Data management and data usage in KM3NeT

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KM3NeT: High-energy neutrino research

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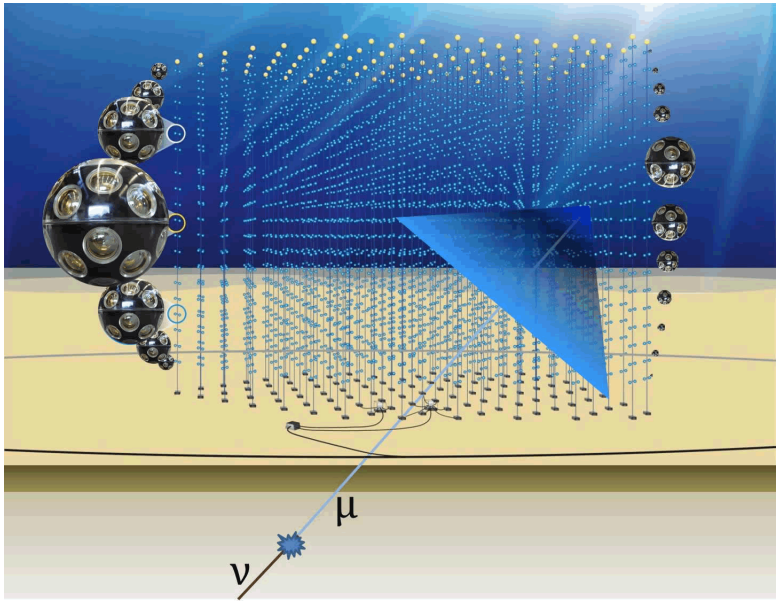
KM3NeT scientific target

Main target: cosmic neutrinos in TeV range and above (ARCA)

- point-source identification through Cherenkov radiation of $\nu_{\mu CC}$
- wider neutrino physics with atmospheric neutrinos (ORCA)
- add-on: acoustic neutrino detection, sea science
- main data format: event-based (describing single ν, μ)

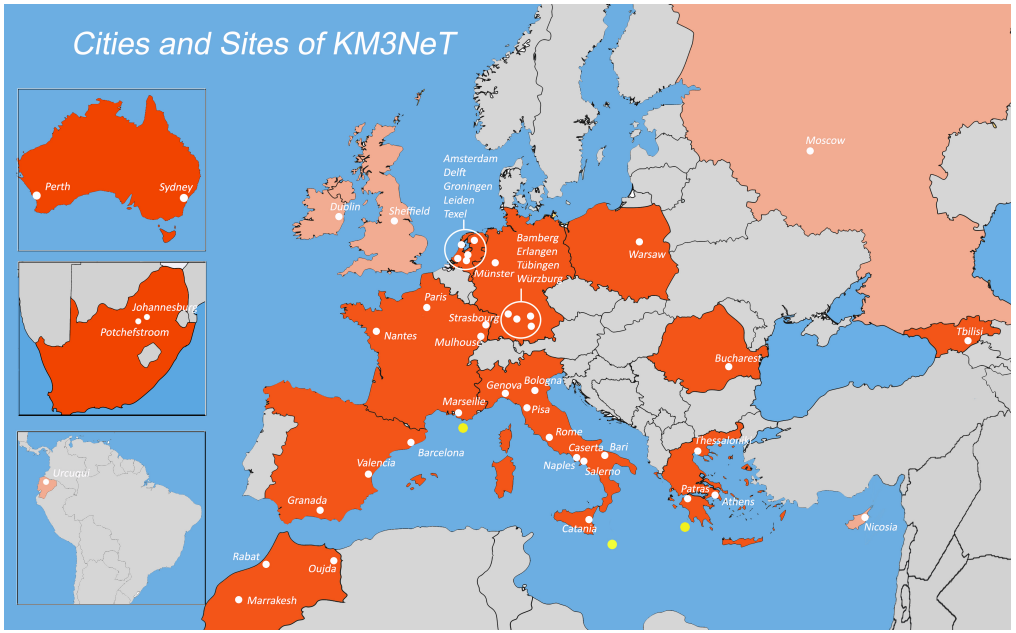


KM3NeT - Under construction

Detector construction

- Multi-PMT modules:
  31 3”-PMTs in one sphere)
- 18 modules per
  string (Detection Units, DUs)
- Building
  blocks of 115 Detection Units

