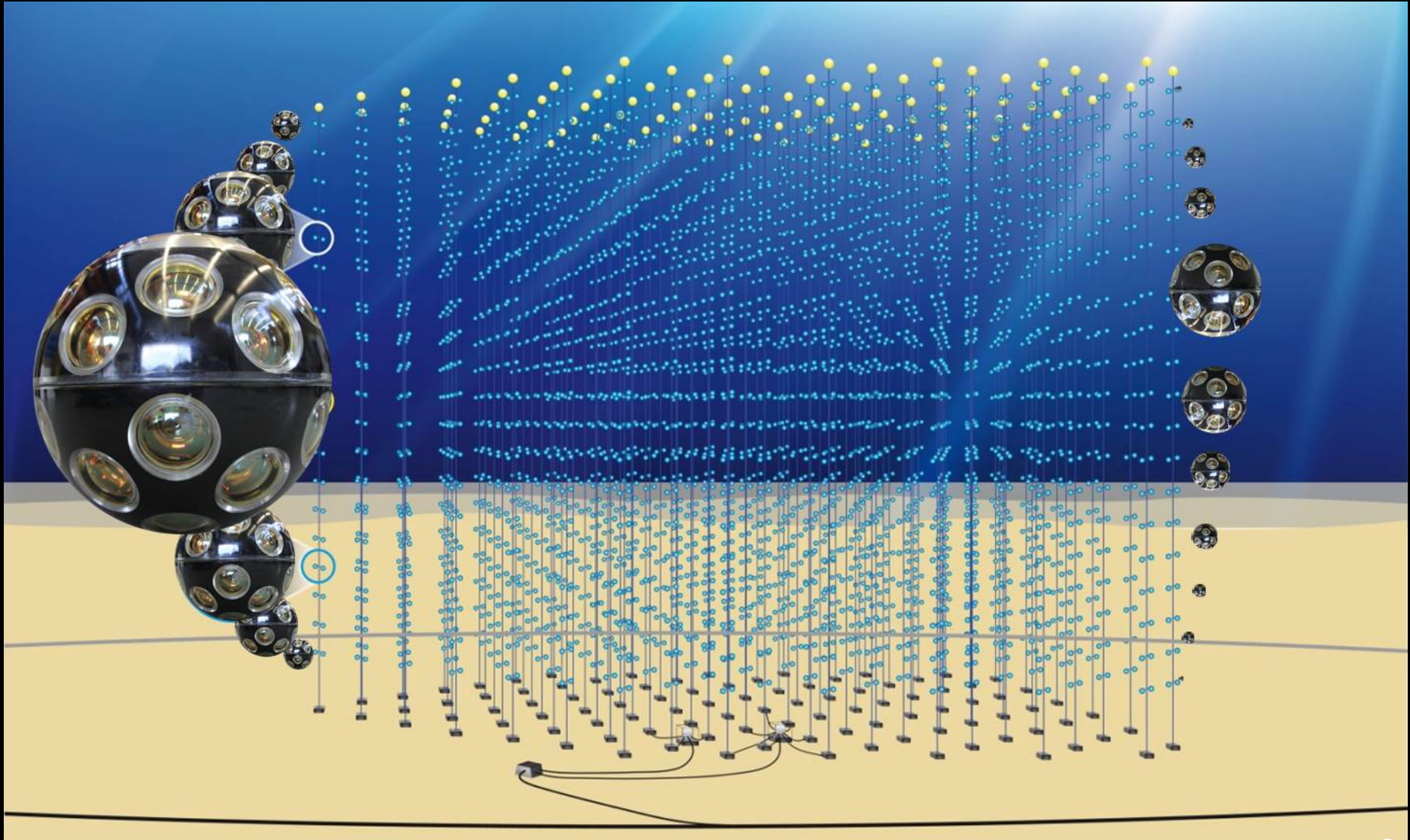


# KM3NeT

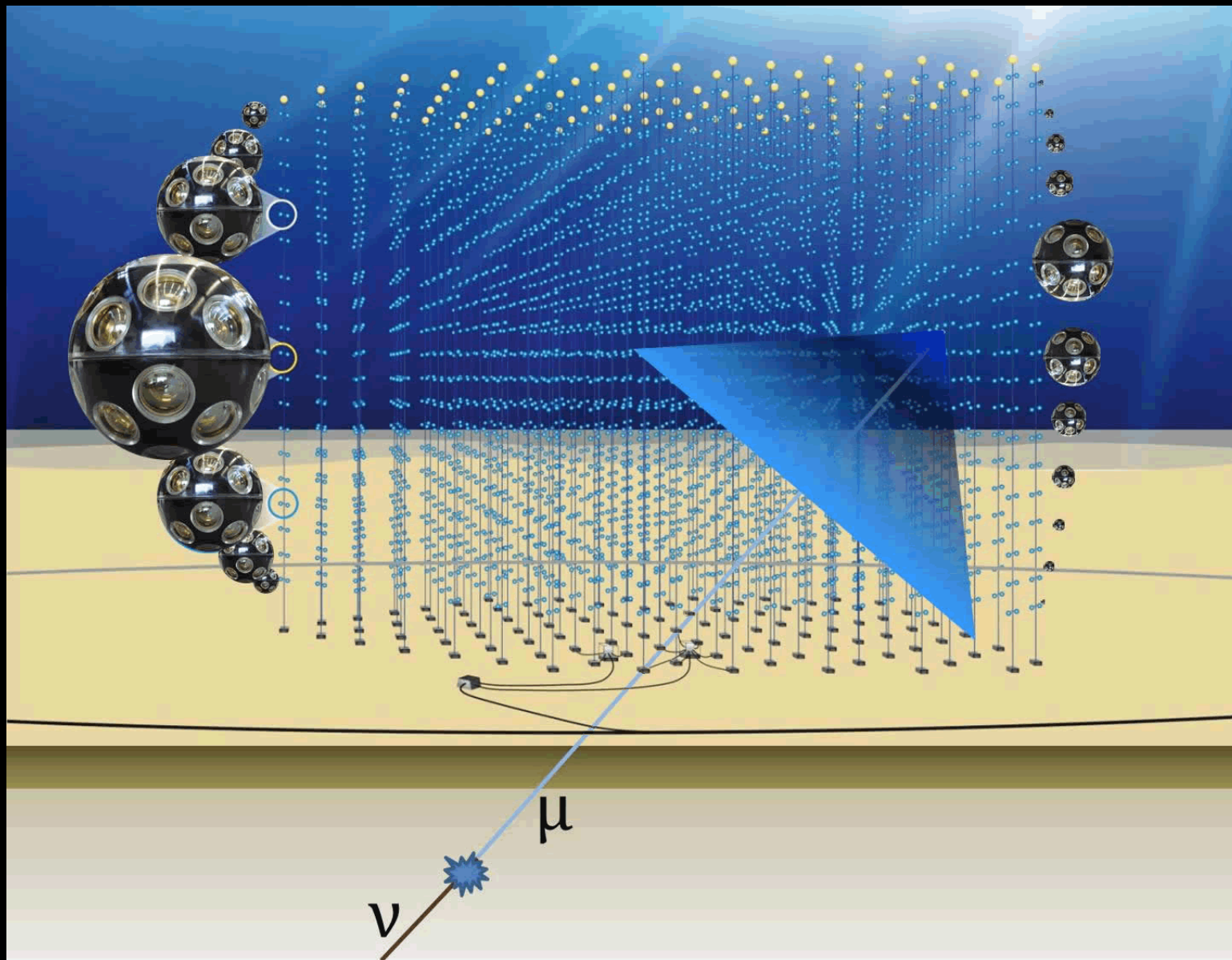
## Introduction

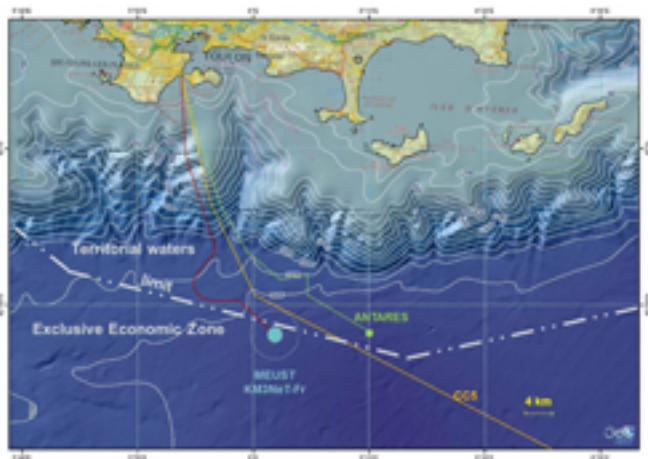
# KM3NeT

A neutrino telescope at the bottom of the Mediterranean Sea

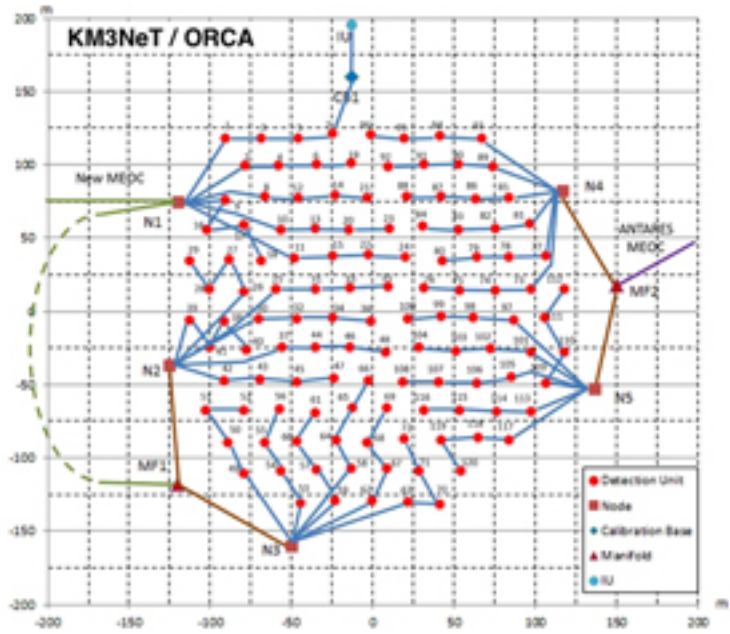


# Array of light-sensitive sensors, looking for Cherenkov light





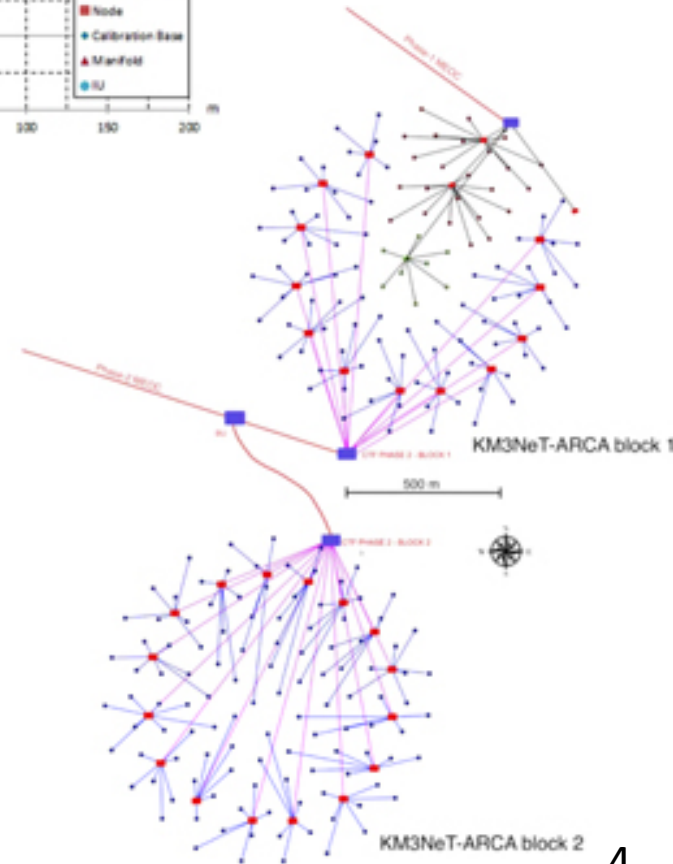
