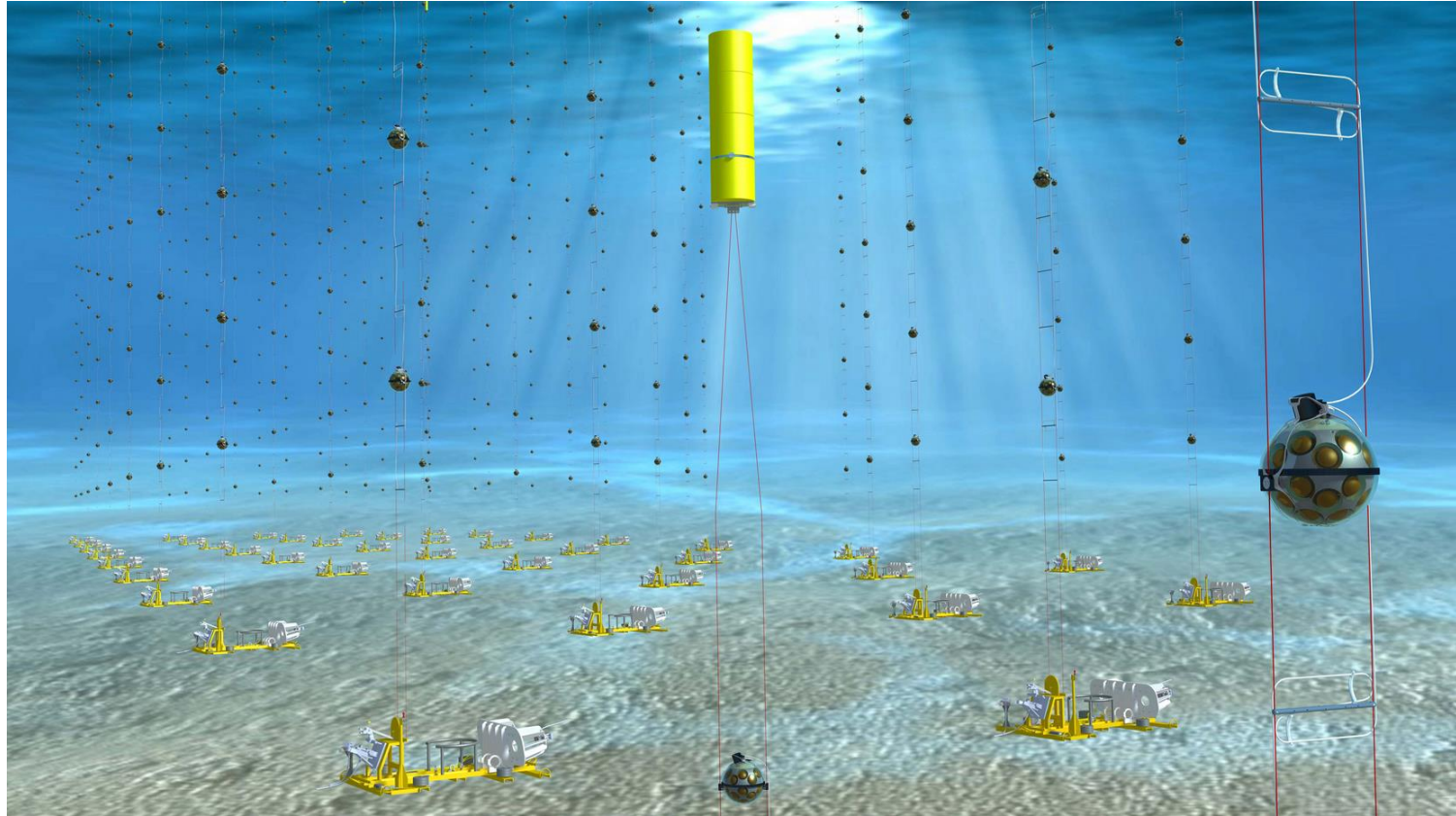
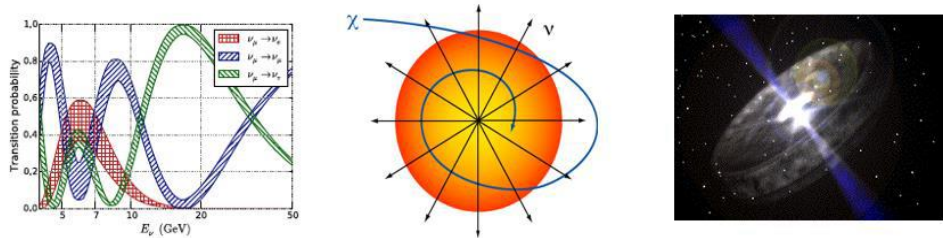


# ORCA Calibration Unit



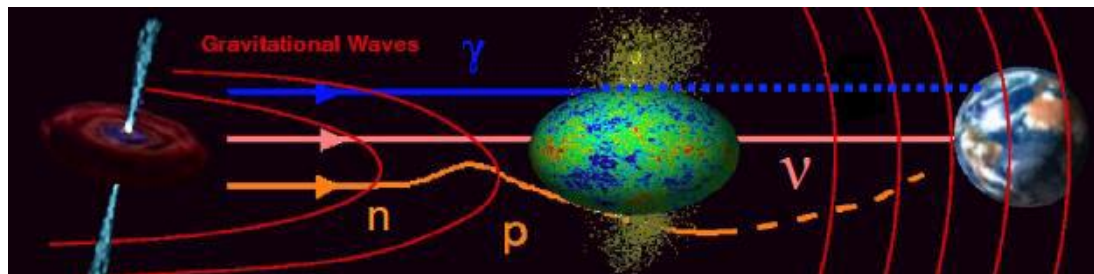


<b>Low Energy</b> $\text{MeV} < E_\nu < 100 \text{ GeV}$	<b>Medium Energy</b> $10 \text{ GeV} < E_\nu < 1 \text{ TeV}$	<b>High Energy</b> $E_\nu > 1 \text{ TeV}$
---	--	---

- |   |  |   |
|---|--|---|
| <ul style="list-style-type: none"> <li><math>\nu</math> Oscillations</li> <li><math>\nu</math> Mass hierarchy</li> <li>Supernova</li> <li>Solar flares,...</li> </ul> | <ul style="list-style-type: none"> <li>Dark matter search</li> <li>Monopoles, nuclearites,...</li> </ul> | <ul style="list-style-type: none"> <li><math>\nu</math> from extra-terrestrial sources</li> <li>Origin and production mechanism of HE CR</li> </ul> |
|---|--|---|

