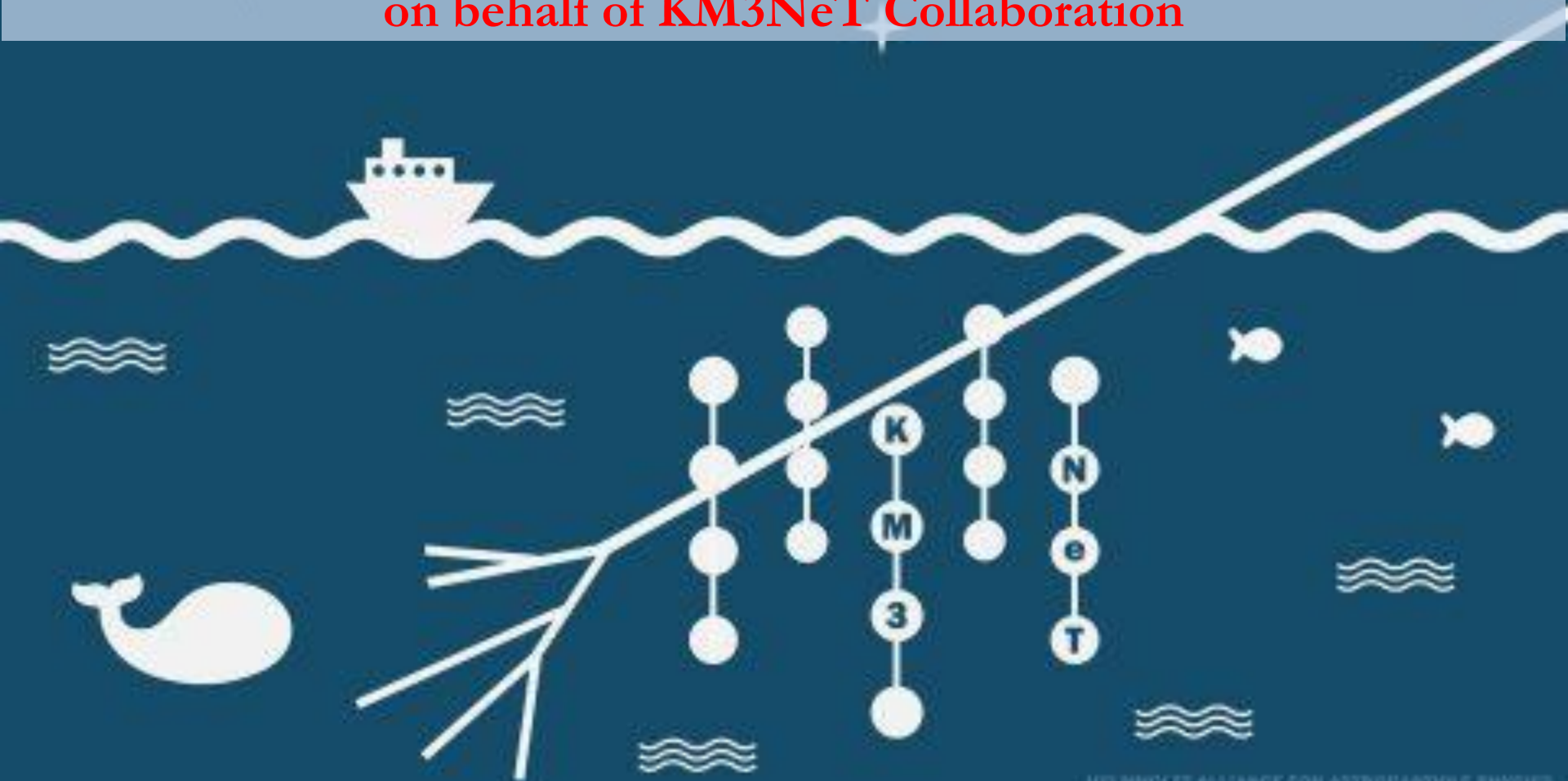


The Detection Unit of the KM3NeT: qualification, integration procedures and technical results

I. Sgura INFN Bari
on behalf of KM3NeT Collaboration



The Neutrino Telescope in the Mediterranean

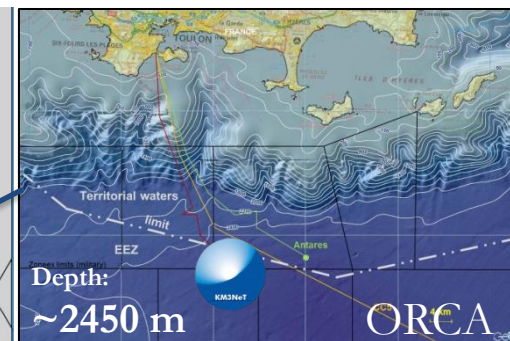
A distributed research infrastructure with 2 sites:

Cities and Sites
of KM3NeT

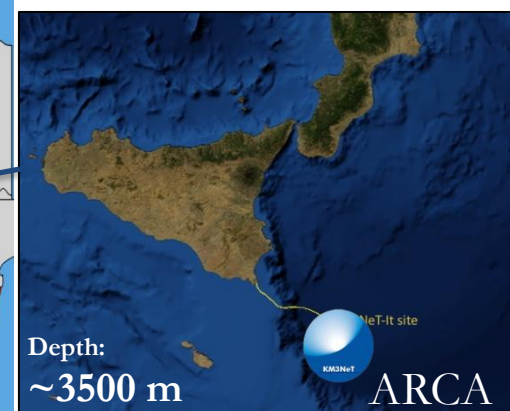
www.km3net.org



+ since April 2017:
CIRA Perth Australia
+ since May 2018:
Western Sydney U.



Oscillation Research
with Cosmics In the Abyss

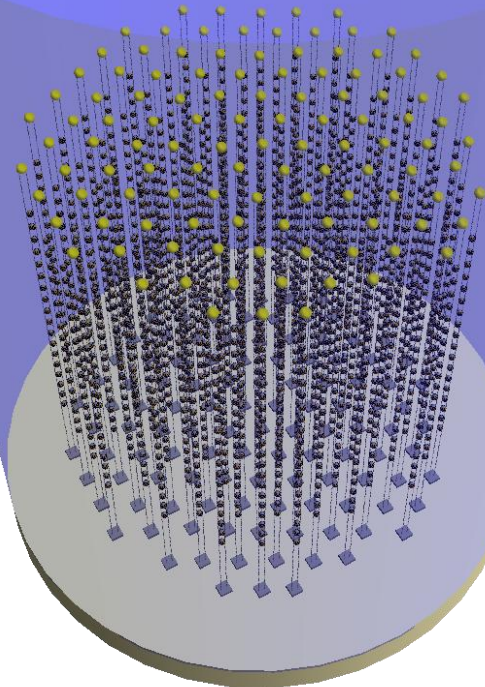


Astroparticle Research
with Cosmics In the Abyss

>240 people 57 institutes / 43 cities/ 16 countries

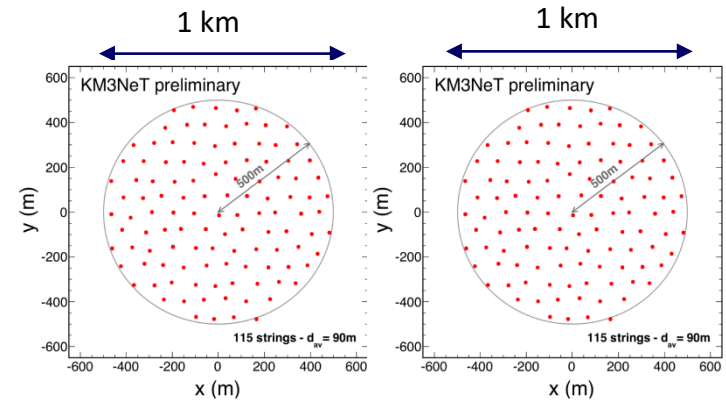
The KM3NeT detector

1 building block:
115 lines
18 DOMs/line
31 PMTs/DOM
Total: 64k 3" PMTs



All-flavour neutrino astronomy

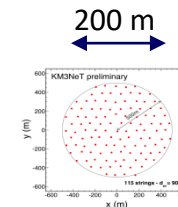
ARCA



2 building blocks (1 Gton)
Inter-DOM spacing: $\sim 36\text{m}$
Inter-DU spacing: $\sim 100\text{m}$

Neutrino physics: Mass hierarchy,
oscillations

ORCA



1 building block (6 Mton)
Inter-DOM spacing: $\sim 9\text{m}$
Inter-DU spacing: $\sim 23\text{m}$

