KM3NeT

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Nikhef 2019

KM3NeT

KM3NeT Building Block

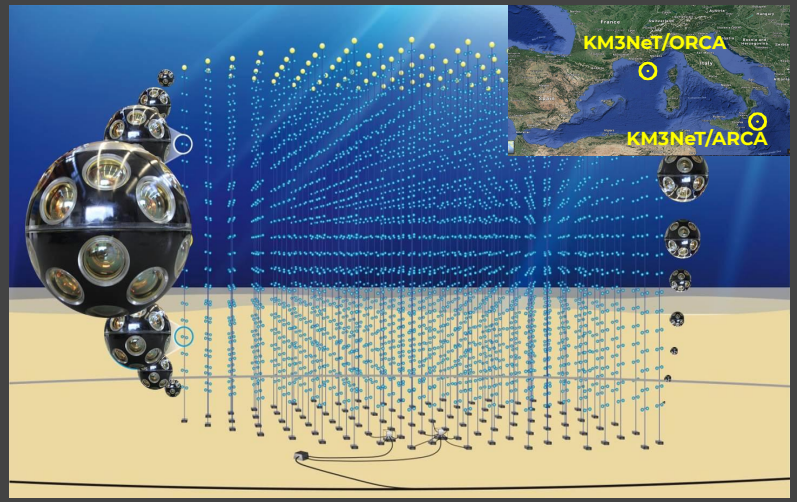
- **115** strings
- **18** DOMs / string
- **31** PMTs / DOM: Improve reconstruction and background rejection!
- Total: **64k*3¨ PMTs**

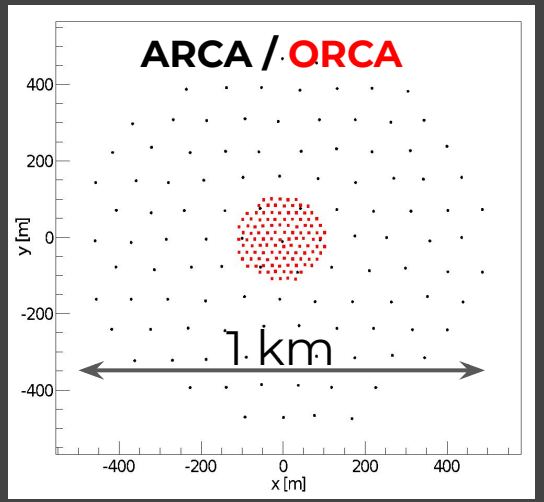
KM3NeT/ORCA

- Low energies
- 1 Building Block

KM3NeT/ARCA

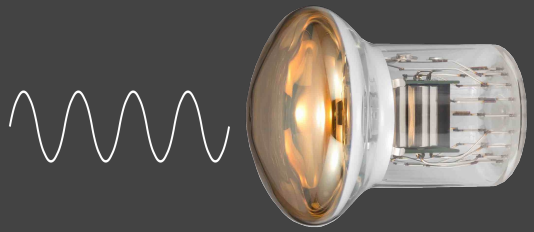
- High energies
- 2 Building Blocks

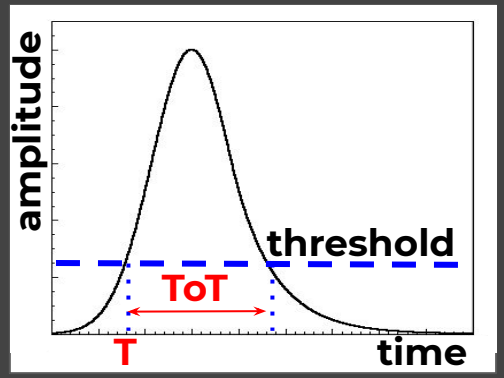




	String Spacing (m)	DOM Spacing (m)	Depth (m)	Instrumented mass (Mton)	Building blocks
ORCA	23	9	2470	8	1
ARCA	90	36	3400	500*2	2

Data generation in KM3NeT





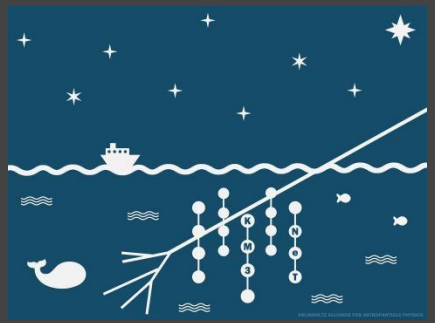
HIT

- Time
- Time over threshold
- PMT ID

6 Bytes

- PMT analog signal above threshold is digitised into a HIT
- HIT rate ~7-8 kHz per PMT (mainly optical background)
- ~ 64000 PMTs in each KM3NeT building block
- **Data production rate per building block: ~0.1 Tb / s !**