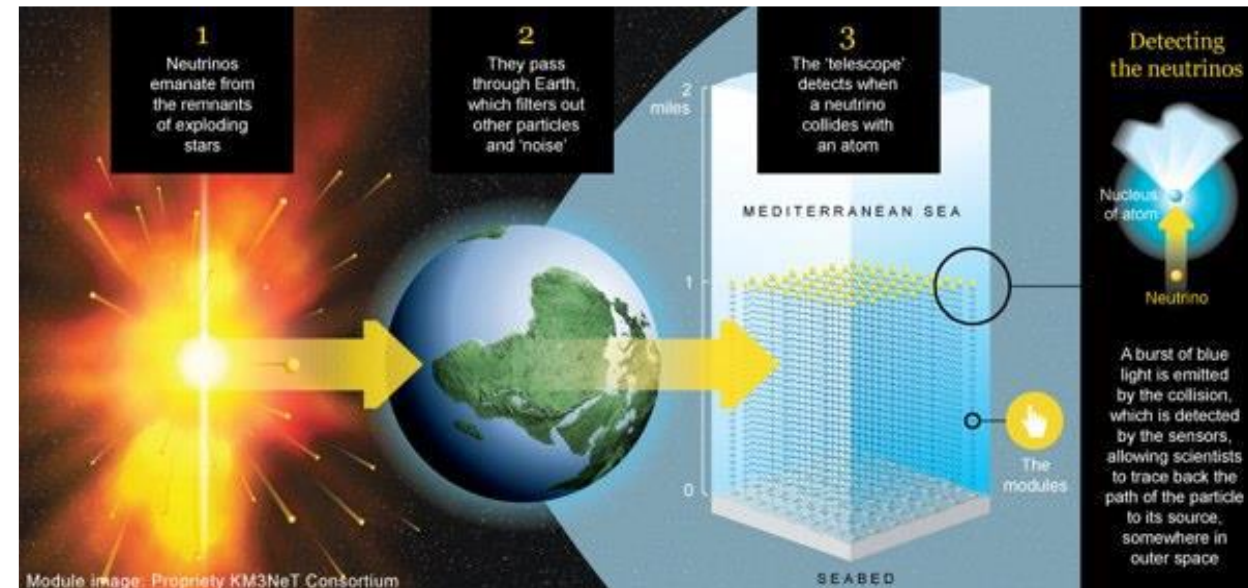


+ oceanography, biology, seismology,...

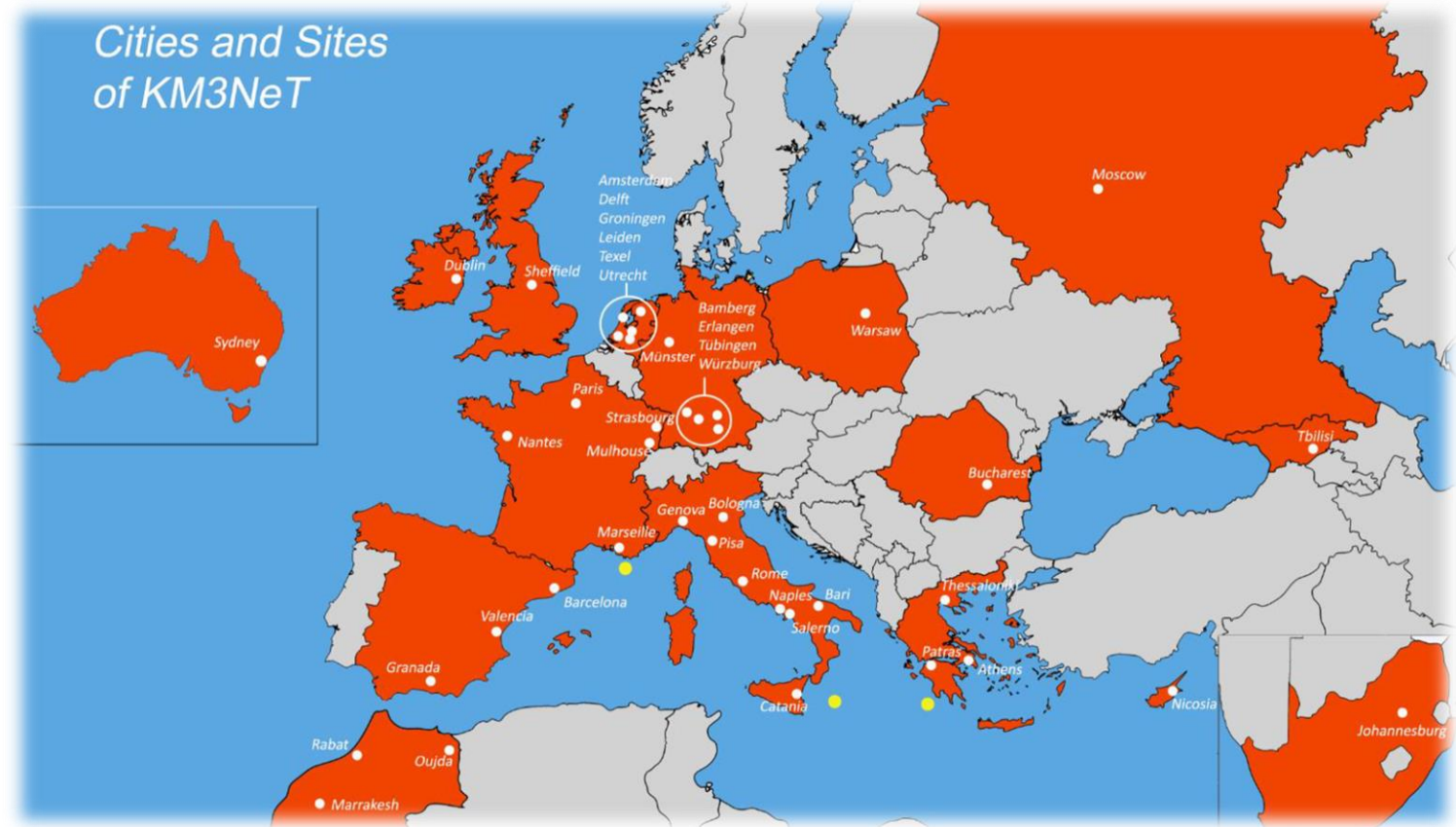


## Neutrinos:

- No electric charge
- Very low interaction with the matter (hard to detect)
- Non-deviated trajectory
- Travel across cosmological distances
- A large energy range
- A new window to study and observe the Universe



- ❖ ESFRI Roadmap Project:  
«Infrastructure de Recherche d'excellence»
- ❖ MasterProject»IN2P3  
Budget: ~200M€
- ❖ 18 countries
- ❖ 60 instituts
- ❖ 300 personnes
  
- ❖ 3 sites:
  - ❖ ORCA(2500m,France)
  - ❖ ARCA (3500m, Italie)
  - ❖ Grèce(TBC)
  
- ❖ Started : 2013
- ❖ Expected to end: 2026(ORCA) - 2028(ARCA)



## KM3NeT Detector

ORCA Oscillation Research with Cosmics in the Abyss (DUs)

ARCA Astrophysics Research with Cosmics in the Abyss (230DUs)

Digital Optical Module (DOM)



Unfurling a line



Anchor



6300 DOMs  
~200 000 PMTs  
> km<sup>3</sup>  
>1 Gtone d'eau

Précision t:~1ns  
Résolution ang.:<1°  
Flux données:10Gb/s



2500m/3500m below the sea level

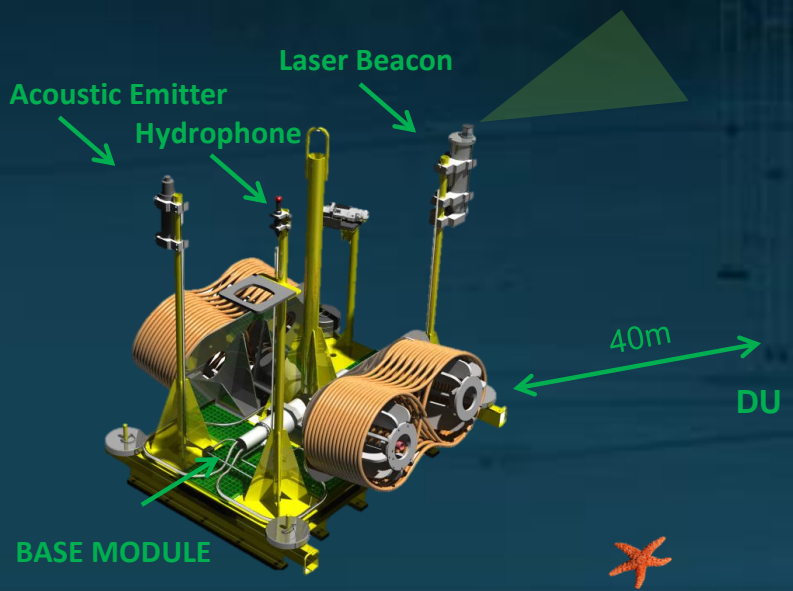


Detection Unit (DU)

