

# M2TECH

Edwige Tournefier (CNRS-LAPP) on behalf of the M2TECH partners

June 8th, 2022

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M2TECH is a proposal to answer the [HORIZON-INFRA-2022-TECH-01-01](#) call on

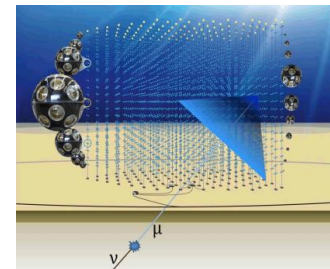
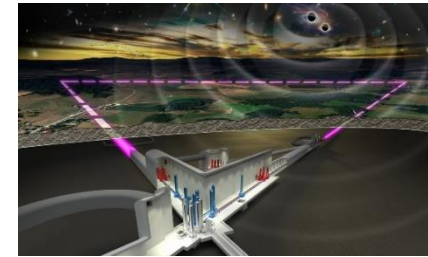
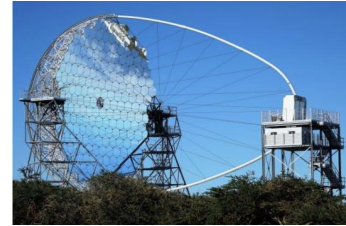
“R&D for the next generation of scientific instrumentation, tools and methods”

- Total budget: 110MEuros - ~10 projects will be funded
- Scope:
  - The aim of this topic is to deliver **innovative scientific instrumentation, tools and methods**, which advance the state-of-art of European RIs, and show **transformative potential in RIs operation. The related developments**, which underpin the provision of improved and advanced services, **should lead research infrastructures to support new areas of research and/or a wider community of users, including industrial users.**
  - Cutting-edge technologies will also enhance the potential of RIs to contribute addressing EU policy objectives and socio-economic challenges.
- Expected outcomes:
  - enhanced **scientific competitiveness of European research infrastructures**
  - foundations for the **development of innovative companies**;
  - **increase of the technological level of industries** through the **co-development of advanced technologies** for research infrastructures and creation of potential new markets
  - **integration of research infrastructures** into local, regional and global innovation systems
- Consortia must be built around a leading core of at least **3 world-class research infrastructures (RIs)**

## M2TECH : Technologies for Multi-Messenger Astrophysics

**Aim:** realisation of a common technological platform for research infrastructures in the multimessenger astrophysics research field

- Involved research infrastructures:
  - **CTAO and MAGIC** for gamma-ray astronomy,
  - **ET and Virgo** for gravitational wave interferometry
  - **KM3NeT** for neutrino astronomy
  - **ELI** for high power laser related technology
- Diversity of the *messengers*  $\Rightarrow$  heterogeneity of the technologies used in the observatories
- **M2TECH** will:
  - explore the **synergies between these technologies**
  - develop a **common technological platform**, aiming to the **integration of some of the neighbouring technology**,
  - support **the different specialisations**,
  - promote a **cross-fertilisation between the different observatories** and **the connection with industrial partners**
  - fully make use **of the different life stage at which the different RIs are**



