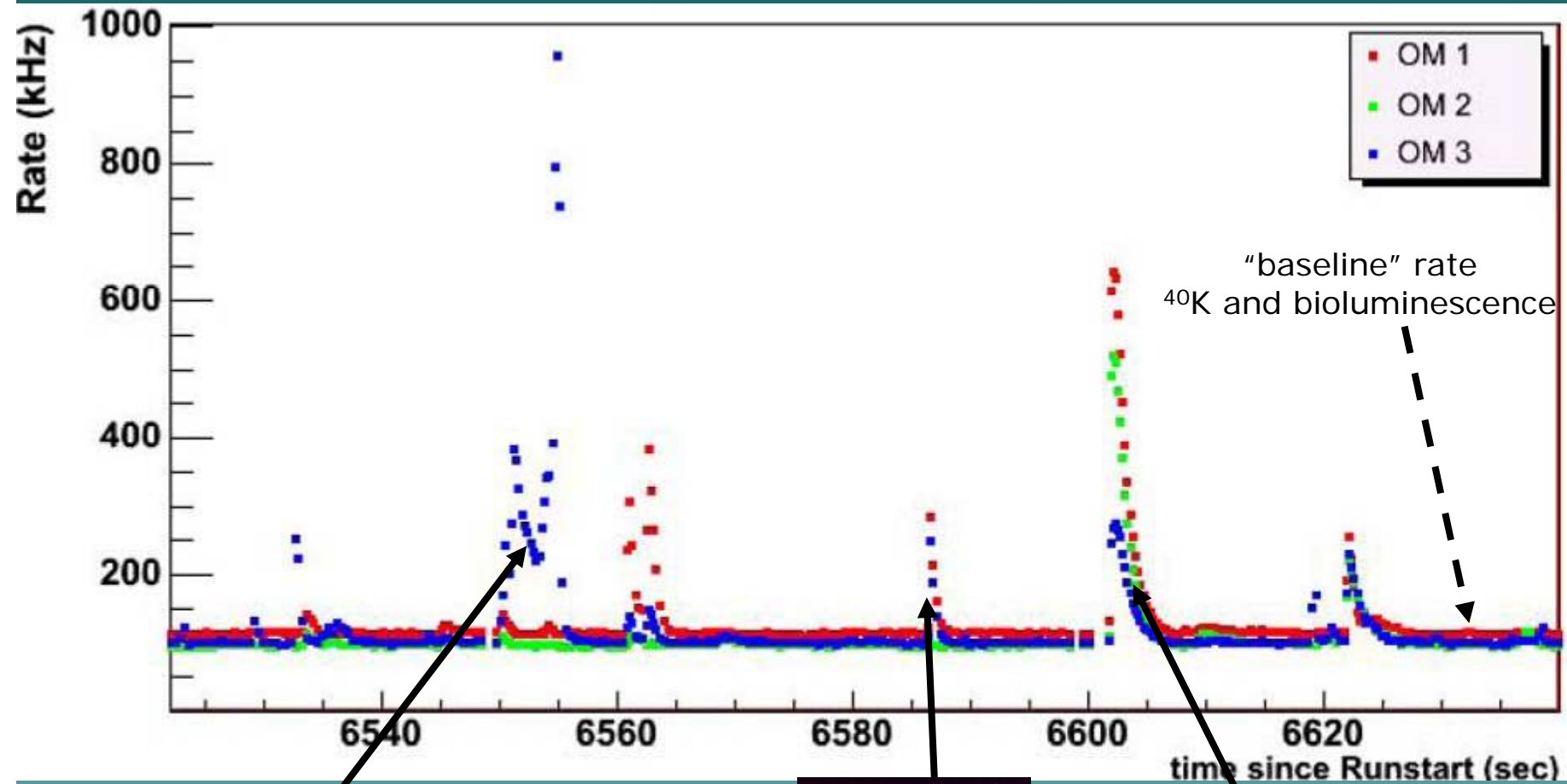


Accumulated data taking time

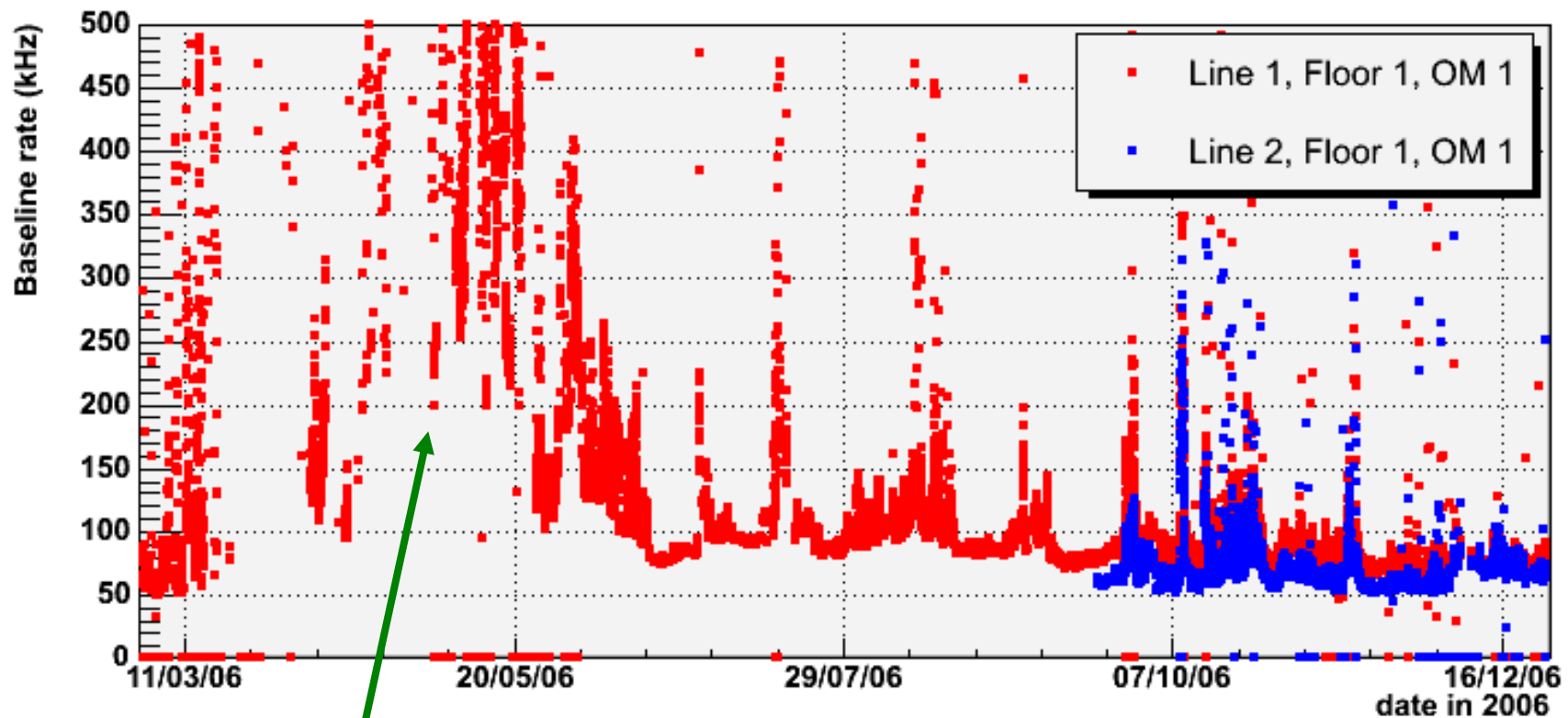
Effective number of days with all losses and inefficiencies included