KM3NeT data treatment



0.1 Tb/s

off-shore

on-shore

TIER-0

Real time data filter
Detector monitoring

10 Mb/s

TIER-1

Detector calibration
Detector simulation
Event reconstruction

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Jpp
by
Maarten de Jong

All data sent to shore

Simulations

Neutrinos

Atmospheric muons

Nikhef

TIER-2

High level data analysis

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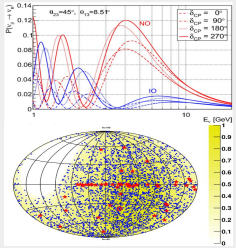
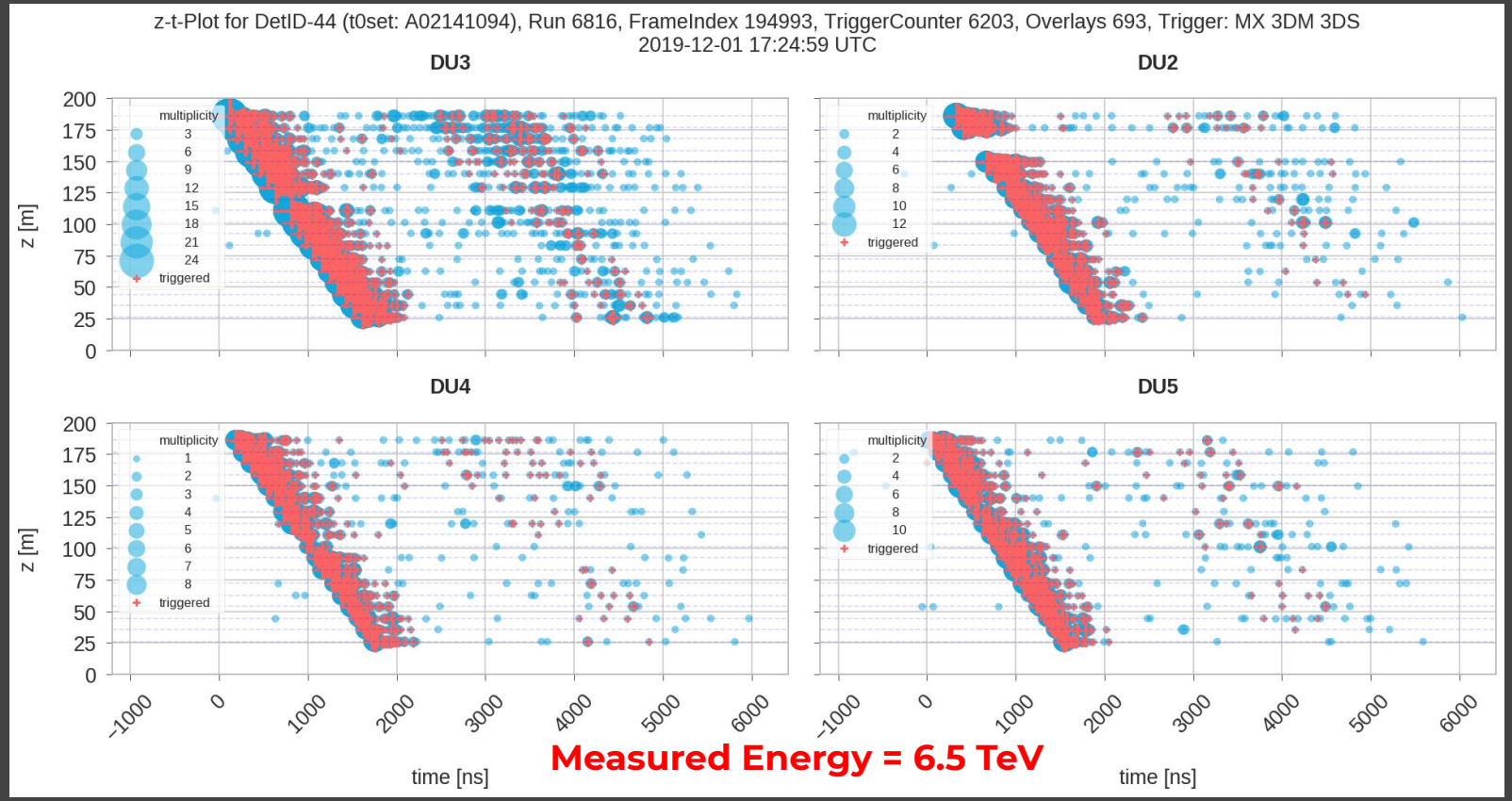