**WP1**  
Project management and coordination

**WP2**  
Surface materials and coatings

**WP3**  
Advanced photosensing

**WP4**  
Advanced electronics

**WP5**  
Monitoring, control and synchronisation

**WP6**  
Efficient computing and tools

**WP7**  
Technology and knowledge transfer

Technical coordination of the project

High performance optical coatings

Silicon based sensors development

Flexibal readout for photosensors

Digital Twins

Sustainable fast data reduction and processing

Identification of M2Techkey exploitable results

Administrative, legal and financial management

Surface treatments and Environmental durability

Stellar intensity interferometry

Digitizing, optical links and synchronisation

Noise monitoring, cancellation and optimized controls

Operational intelligence for instrument and data flows management

Training activities

Internal quality management

Low defects substrates

Photodiodes and real-time cameras

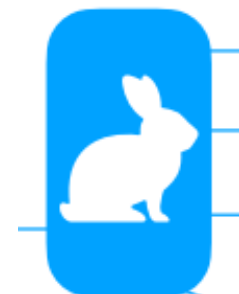
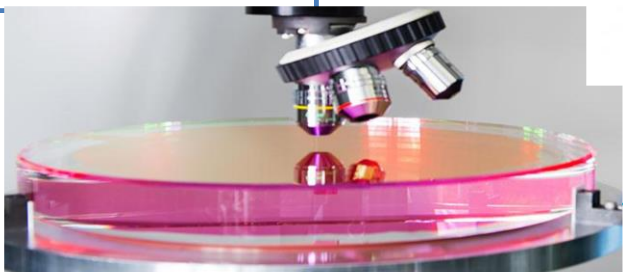
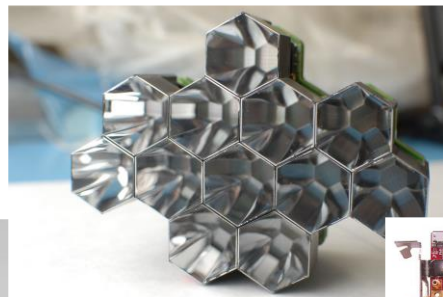
Smart processing for image-forming detectors

White Rabbit developments and real-time networking infrastructure

Efficient tools for multimessenger alerts

Plan for dissemination, exploitation, and communication

Management of the research data and other research output



Edwige Tournefier

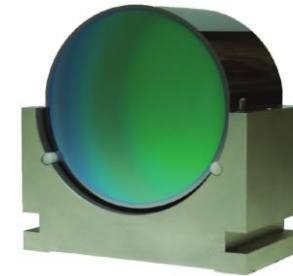


Communication and outreach activities

Dissemination activities

## Optical elements for light collection / optical cavities

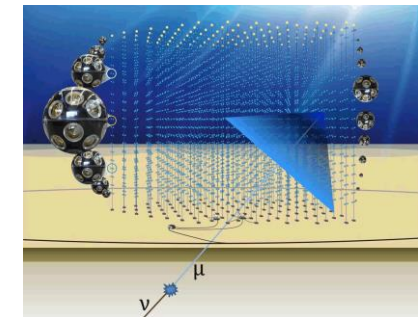
- Gamma ray: high reflectivity in NUV range, resistance to harsh conditions, large area
- Neutrinos: high transmission, resistance to environmental conditions
- GWs: low defects, high uniformity, low thermal noise
- ELI: enhanced laser damage threshold coatings



## M2TECH aims at developing:

- High quality coatings: enhanced optical performances, low thermal noise
- Methods for high quality surfaces immune to environmental conditions
- Low defects substrates

Making use of facilities and knowhow from all partners, in partnership with industries, fostering industrial developments





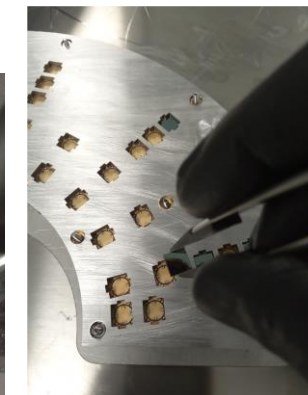
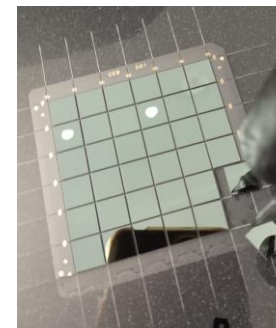
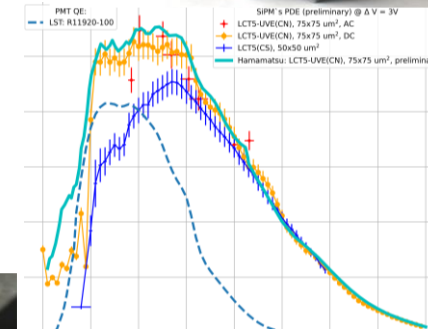
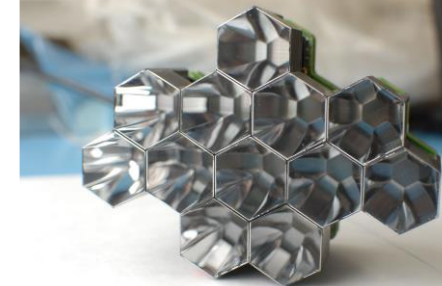
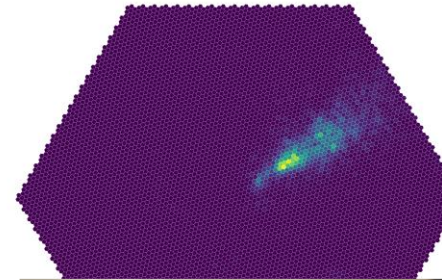
## High efficiency light detection

- Gamma rays & neutrinos: HE for NUV, low at NIR, pixelisation, modularity and large area
- GW: new technology to be developed for ET-LF and enhanced performances for ET-HF