Counting rate in photomultipliers

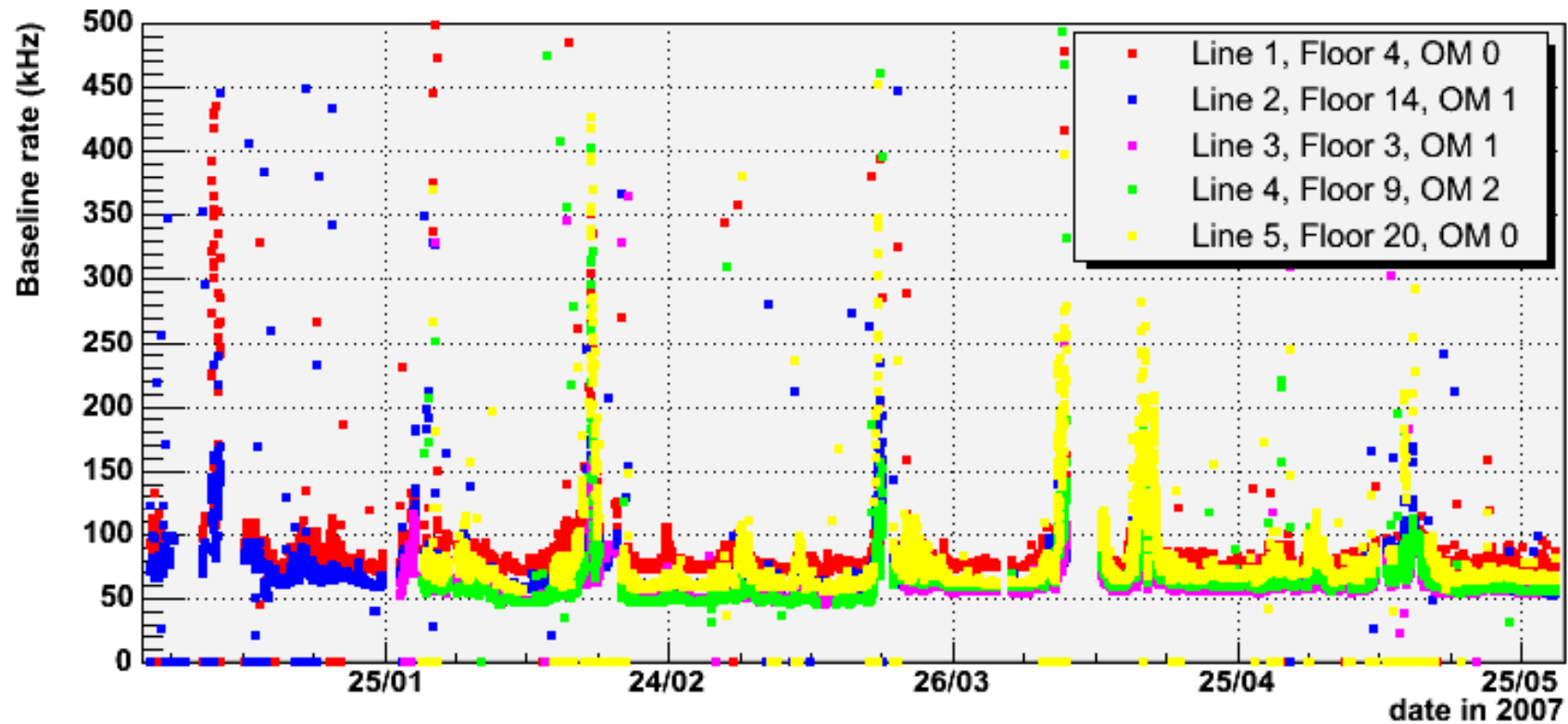


Bioluminescence rates 2006



Bloom of life
in spring
?

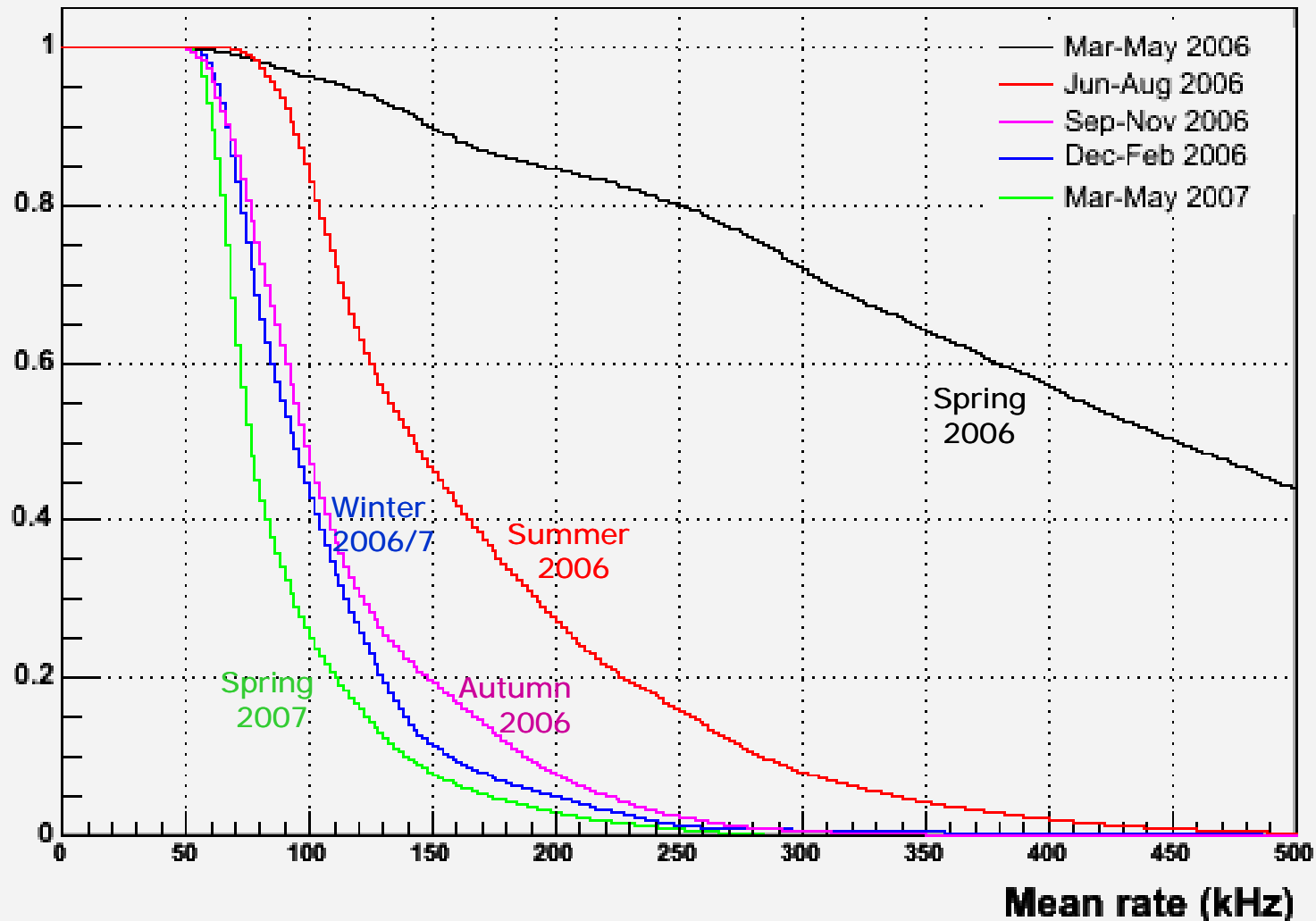
Bioluminescence rates 2007



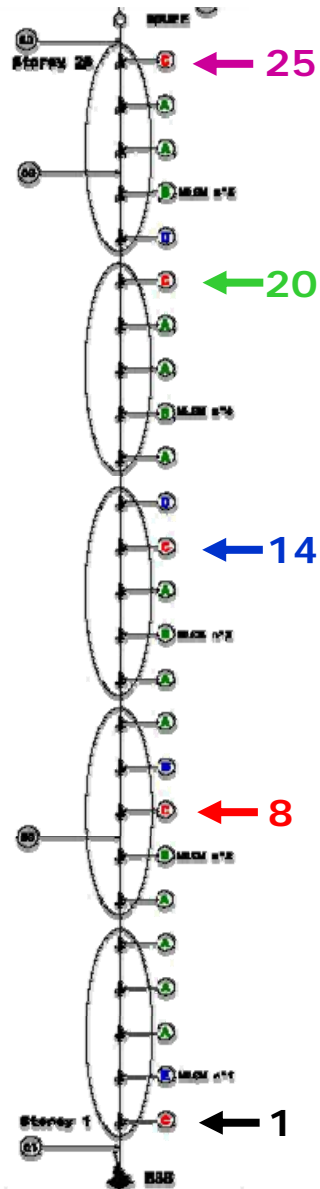
No spring
in 2007
?