KM3NeT (ORCA): Event from data filter

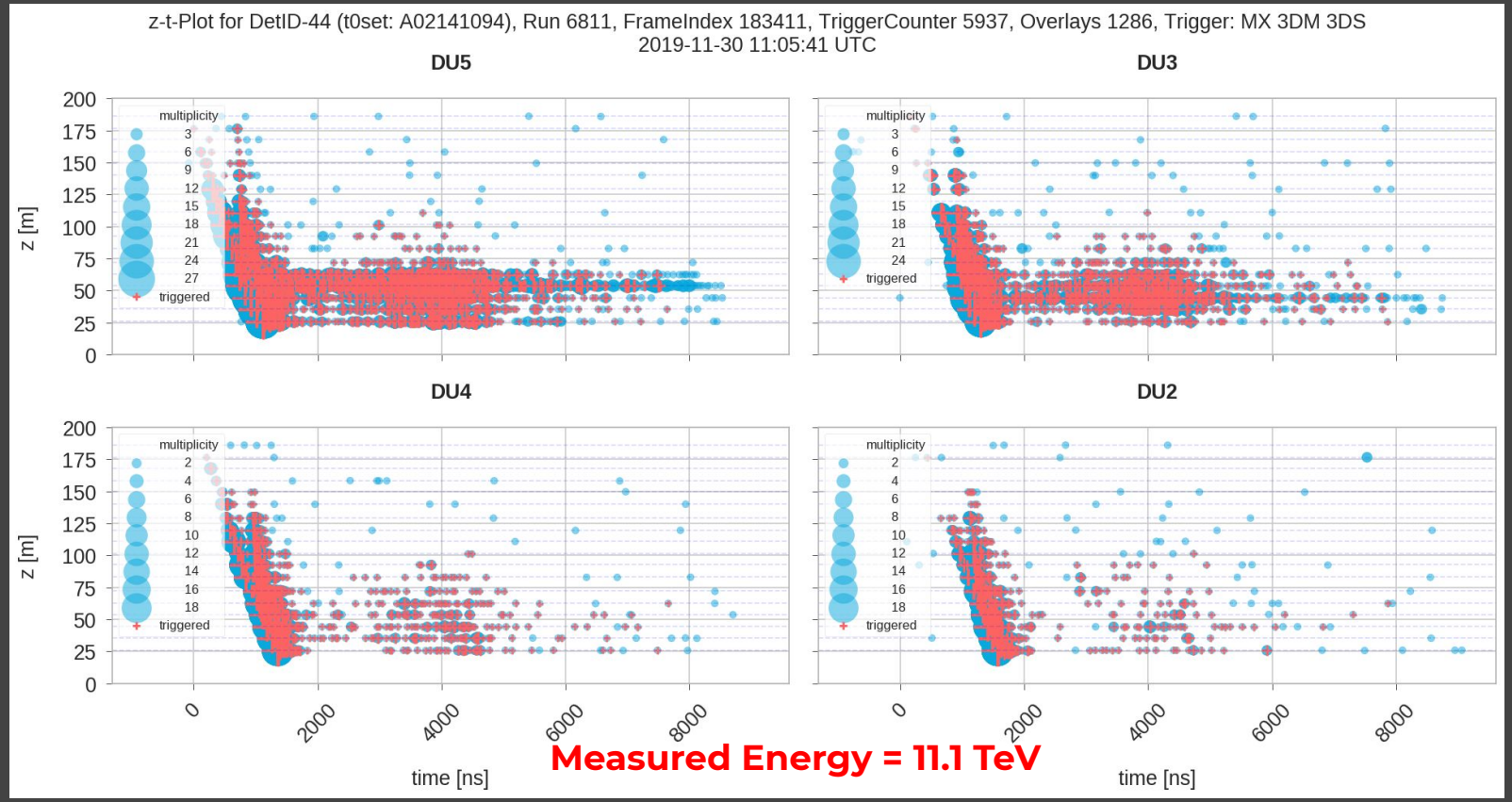
TIER-0



Measured Energy = 6.5 TeV

KM3NeT (ORCA): Event from data filter

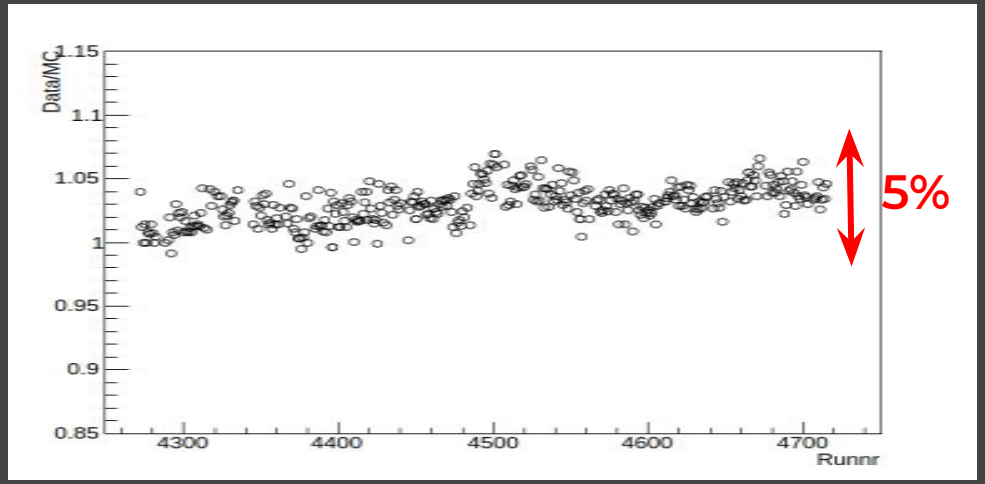
TIER-0

