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Italiadomani
PIANO NAZIONALE
DI RIPRESA E RESILIENZA

KM3NeT @ Rome

Irene Di Palma & Carlo Nicolau
on behalf of the group



SAPIENZA
UNIVERSITÀ DI ROMA

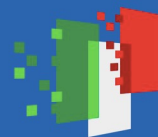




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**Massimo
Mastrodicasa**
RTDA
Co-fund Sapienza

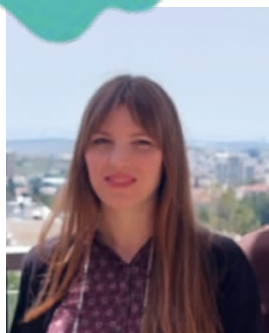


Silvia Celli
RTT

**Multimessenger
and Online
activities**



**Alessandro
Ventro**
PhD



Silvia Gagliardini
PhD in Cotutela



Prof. Antonio Capone



Prof. Irene Di Palma



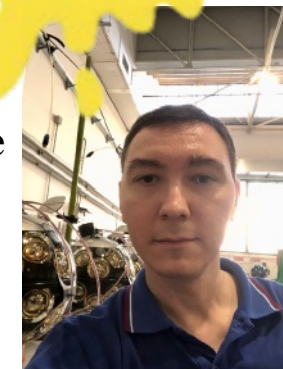
Fabrizio Ameli
Primo tecnologo

**Electronics
and Power**



Carlo A. Nicolau
Tecnologo

Alexandru Tudorache
CTER elettronico

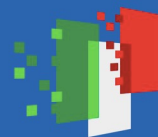




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WP7



Massimo Mastrodicasa
RTDA
Co-fund Sapienza



Silvia Celli
RTT

From KM3NeT4RR 2 units of personnel

Prof. Irene Di Palma



Prof. Antonio Capone



Fabrizio Ameli
Primo tecnologo



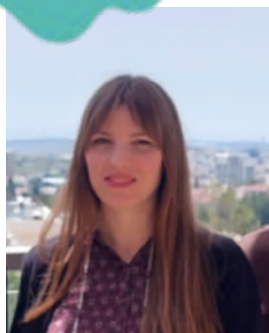
Carlo A. Nicolau
Tecnologo

**Multimessenger
and Online
activities**

**Electronics
and Power**



Alessandro Ventro
PhD



Silvia Gagliardini
PhD in Cotutela

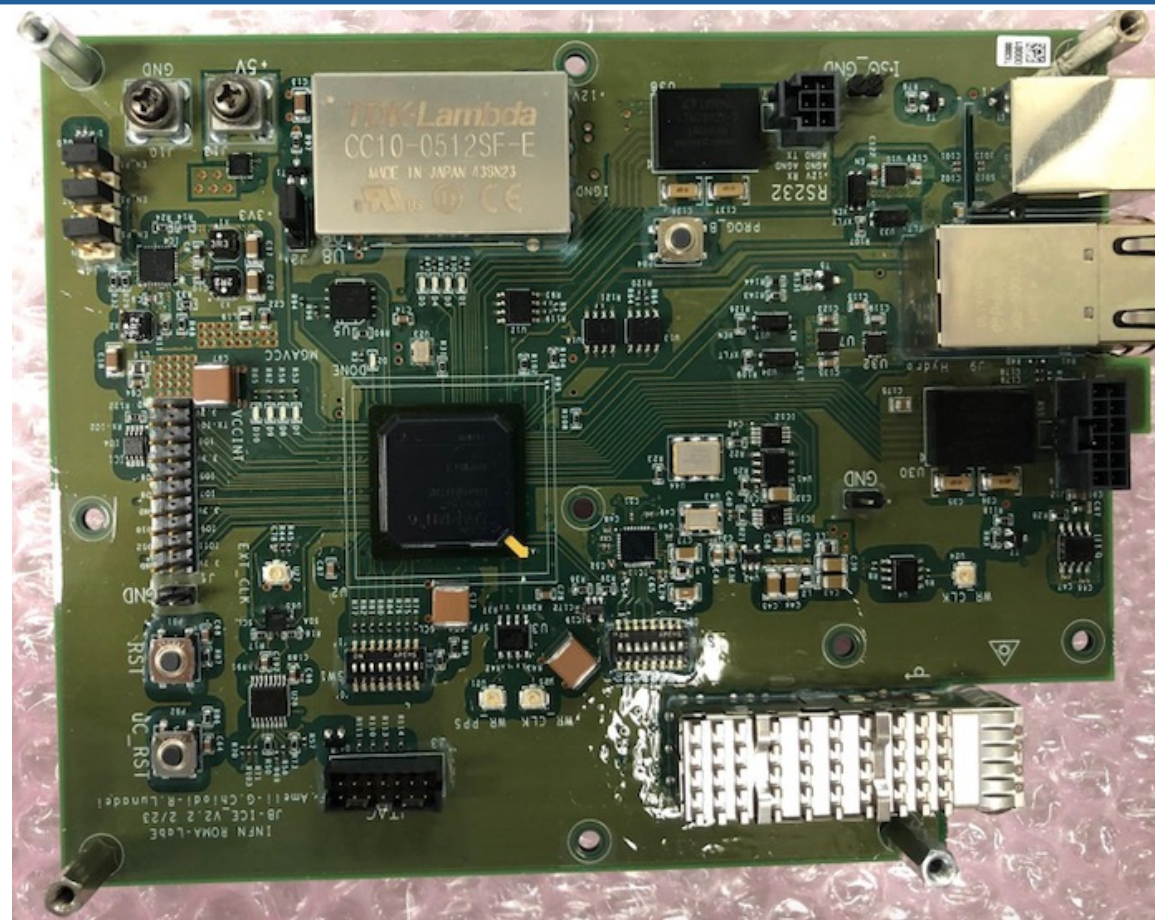
Alexandru Tudorache
CTER elettronico

WP2 & WP5



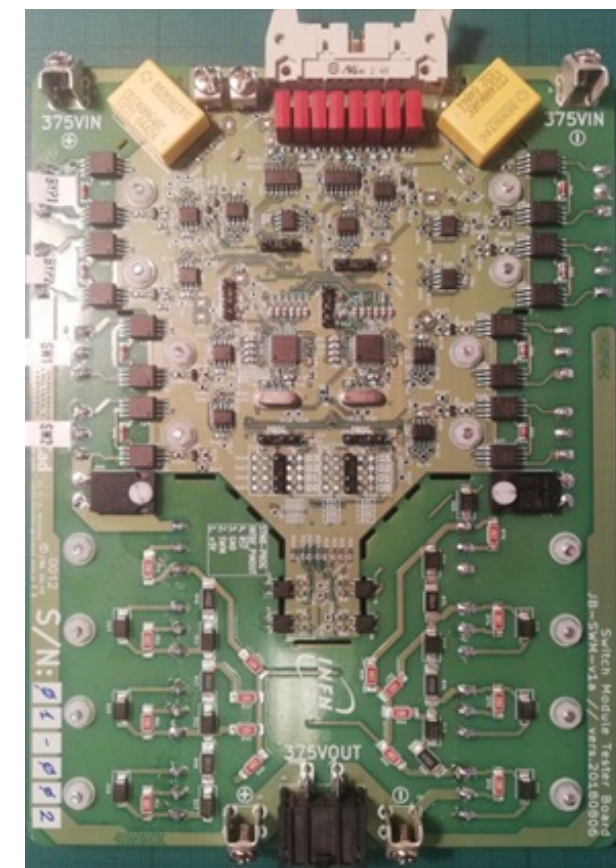
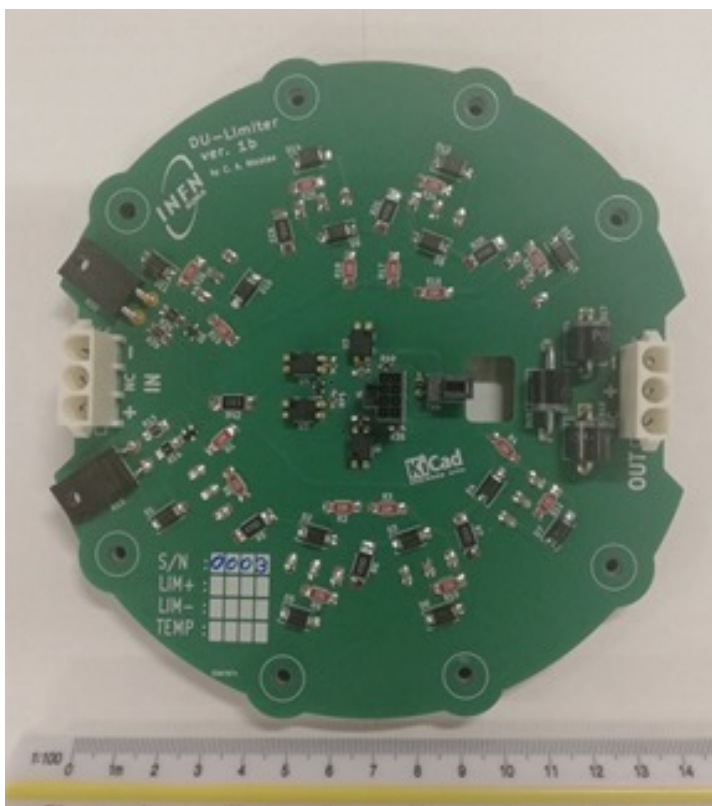
Main activities of the RM1 electronics laboratory

Design, characterisation and test of the Instrumentation Control Electronics (ICE) board, located in the Junction Box. The ICE drives an Acoustic Beacon, and a Laser Beacon and receives data from a Hydrophone, synchronizing the 3 instruments to the detector timing distribution, through a White Rabbit link.