Cumulative mean counting rates

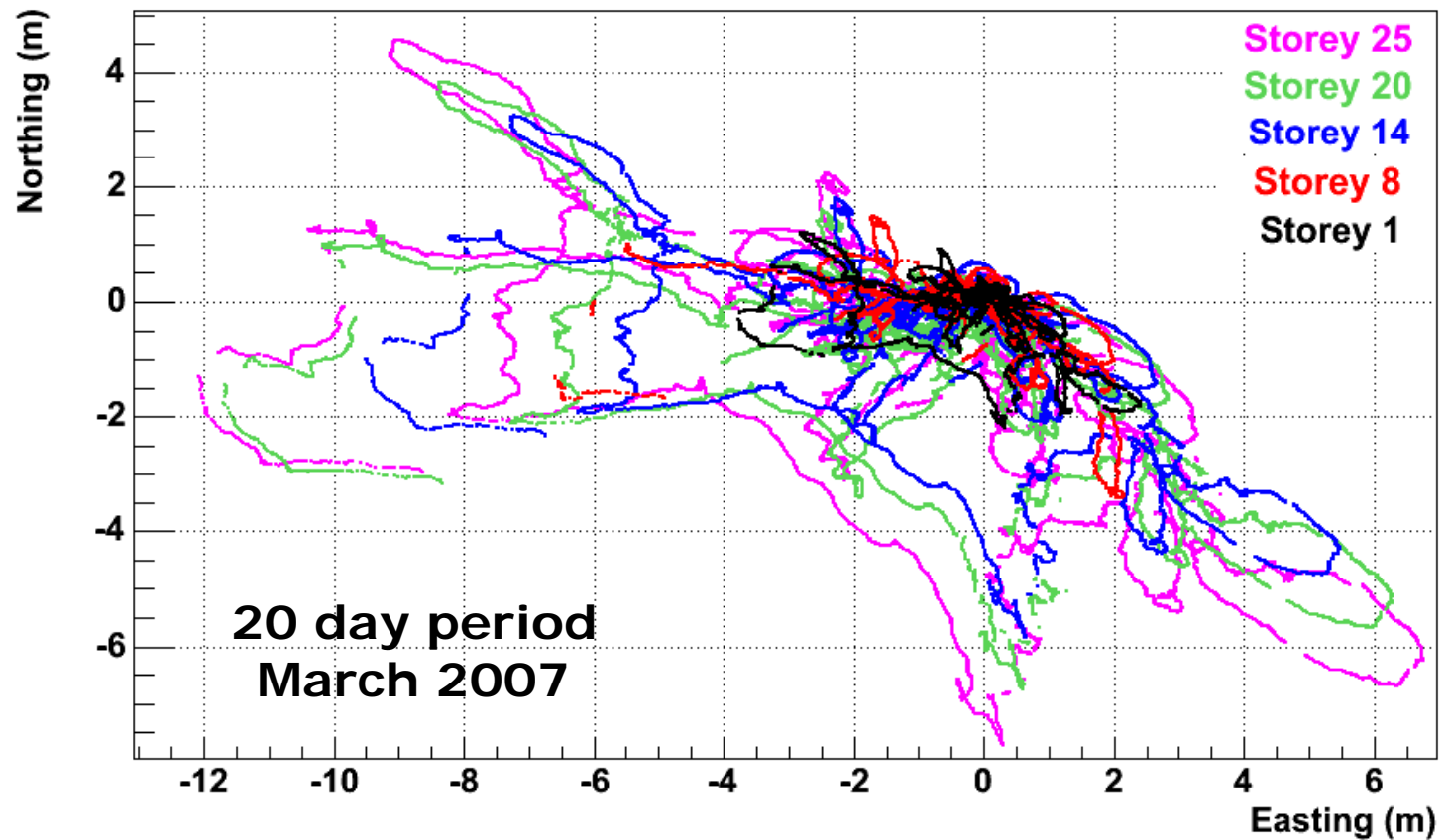
Proportion of time mean counting rate less than given value