**KM3NeT Collaboration**  
ORCA Oscillation Research with Cosmics in the Abyss

**ORCA Calibration Base**

APC is involved in the development and integration of the ORCA Calibration Base

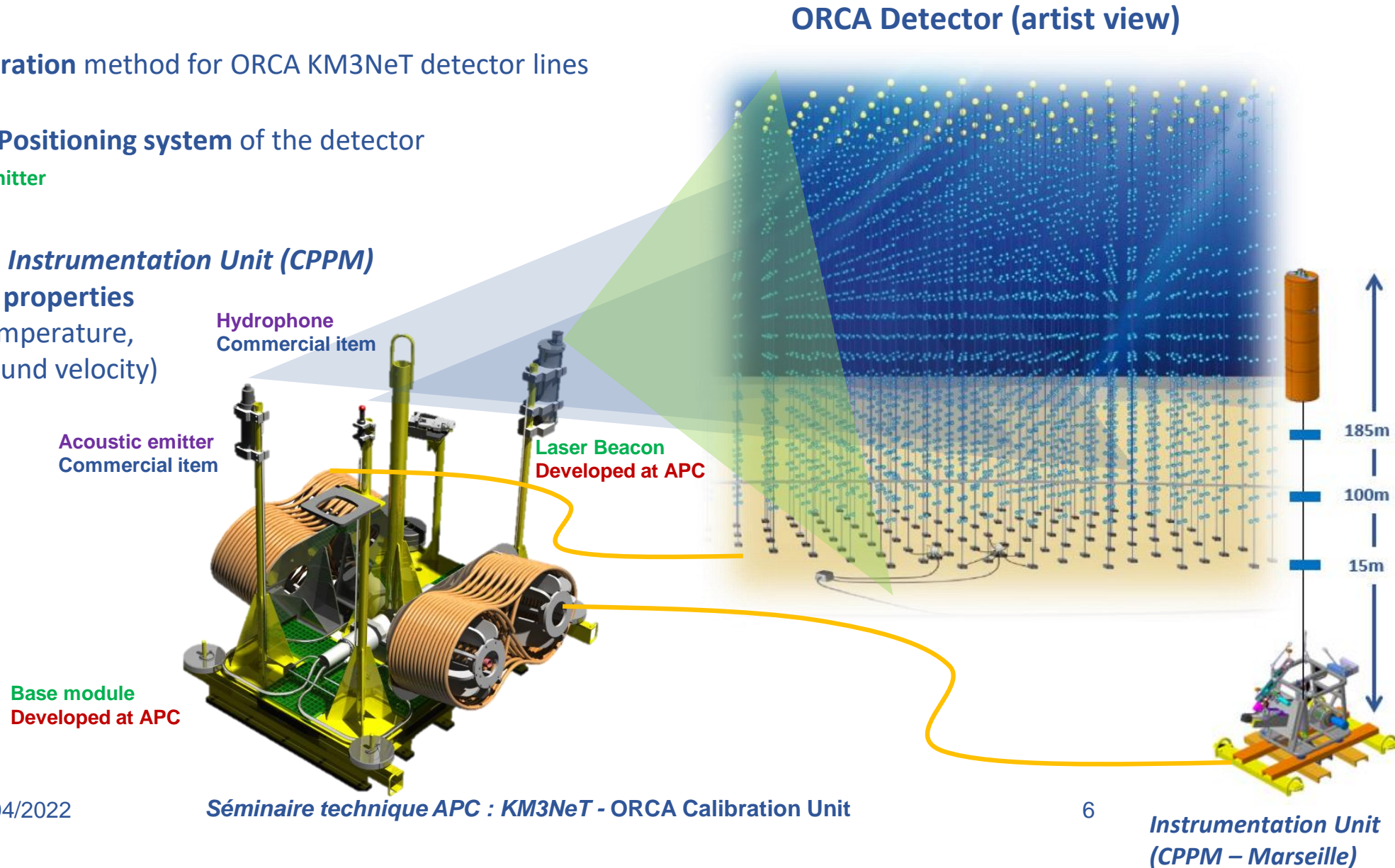


## Scientific Objectives :

- Complementary **Time calibration** method for ORCA KM3NeT detector lines
  - **Laser Beacon**
- Part of the **Long Base Line Positioning system** of the detector
  - **Hydrophone and Acoustic Emitter**

## Technical Objectives:

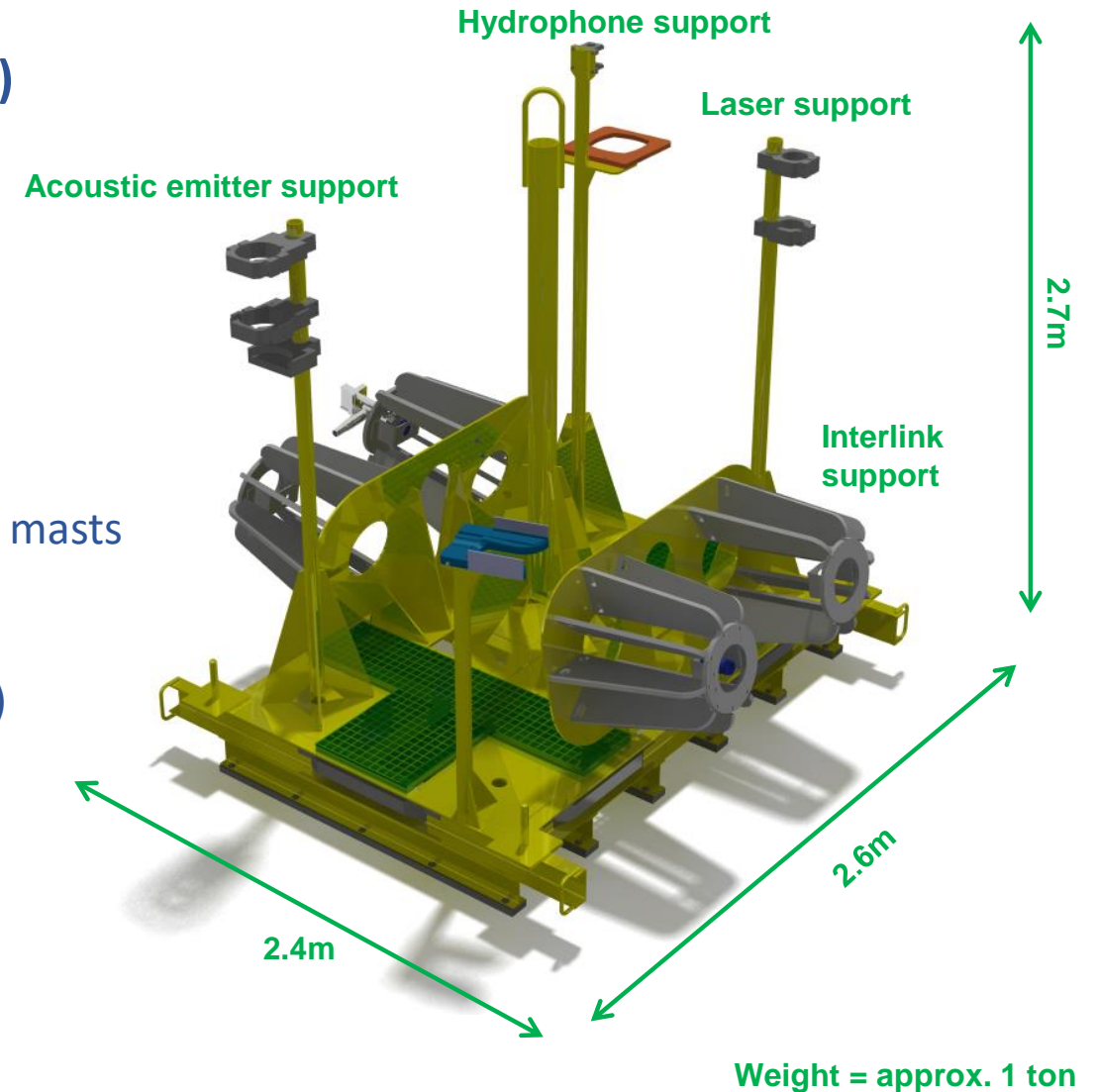
- Connect and command the **Instrumentation Unit (CPPM)** used to monitor **sea water properties** (conductivity, pressure, temperature, salinity, current profiler, sound velocity)



