The KM3NeT project and Tier2 computing at Tbilisi State University

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- ✓ Physics goals of KM3NeT
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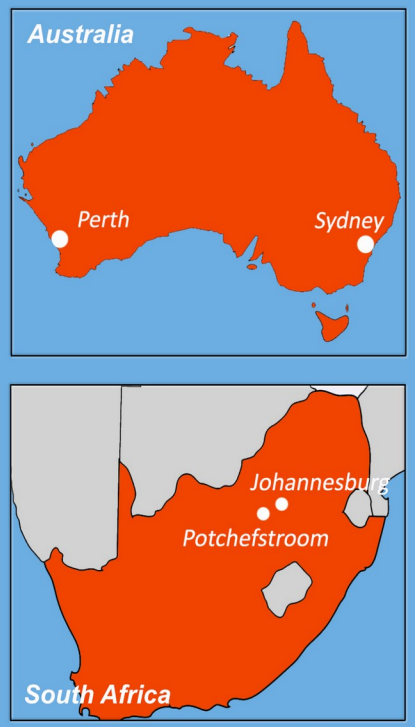
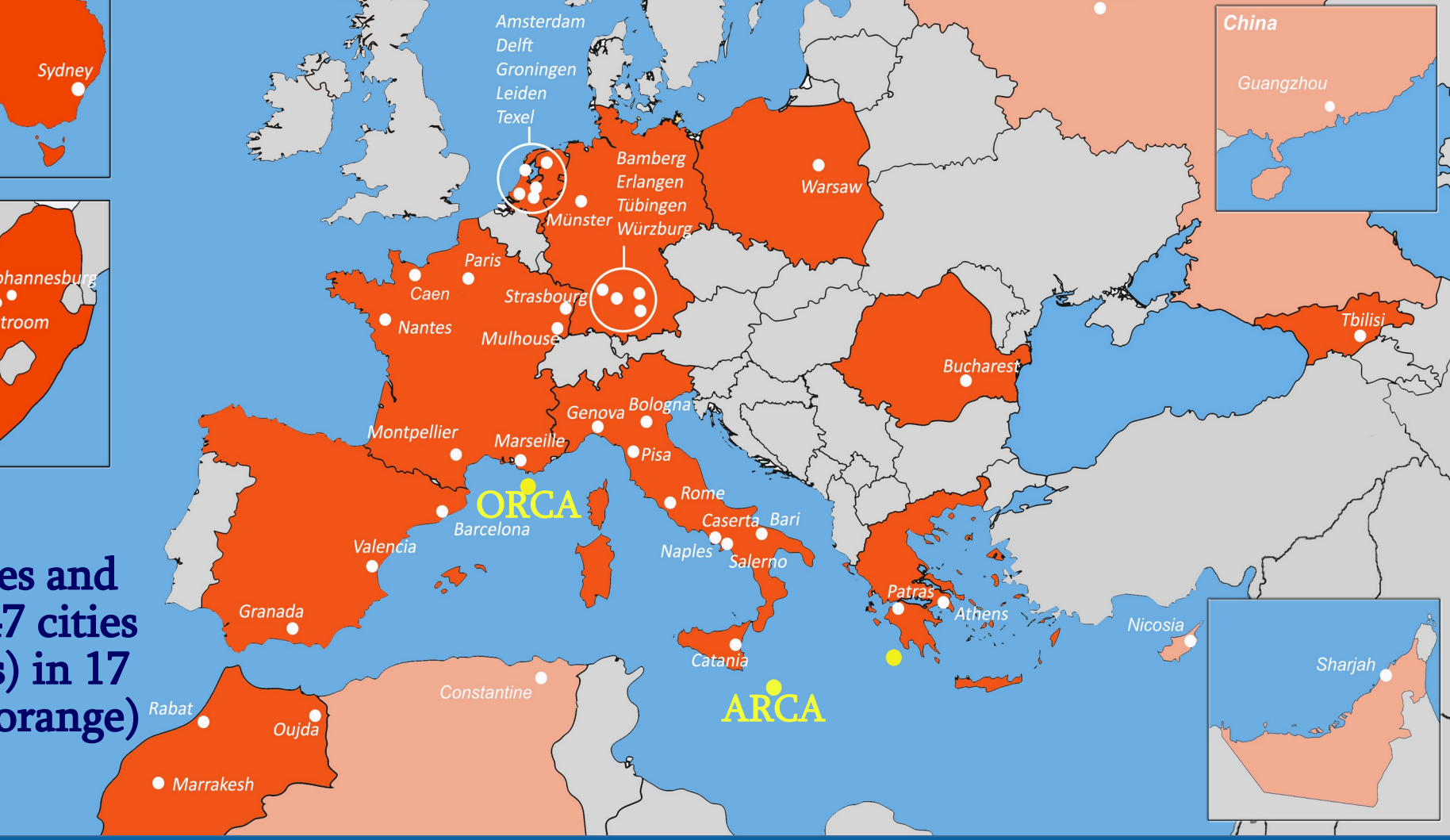
KM3NeT Collaboration

