Navigating from raw to high-quality data in the KM3NeT experiment: advantages and challenges

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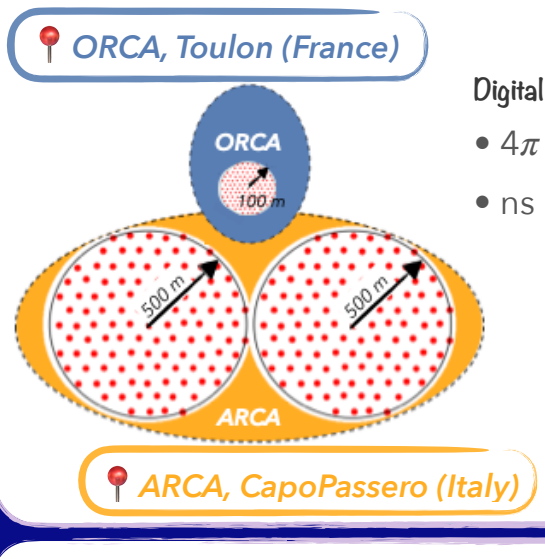
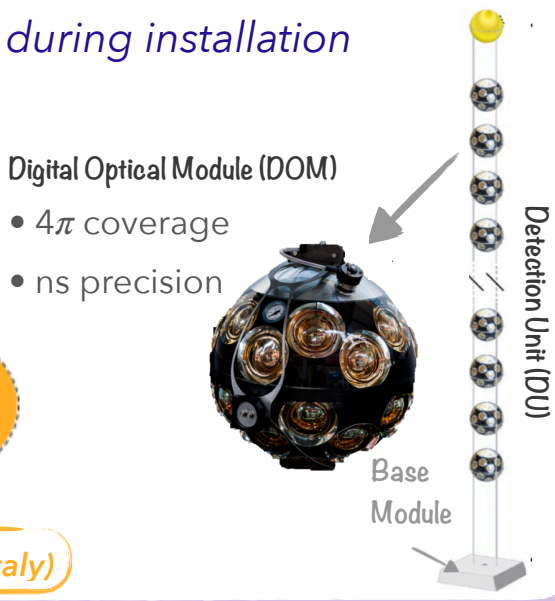
The KM3NeT experiment

- *two detectors, complementary physics [1]:*
  - ❍ ***ORCA*** *for* ***neutrino oscillations*** *at (1, 100) GeV*
  - ❍ ***ARCA*** *for* ***neutrino astronomy*** *at TeV-PeV*
- *ready for physics data during installation*



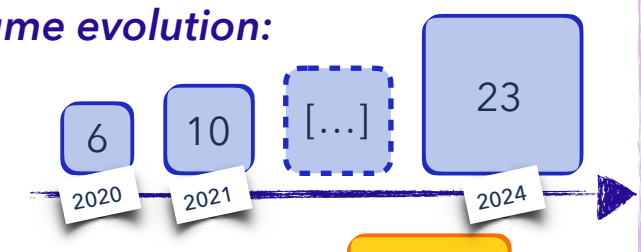


Data taking and calibration

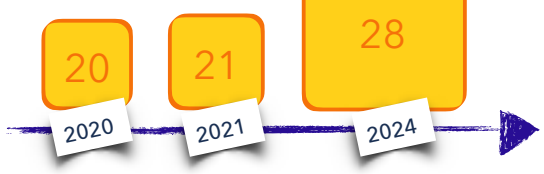
- *a new geometry, for each new set of installed DUs*

Instrumented volume evolution:

- ***ORCA:*** *23 DUs (**20%** of nominal)*



- ***ARCA:*** *28 DUs (**12%** of nominal)*



Calibrating a "moving" detector *[2]:*

- *~ns time accuracy*
- *dynamic DU position and orientation for each geometry (precision at 0.1 m and 2^0 degrees)*

A run-by-run optimization: from simulation to data

Motivation: *time-dependent data-taking conditions (sea-current variation, bioluminescence activity, etc…)*