## ❖ Support structure of the ORCA Calibration Base (Anchor)

- Design of the steel anchor structure  
(35 mechanical drawings)
- Design of interlink support
- Design of instrument fixation
- Define materials, overall dimensions, height of instrument masts
- Anodes corrosion protection
- Documentation (Integration procedures, Qualification, etc)

**Delivered in June 2020**





CPPM/La Seyne sur Mer  
June 2020

Date: 24/04/2022

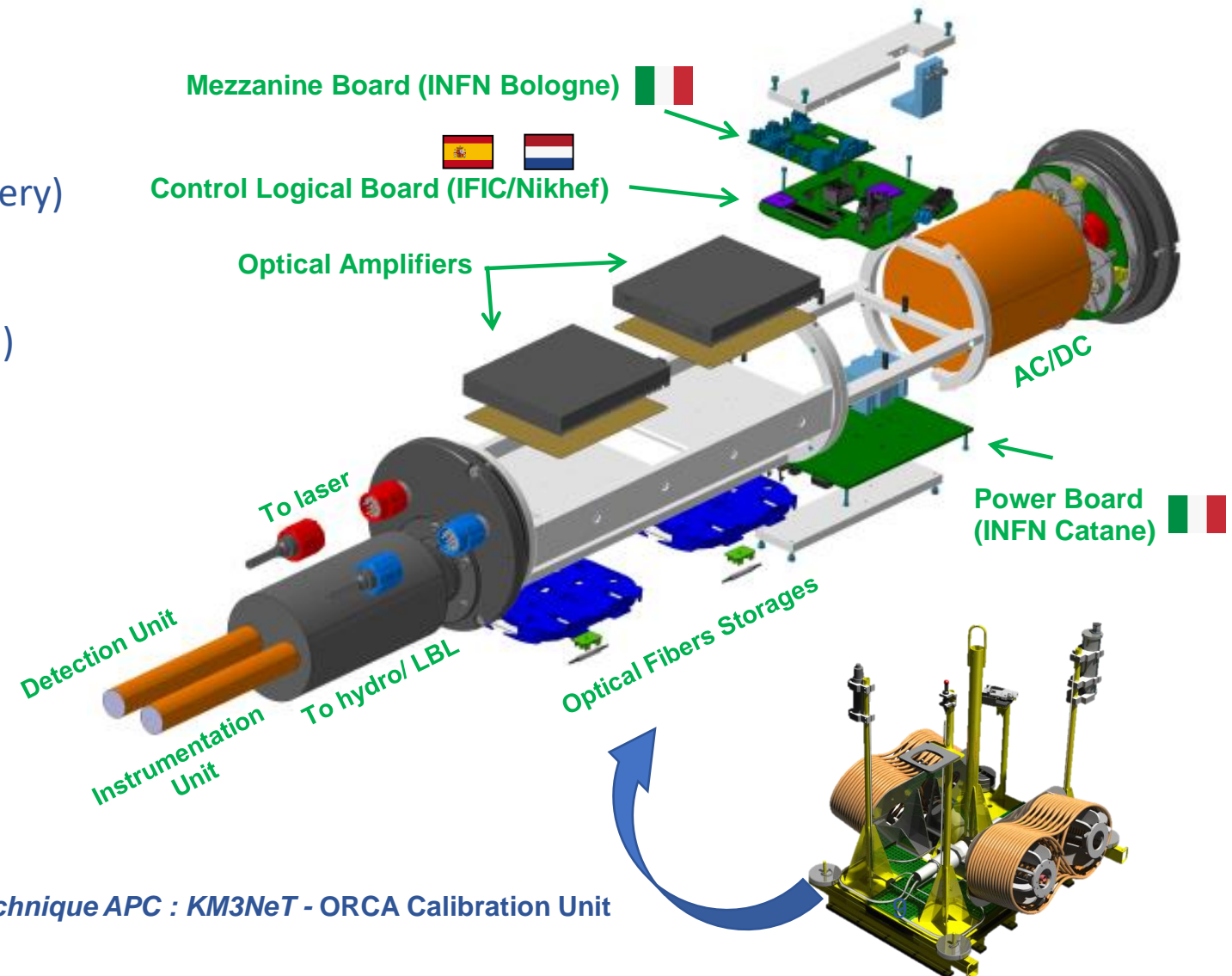
Séminaire technique APC : KM3NeT - ORCA Calibration Unit



## 1. Base Module

- ❑ Design of the external container
- ❑ Design Internal support
- ❑ Electronics integration (boards, laser, battery)
- ❑ Internal Cabling
- ❑ Documentation (Integration, Qualification)