Toulon



2 sites

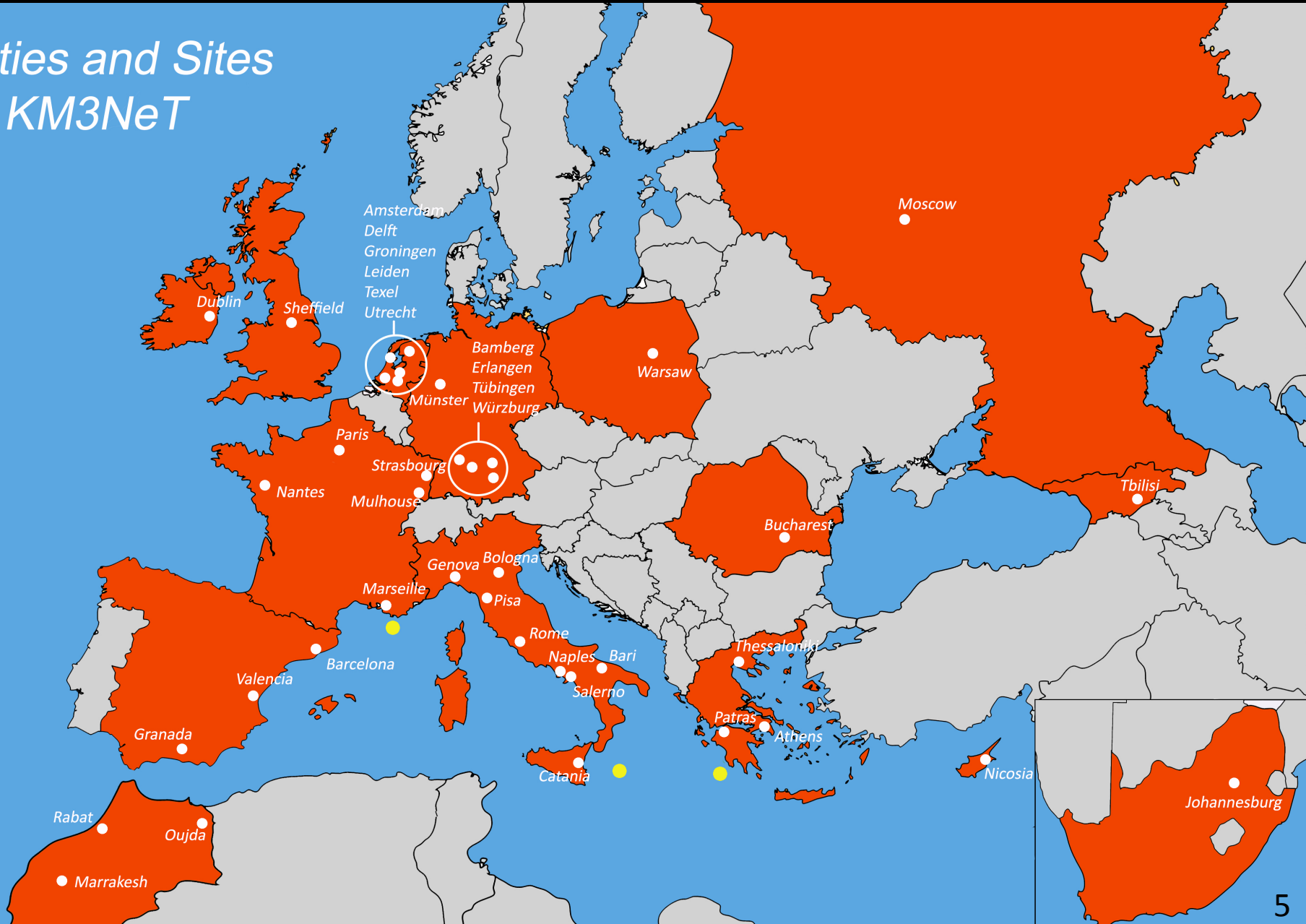


Sicily



# One collaboration

*Cities and Sites  
of KM3NeT*

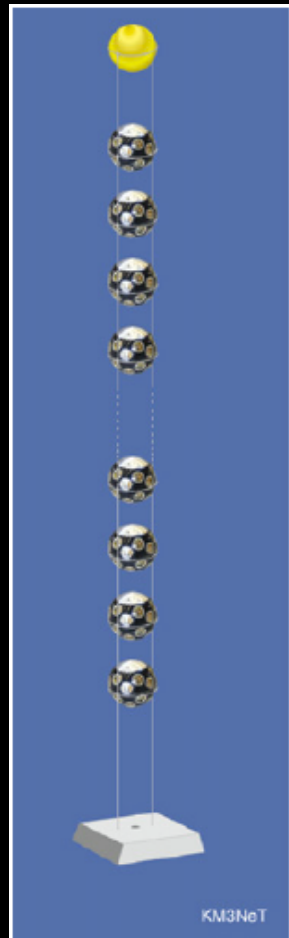
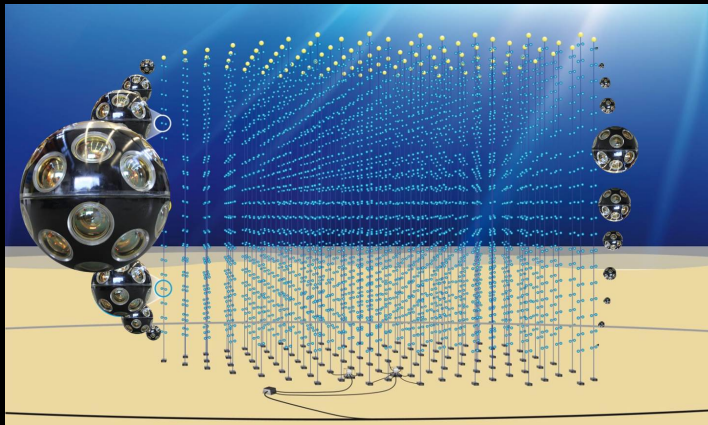




# A KM3NeT building block:

115 Detection Units (DUs)

x 18 Digital Optical Modules (DOMs)