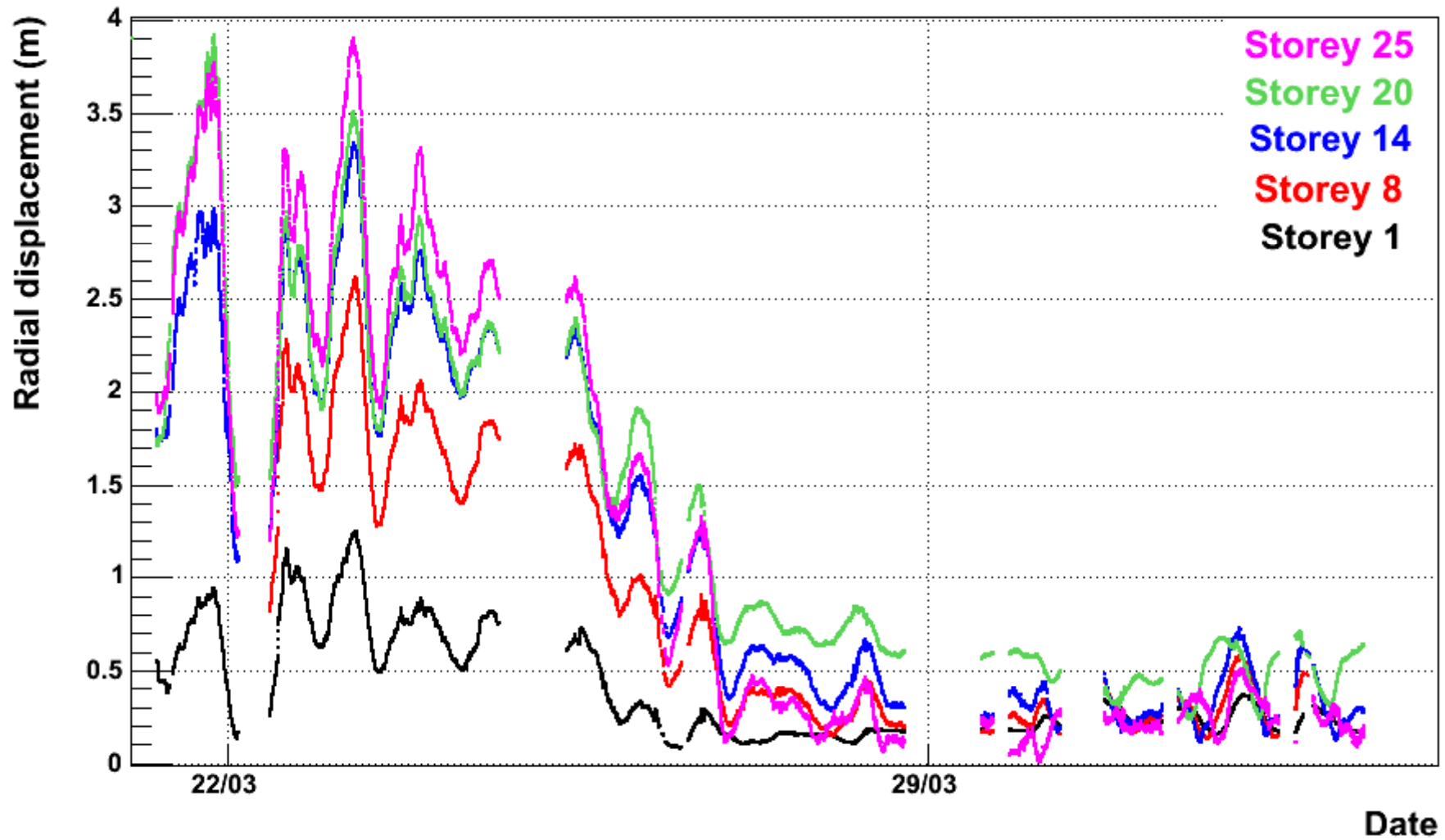
Data from acoustic positioning system



Position of hydrophone relative to line base location



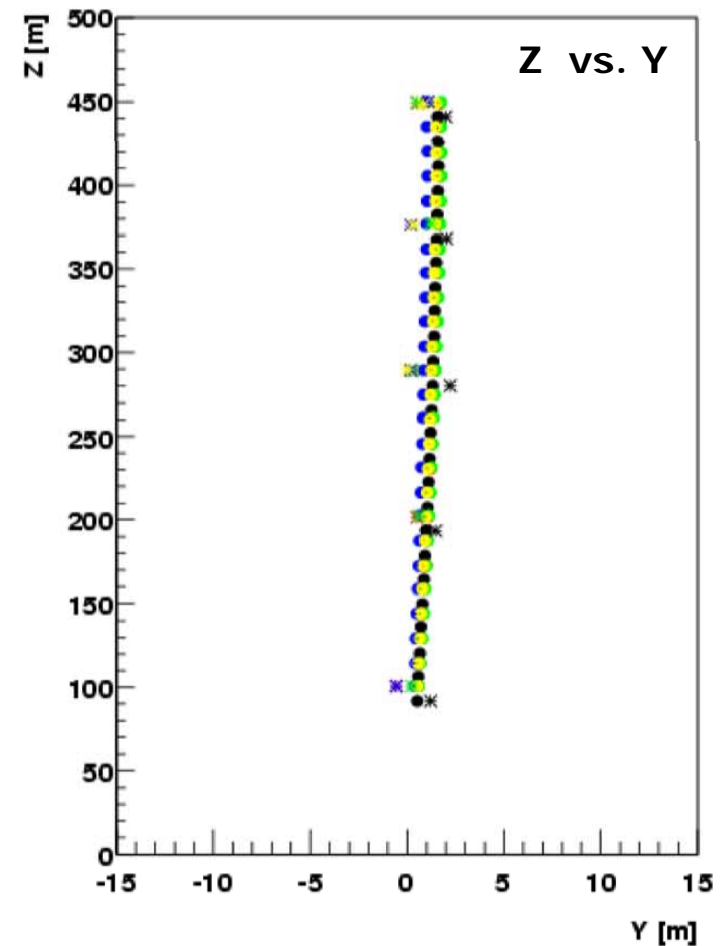
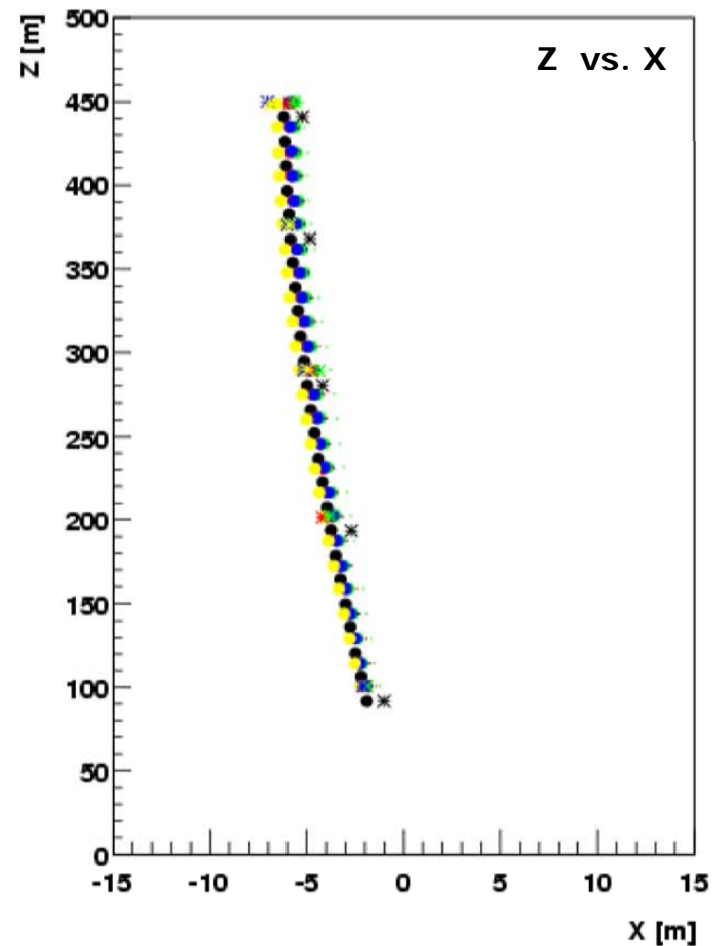
Radial position of hydrophones



Line shapes

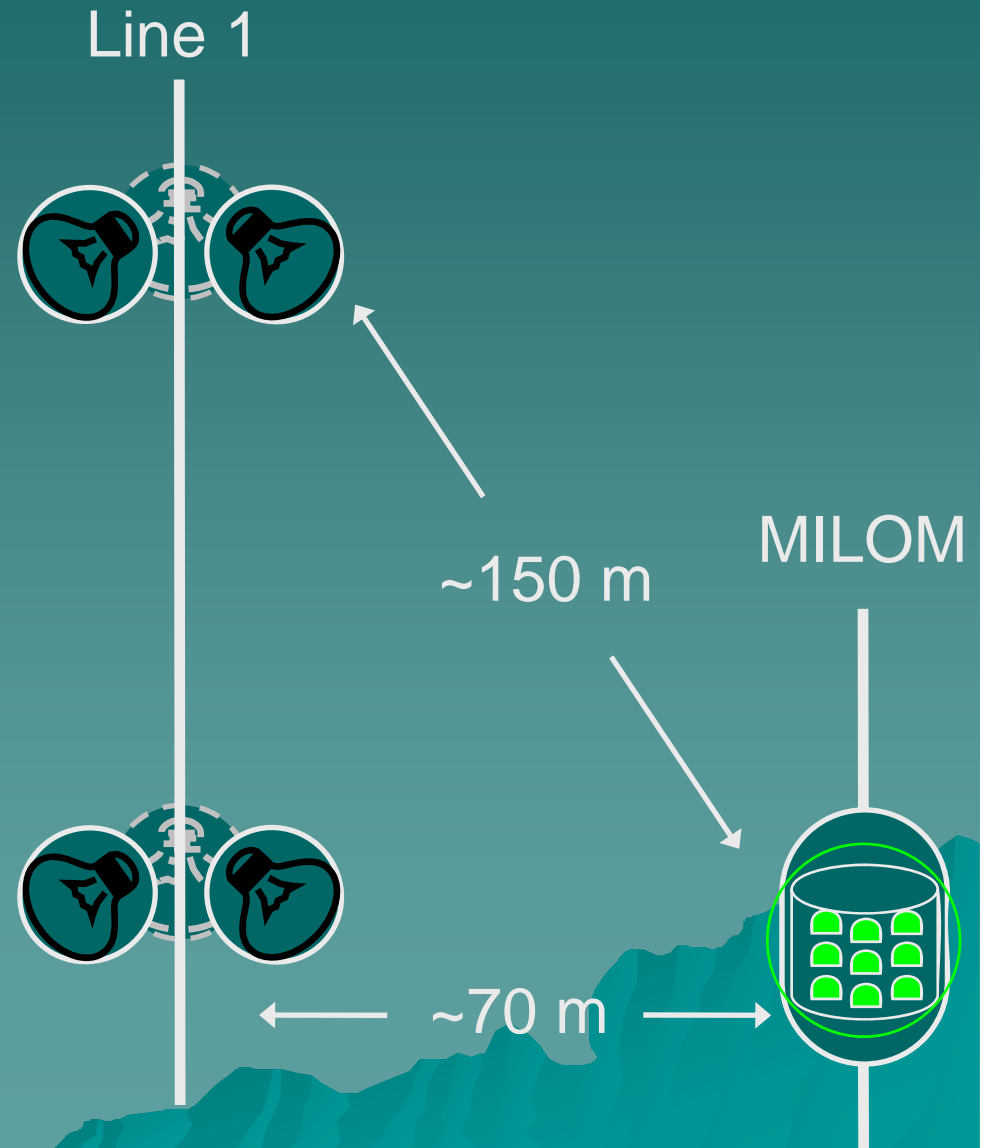
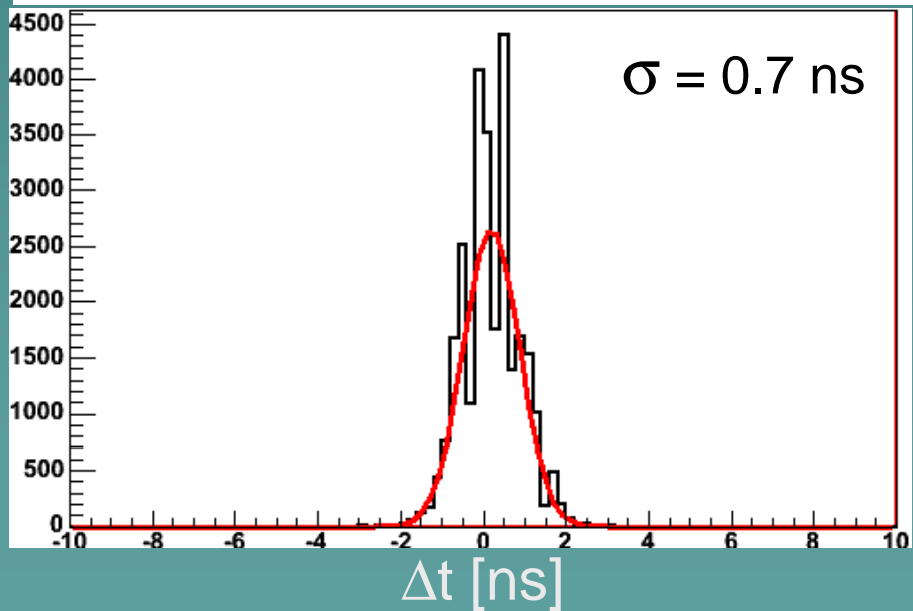
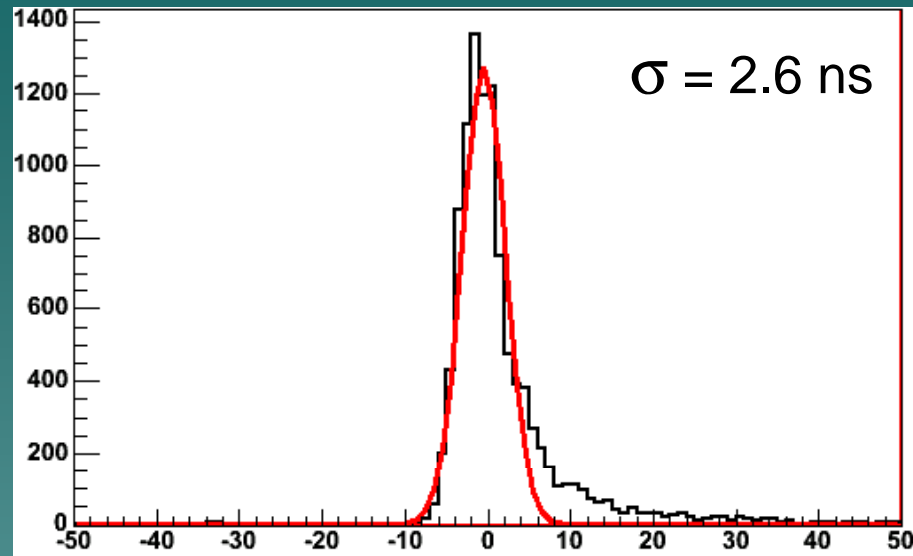
5 space points from acoustics system