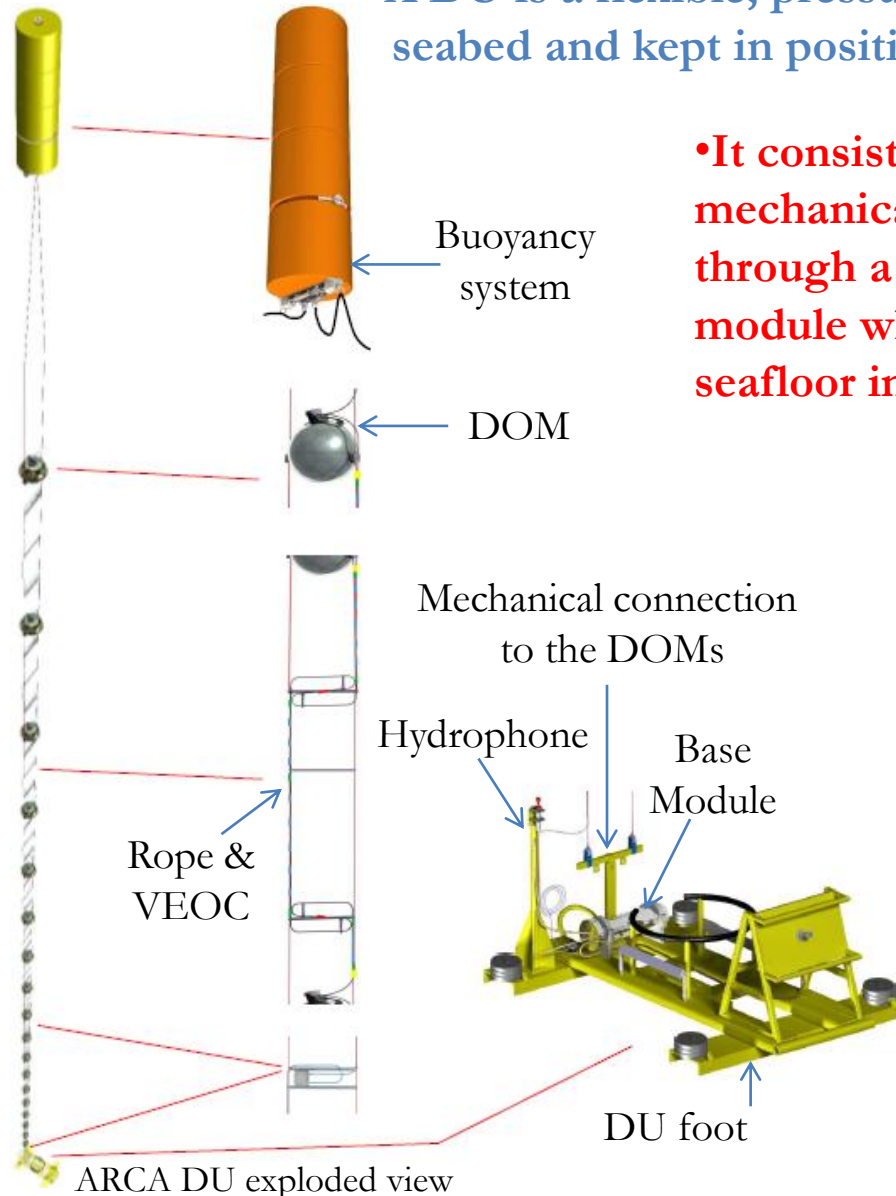
The Detection Unit (DU): ARCA and ORCA same technology

A DU is a flexible, pressure resistant, structure anchored to the seabed and kept in position by a submerged buoyancy system.

•It consists of 18 DOMs connected: i) mechanically through 2 ropes, ii) electro-optically through a backbone cable (VEOC) and a base module which allows the communication with the seafloor infrastructure.

The DU is packed on a launcher vehicle (LOM) and installed on the DU foot. After deployment on sea bed, unfurling is triggered by opening a ROV-operable release. The LOM is recovered for its reuse.