	ARCA	ORCA
planned DUs		2×115
current DUs	1	2
funded	24	6
DU distance	90 m	20 m
DOM spacing	36 m	9 m
instrumented mass	$2 \times$ 500Mton	5.7Mton



KM3NeT 2.0 Letter of Intent: arXiv: 1601.07459

Data management in KM3NeT

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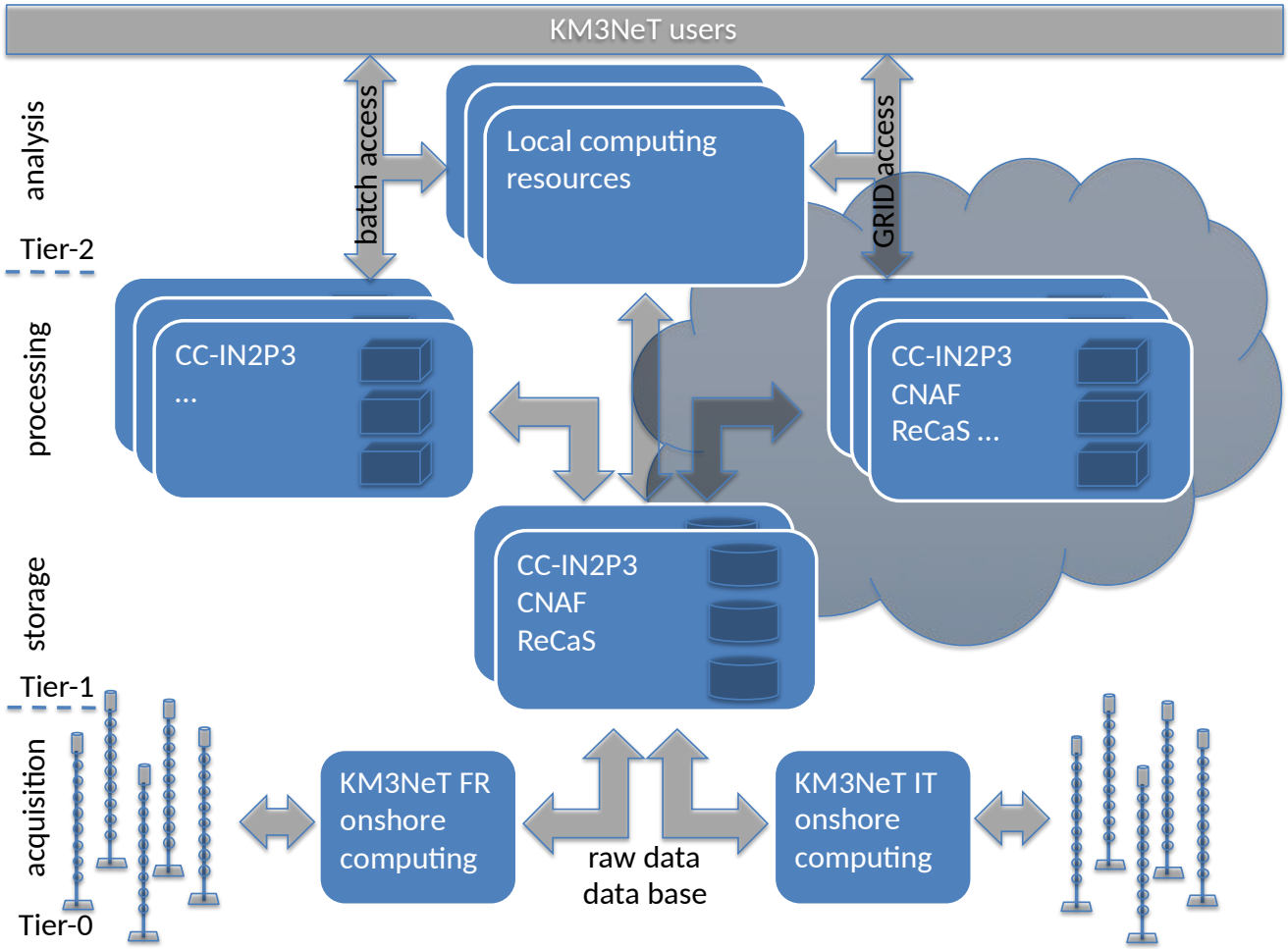
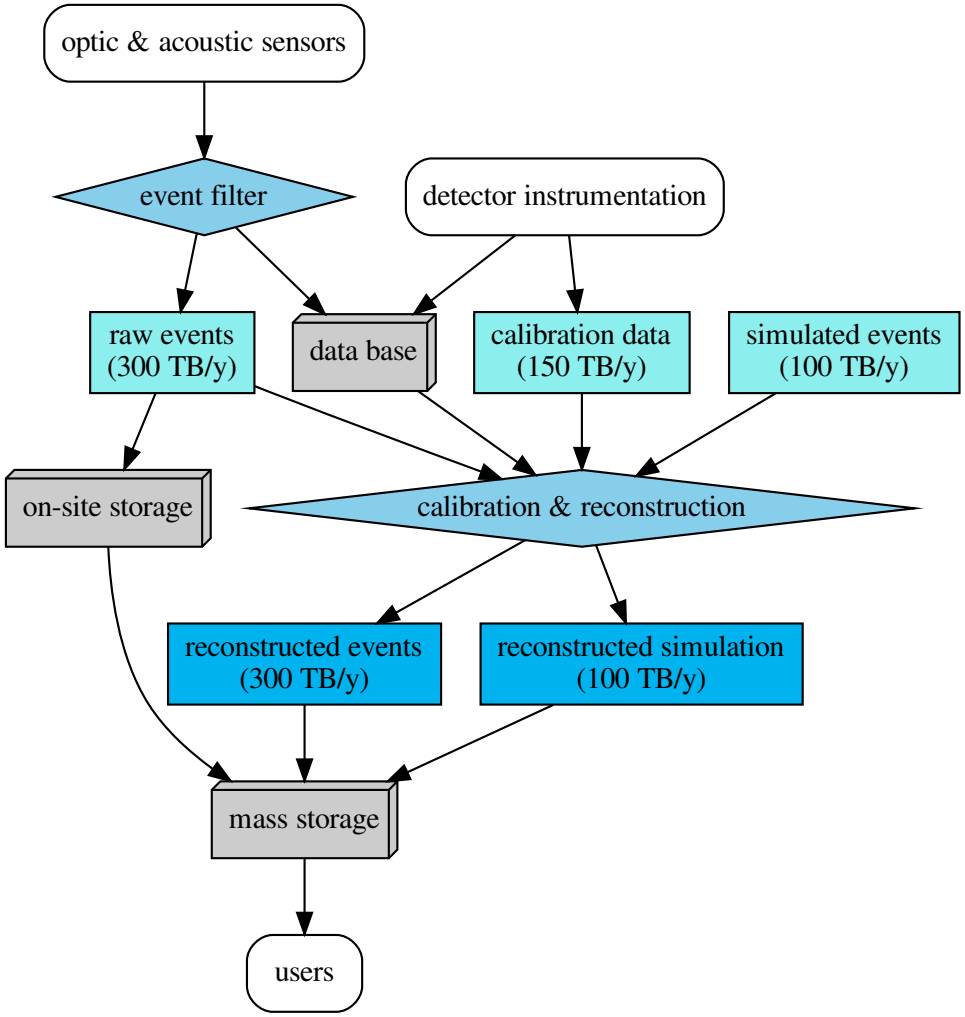
Data processing levels: Tier approach