Main activities of the RM1 electronics laboratory

Design, characterisation and test of the power distribution and protection electronics for the junction box and protection electronics for the DU-base; design and implementation of the power electronics slow-control firmware (junction box and DU-base). Active continue contribution to the integration activities.



Integration activities of the group in Caserta

- No DU integration laboratory in Roma
- We profit from the Lab. and infrastructure provided by Caserta site
- So far two technicians (Antonio Girardi and Riccardo Lunadei) participated to the DU-phase1 integration
- One technician (Alexandru Tudorache) hired recently within PNRR funding joined the DU integration team
- Ready for other lines and/or new integration phases





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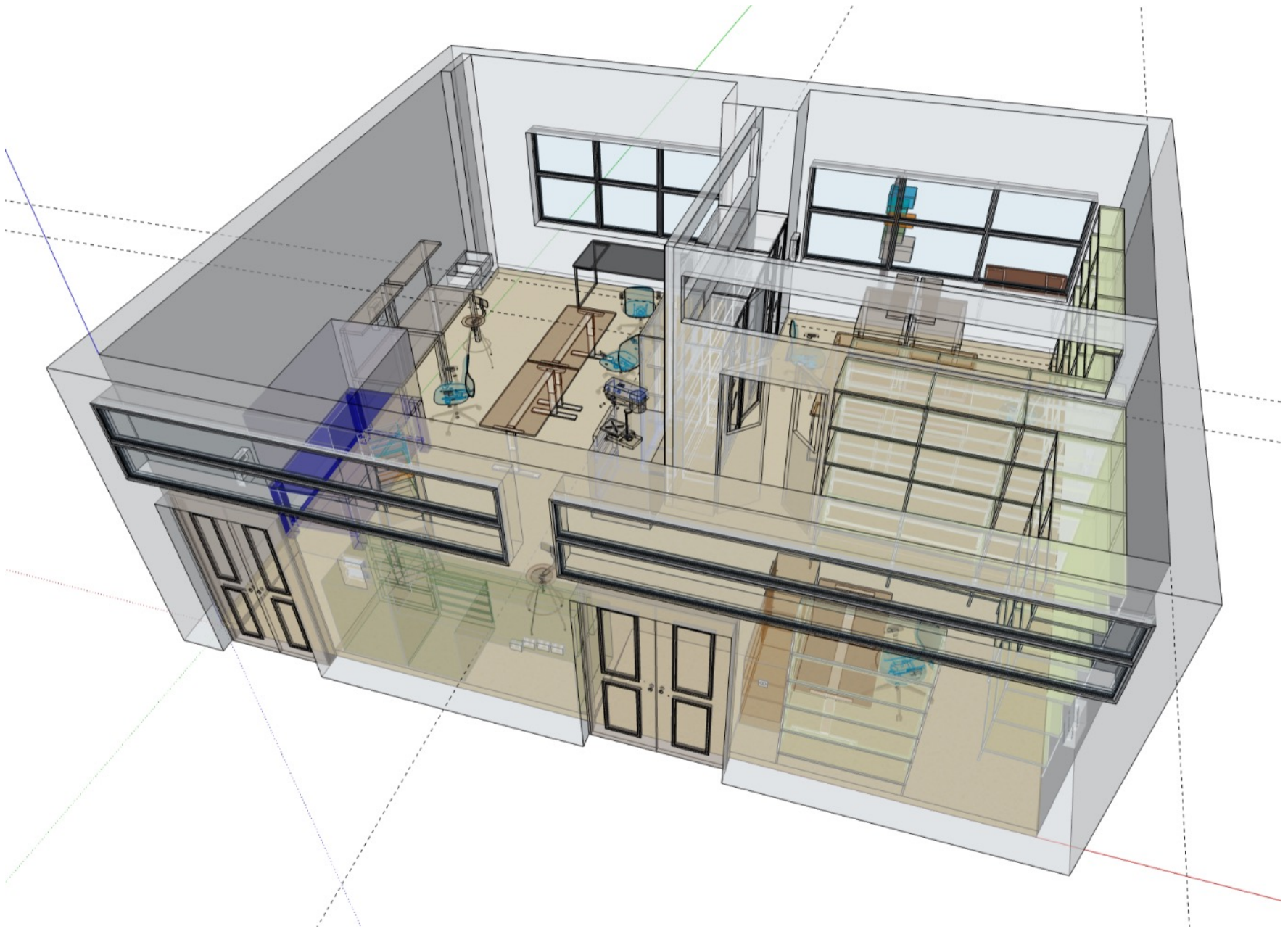


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Panoramic view of the laboratory before the upgrade



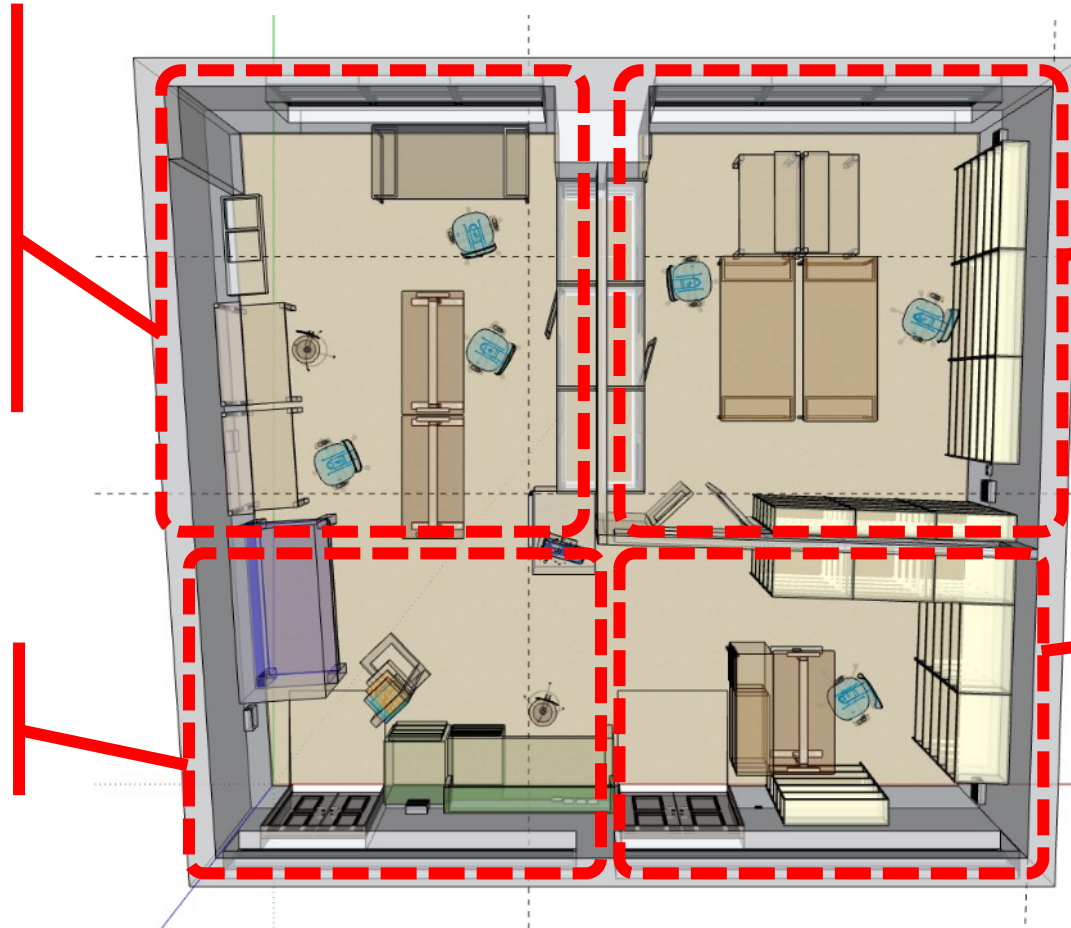




Preliminary reorganisation of space

Area mainly dedicated to testing and characterization activities for **high-speed electronics** (based on the White Rabbit protocol) and the development of future versions (10Gb White Rabbit), as well as a **workstation for the technician** hired with PNRR funding.