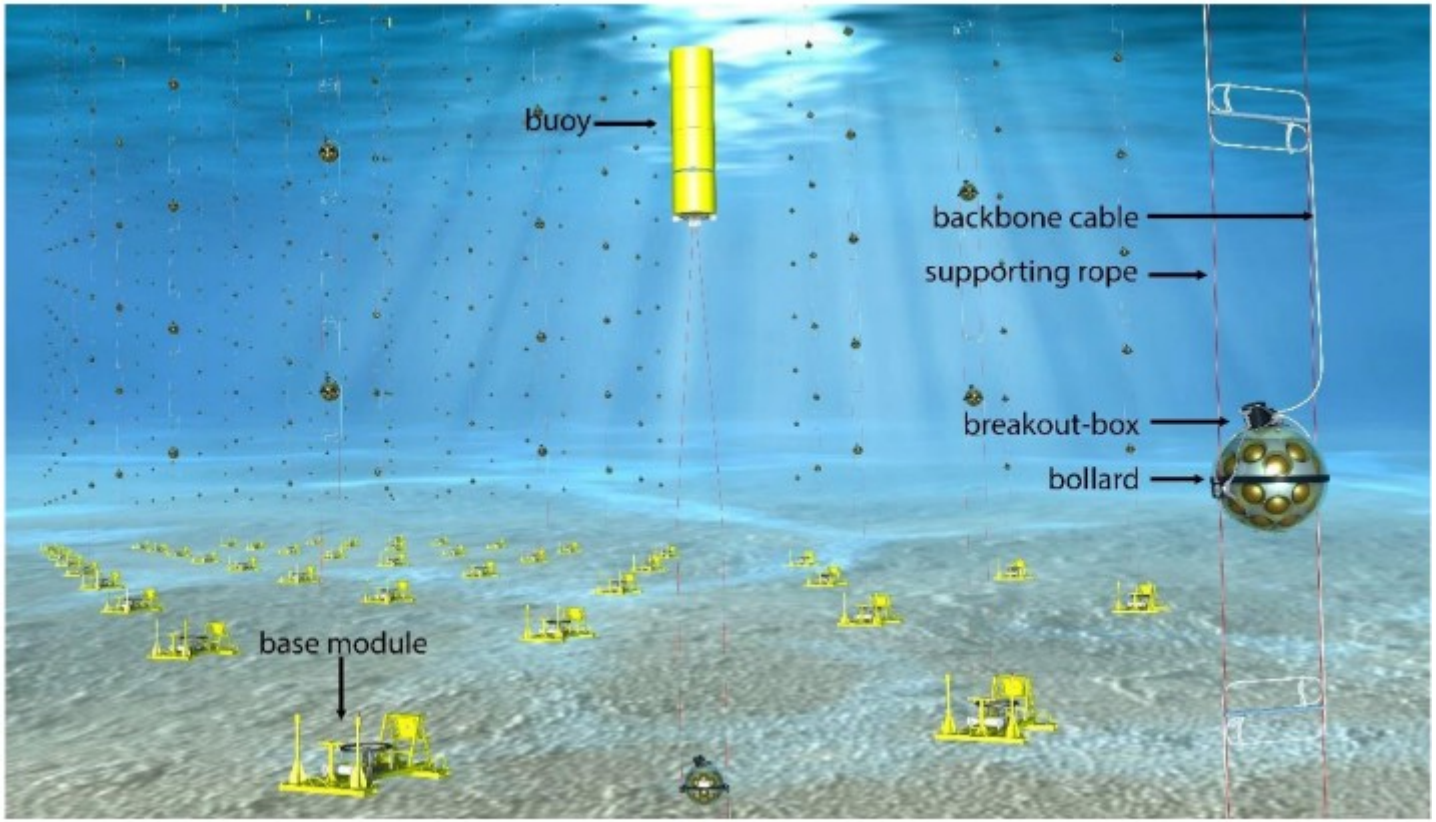
Cities and Sites of KM3NeT

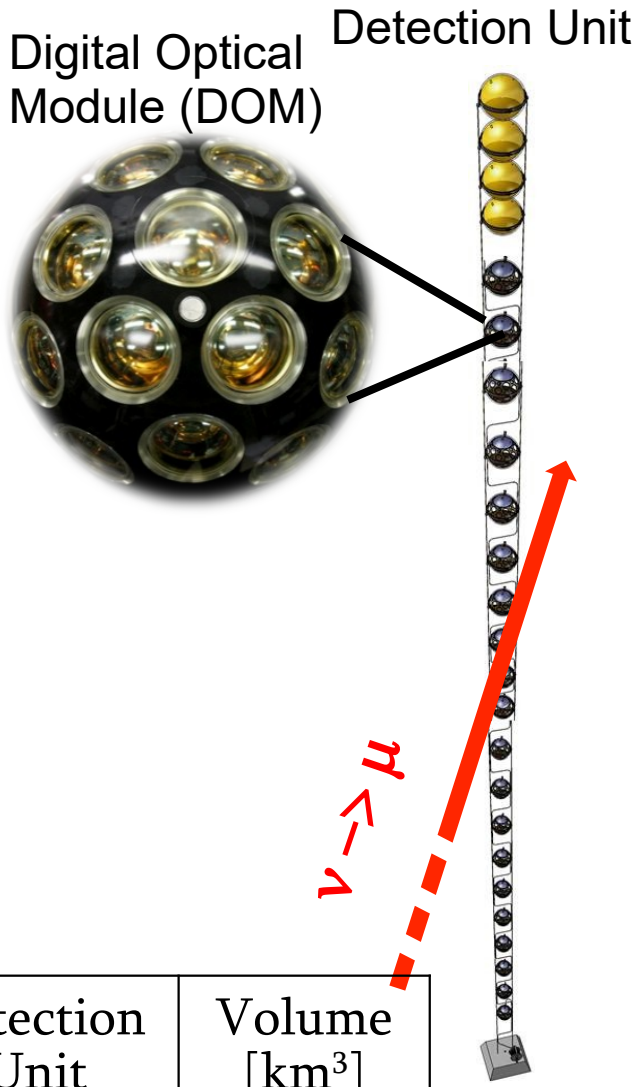




55 institutes and groups in 47 cities (white dots) in 17 countries (orange)