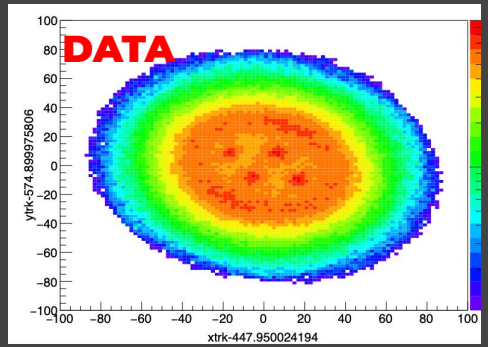


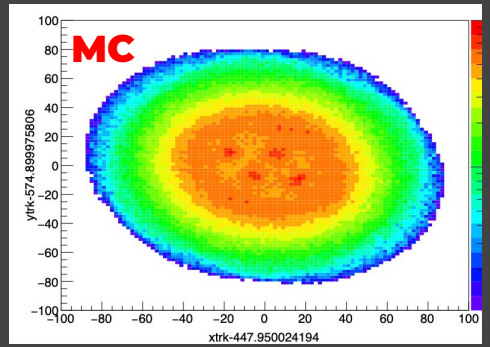
Measured Energy = 11.1 TeV

KM3NeT (ORCA) data vs Monte Carlo

TIER-1







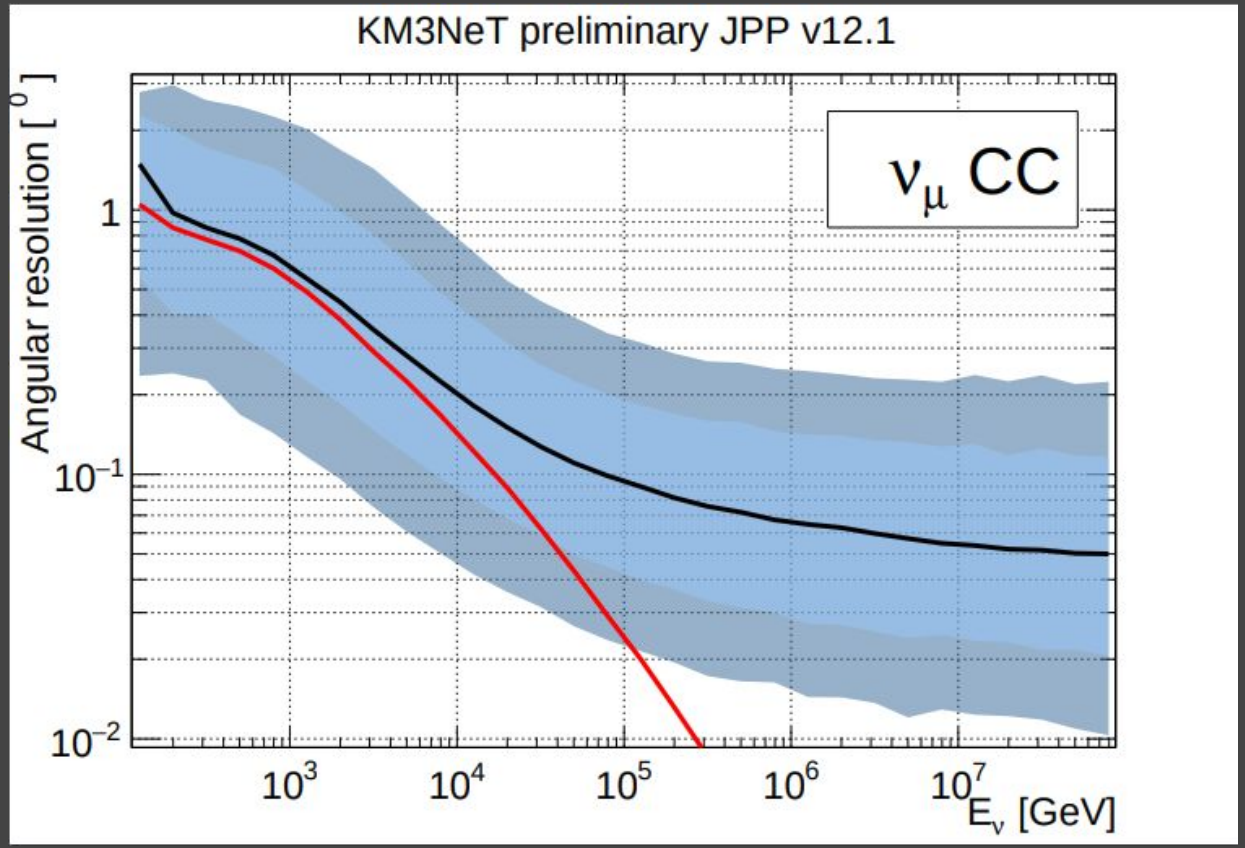