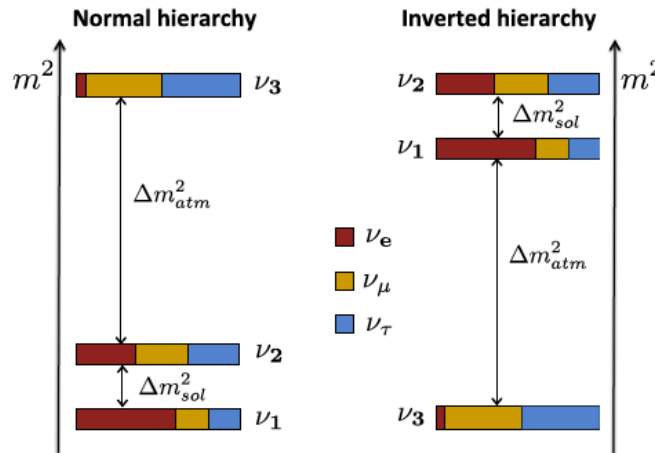
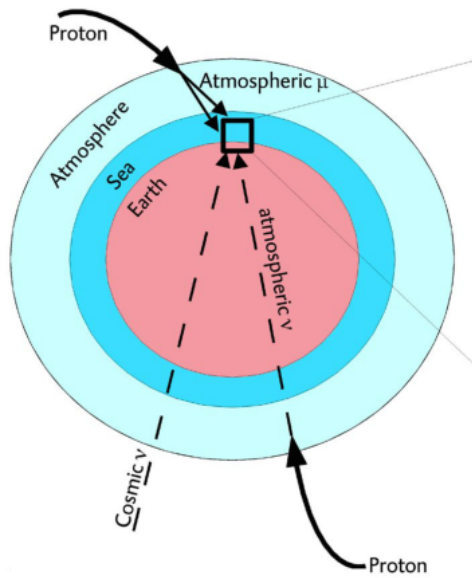
x 31 PMTs



# Toulon site: ORCA

↙ Oscillations

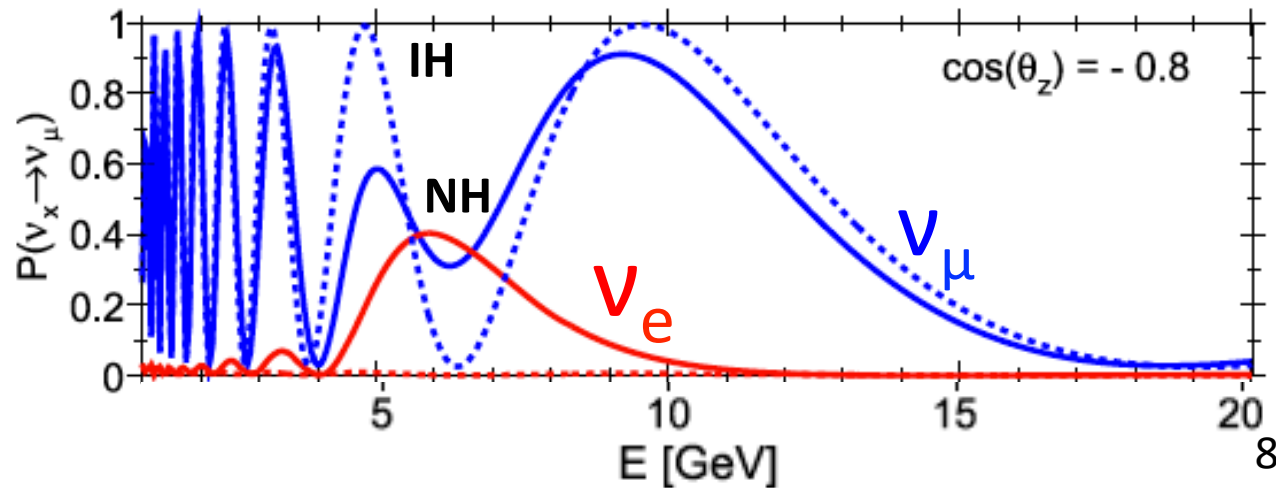
One building block, densely spaced (20 m between lines, 10 m between DOMs)



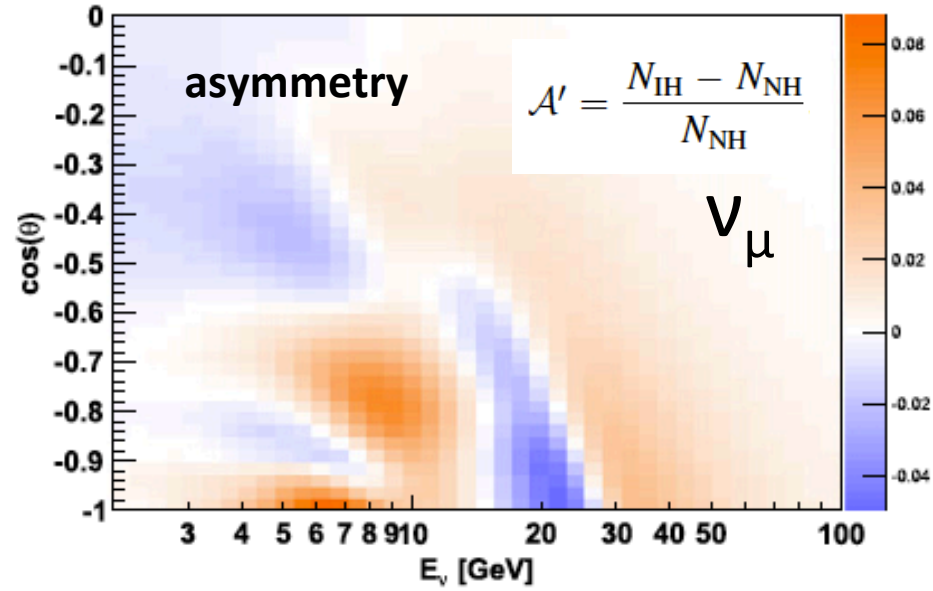
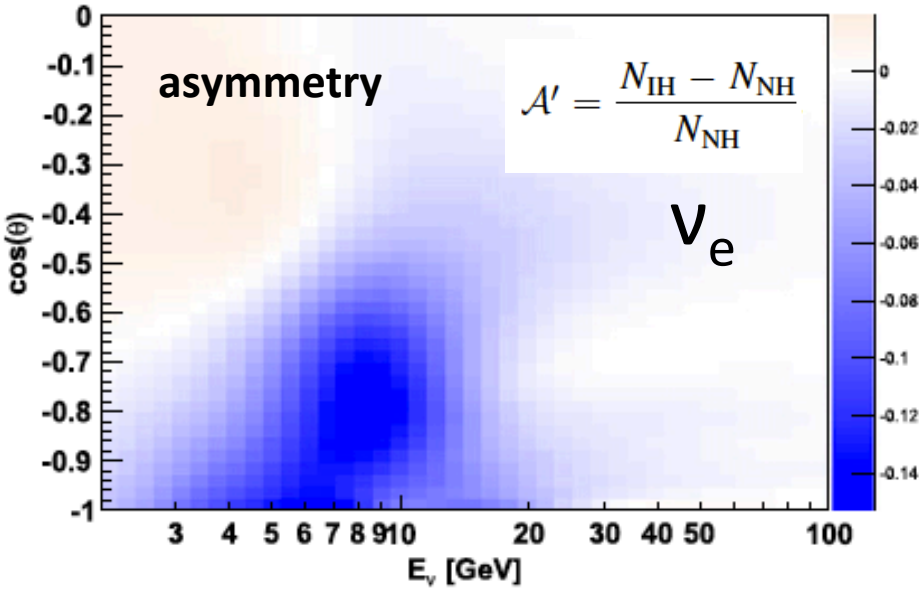
oscillations of atmospheric neutrinos

sensitive to oscillation parameters, and mass hierarchy

oscillation probability

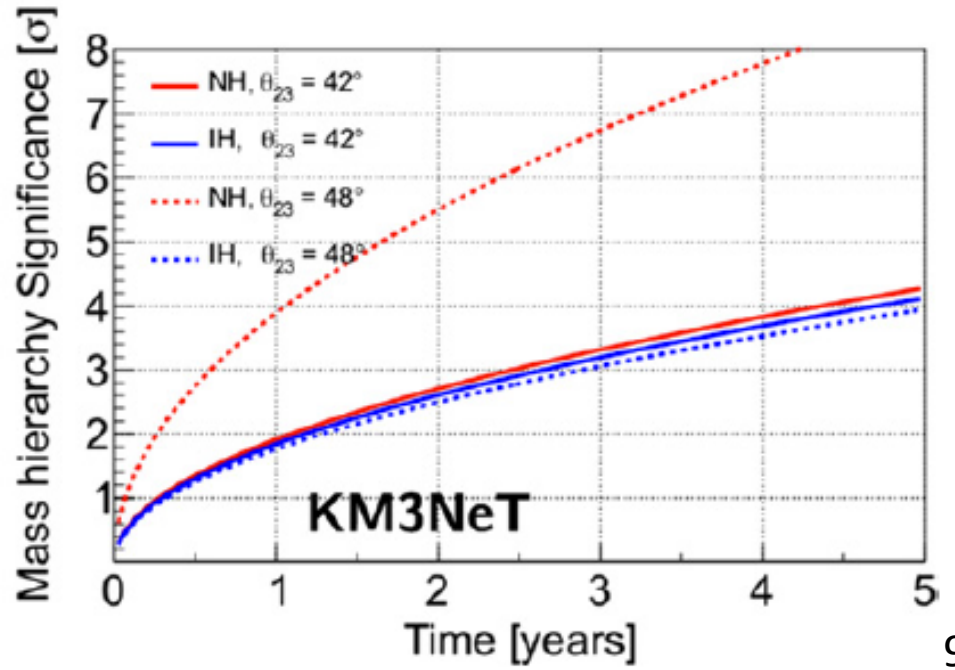






Very significant contributions  
from Martijn Jongen  
(thesis 2018)