Area mainly dedicated to the rework and debugging of electronic boards.



Area mainly dedicated to testing, characterization, and hardware, embedded-software, and software development activities mainly related to **power electronics**.

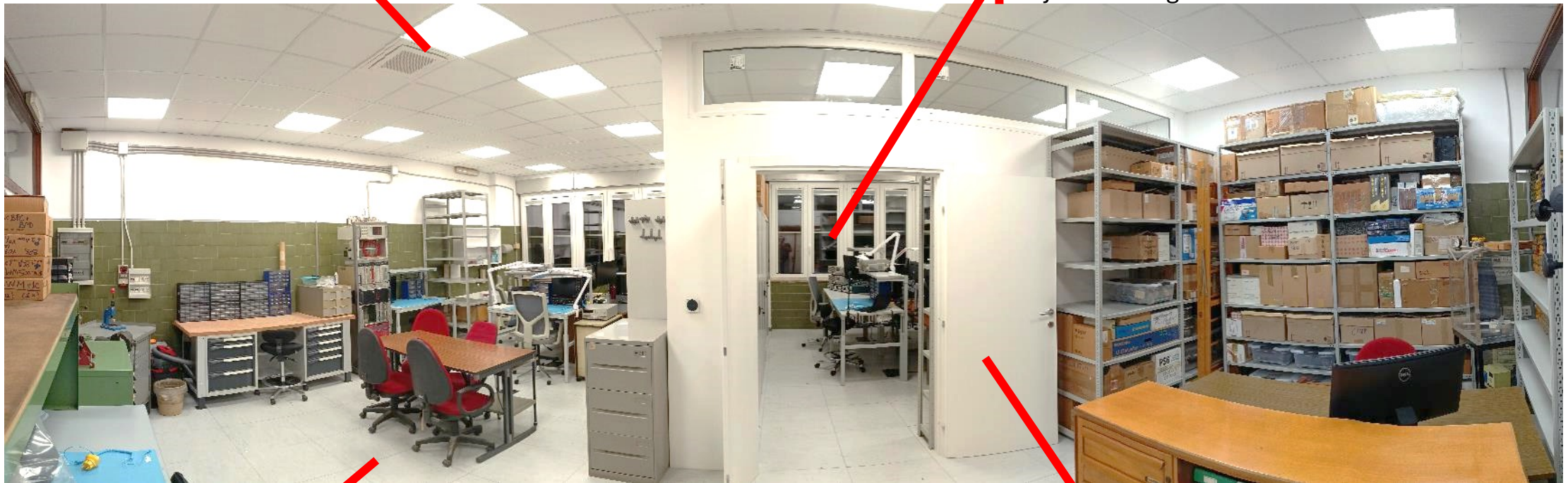
Area dedicated to **storage**, with an additional workspace.



Panoramic view of the new laboratory

False ceiling with heat pump conditioning and LED lightning.

Secondary glazing installed as an additional window layer to improve the thermal performance of a space by enhancing insulation.



Floating floor.

Dedicated area for power electronics.



Power electronics workbench

- Programmable electronic DC-loads to simulate variable loads such as Detection Unit, Junction Boxes, ... in nominal and non-nominal operating conditions
- Programmable high-voltage power supply units

Not shown in this picture:

- Multichannel programmable PC oscilloscope
- Differential voltage probes
- Current clamps
- Multi-point temperature monitoring system



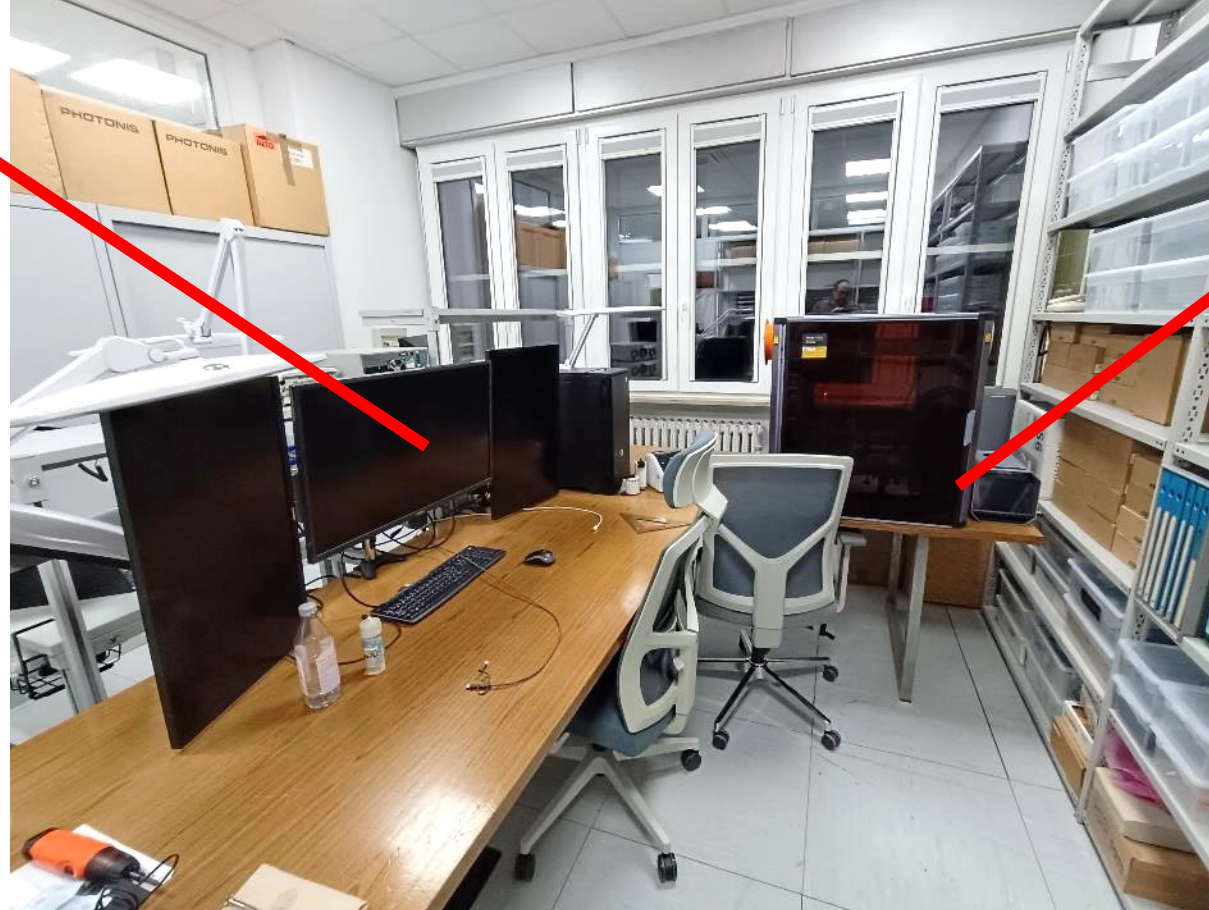
Standard workbench equipment
(low voltage multi-channel
programmable power supply
unit, programmable multimeter)

Laptop mainly dedicated to
controlling the instrumentation
and executing automated test
procedures



Firmware development, electronic design, mechanical prototyping workbench

- Workstation for embedded-software and software development, electronics design, mechanical prototype design
- Label printing system



Multifunctional mechanical prototype system: dual nozzle filament deposition modeling printer, numerically controlled mini-milling machine, laser engraver.