Number of events per run.

1 Run ~ 6h

Data-MC agreement within 5% !

KM3NeT (ARCA) reconstruction

TIER-1



WORLD'S BEST ANGULAR RESOLUTION!

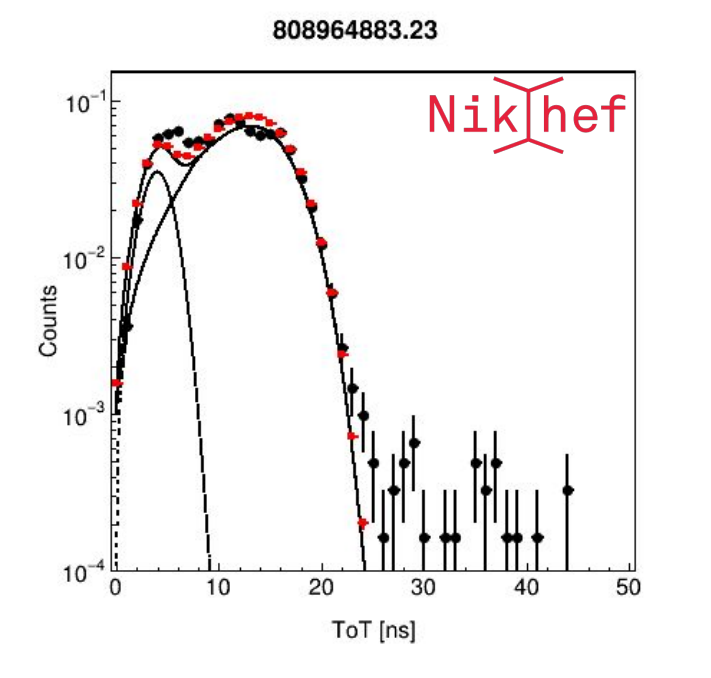
As good as CTA.