25 gradients (tiltmeter data from each storey)



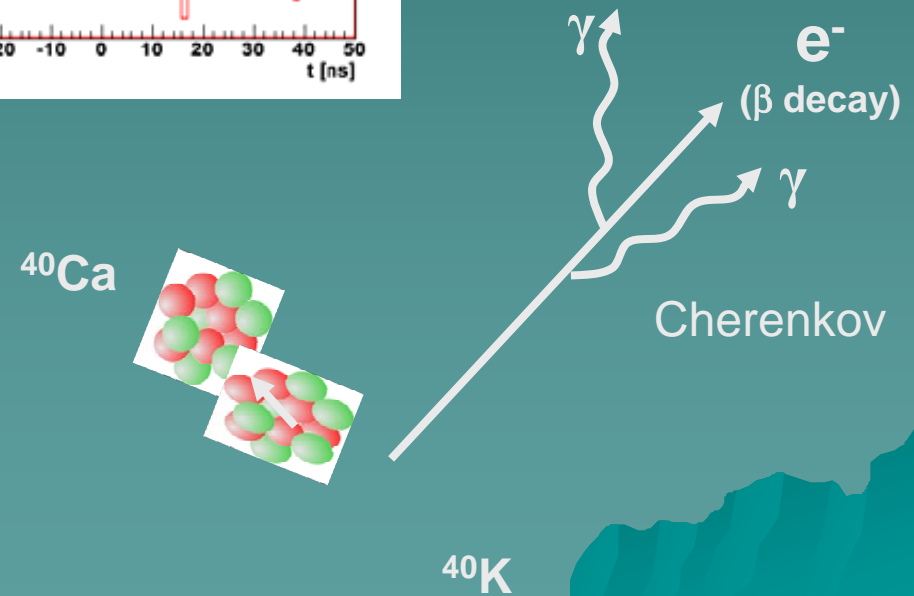
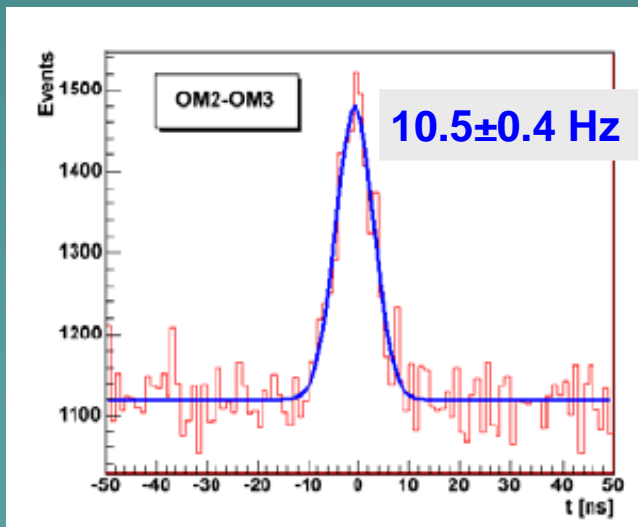
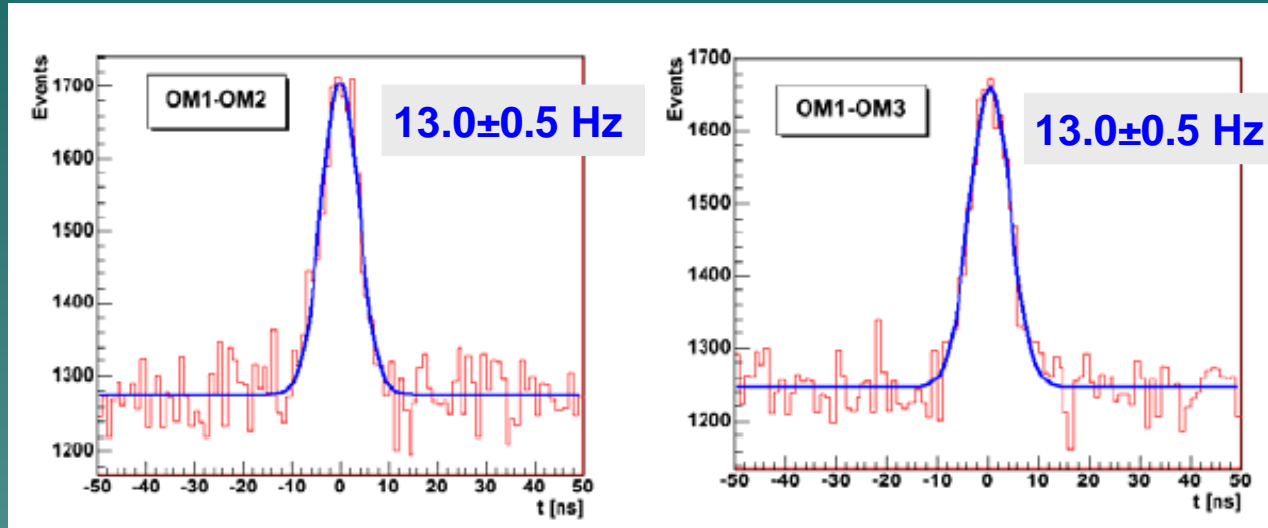
● Alignment from Tiltmeters * Hydrophone position