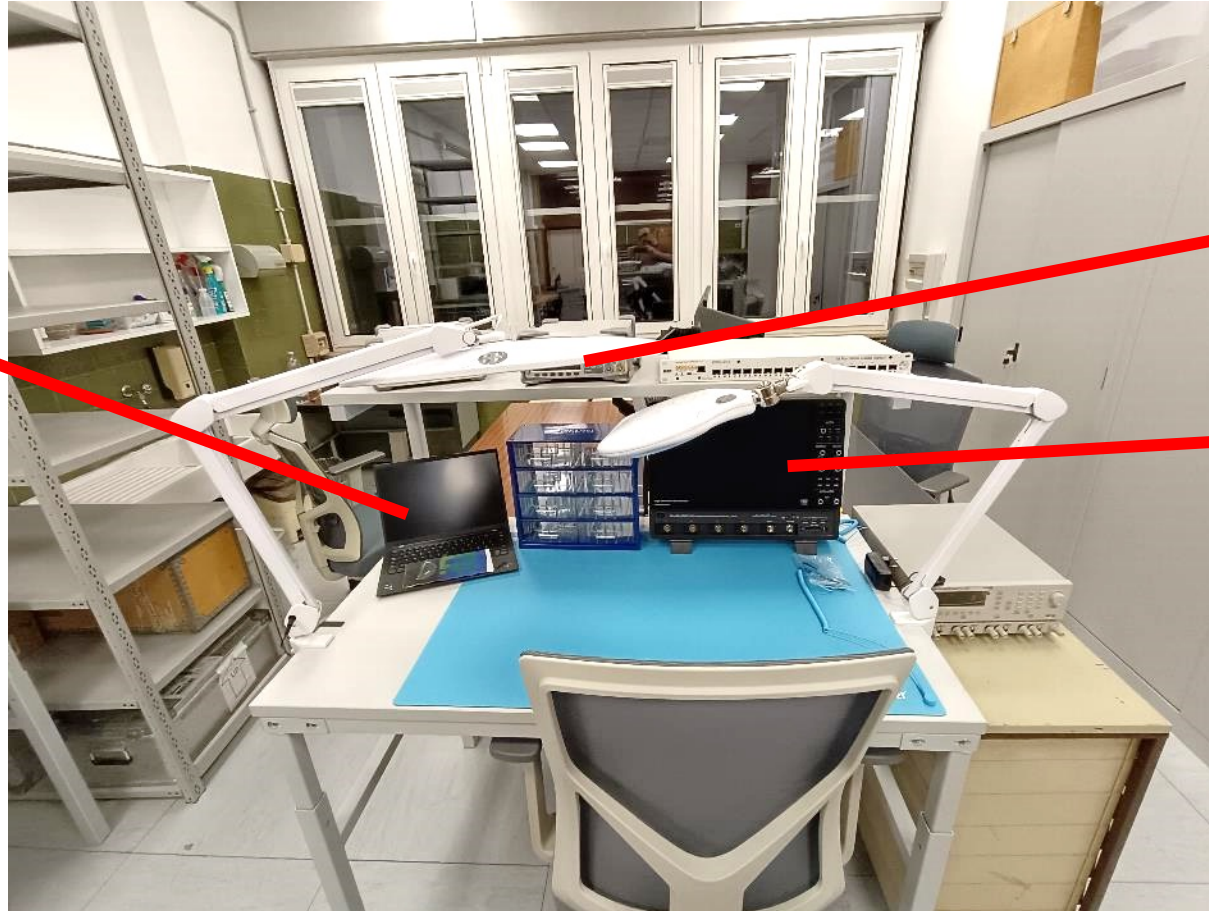
Not shown in this picture:

- Resin 3D printer (for higher temperature resistant prints)



Fast-signal electronics workbench

Laptop mainly dedicated to controlling the instrumentation, data acquisition, and executing automated test procedures



Standard workbench equipment (low voltage multi-channel programmable power supply unit, programmable multimeter, programmable signal generator)

High-end, high speed, mixed signal multichannel oscilloscope

Not shown in this picture:

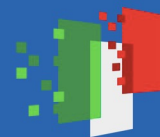
- Vector Network Analyzer



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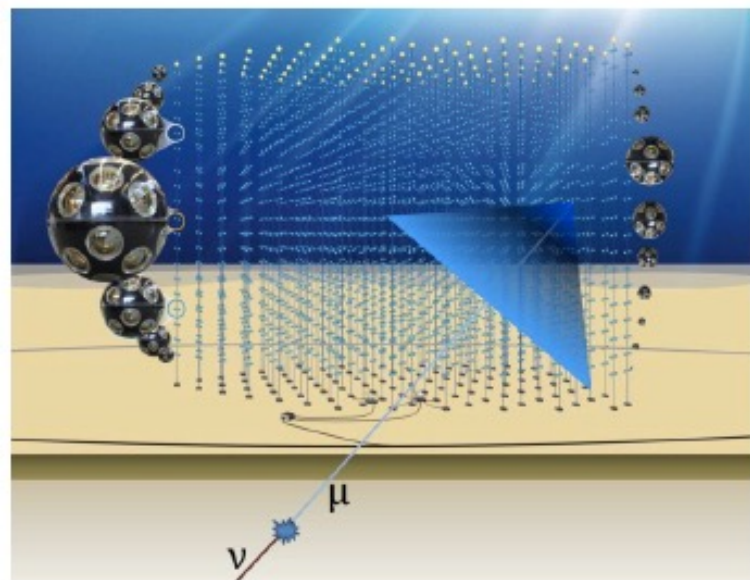


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KM3NeT Real Time Analysis System

KM3NeT ARCA and ORCA



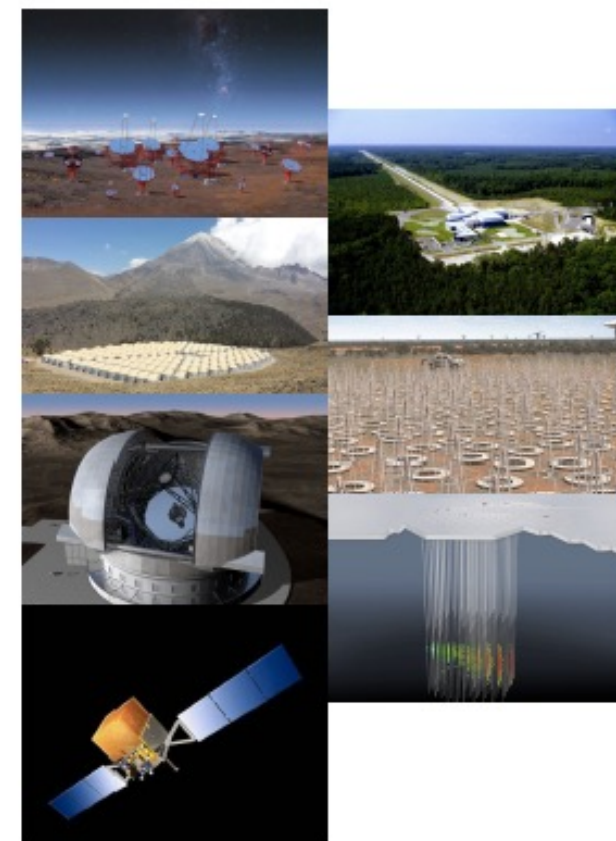
Follow-up of external alerts received from the multi-messenger community and search for spatial and temporal coincidences

LOADING...