Also @ORCA: dark matter search

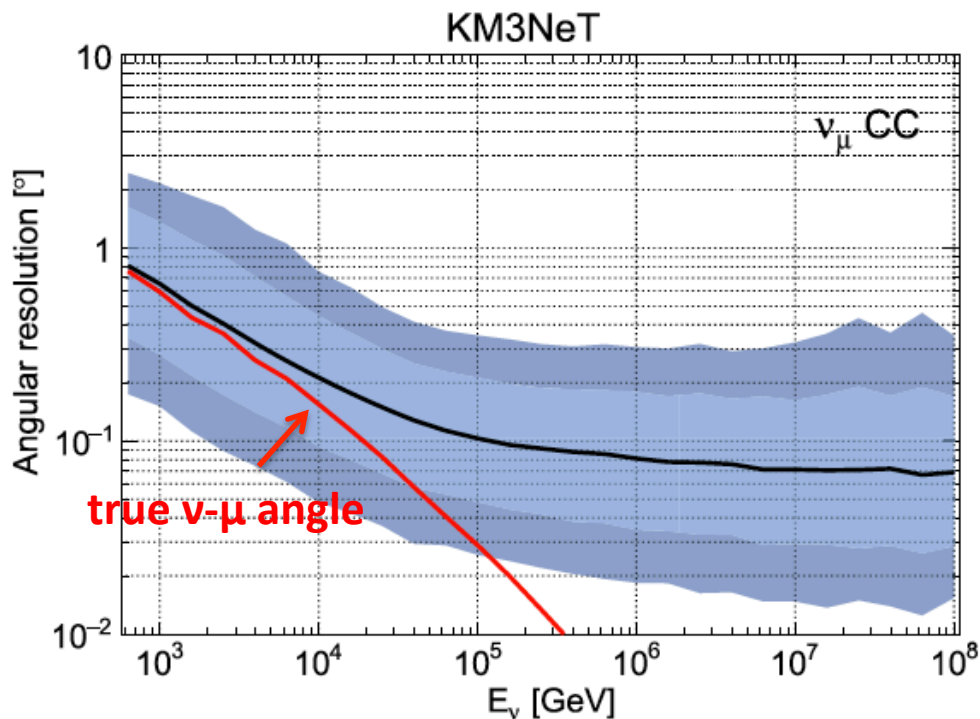


# Sicily site: ARCA

→ Astrophysics

*Two building blocks, sparsely spaced*

*(90 m between lines, 36 m between DOMs = 1.2 km<sup>3</sup>)*



excellent angular resolution

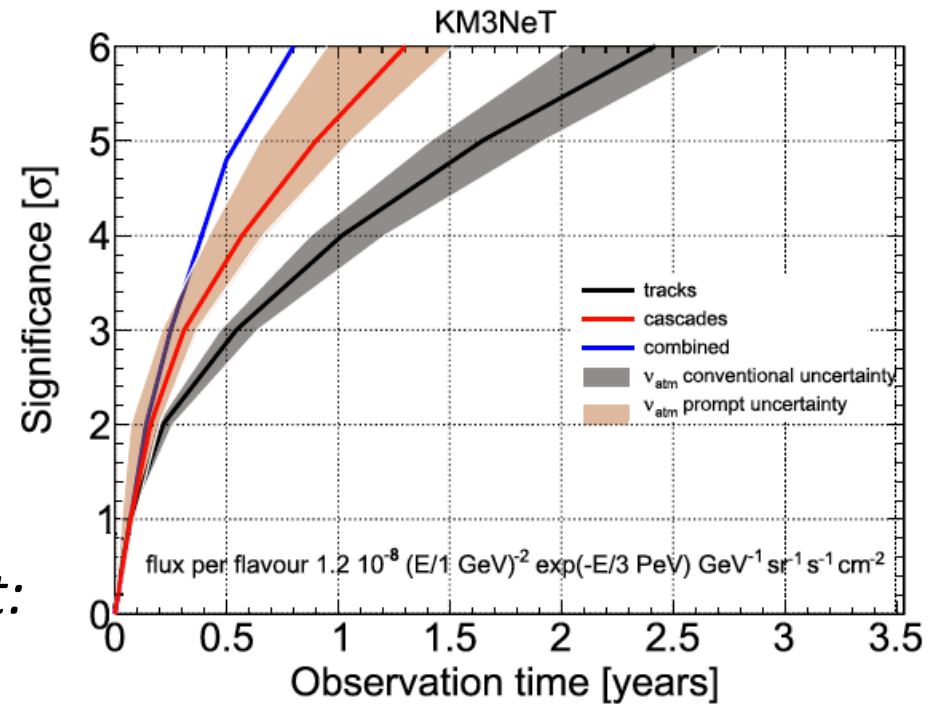
tracks, but also showers (e, tau)

galactic center visible

tuned for galactic sources

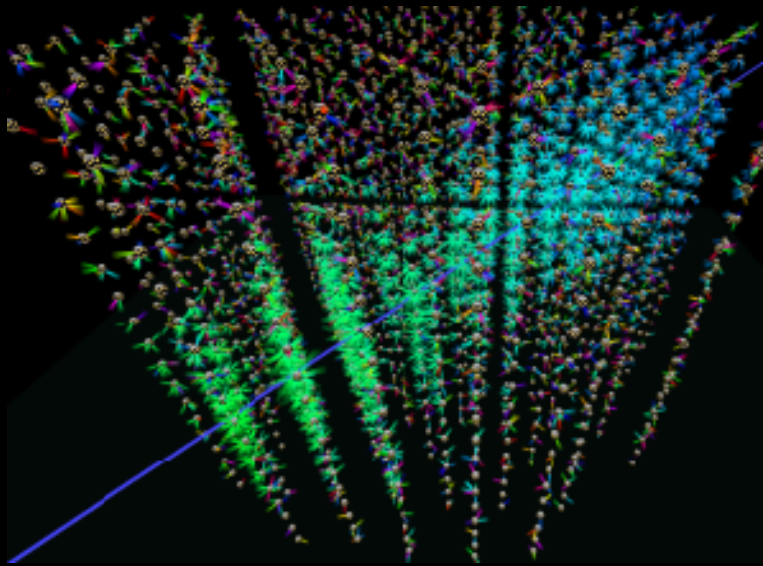
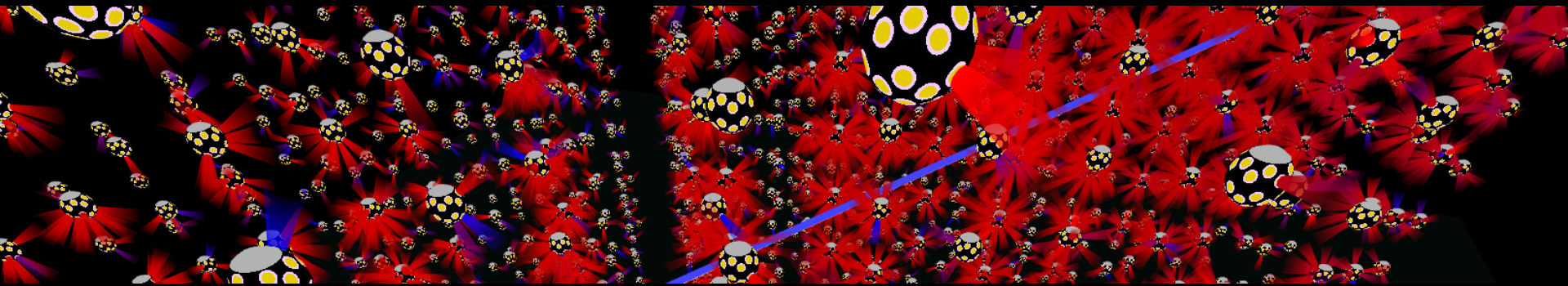
IceCube measurement implies significant cosmic  $\nu$  flux. Similar energy density in neutrinos as in gamma rays.