The KM3NeT Detector

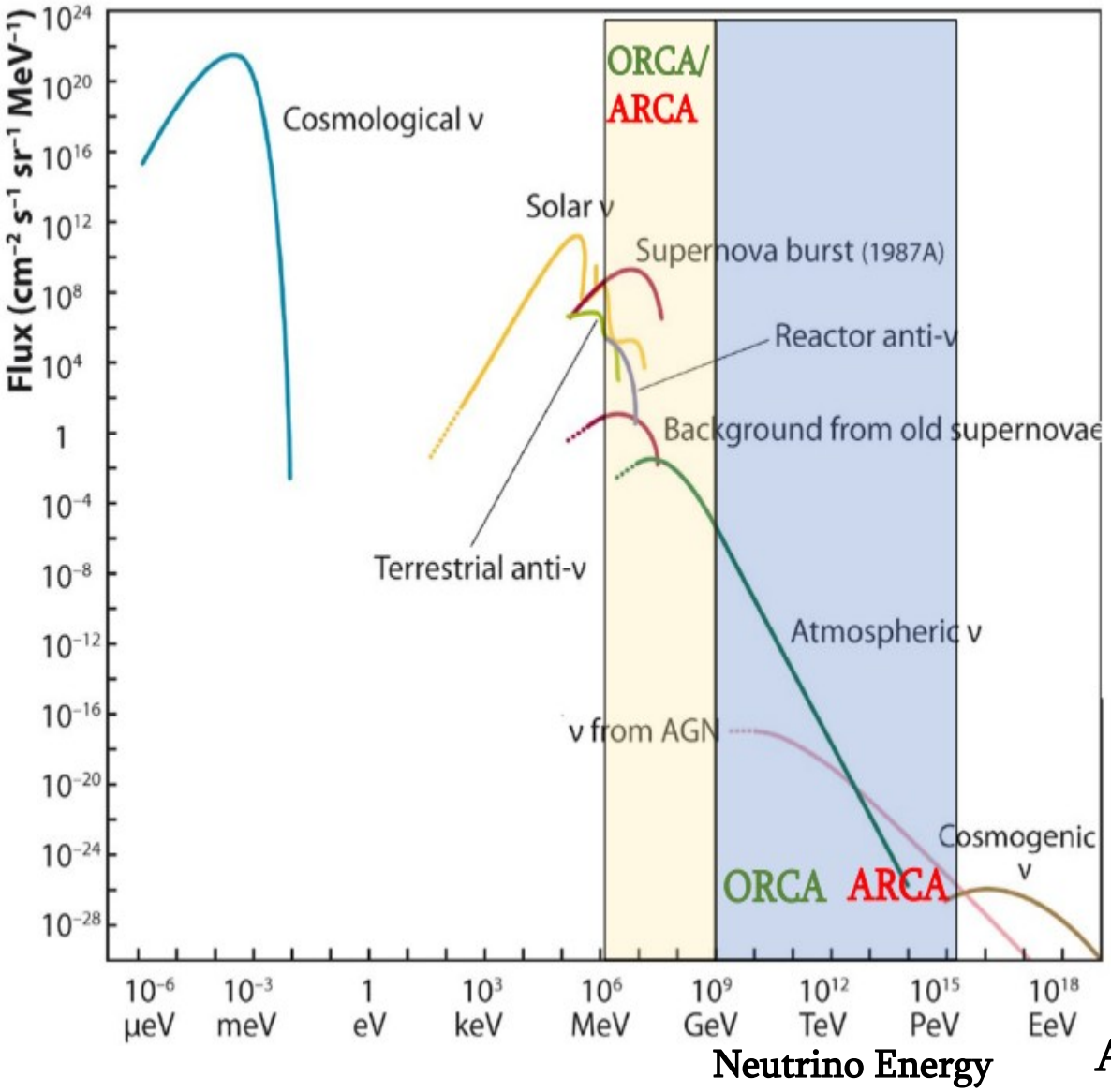


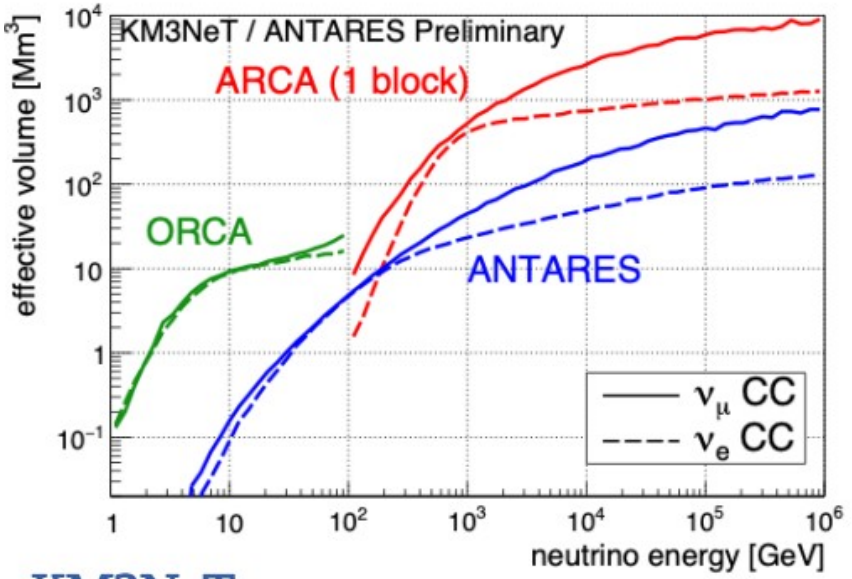


115 Strings, 18 Floors,
2070 DOMs, 64170 Photomultipliers

KM3NeT	Depth [m]	Horizontal spacing [m]	Vertical spacing [m]	Detection Unit	Volume [km^3]
ARCA	3500	90	36	2 x 115	1
ORCA	2450	20	9	115	0.005

Neutrino Energy Range





KM3NeT:

- neutrino energy range: MeV - PeV
  reconstruction of neutrinos:
  above few GeV