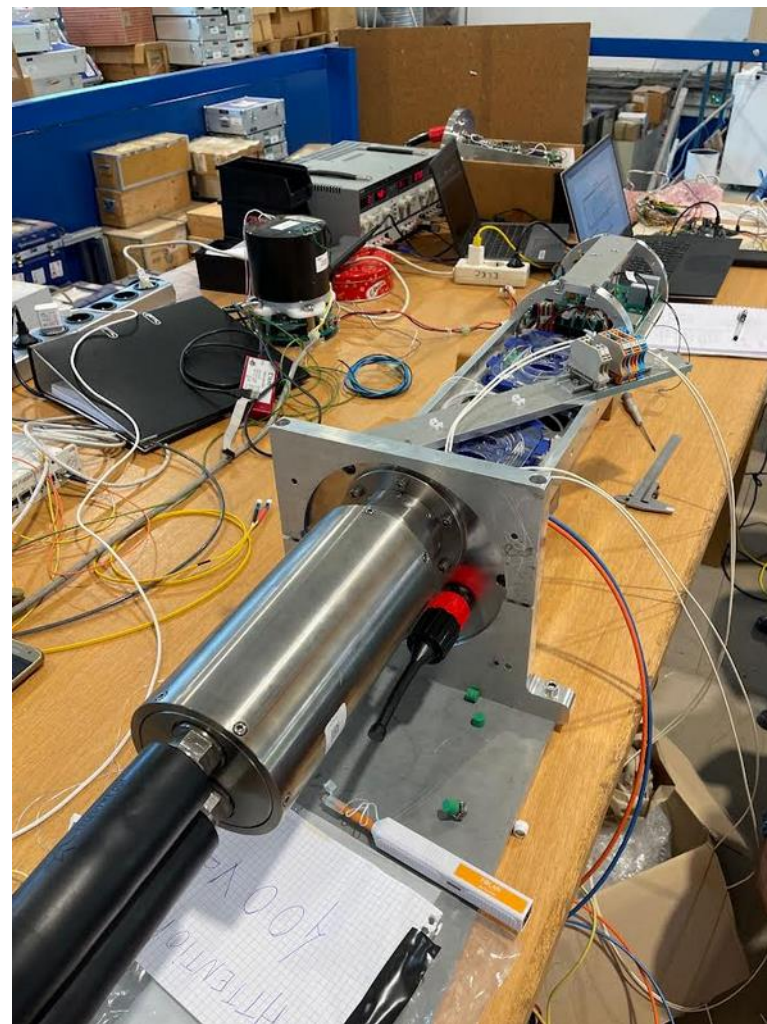
**Delivered in July 2021**



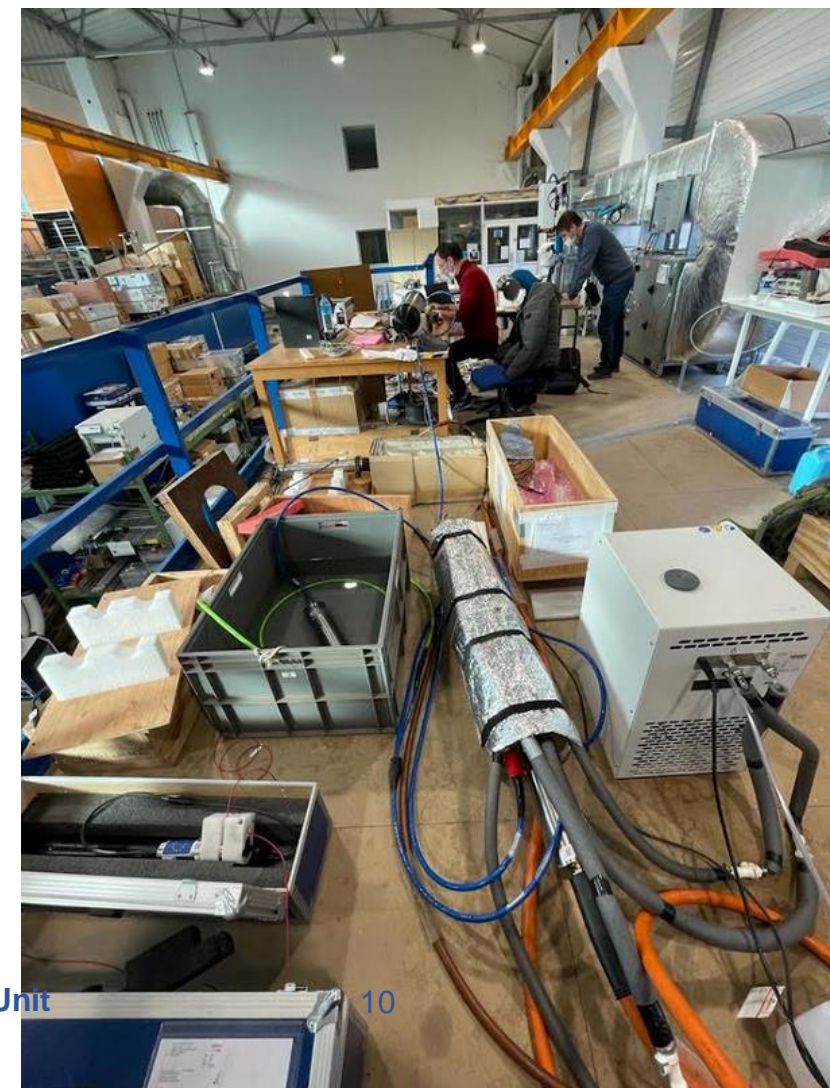


# Communication tests performed at CPPM in July 2021

Date: 24/04/2022

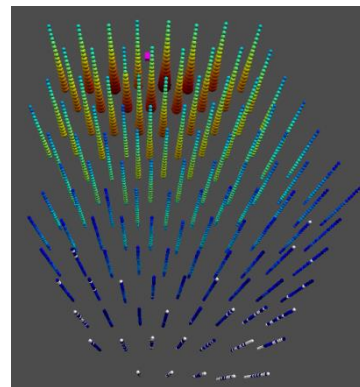
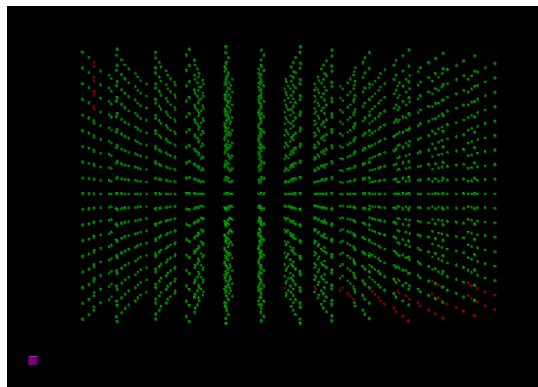
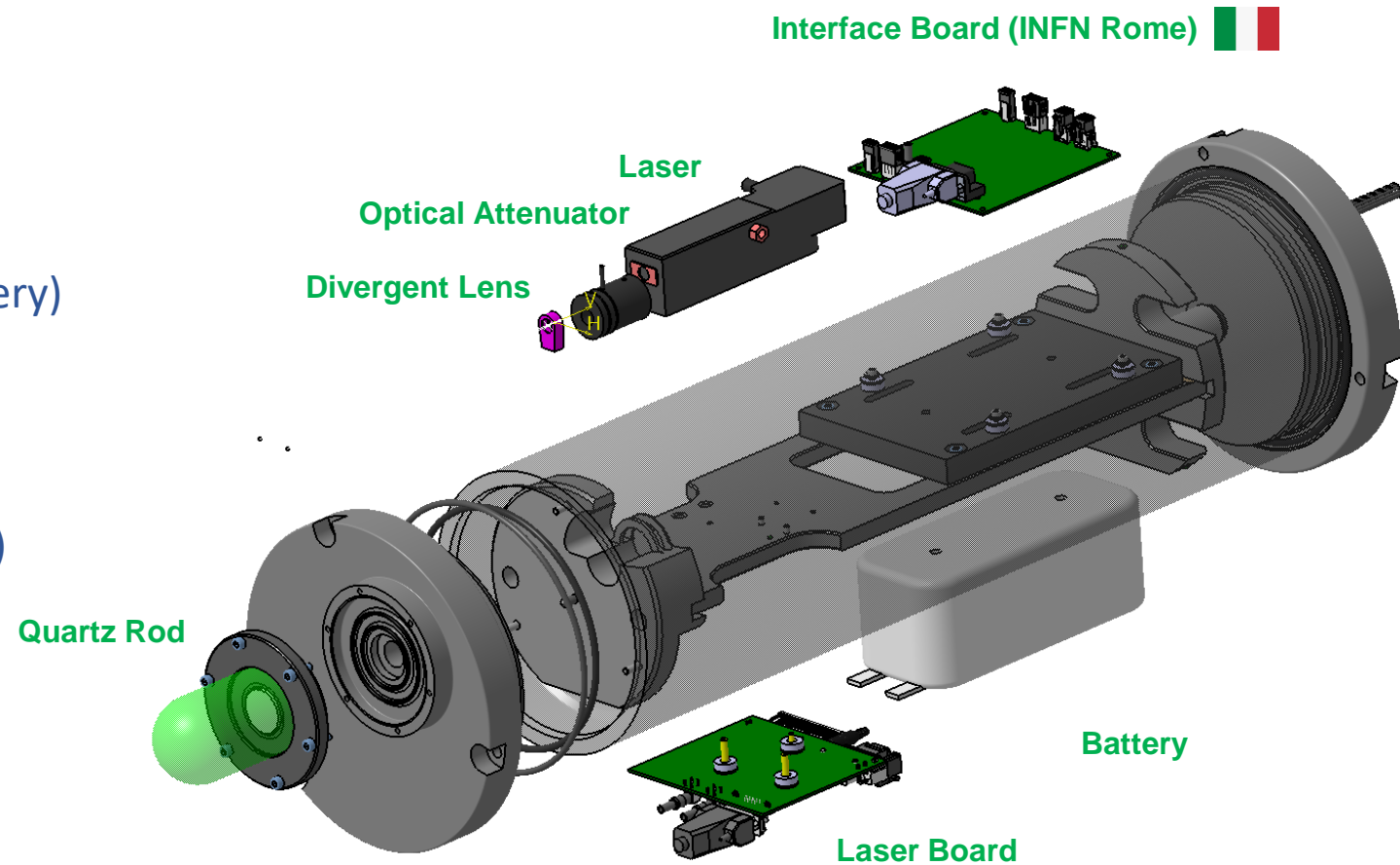