*Re-establishing IceCube diffuse flow should be fast:*

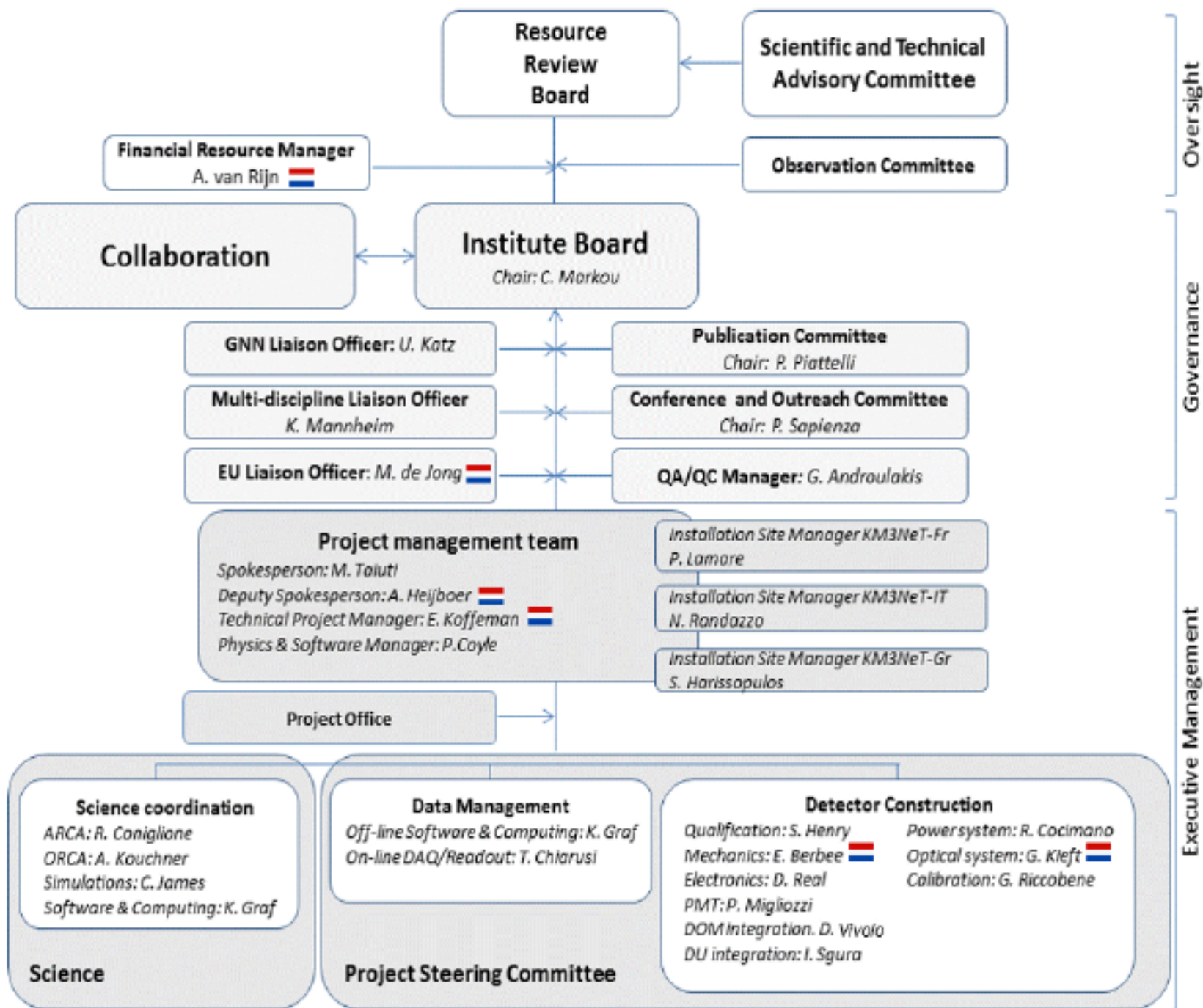


Physics programme:

- Cosmic diffuse flux measurement
- Point-like sources
- Gamma Ray Bursts
- Multimessenger analyses
- Cosmic ray physics, asymmetries, muon bundles
- Charm production
- Exotics (monopoles)
- Lorentz violation



<http://www.cherenkov.nl>



## Group changes 2017

KM3NeT deputy-spokesperson: Aart Heijboer

KM3NeT technical coordinator: Els Koffeman

Thesis defense: Robert Bormuth

Down under: Maarten de Jong and Mieke Bouwhuis

Formally retired: Paul Kooijman

To the USA: Daan van Eijk



New PhD student: Lodewijk Nauta

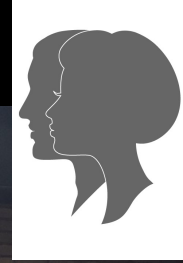
New Postdoc: Bruno Strandberg

New deputy programme leader: Dorothea Samtleben

New programme leader: Paul de Jong

Bachelor/master students: Lieselotte, Federica, Jordan, Jeroen, Rasa, Maarten

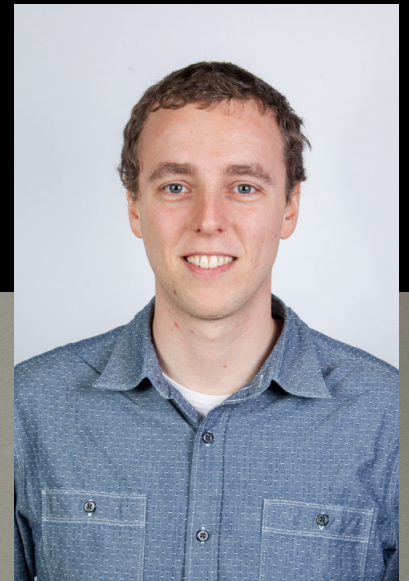
# Group 2017



Jos, Martijn,  
Ernst-Jan, Rasa,  
Jordan

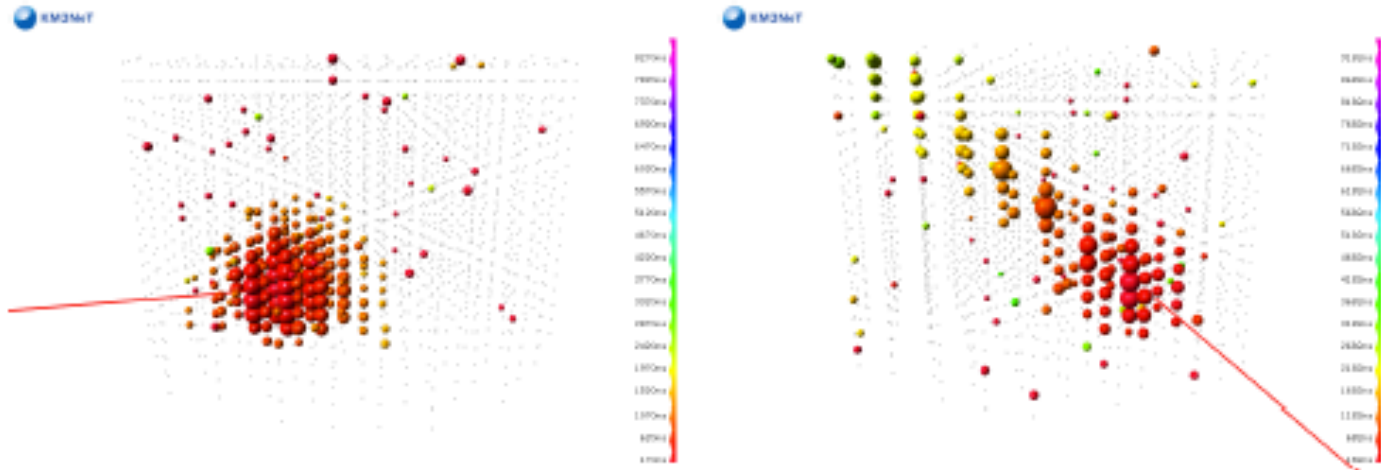


# Thesis defense Robert Bormuth, December 7

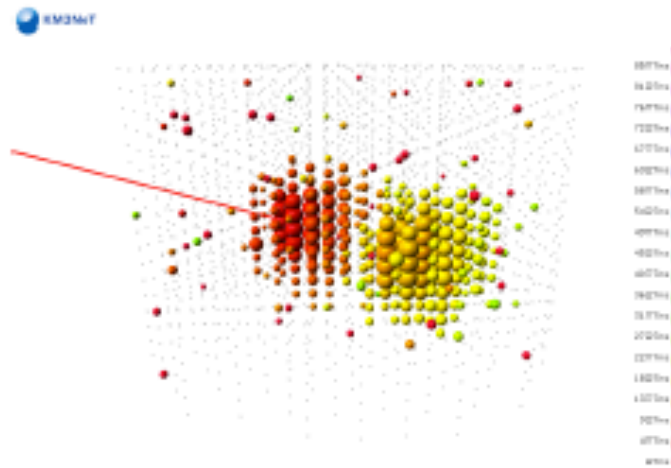




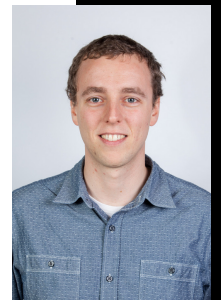
# Reconstruction of tau neutrinos in KM3NeT, for all-flavour analyses