LED beacon Time Calibration



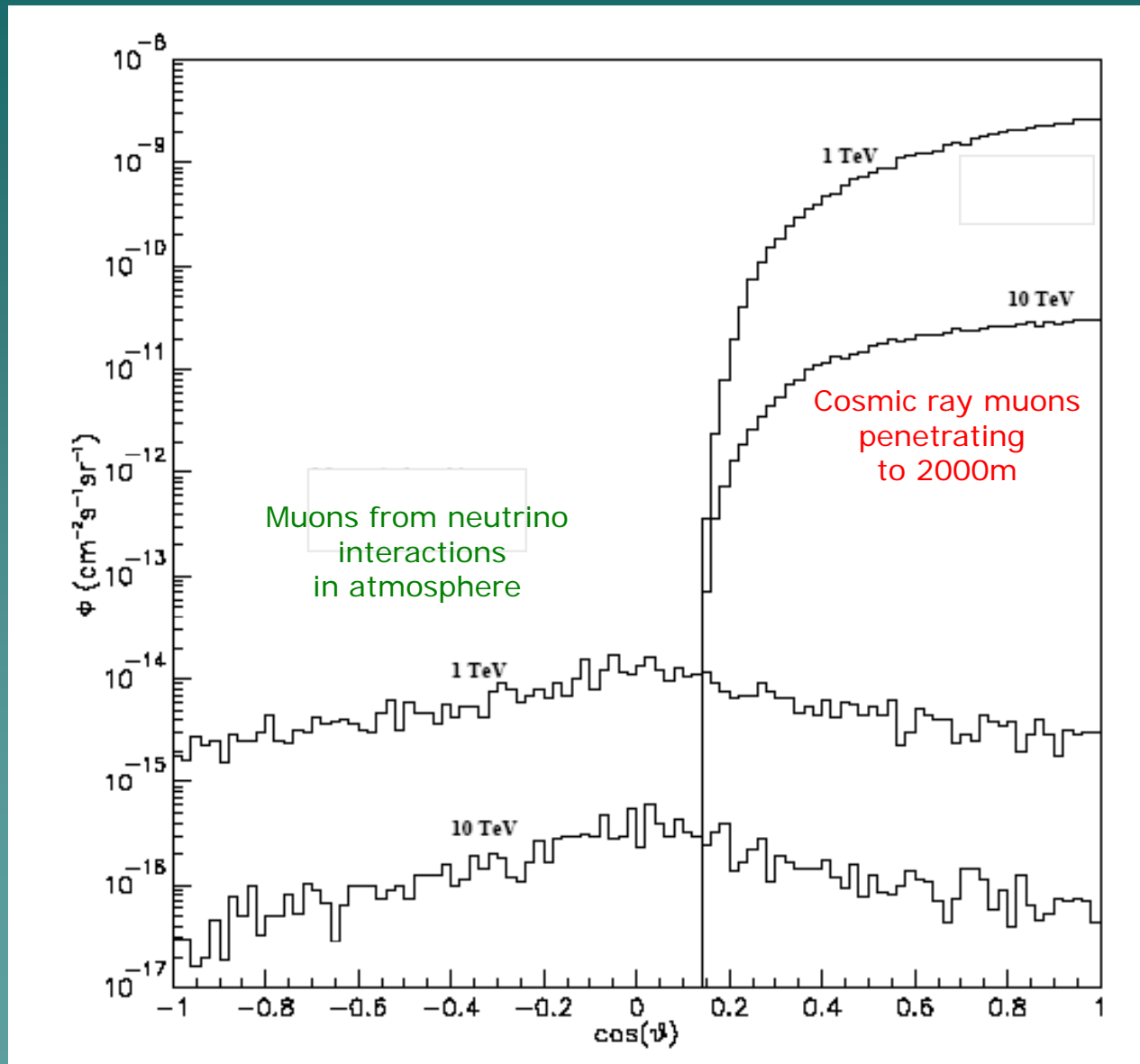
Coincidence rates from ^{40}K decays

^{40}K coincidence rate from Gauss fit:



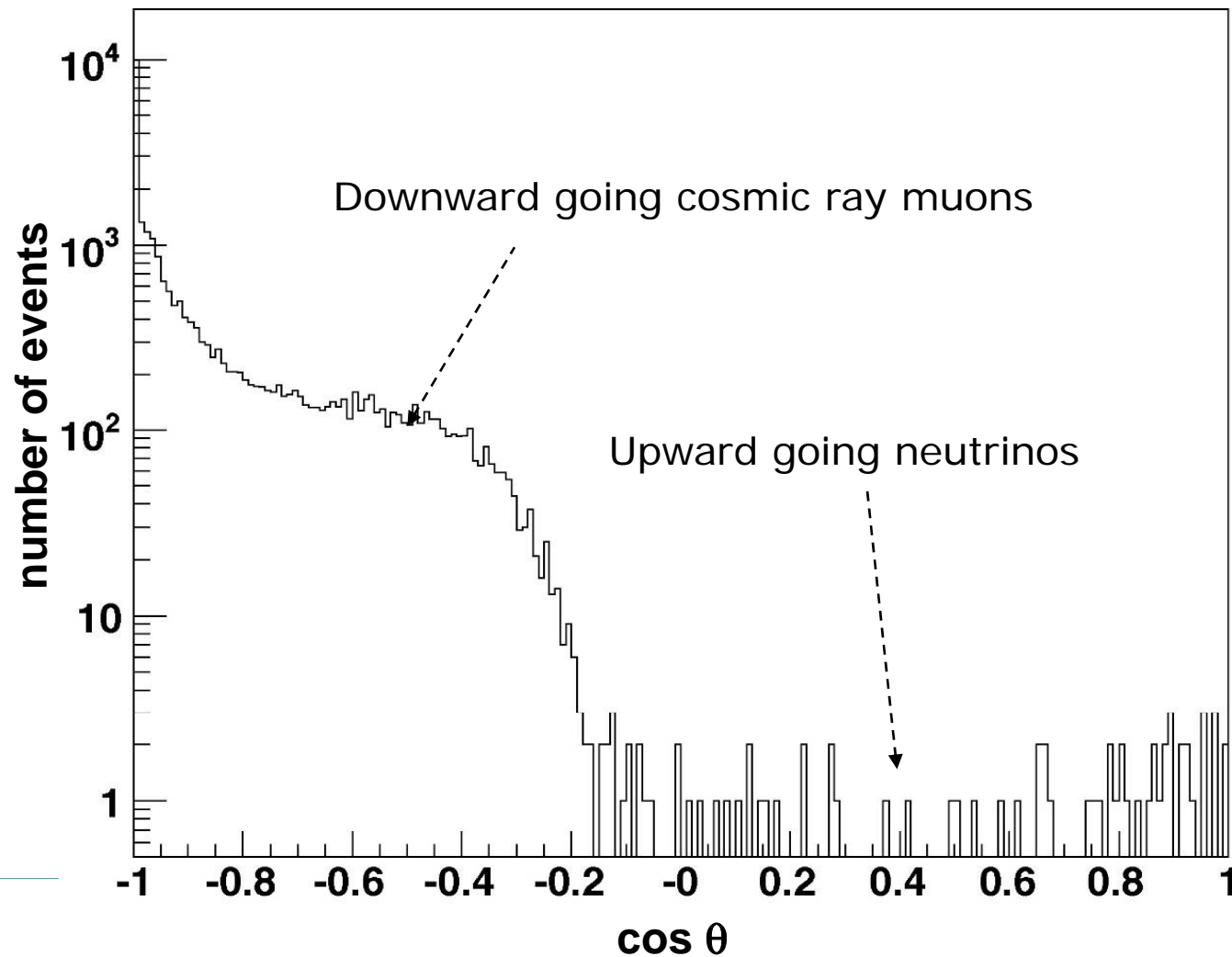
Simulation: $12 \text{ Hz} \pm 4 \text{ Hz (sys)}$