Séminaire technique APC : KM3NeT - ORCA Calibration Unit

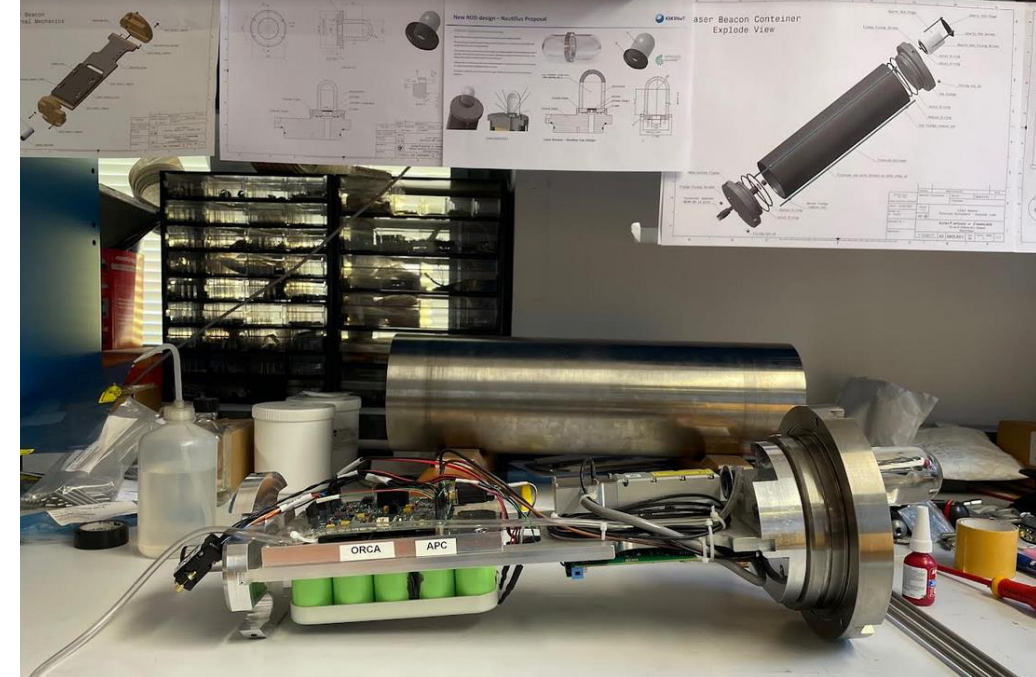


## 1. Laser Beacon

- Design of the external container
- Design Internal support
- Electronics integration (boards, laser, battery)
- Internal Cabling
- Optical Simulations (performances)
- Documentation (Integration, Qualification)



Laser Beacon - Optical Simulations ORCA



**Laser Beacons:**  
**ORCA delivered by July 2021**  
**ARCA 1 delivered by March 2022**  
**ARCA 2 expected to be delivered in June 2022**

### Electronics / Instrumentation

- Claude **BOUTONNET**
- Jean **LESREL** (Technical Coordination)

### Software / Firmware

- Cedric **CHAMPION**

### Quality / Documentation

- Stéphane **COLONGES** (RAMS Manager in Project Office)

### Optics / Time Calibration

- Alexandre **CREUSOT** (Scientific Coordination)
- Bruny **BARET**

### Mechanics / Workshop

- Alin **ILIONI** (Technical Coordination)
- Stéphane **DHEILLY**

### Administrative

- Lydie **PAVILI-BALADINE**
- Beatrice **SILVA**

### Project coordinator APC

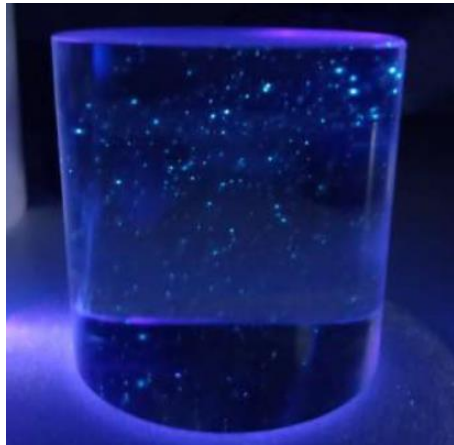
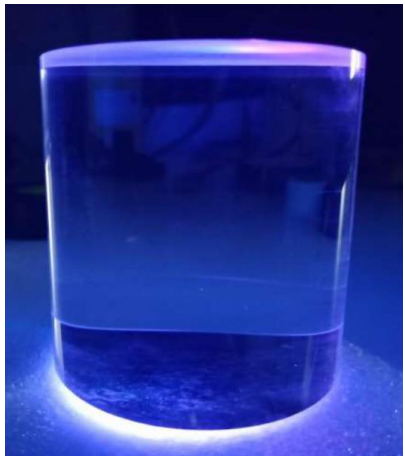
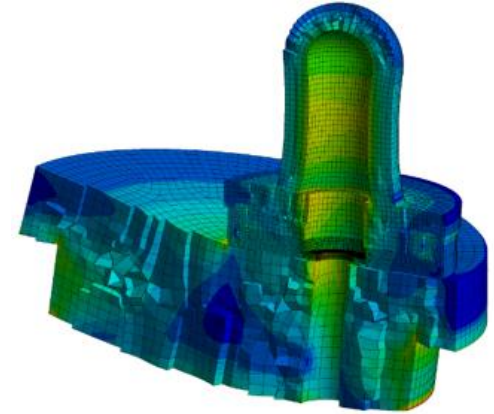
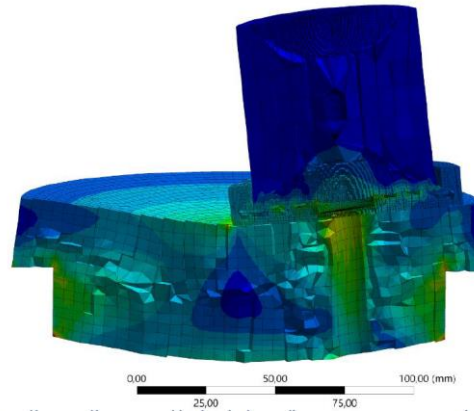
- Joao **Cohelo**
- Véronique **Van Elewyck**