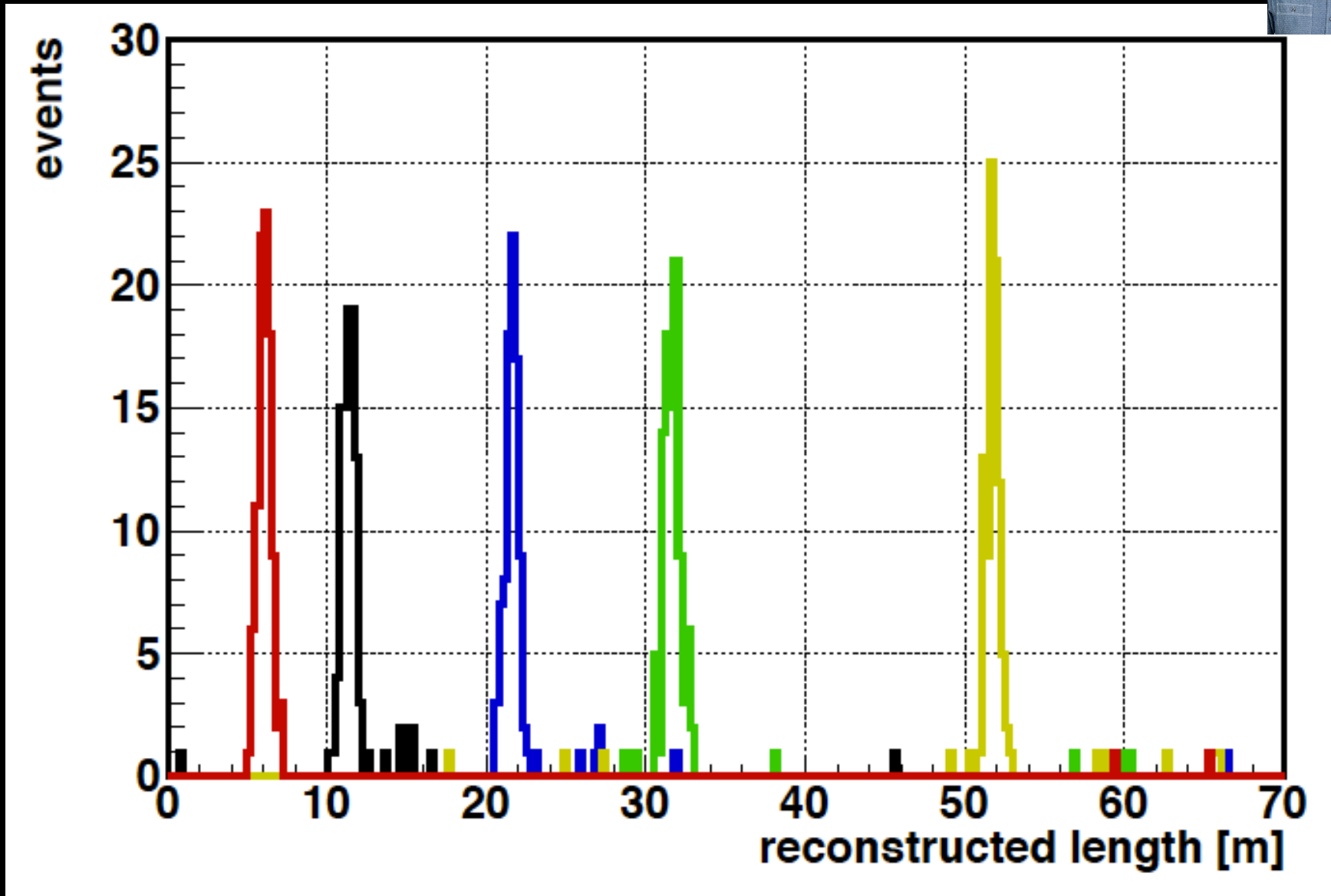
(a) A shower signature induced by an electron neutrino. (b) A track signature induced by a muon neutrino.



(c) A two shower signature induced by a tau neutrino.



# Reconstructed tau decay lengths (gen=5,10,20,30,50 m)

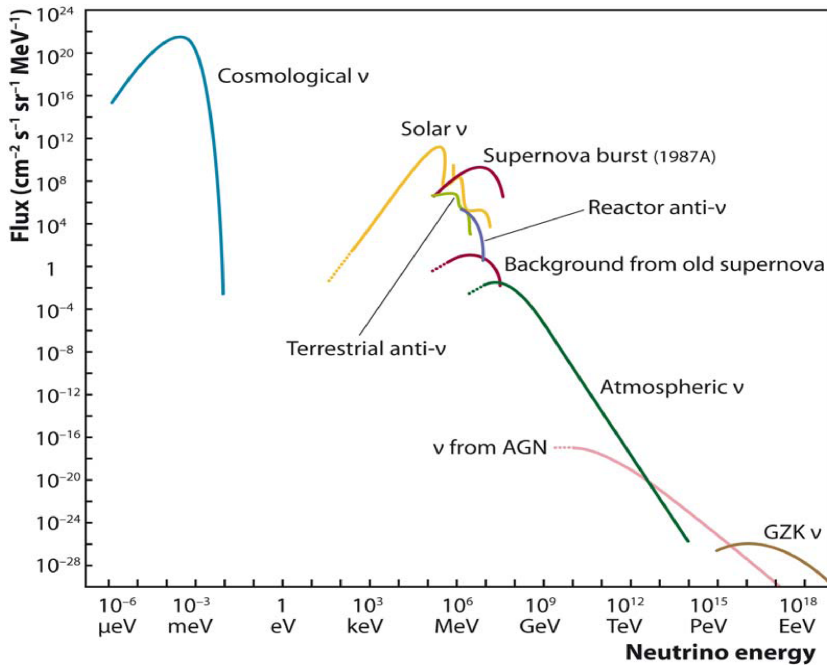
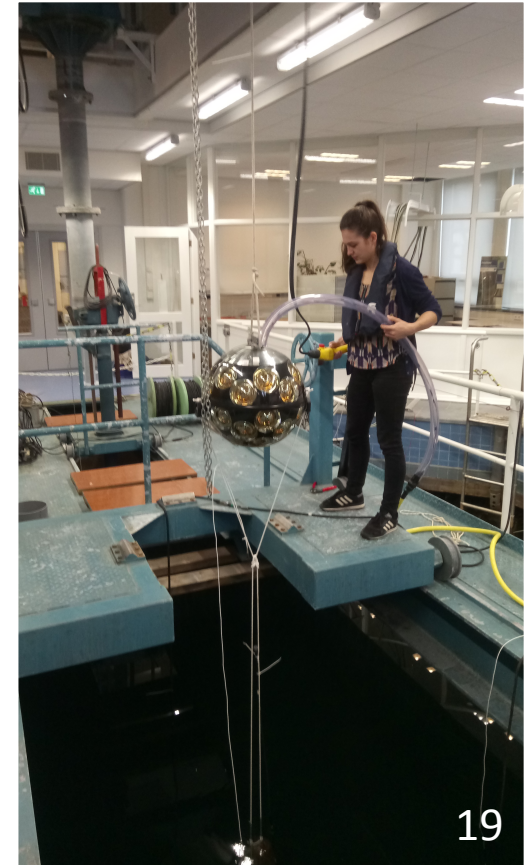


# Acoustic detection of ultra high energy neutrinos

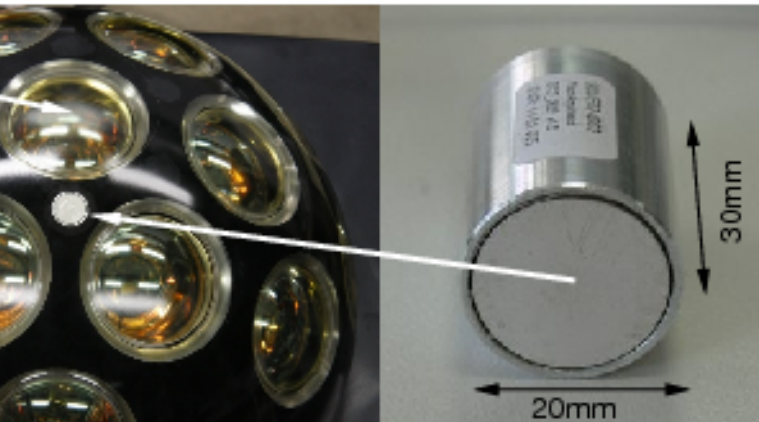
$E > 10^{18}$  eV: possible acoustic detection  
e.g.  $\nu$  of cosmogenic origin

*KM3NeT DOMs have hydrophones*  
*Tested in TNO anechoic basin* Ernst-Jan Buis  
Rasa Muller

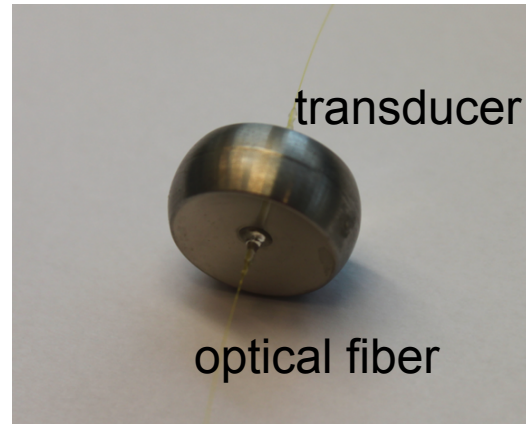
TNO develops better hydrophones  
Also: marine biology!