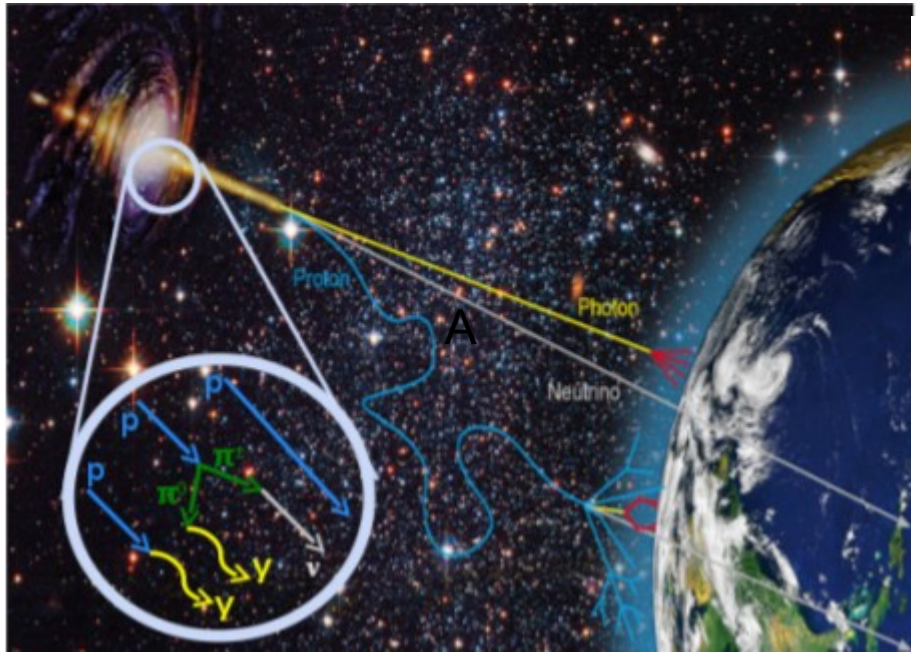
ORCA:

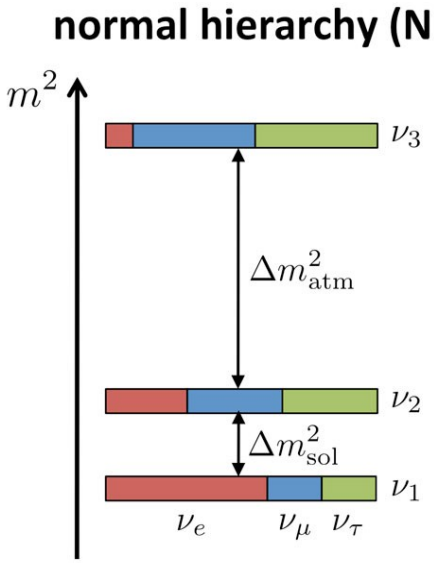
Oscillation **R**esearch with **C**osmics in **A**byss

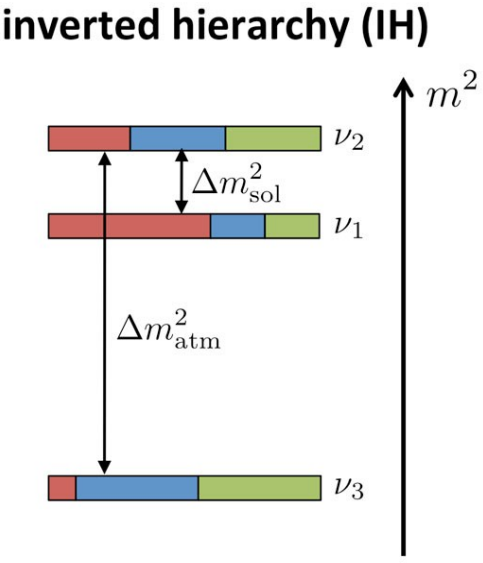
ARCA:

Astroparticle **R**esearch with **C**osmics in **A**byss

KM3NeT Physics Objectives







ARCA:
Astroparticle **R**esearch
with **C**osmics in **A**byss

Main objective:
Search for cosmic ν sources

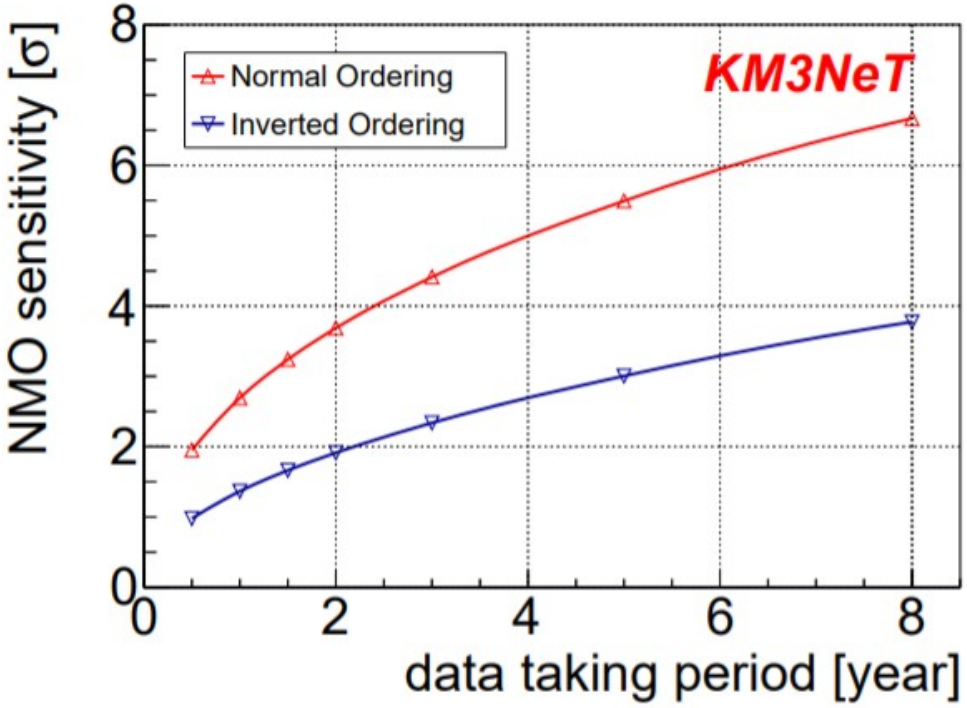
ORCA:
Oscillation **R**esearch
with **C**osmics in **A**byss