KM3NeT PMT Calibration

TIER-1

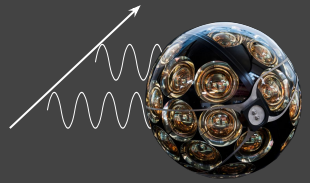
Relation between observables and PMT parameters:

- Model based on laboratory measurements
- Relates PMT parameters with the observed time-over-threshold distribution.
- Used for PMT gain calibration



KM3NeT PMT Calibration

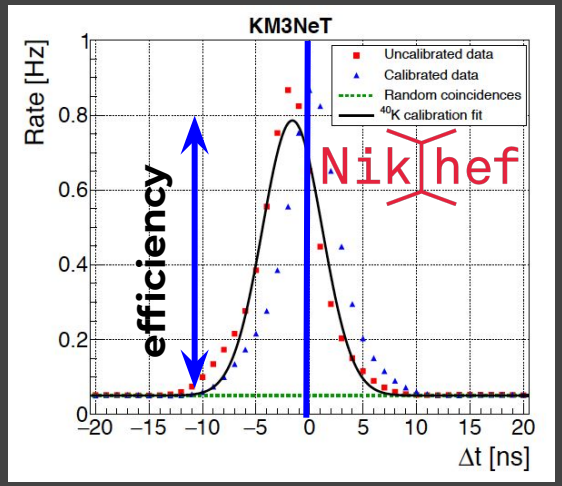
$^{40}K \longrightarrow {}^{40}Ca + \nu_e + e^-$

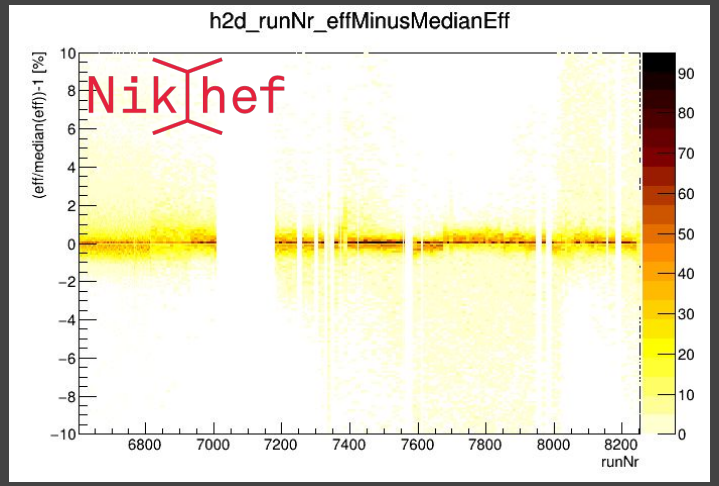


40K decays produce correlated signals on different PMTs

- ➢ PMT time calibration
- ➢ PMT efficiency (continuous monitoring ~1% variation)