Data flows


optic & acoustic sensors
event filter
detector instrumentation
raw events
(300 TB/y)
data base
calibration data
(150 TB/y)
simulated events
(100 TB/y)
on-site storage
calibration & reconstruction
reconstructed events
(300 TB/y)
reconstructed simulation
(100 TB/y)
mass storage
users

Storage/Processing demands for 1 BB - preliminary

processing block	size per proc. (TB)	time per proc. (HS06.h)	size per year (TB)	time per year (HS06.h)	periodicity (p.a.)
Raw data					
Raw filtered data	300		300		1
Monitoring Data	150		150		1
Experimental Data Processing					
Calibrated Data (temp.)	*750*	24M	1500	48M	2
reconstructed data	150	119M	300	238M	2
DST	75	30M	150	60M	2
Simulation					
air showers	100	14M	50	7M	0.5
atm. muons	50	1M	25	638k	0.5
neutrinos	2	22k	20	220k	10
total	**827**	**188 M**	**995**	**354 M**	

KM3NeT event format, storage and access

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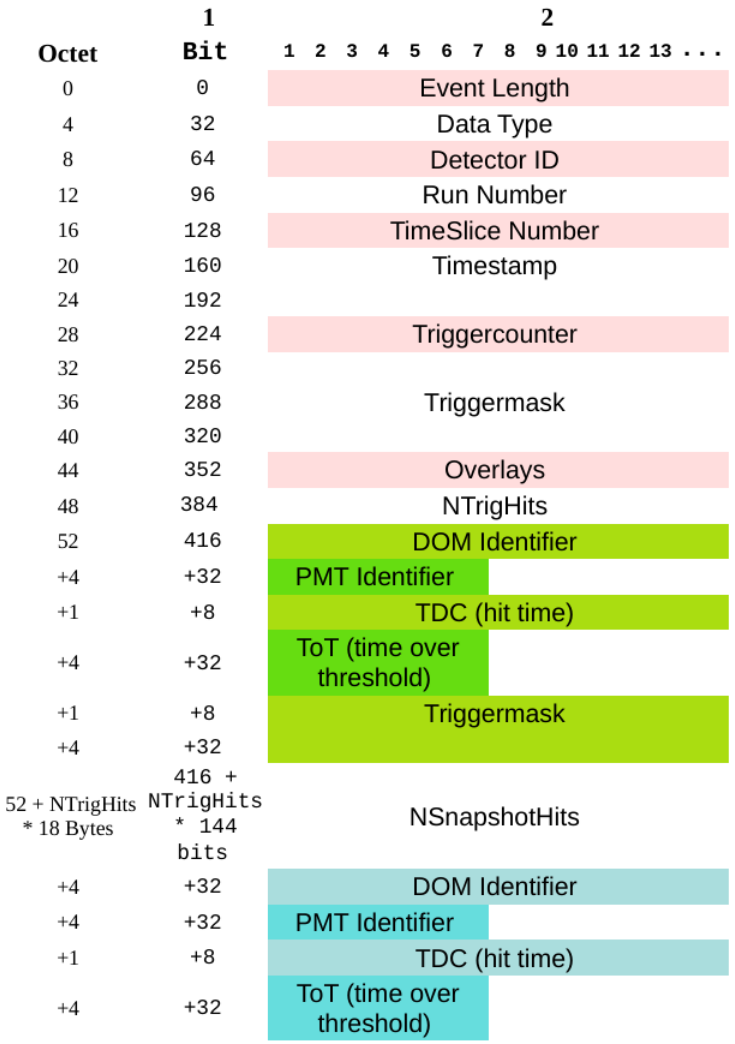
Event raw data format

- **Frames**: All information from detector
- photomultipliers, acoustic
- monitoring, slow control
- **Timeslice**: common header + frames
- Filtering: **JDAQEvent** (ROOT)
- JDAQSummaryslice (monitoring)

Implemented in JPP software package, available via ASTERICS/OBELICS catalogue of software



Storage and processing

- CC Lyon (+CNAF) for main storage and processing
- Using SPS, HPSS for mass storage (iRODS access, xrd, gridftp access)
- Grid-facilites (INFN, ReCaS)
- further resources available (e.g. CIŚ Poland)
- various final storage formats (ROOT, HDF5), conversions to other formats possible

Current storage/processing only small fraction of final requirements!

Event processing and software

main frameworks

- Jpp for Tier 0/1 usage (C++)
- AANeT and KM3Pipe for Tier 1/2 usage (python/C++)
- applicable to both events and simulation

$\rightarrow$ all maintained and developed on KM3NeT GitLab

$\rightarrow$ complete CI/CD chain with docker and singularity containers available

KM3NeT standard user

Current access

- Authentification to common services (mostly documentation, full software, database) through Google account (GitLab, Wiki, Internal Notes)
- Access to data through CCLyon login

$\rightarrow$ currently full access for collaboration members to all stages of data processing (development stage)

Future goal

- Access to full sets of processed (reconstructed) simulation and events, database (detector condition)
- Full access for developers, detector maintainance

Plans and outlook

Access for external users

- so far: public software, publications on construction
- pipeline tested for a VO server hosting GAVO software

Metadata and access

- CWL implementation testing
- Modelling of data management with computer science at FAU
- open data access modell and embargo period under discussion

Useful documents

- KM3NeT Homepage: www.km3net.org
- KM3NeT Data Management Plan: available *on Homepage*

Thank you for your attention!
Questions?

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