### KM3NeT Technical Project Coordinator

- Miles **Lyndsey Clark**



## ❖ Laser Beacon Pressure Qualification Tests:



## ❖ Software/Firmware – User Interface

- Developed remotely inside the collaboration (human resources problems)
- Solving software/firmware bugs remotely – time consuming

## ❖ Increasing the reliability of the Laser Beacon (10 years)

- Lifetime of the battery – defining charging/discharging cycles
- Dealing with the laser power and other optical components (attenuator – divergent lens)

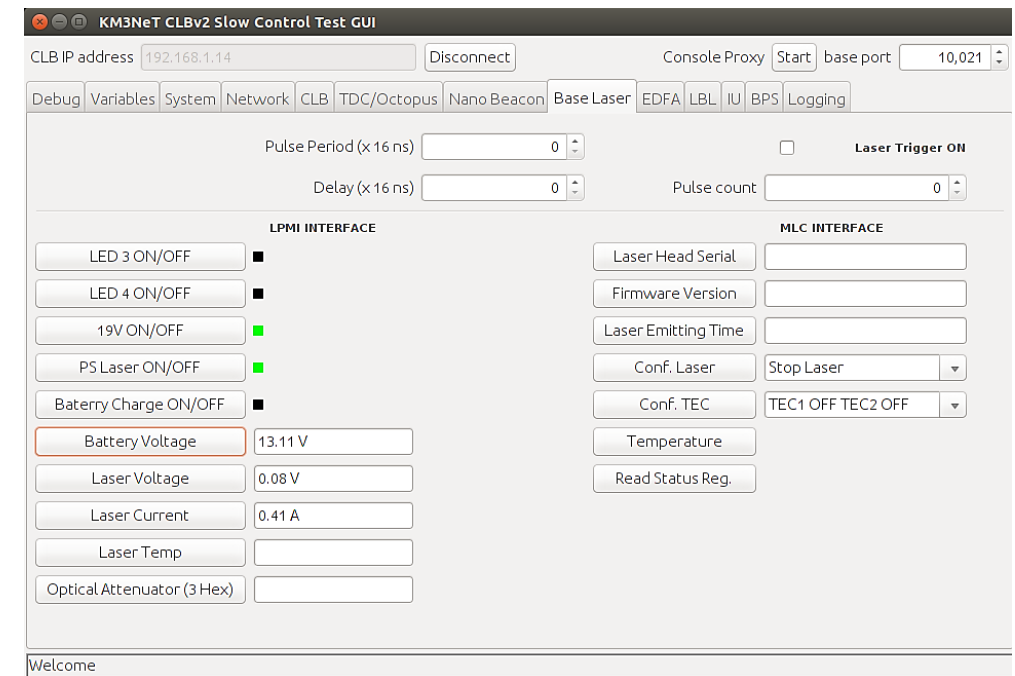
## ❖ Final communication tests with Instrumentation Unit

- Interference with other important tasks at CPPM

## ❖ Being at the end of the integration chain

- Dealing with the delays
- Tight planning

## Calibration Unit Graphic User Interface

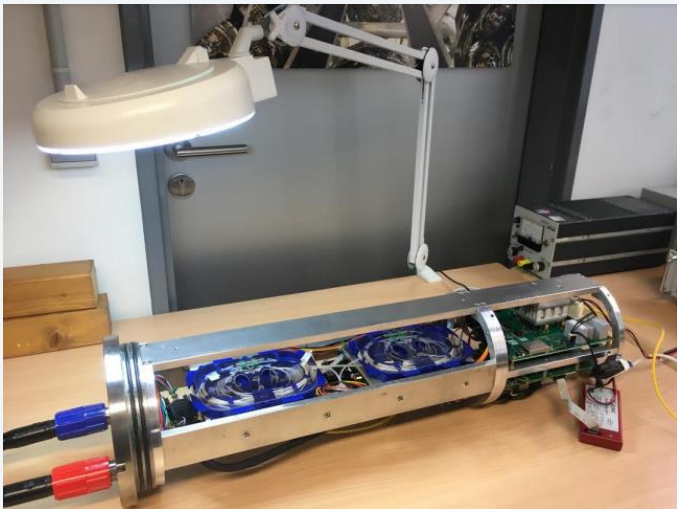


May 2021

July 2021

## External Review of the Base Module

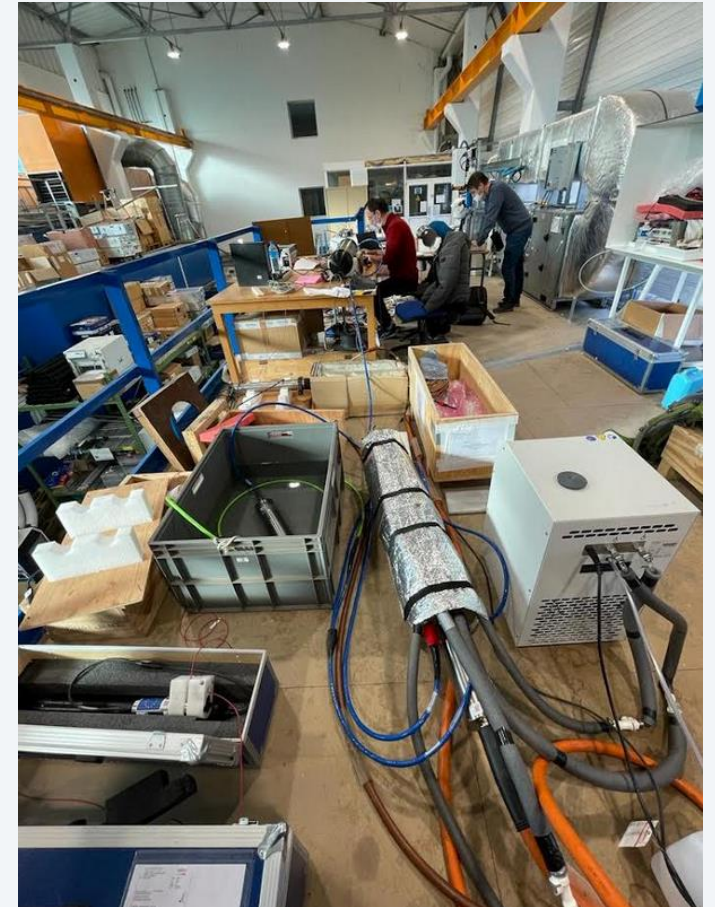
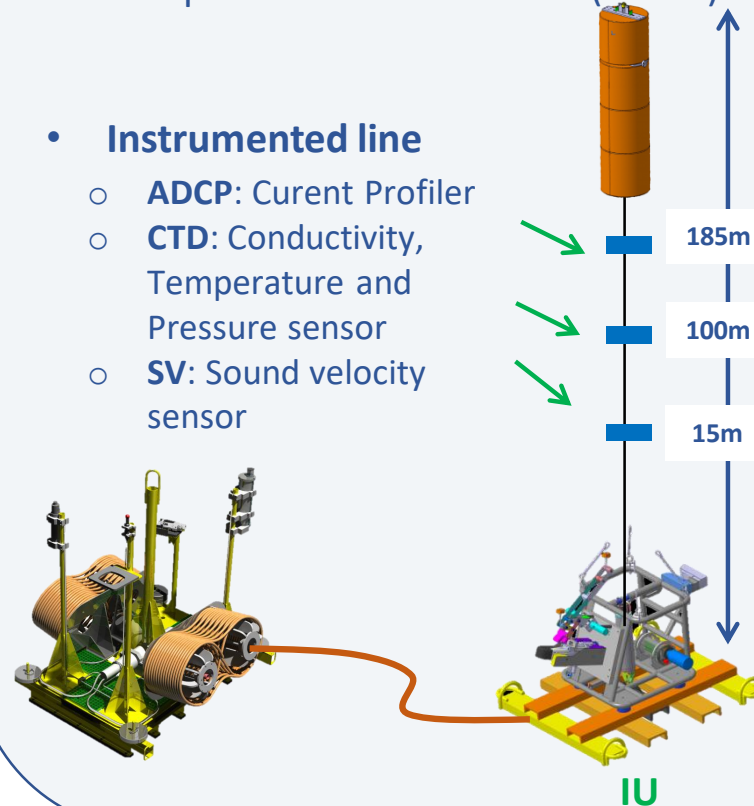
- Mechanical Design
- Electronics
- Optics
- Power