Expectations of muon events in detector

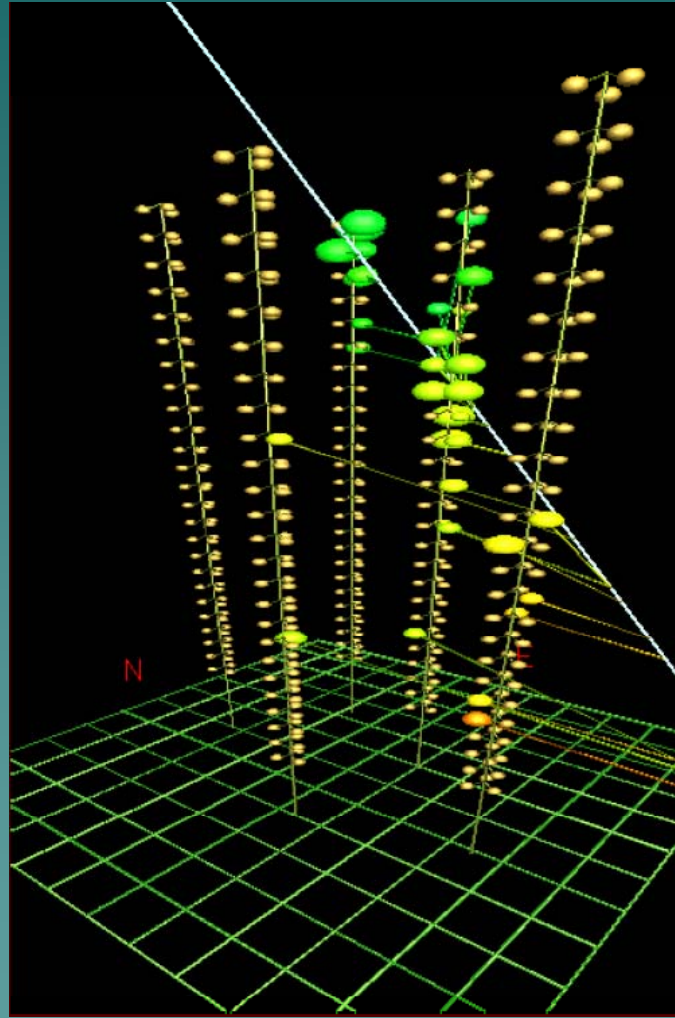


Zenith angle distribution

First look at data, no position alignment used

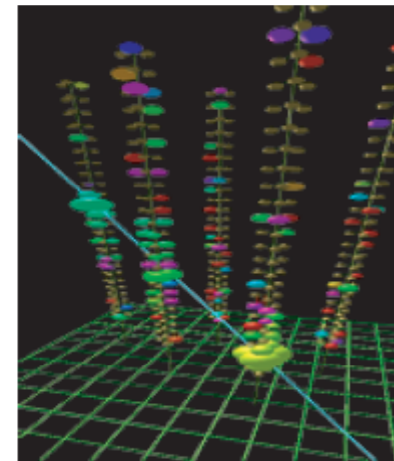
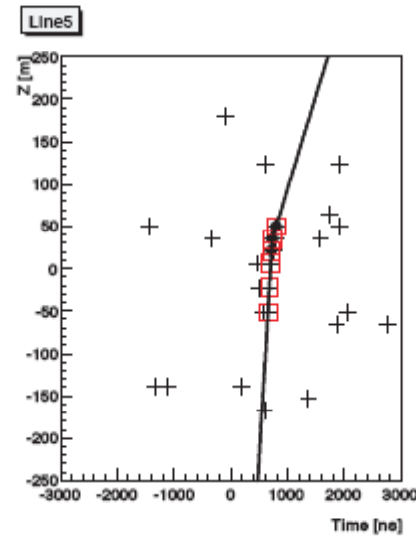
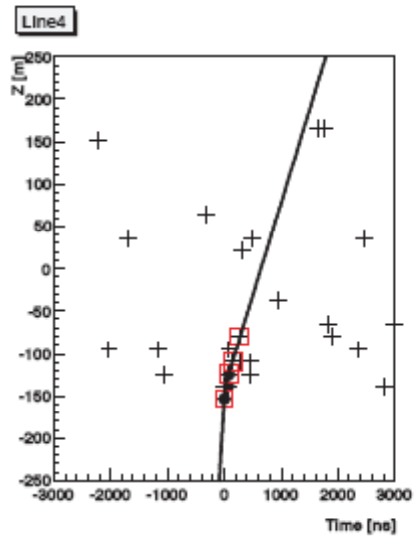
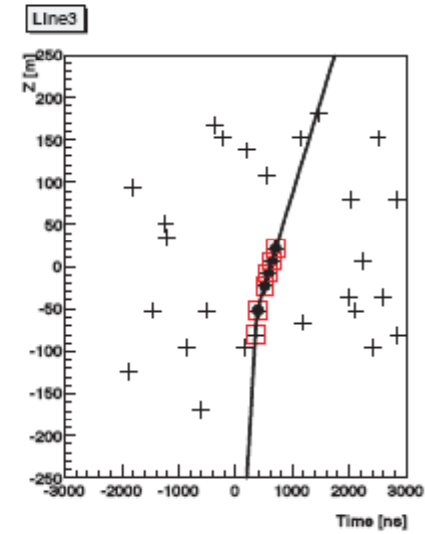
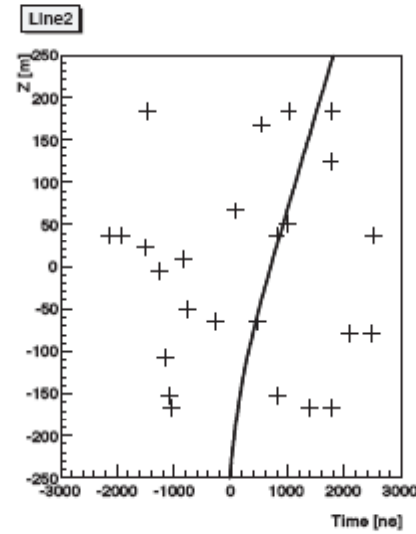
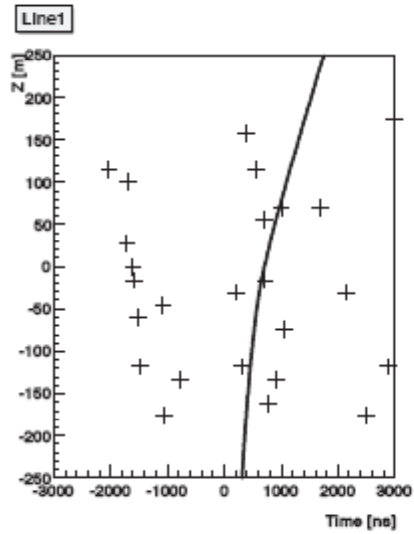


Candidates Neutrinos (I)