Main objective:
Researching NMO and ν oscillation parameters

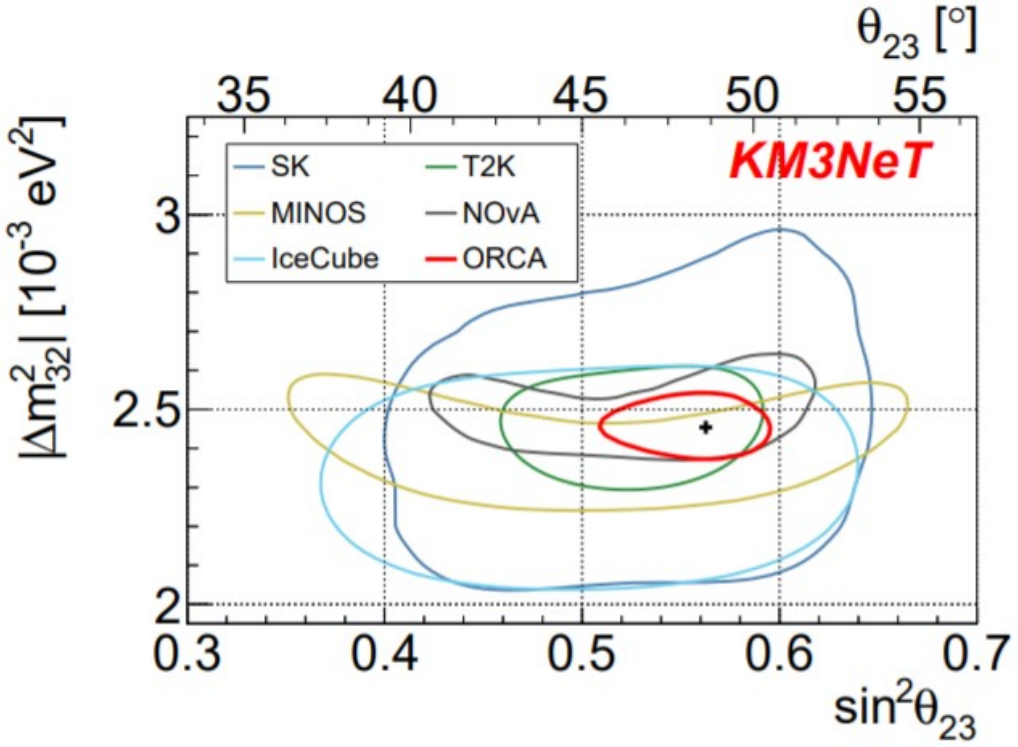
Other studies concluded with both of the detectors:

- Neutrino flux from CCSN
- Indirect Search for the DM
- Multimessenger observations

KM3NeT/ORCA Physics Sensitivities*



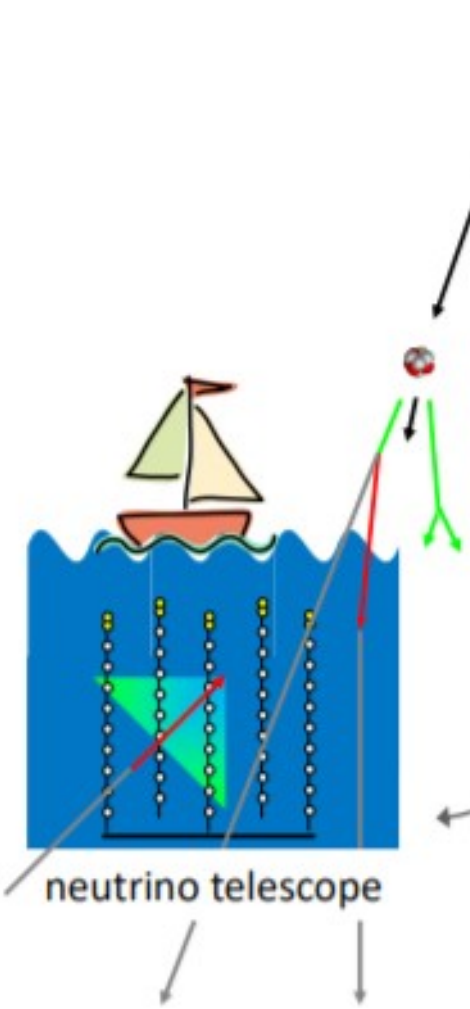
Sensitivity to NMO as a function of data taking time



KM3NeT/ORCA expected measurement precision of Δm^2_{32} and θ_{23} for NO after 3 years of data taking at 90% confidence

*KM3NeT Collaboration
Determining the Neutrino Mass Ordering and Oscillation Parameters with KM3NeT/ORCA
arXiv:2103.09885