## M2TECH aims at developing:

- A plug-and-play modular universal tile of SiPM sensors for large photosensing areas
- A digital photon counter 3D sensor for stellar interferometry
- UHV compatible photosensors for scattered light monitoring
- Pixelated phase camera for mapping the laser field

Partnership with companies FBK, VIGO, Bright Photonics



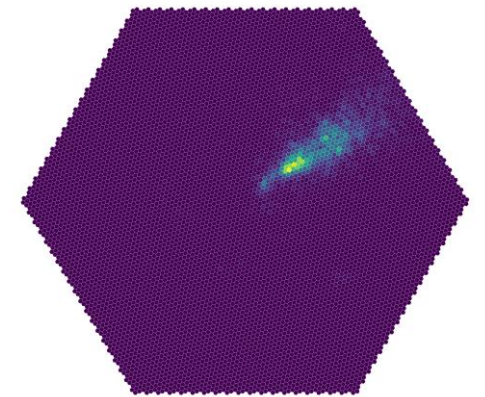
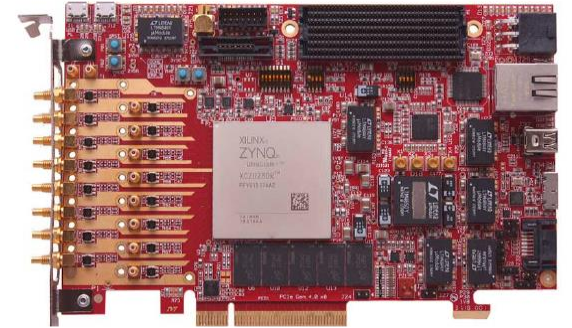
## Efficient, low noise, precise, flexible electronics

- Signal readout: Low noise and low power electronics for photosensors
- Data transmission: low noise digitisation and high flux data transfer
- Precise timing
- Image reconstruction

## M2TECH aims at developing:

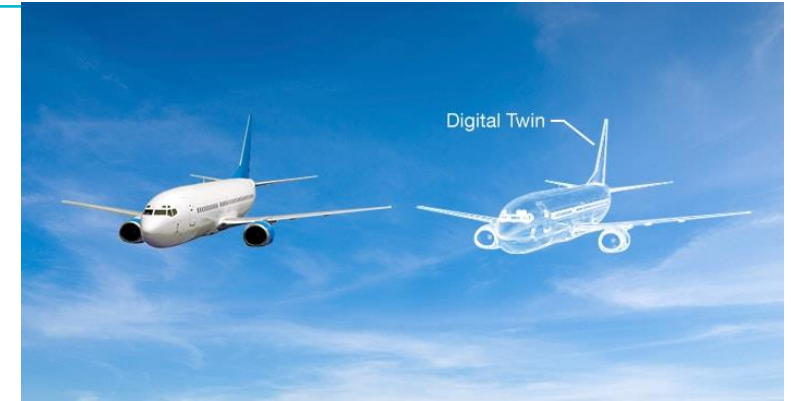
- Flexible readout for SiPM modules
- Low noise, low power digitization and optical links and transceivers
- Accurate timing distribution system / local timing generation system
- Smart image processing (triggering)

Involved industry: SCI



## Complex detectors monitoring, control and understanding

- Detector monitoring and control
- Simulation
- Timing and clock distribution

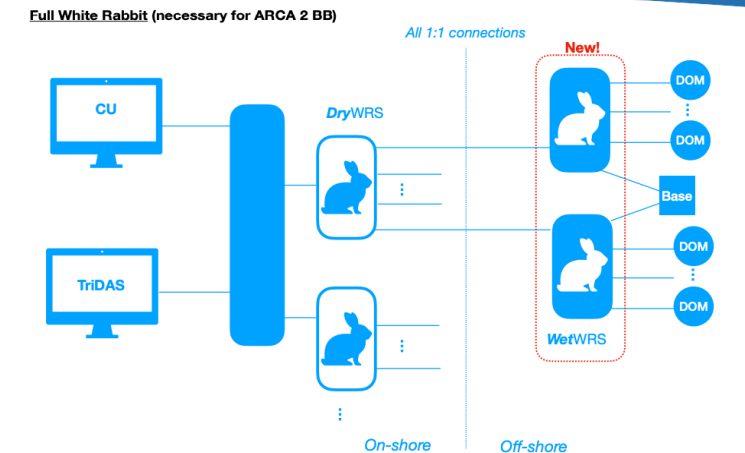


## M2TECH aims at developing:

- Digital twins for better detector understanding: coupling of noises, detector behaviour, control system design
- Sensors for noise monitoring, new control methods
- Anomaly detection DNN based
- Real time infrastructure based on White rabbit technology (switches, low phase noise, clock repeater, connectors,...)