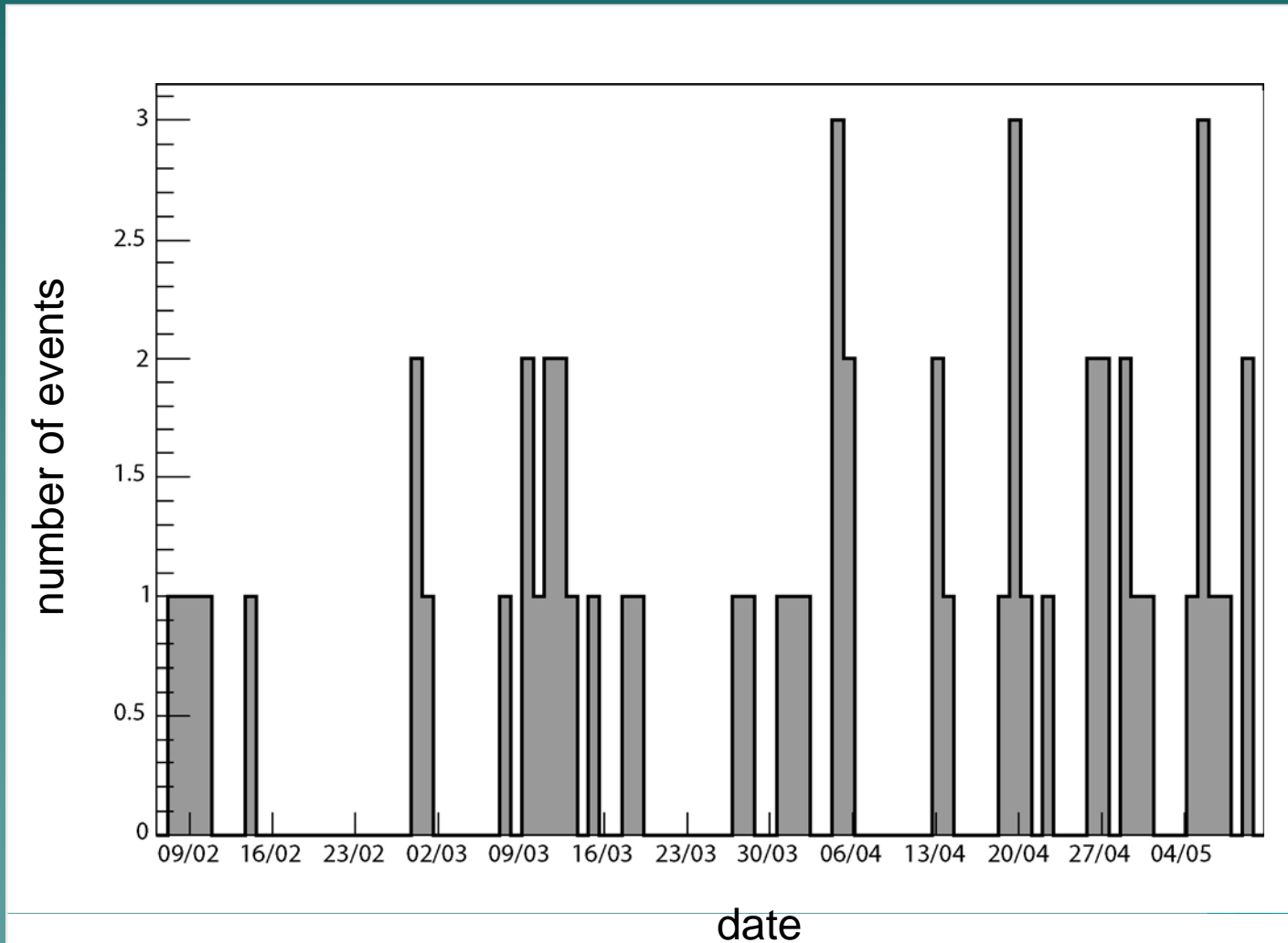


Candidates Neutrinos (II)

Run : 25929 Event : 6742



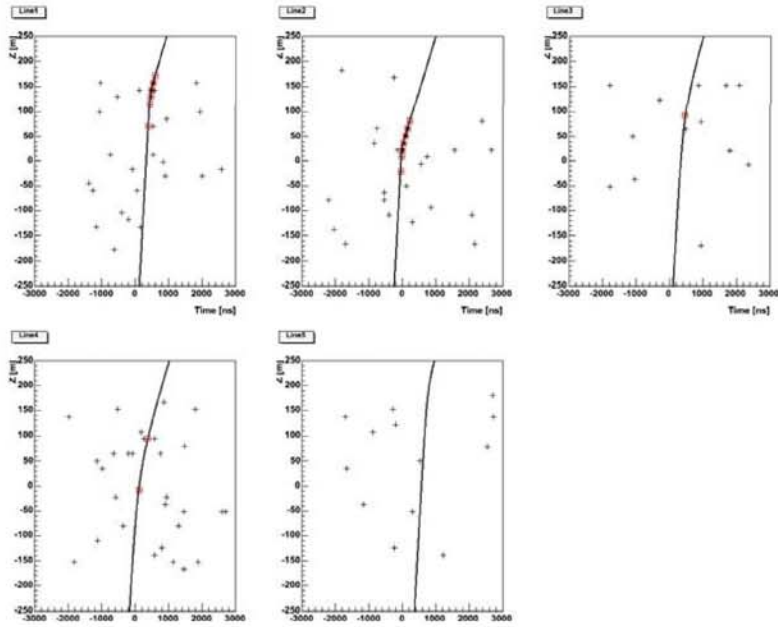
Date of neutrino candidate events



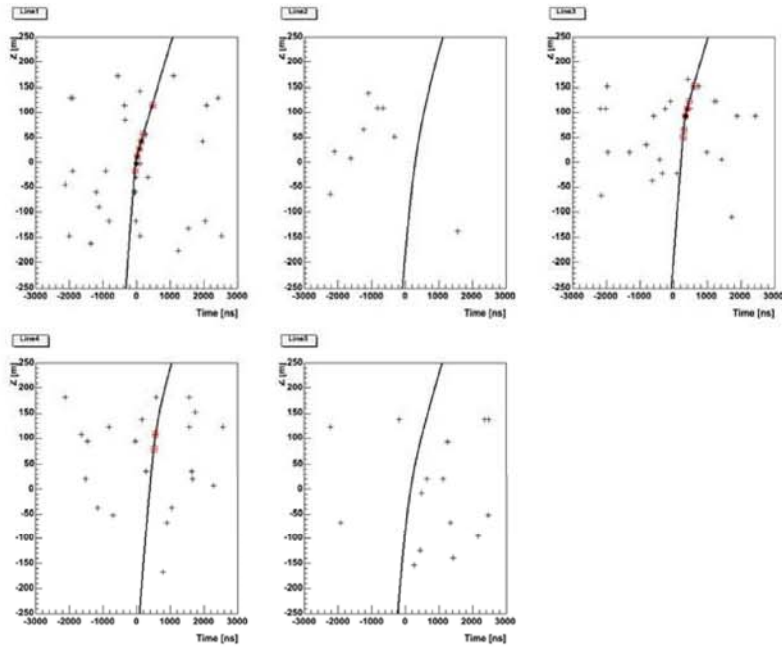
Summary

- ◆ ANTARES detector ~half complete
- ◆ Already largest detector in Northern Hemisphere
- ◆ First data very encouraging
- ◆ Much work in progress to understand data
- ◆ ANTARES 12 line detector finished early 2008

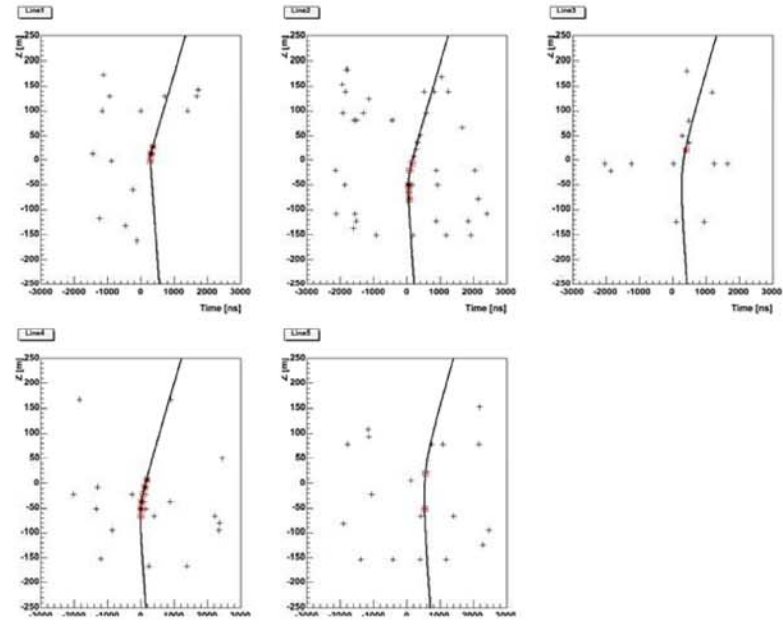
a: -65.1889 b: -23.558 t0: 80783852.68 θ : 0.63152 ϕ : 2.7732 fit : 5/8



Run : 26543 Event : 9110 FrameTarget : 2 FrameIndex : 74174
a: -34.6223 b: -14.6944 t0: 146439102.4 θ : 0.5631 ϕ : -1.5146 fit : 4/6



a: 9.65844 b: -19.9162 t0: 377700412.5 θ : 1.0511 ϕ : 2.3004 fit : 8/24



Run : 26332 Event : 3858 FrameTarget : 17 FrameIndex : 173299
a: -19.401 b: -58.5949 t0: 244085709.7 θ : 0.65241 ϕ : -2.2322 fit : 19/23