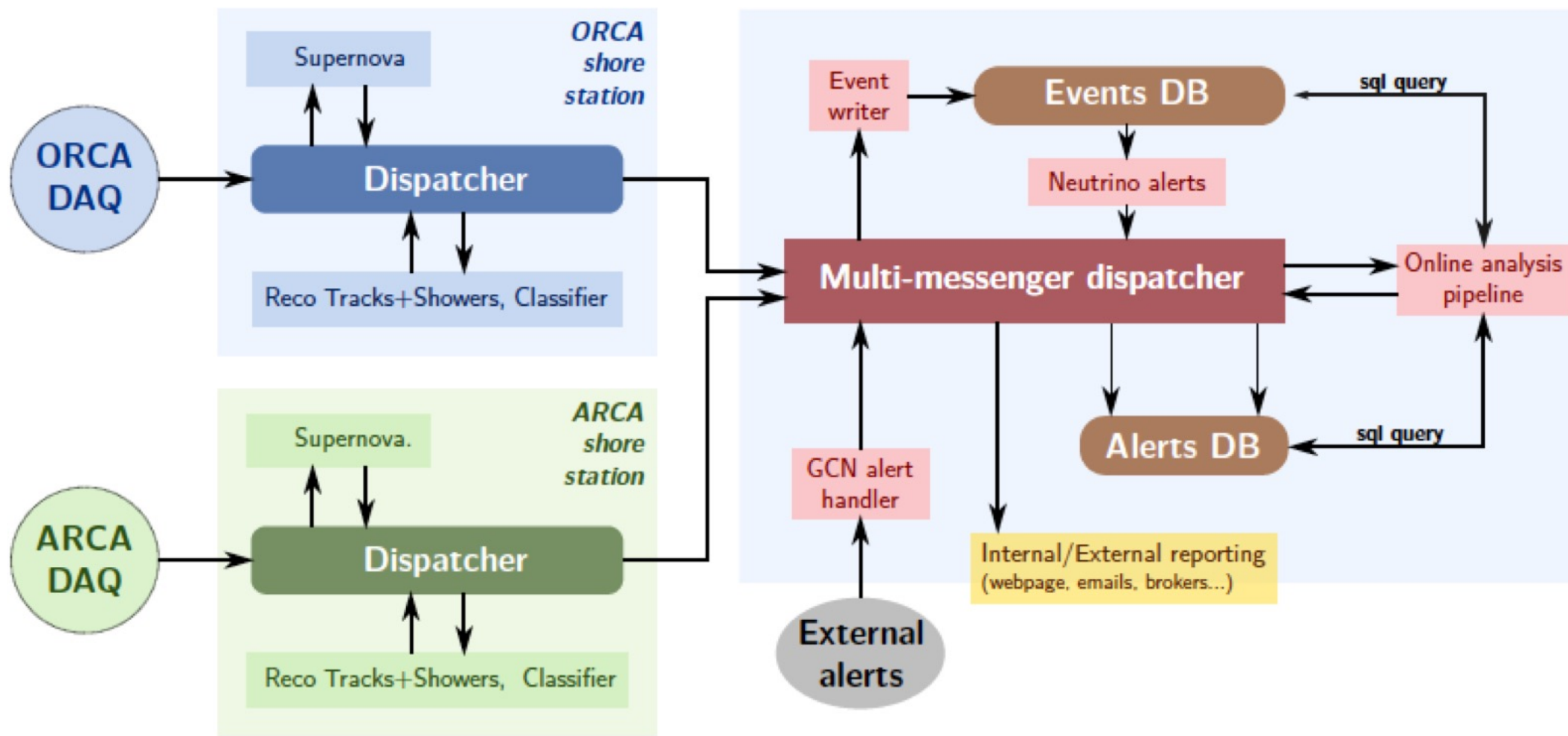


Sending of alerts when potentially interesting events are detected to trigger follow-ups

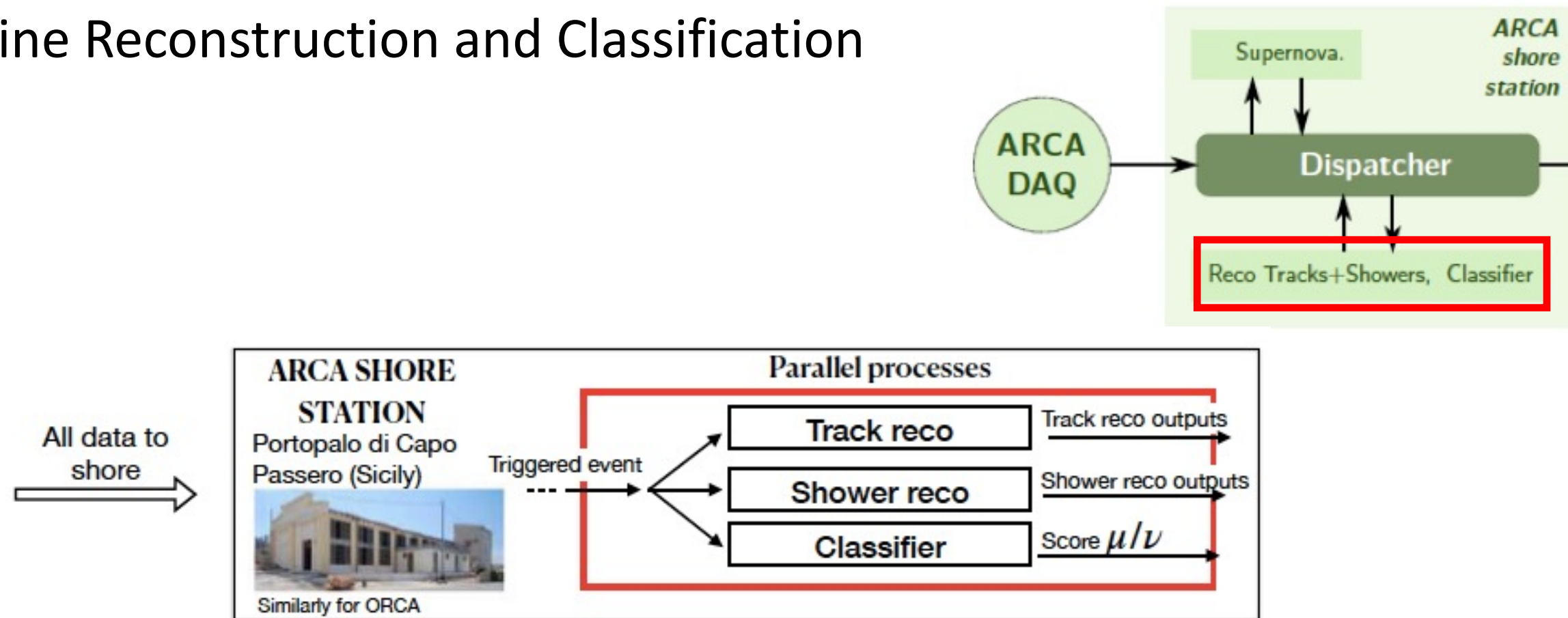
Multi-messenger community



KM3NeT Real Time Analysis System

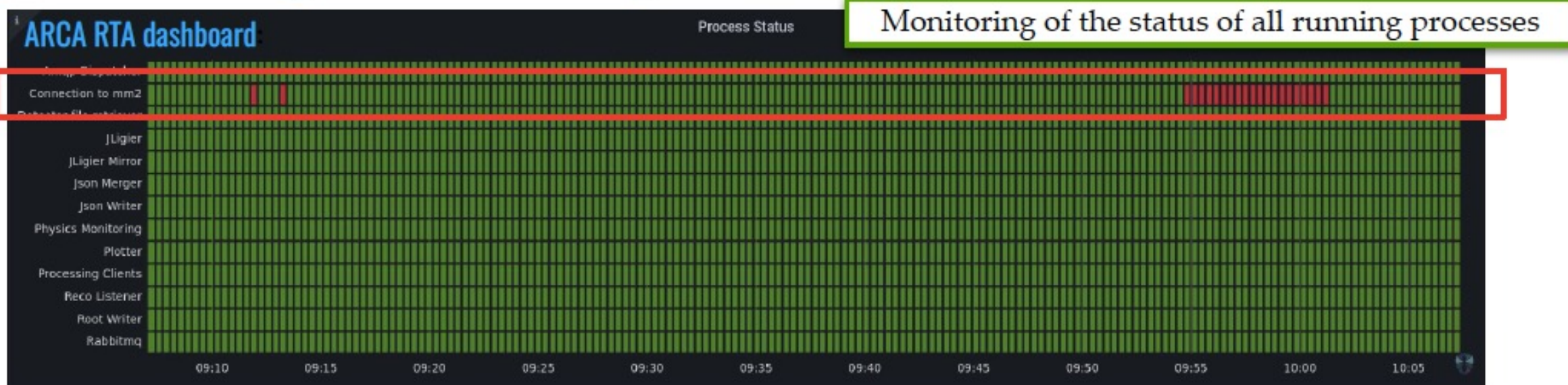


Online Reconstruction and Classification



Real Time Analysis Dashboard

RTA dashboard provides an overview of running processes, Rabbit-MQ, resource usage etc.
ARCA (ORCA) dashboards available at <https://antorcamm2.in2p3.fr:3001/dashboards>
(<http://antorcamm2.in2p3.fr:3000/dashboards>)