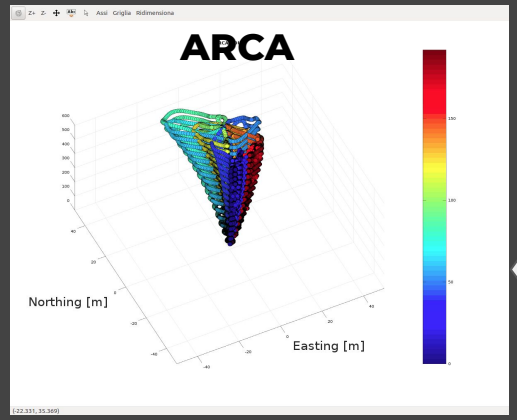
TIER-1





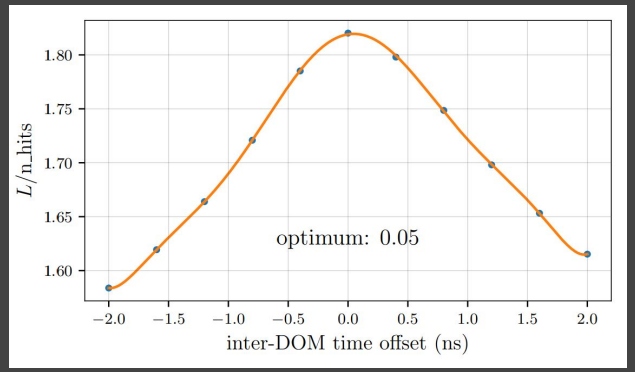
KM3NeT Calibration

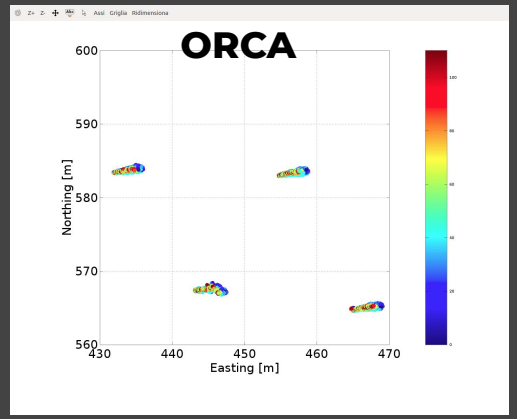
TIER-1



Acoustic positioning system.

Detector geometry calibration





Atmospheric muon background used for time and position calibration.

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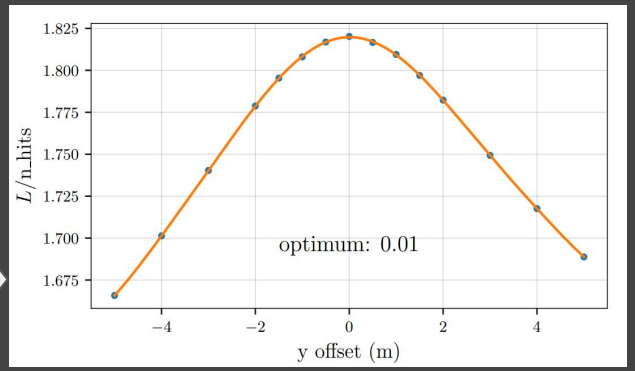
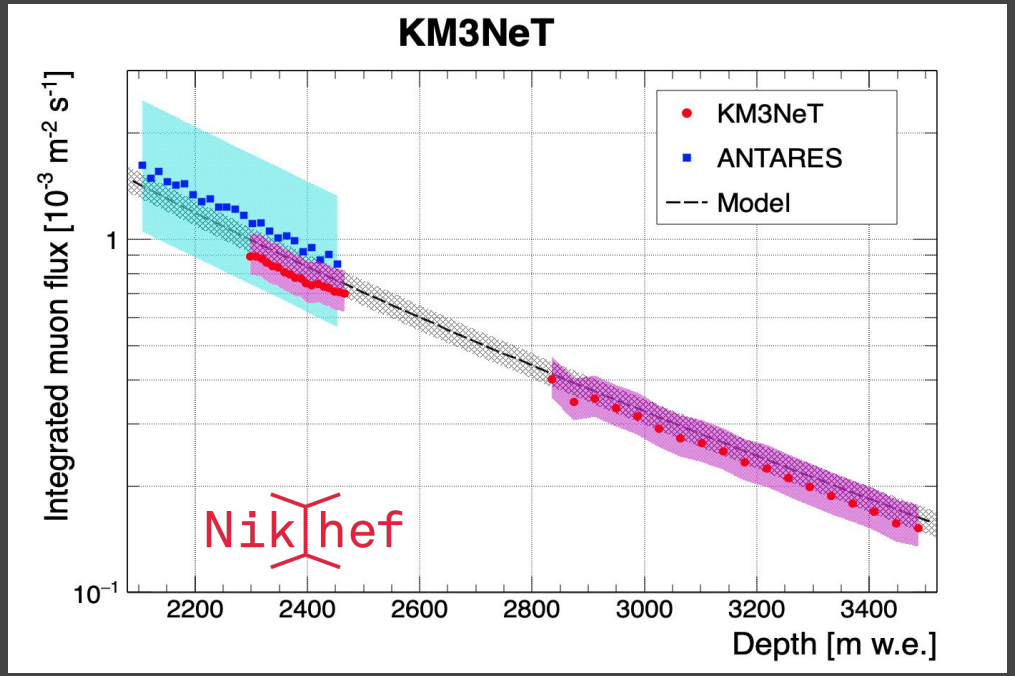


KM3NeT first measurements !

TIER-2



- Coincident hits in 8+ PMTs from the same module, within 15 ns
- Rate translated to flux from MC simulations
- ARCA: 1269 hours , 2 strings
- ORCA: 320 hours , 1 string

arXiv:1906.02704 [physics.ins-det]

THANKS !