Development of innovative solutions sharables among all RIs

In collaboration with COSYLAB





## MM astronomy from rare to high rate observation

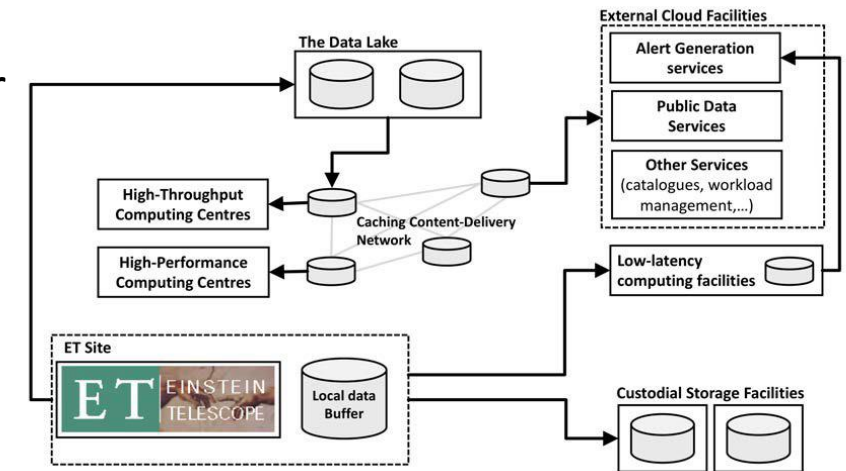
- Large data sample to be analysed at a fast rate / computing power
- Low latency alert release
- Alert management challenges

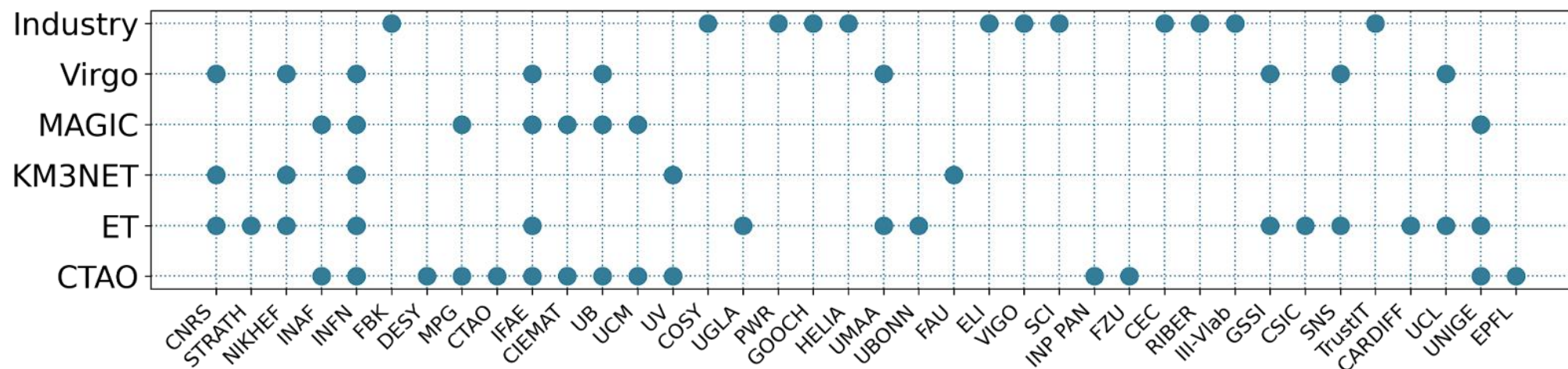
## M2TECH aims at developing:

- sustainable fast data reduction and online processing methods (ML based)
- experiment-agnostic ML based and human-machine interface tools for instrument and data flow management
- tools and interfaces for multimessenger alerts (communication, common infrastructure)

Common methods and tools among RIs and sharing of knowhow.

Partnership with industry: Trust-IT





- Proposal submitted on April 20th to EU Horizon program
- Total cost: 11.8ME
- Duration: 48 months
- 39 beneficiaries among which 14 from ET and 12 industries
- Decision expected in fall 2022, to start in Feb 2023 (duration: 4 years)

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Stay tuned!