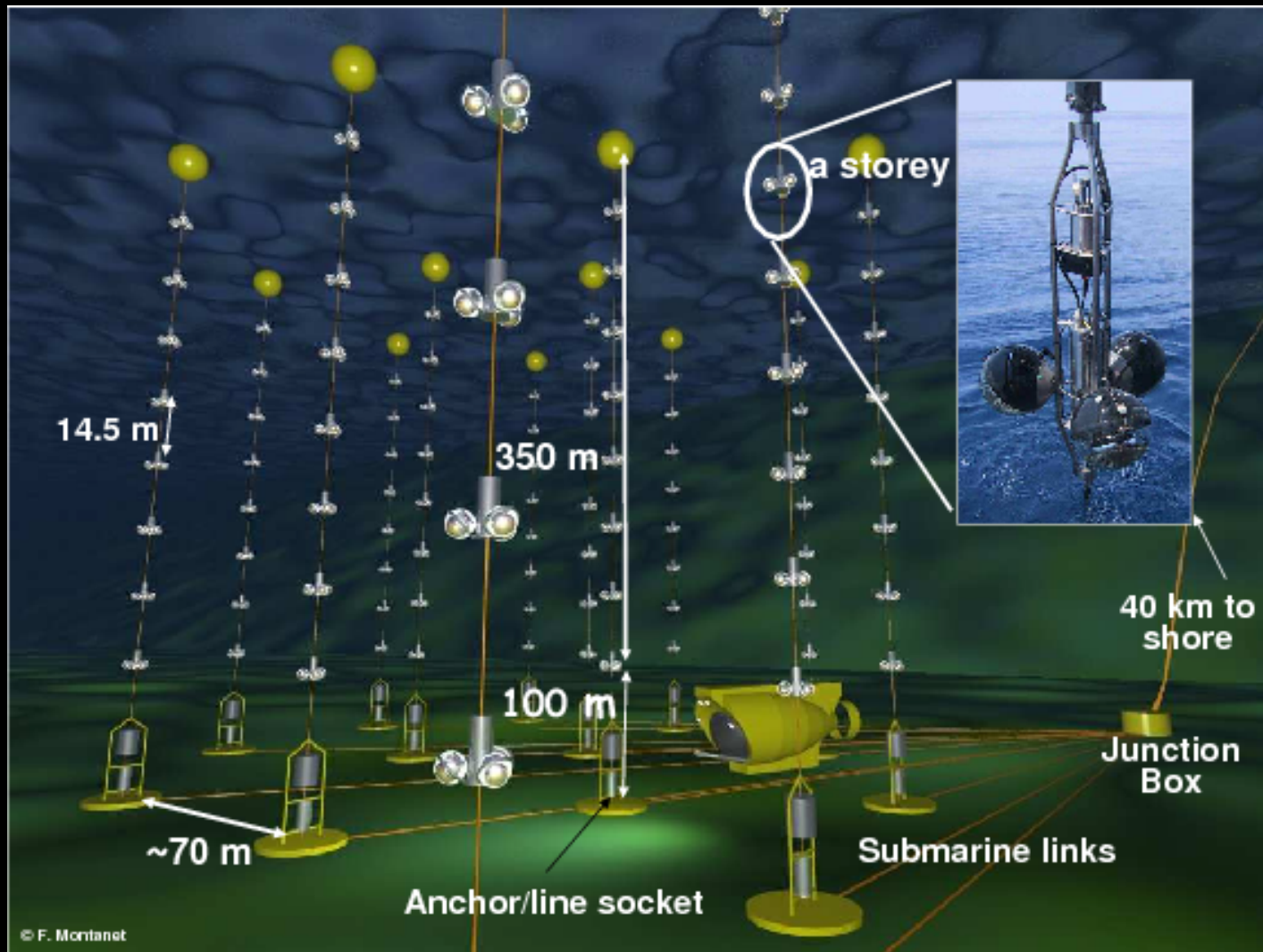
**KM3NeT DOM piezo hydrophone**



**TNO hydrophone**



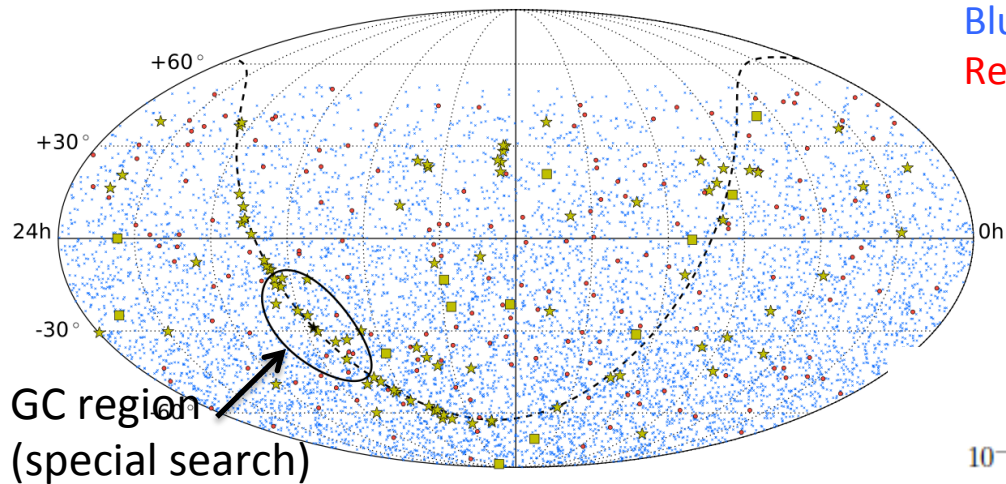
# Predecessor of KM3NeT: ANTARES 12 lines active since >10 years



Antares: 2017 15 papers and 30 conference contributions

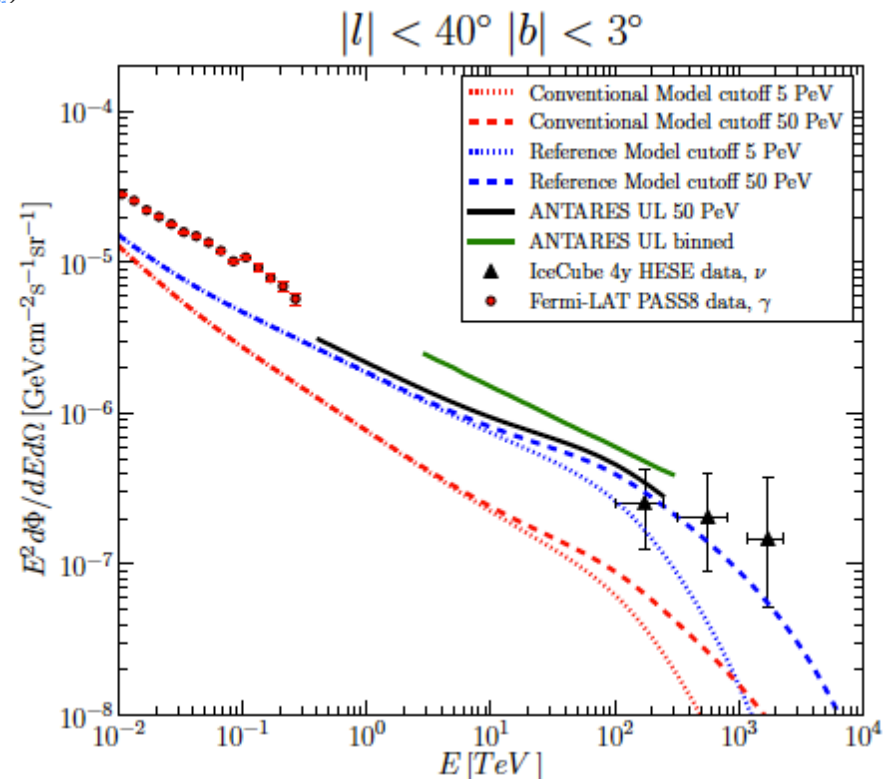
# Picking out a few recent ANTARES results:

*All-flavour neutrino point-like source search, Phys. Rev. D96 (2017) 082001*

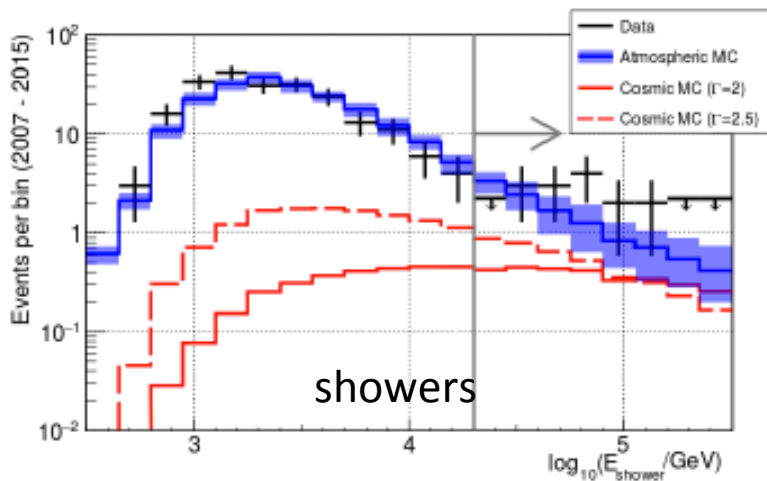
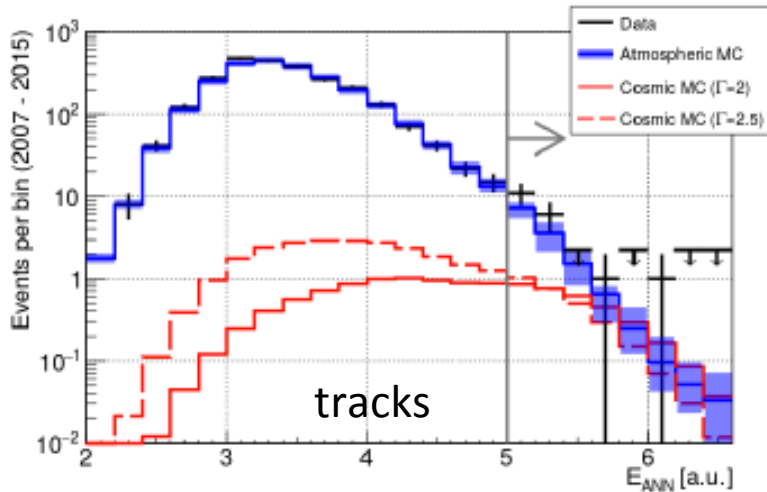


*Constraints on all-flavour galactic diffuse emission, Phys. Rev. D96 (2017) 062001*