Run-wise simulation and data-processing *based on Snakemake workflow [3]*

- *each event is simulated with data-driven optimization (trigger rate, PMT mean and RMS rates, etc..)*
- *Monte Carlo simulations:*
  signal: atmospheric and cosmic neutrinos in the GeV-TeV energy scale
  backgrounds: atmospheric muons, optical noise

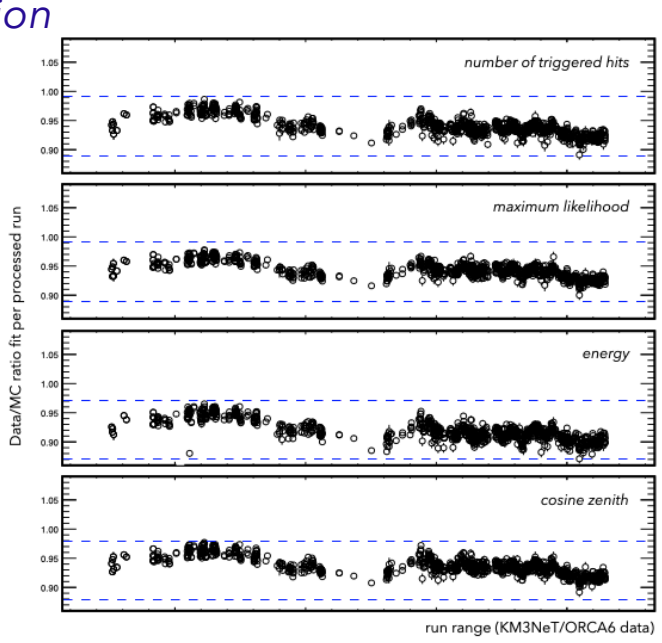
Data / MC

Building a ***common ground-floor for physics studies****:*

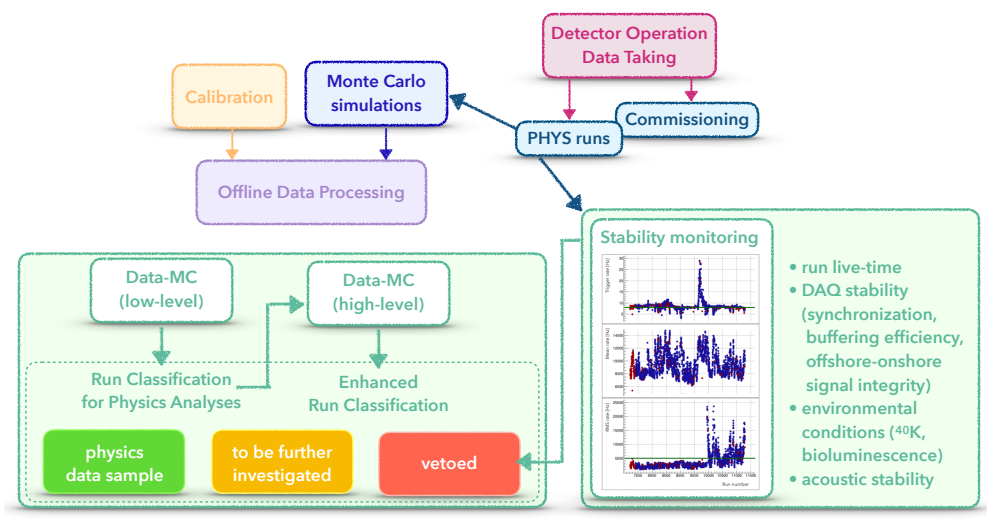
- *exploring different reconstruction variables*
- *same data selection*

Example of data-quality monitoring for KM3NeT/ ORCA (6 operational DUs, 632 days):

- *consistency among considered variable*
- *<10% spread in Data/ MC ratio*



Data Quality workflow



Performance: *11 geometries, 4 computing clusters for* ***97% relative high-quality efficiency***

- *raw-data live-time: 1523 days*
- *processed data: 1417 days*
- *high-quality data: 1363 days*

References

[1] KM3NeT Collaboration, J. Phys. G 43 (2016) 084001
[2] L. Bailly-Salins, PoS (ICRC2023) 218
[3] https://snakemake.github.io/