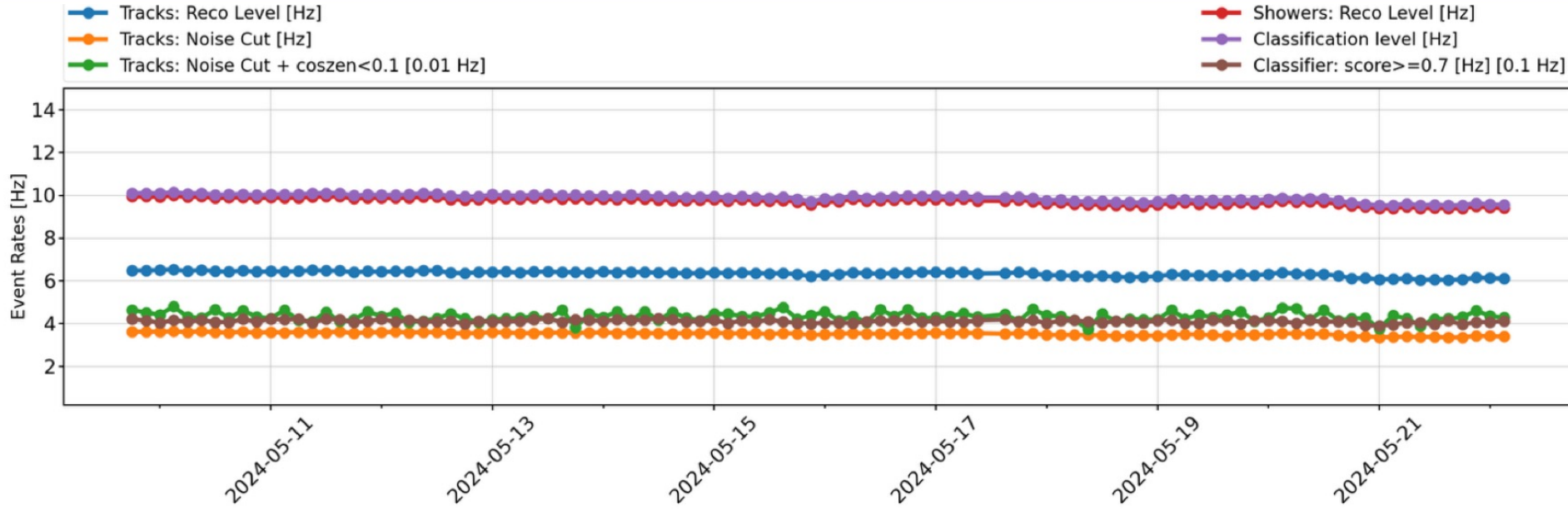
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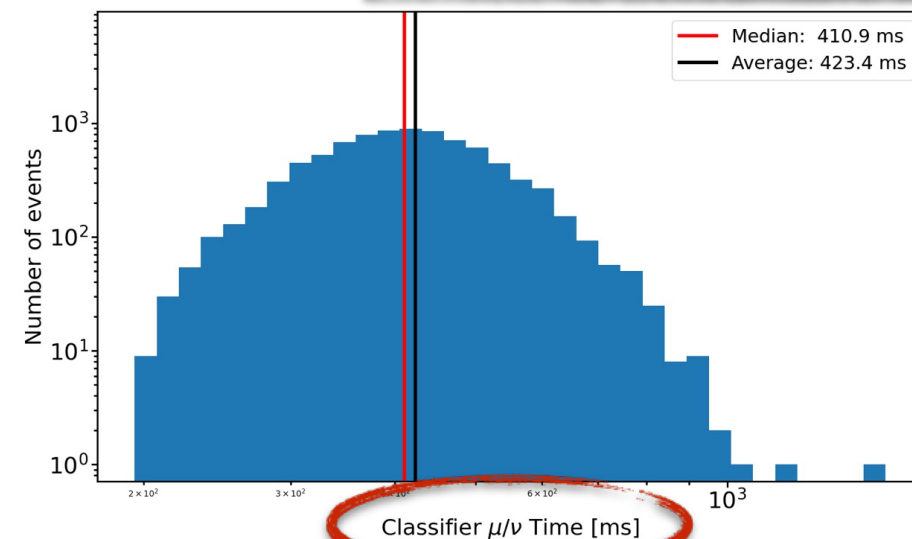
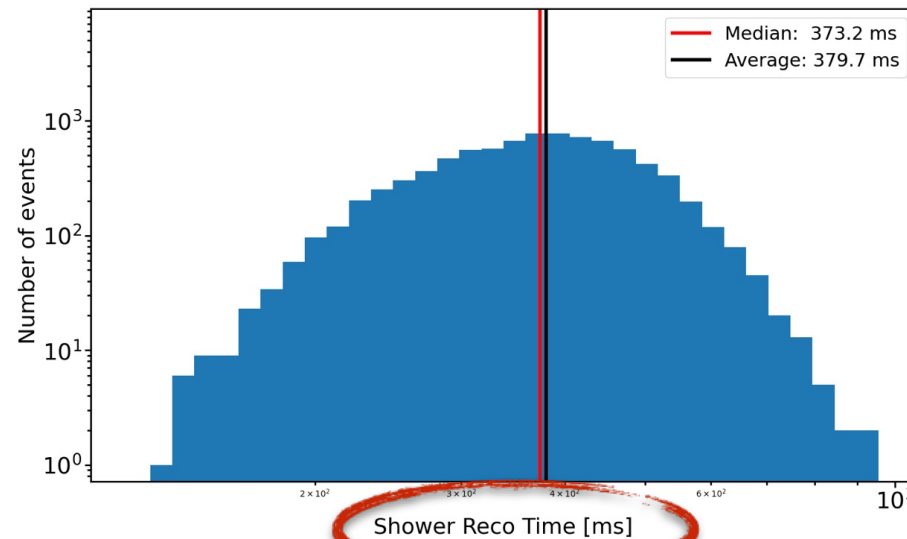
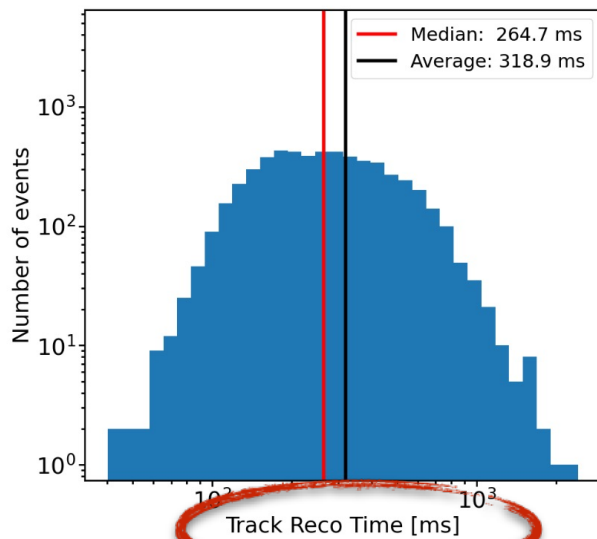
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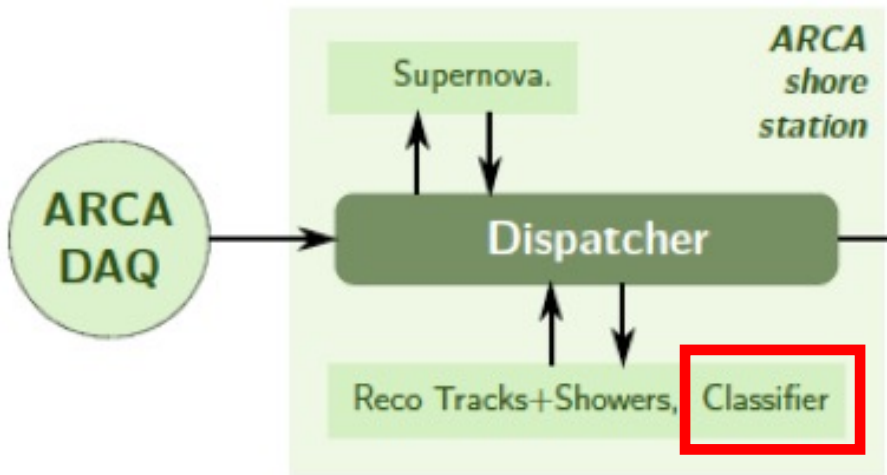


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**+ distribution & analysis time →
KM3NeT can provide
neutrino candidates
within ~10 seconds!**