Date: 24/04/2022

## Final Communication tests between Calibration Base and Instrumentation Unit

- Will performed in Marseille (CPPM)
- Instrumented line
  - ADCP: Curent Profiler
  - CTD: Conductivity, Temperature and Pressure sensor
  - SV: Sound velocity sensor





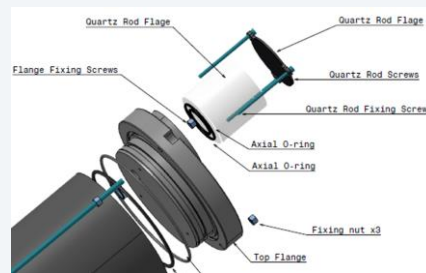
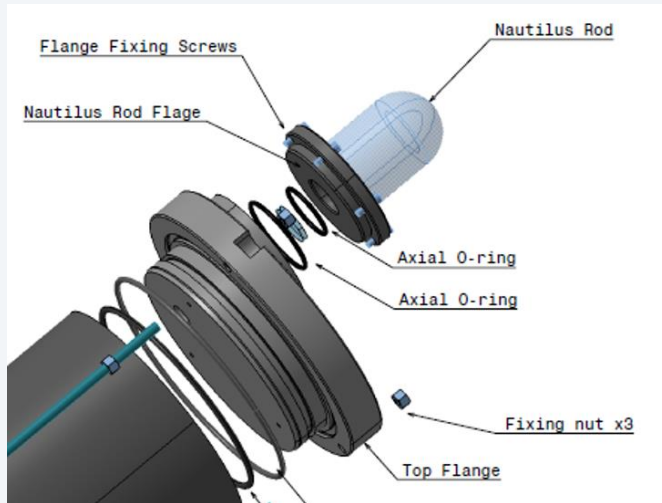


# Important milestones

July 2021

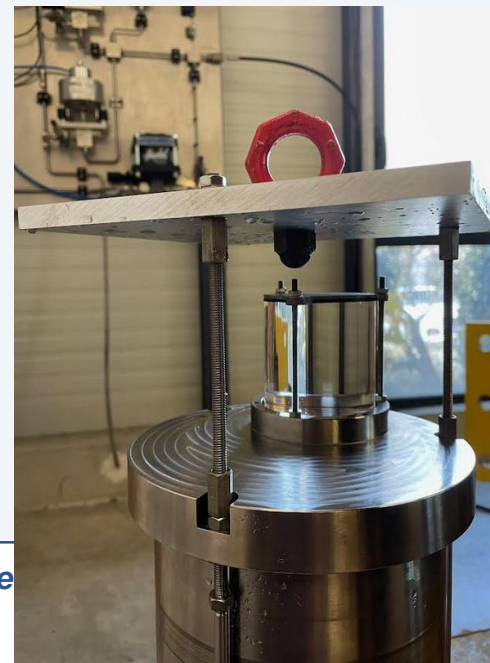
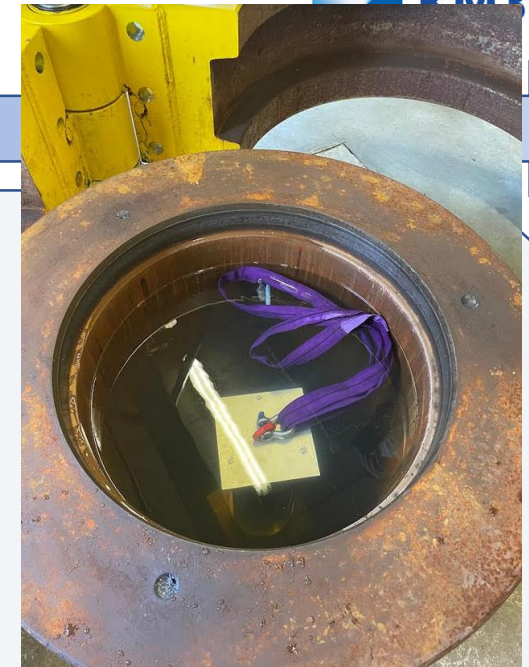
## Pressure qualification test of the Laser Beacon Container -

- 2 Different Mechanical Designs are now being analyzed



Qualified for 2500m (ORCA)

Qualified for 3500m (both ORCA and ARCA)



March 2022

## ARCA 1 Laser Beacon has been delivered in Italy

- Installed on the Junction Box 1
- First communication test OK
- In the next days new pressure test will be performed before deployment in **June 22**

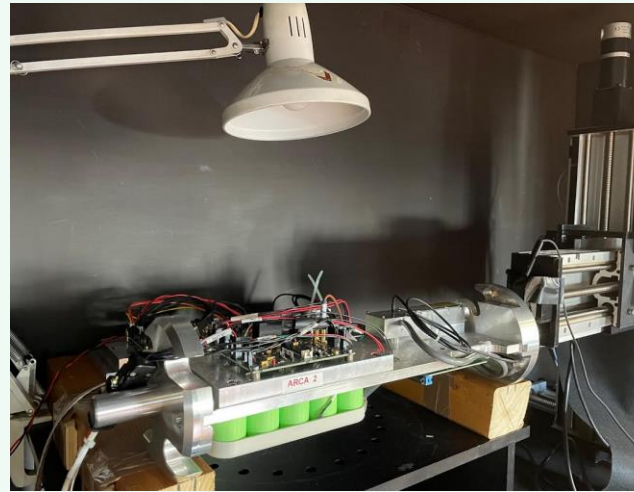


Date: 24/04/2022

May 2022

## ARCA 2 Laser Beacon expected to be delivered

- Will be installed on JB2
- Expected to be deployed in September 2022
- Currently being tested in the Black Chamber



May/June 2022

## Deployment of the ORCA Calibration Unit

- Delayed several times due to COVID and FW issues



- ❖ APC developed **strong competences** in instrument development adapted for **marine environment**
- ❖ New possible **technical contributions in KM3NeT** Collaboration are now being investigated
- ❖ Exploitation of the ORCA Calibration Unit data
  - ❖ keep being involved in the time calibration team