For galactic flux, ANTARES sensitivity is equal to IceCube

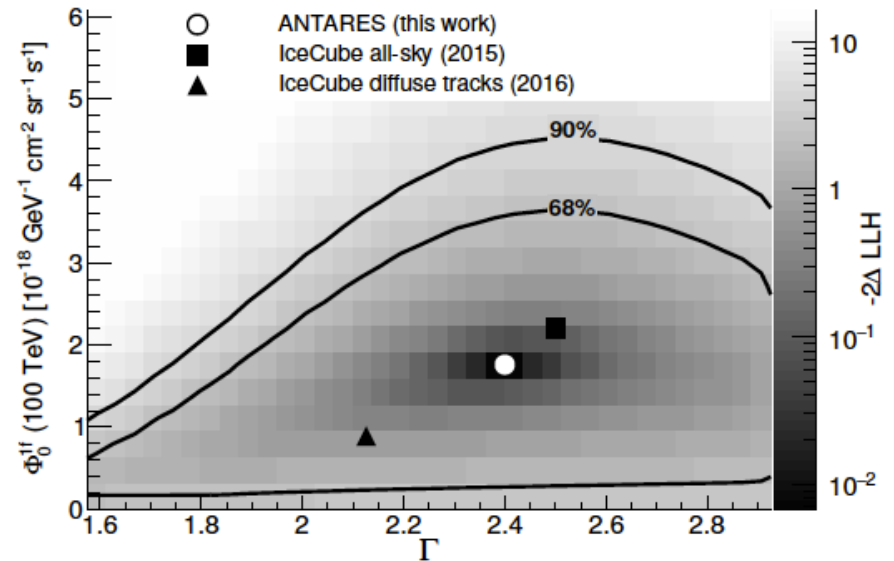


# All-flavour search for a diffuse flux with 9 years of ANTARES data, *arXiv:1711.07212*



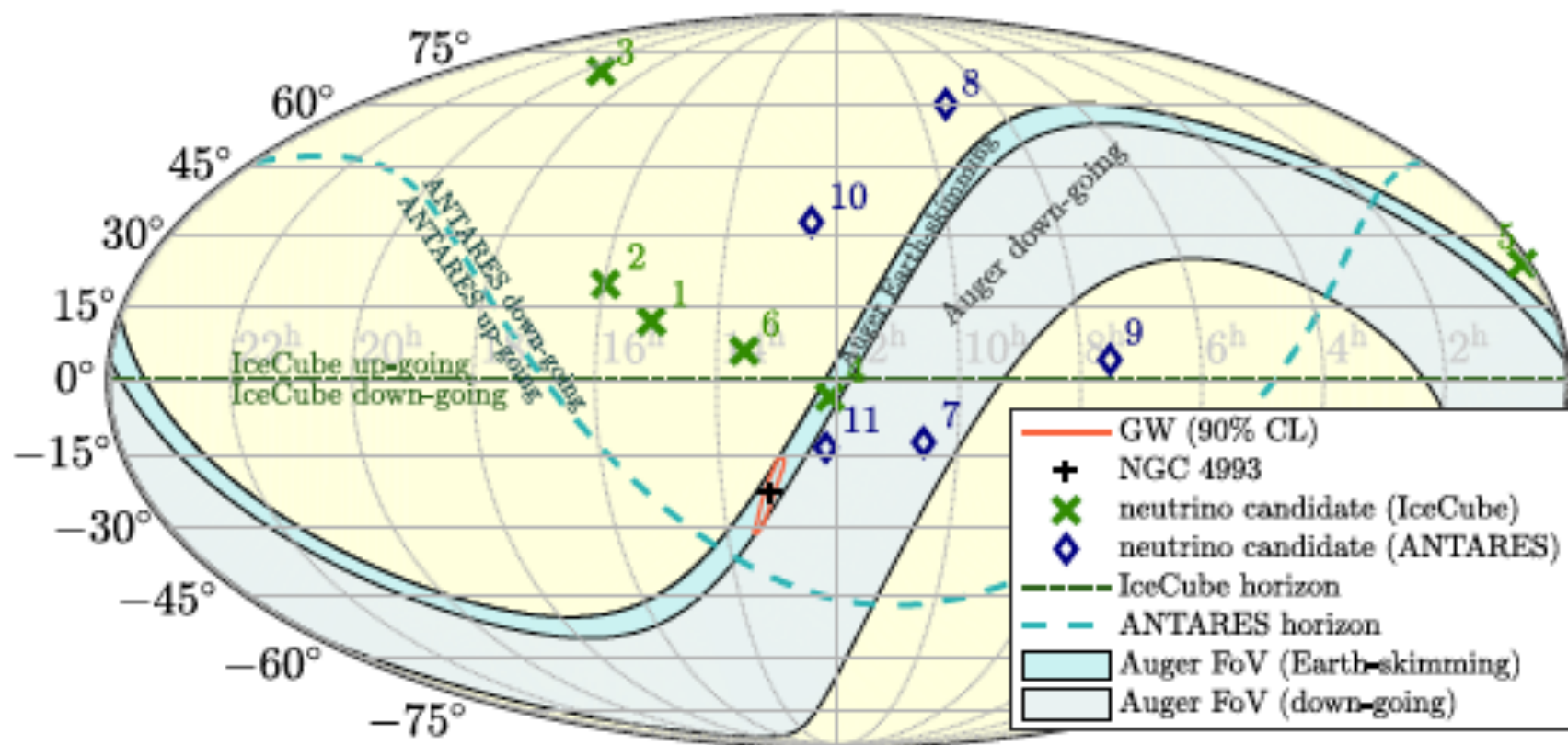
Mild excess over atmospheric bg,  
significance 1.6 sigma

Consistent with IceCube best fit



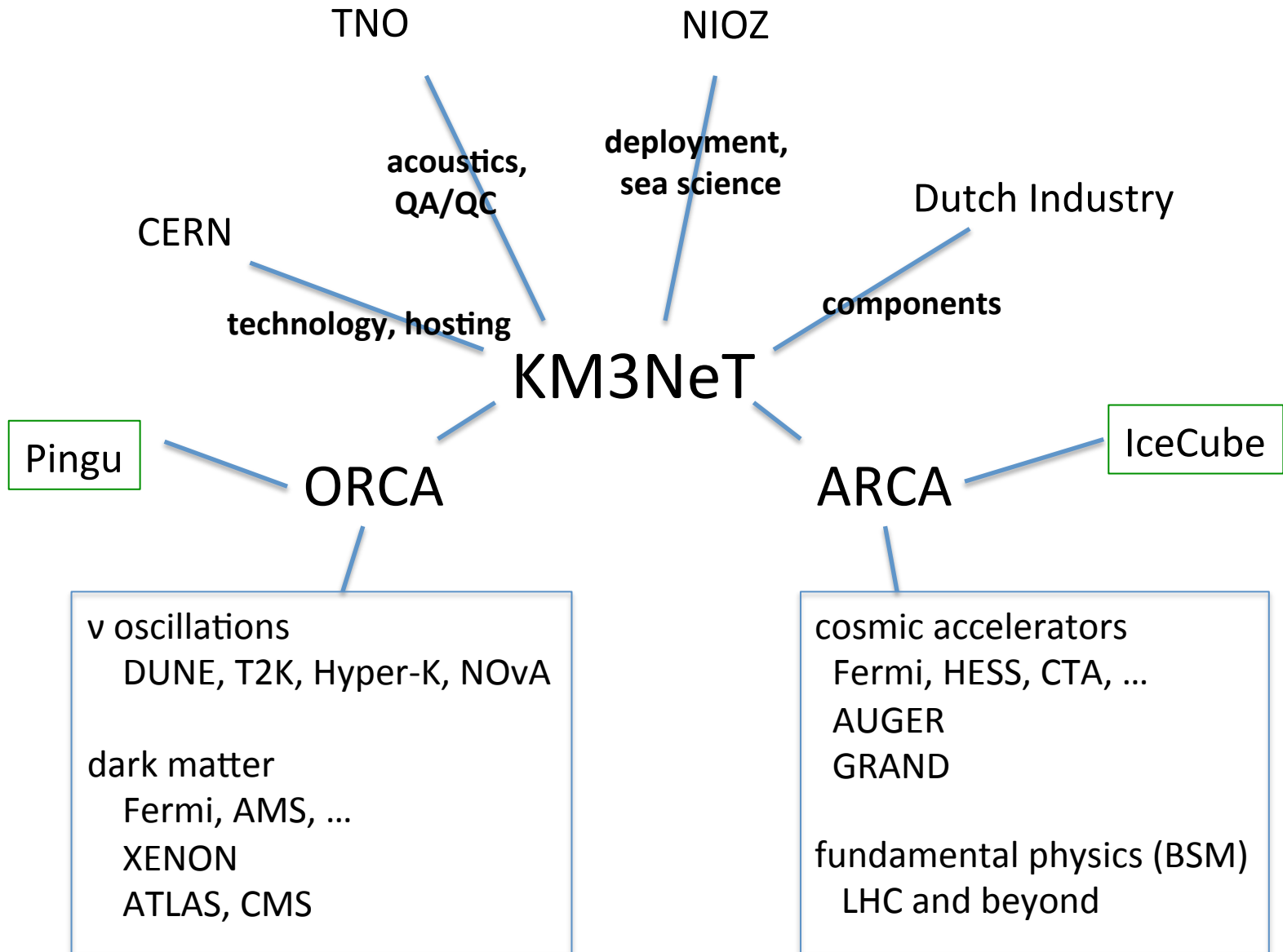
# Search for High-energy Neutrinos from Binary Neutron Star Merger GW170817 with ANTARES, IceCube, and the Pierre Auger Observatory,

Astrophys.J. 850 (2017) no.2, L35









Further talks at the jamboree:

Ronald Bruijn: construction status and plans

Karel Melis: in-situ calibration