KM3NeT Computing Model



Tier-0
Real-time data filter
Detector monitoring

shore station

0.1–1 Tb/s

10–100 Mb/s

Tier-1
Detector calibration
Detector simulation
Event reconstruction

remote operation

remote access to data

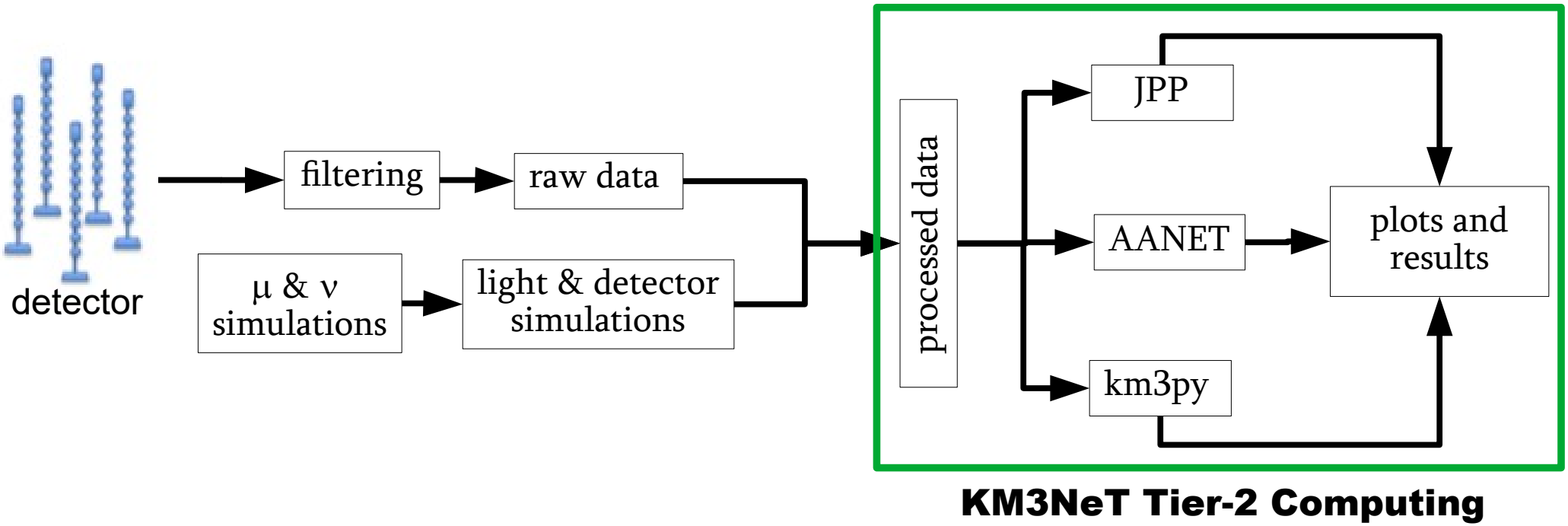
Tier-2
High-level data analysis

Address: t2.km3net.tsu.ge
CPU: 6 cores with up to 4.7GHz

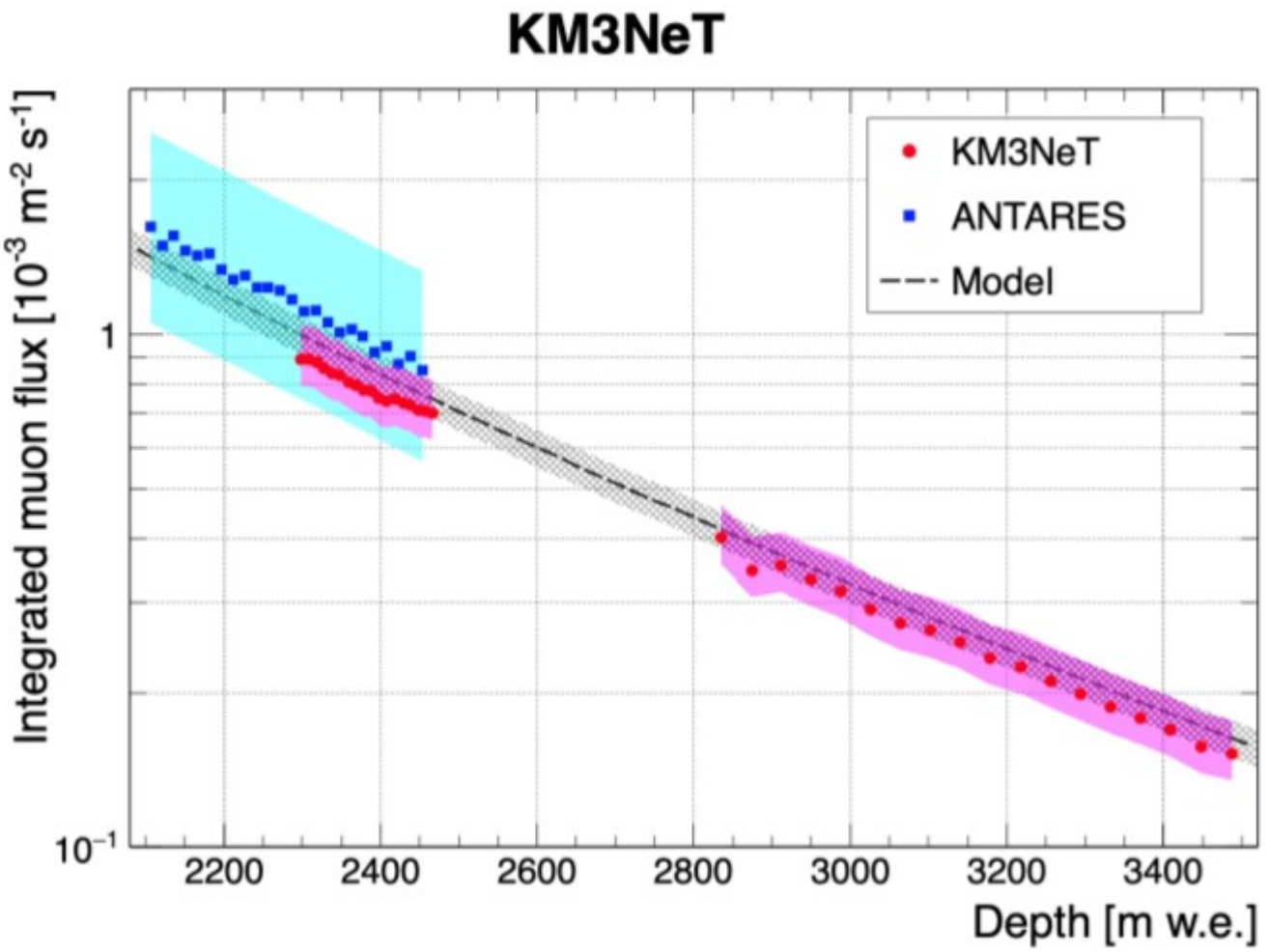
KM3NeT Software Tier-2 TSU

KM3NeT software frameworks:

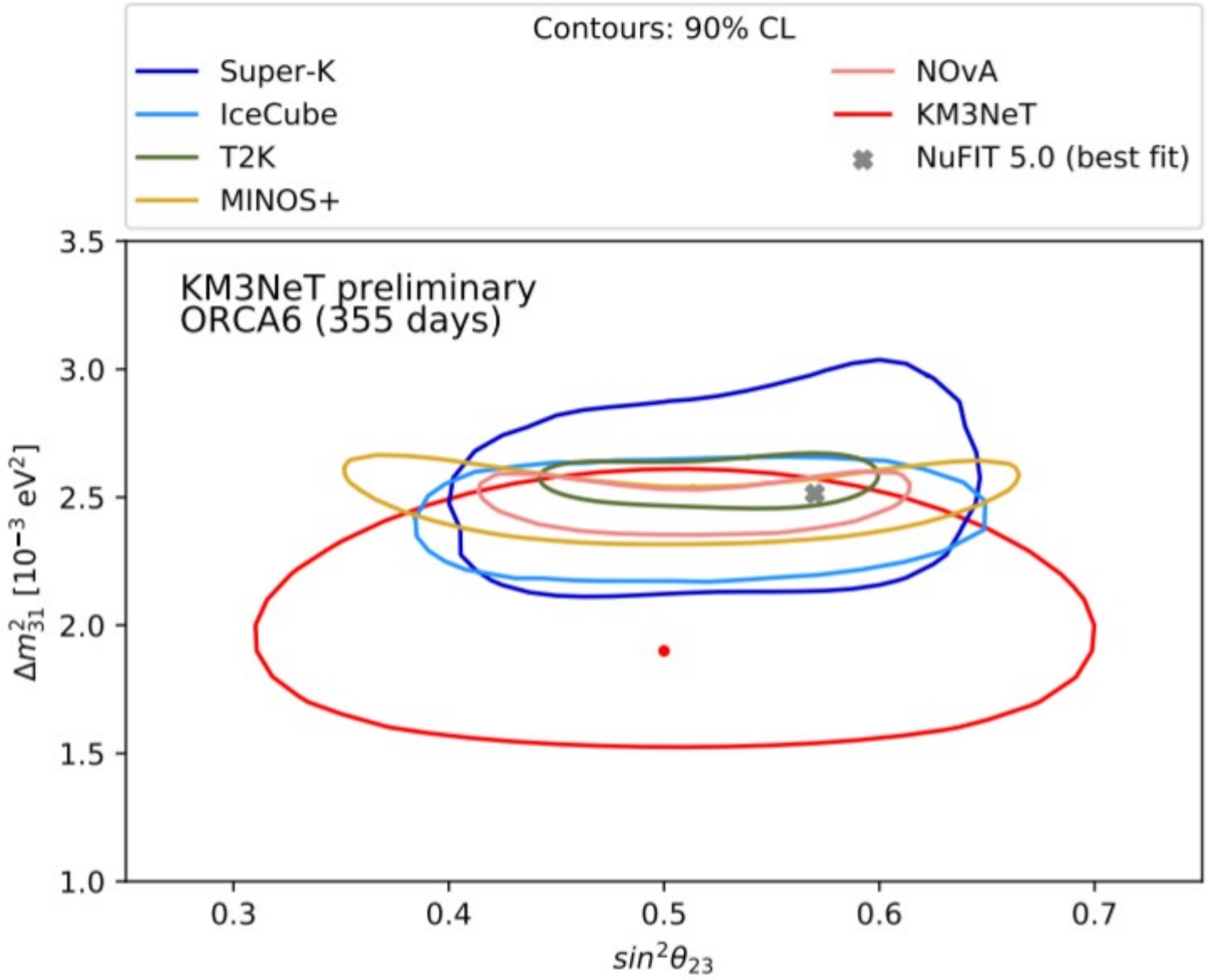
- JPP - Software Framework for DAQ; detector monitoring; callibration; event triggering; Simulations; Reconstructions
- Km3py – Python applicaitons and classes for the data IO, monitoring, analysis
- Aanet – analysis tools