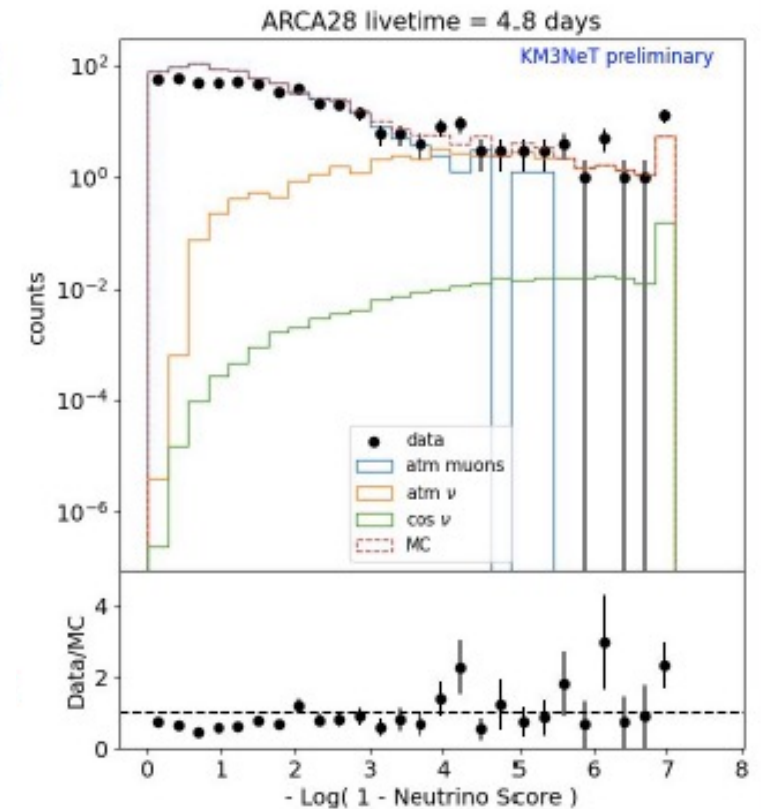


Graph Neural Network (GNN) classifier

Score μ/ν between 0 and 1 to separate neutrinos from the atmospheric muon background



No reconstruction output as input



KM3NeT Real Time Follow-Up of external triggers

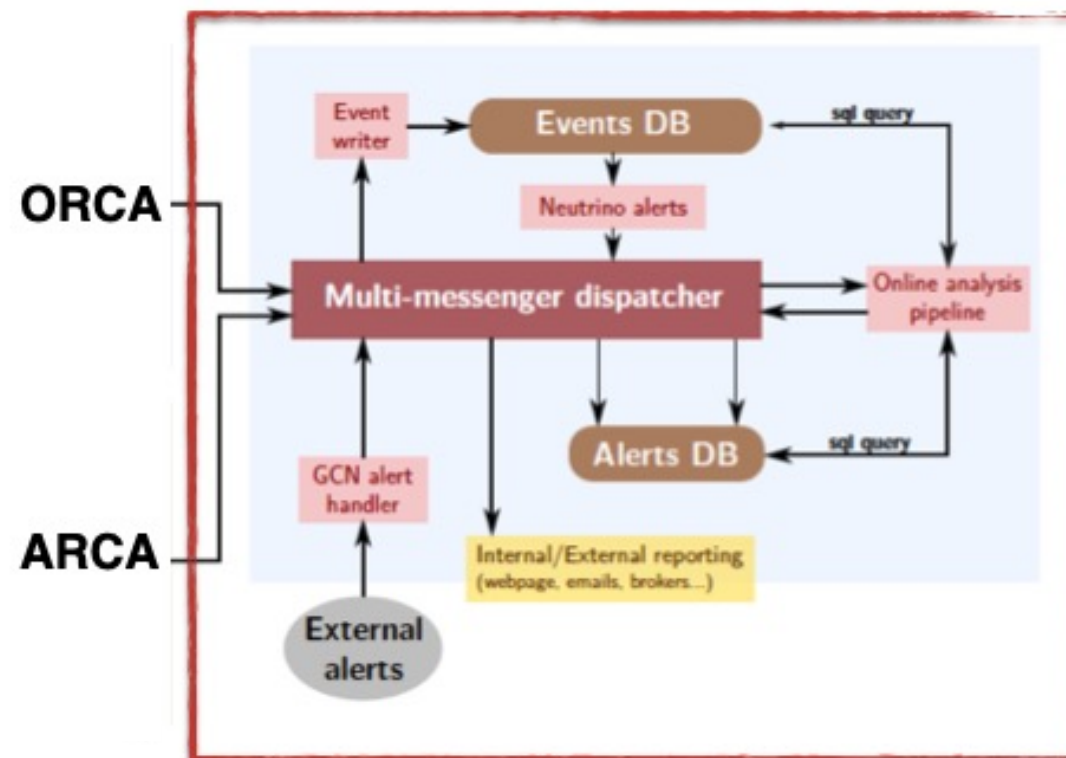
tag ↑	scheduled	launched	exec_time_s	max_vms_MB	max_rss_MB
ARCA_GRB_755576606_1	2024-12-11 03:25:21.87 +0000 ...	2024-12-11 03:25:41.323 +000...	591	4261	647
ARCA_GW_S241210cw_1	2024-12-10 11:54:06.849 +000...	2024-12-10 11:54:17.983 +000...	2865	6791	4533
ARCA_GW_S241210fu_0	2024-12-10 12:11:06.64 +0000 ...	2024-12-10 12:11:19.694 +0000...	1634	6800	4537
ARCA_GW_S241210fu_1	2024-12-10 17:57:00.64 +0000 ...	2024-12-10 17:57:50.3 +0000 ...	1190	6825	4566
MeV_CCSN_1000494_0	2024-12-10 17:02:03 +0000 UTC	2024-12-10 17:02:45.385 +000...	20.4	2642	323

Binned ON/OFF analysis method:

- background estimation
- cut optimization
- flux limit computation

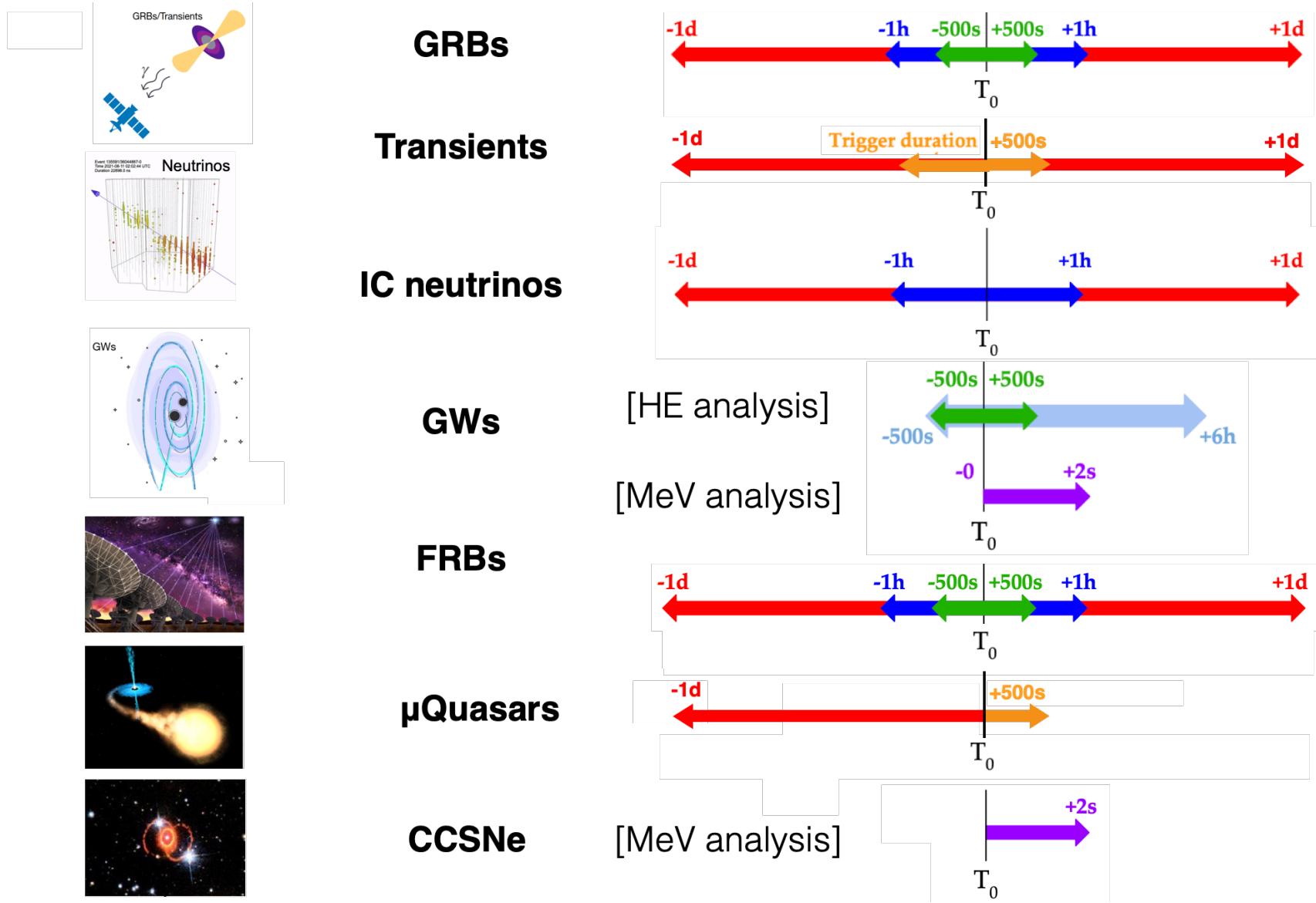
Pipelines currently in place:

- Gamma Ray Bursts (GRBs)
- High-energy transients
- IceCube (IC) neutrinos
- Gravitational Waves (GWs)
- Fast Radio Bursts (FRBs)
- μ Quasars
- Core Collapse Supernovae (CCSNe)



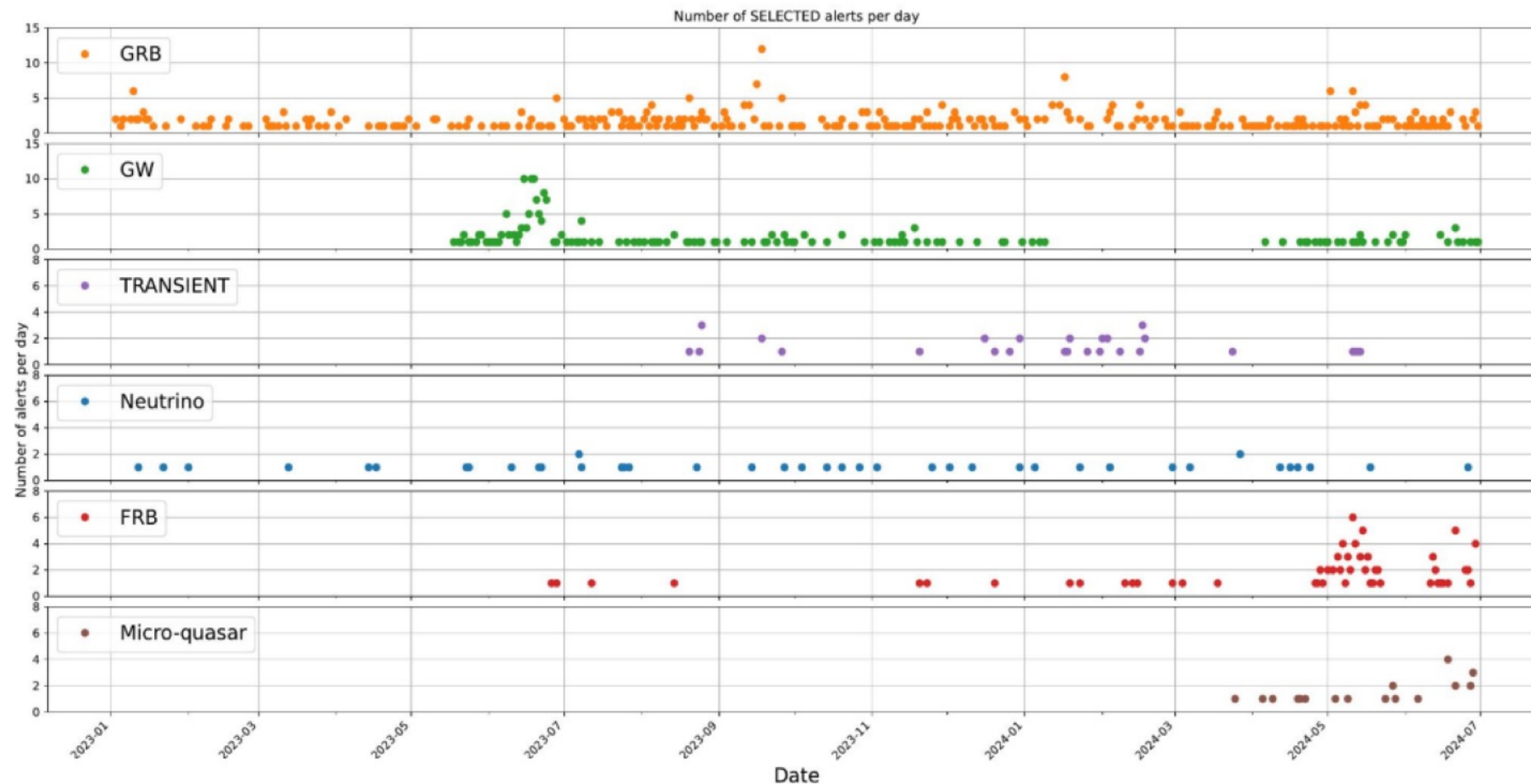


Temporal windows for real time follow-ups





Selected alerts



GRBs	~1 per day
IC neutrinos	~1 per 2 weeks
GWs	~1 per 2 days
Transients	~1 per week
FRBs	~1 per 3 days
μ Quasars	~1 per 3 days



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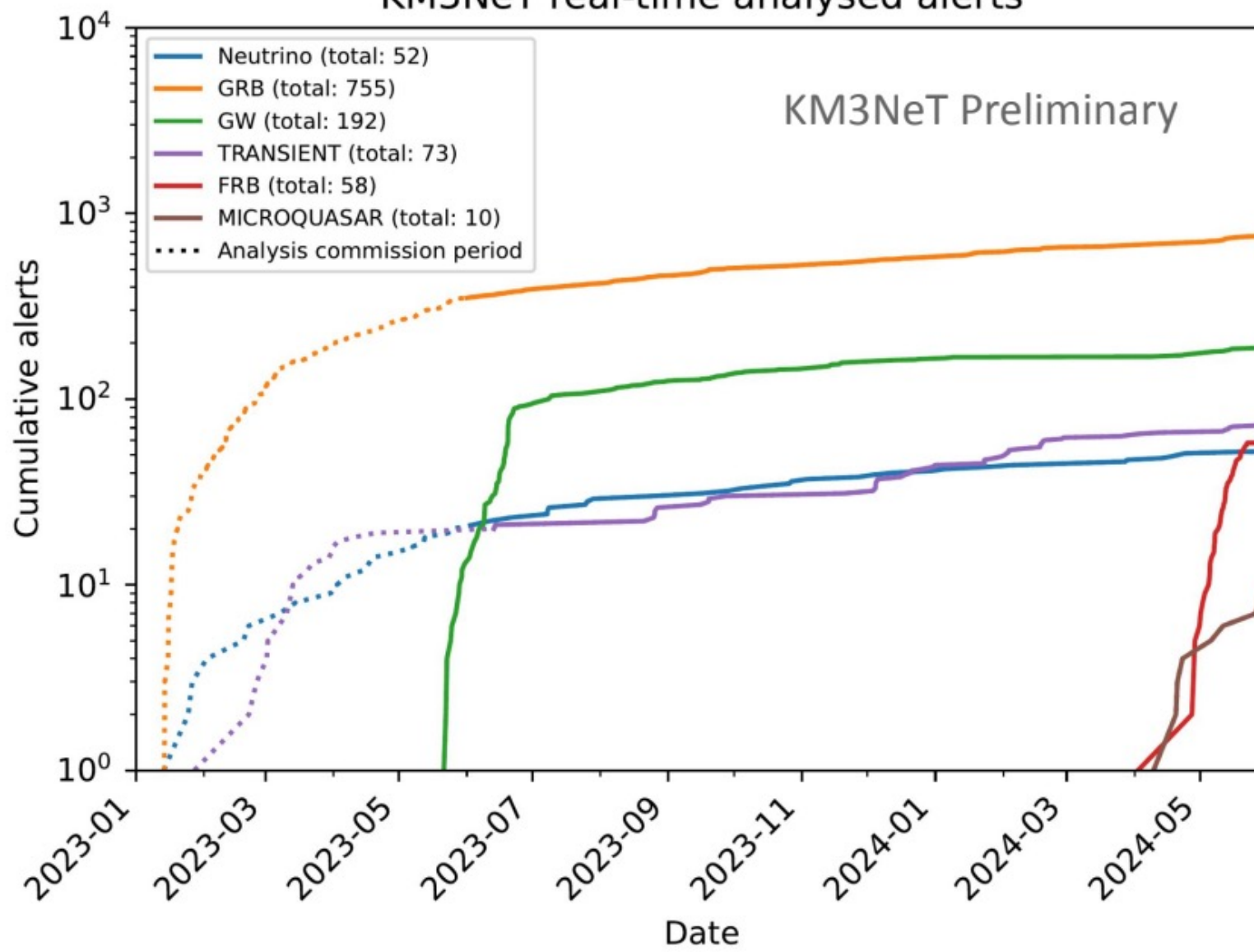
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KM3NeT real-time analysed alerts

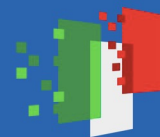




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**THANK YOU
FOR THE ATTENTION**