First Results From KM3NeT



First Results From KM3NeT/ORCA6



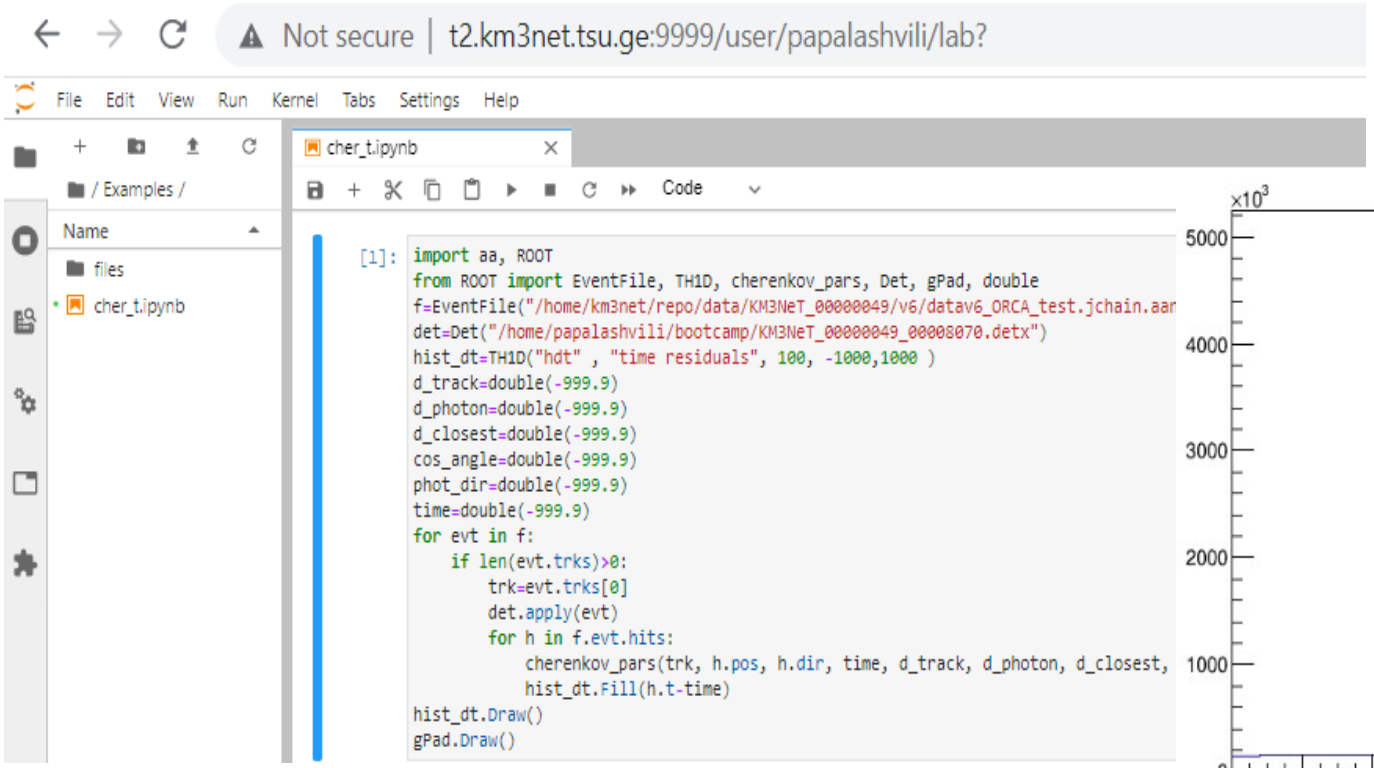
Computing at Tier-2 TSU

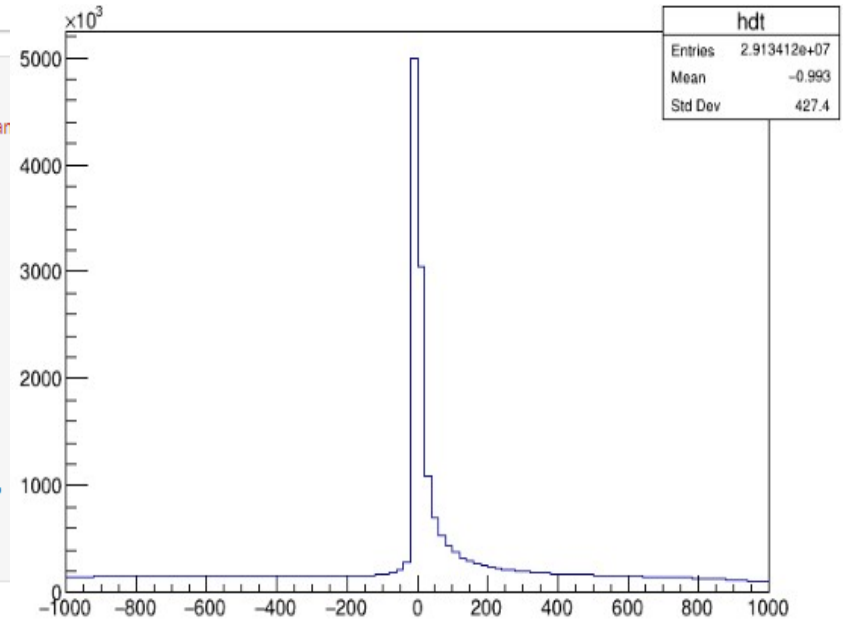
KM3NeT data at tier-2 TSU

KM3NeT	DU	Events ($x10^6$)	Period	L-days
ORCA	6	280	27/01/2020-3/03/2021	367.5
ARCA	6	108	23/04/2021-18/06/2021	53.6

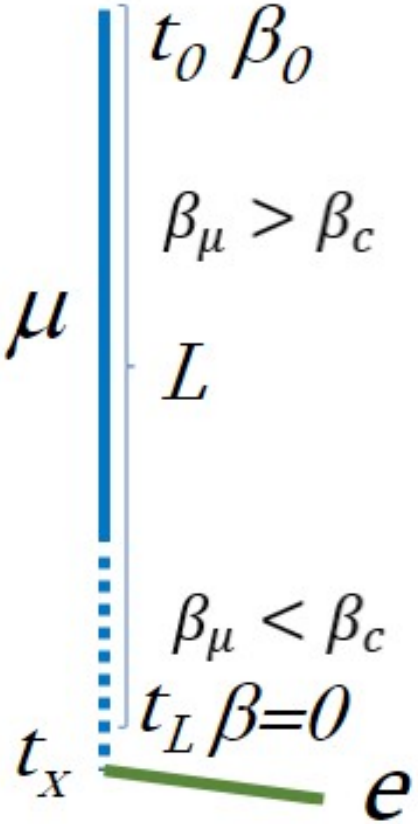
Web based python environment

High level data analysis





Muon decay studies



$$\mu \rightarrow e + \nu_\mu + \nu_e$$

Muon propagation time: $t_L = \dfrac{2L}{\beta_0 c}$

Muon decay time: $t_x - t_L = \Delta t = \exp\left(-\dfrac{\Delta t}{\tau}\right)$

$\tau = 2.1969811(22)\ \mu sec$

Cherenkov condition:

$$\beta_C \geq \frac{1}{n} \qquad E_k = \left(\frac{n}{\sqrt{n^2-1}} - 1\right) m \qquad n = 1.35$$

$$E_k(\mu) = 52\ MeV \qquad E_k(e) = 0.25\ MeV$$

Summary

- KM3NeT research infrastructure with ARCA and ORCA detectors are under construction in the Mediterranean Sea
- Main physics goals of the project are searching for high energy ν sources of the Universe and researches in ν physics (neutrino mass ordering and precision measurements of θ_{23} and Δm^2_{32})
- KM3NeT Tier-2 computing server which was developed in TSU is a part of the data quality group and is actively used for its related tasks
- First results of KM3NeT were presented at summer conferences of 2021
- TSU group is currently working on muon identification in KM3NeT data