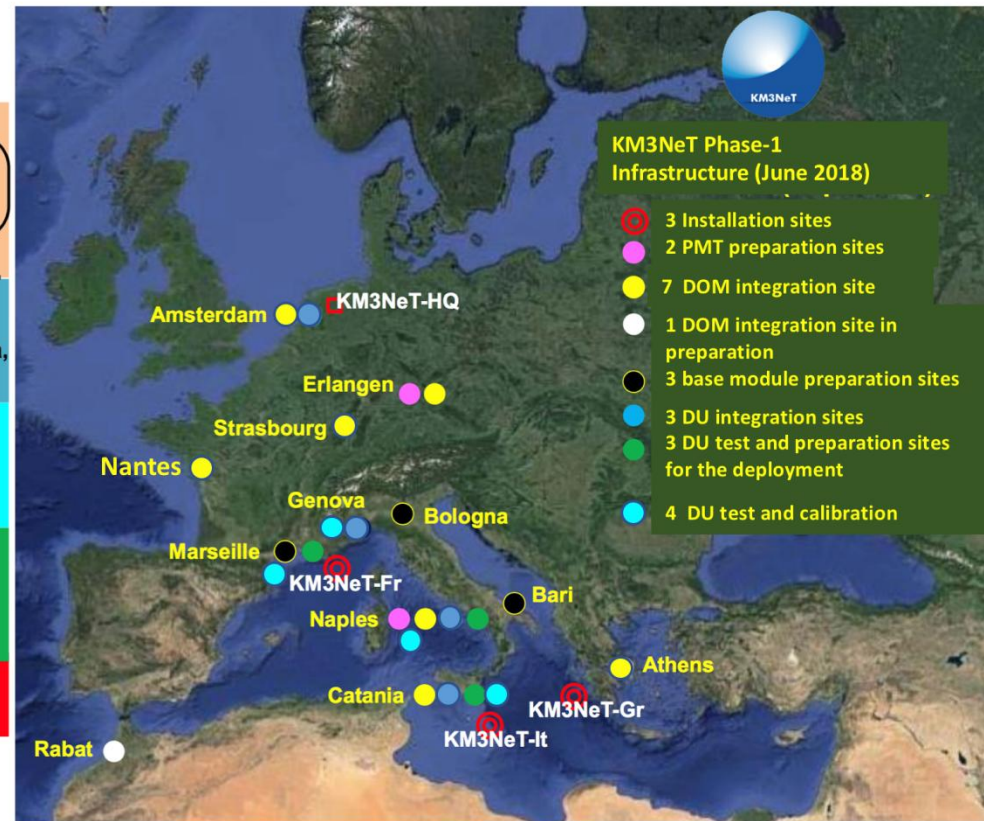
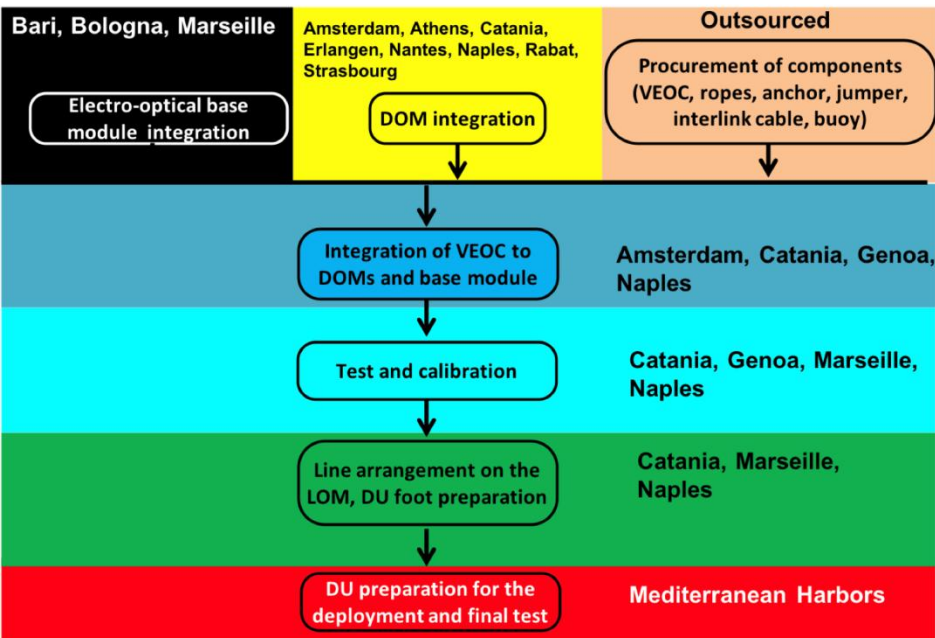
The majority of the DU components have been designed and qualified by the Collaboration for a 15 lifetime without maintenance.



DU production (I)

The DU integration is fully handled by the Collaboration

Production processes and sites



DU production (II)

The DU integration is fully handled by the Collaboration

In order to guarantee an efficient and reliable production processes:

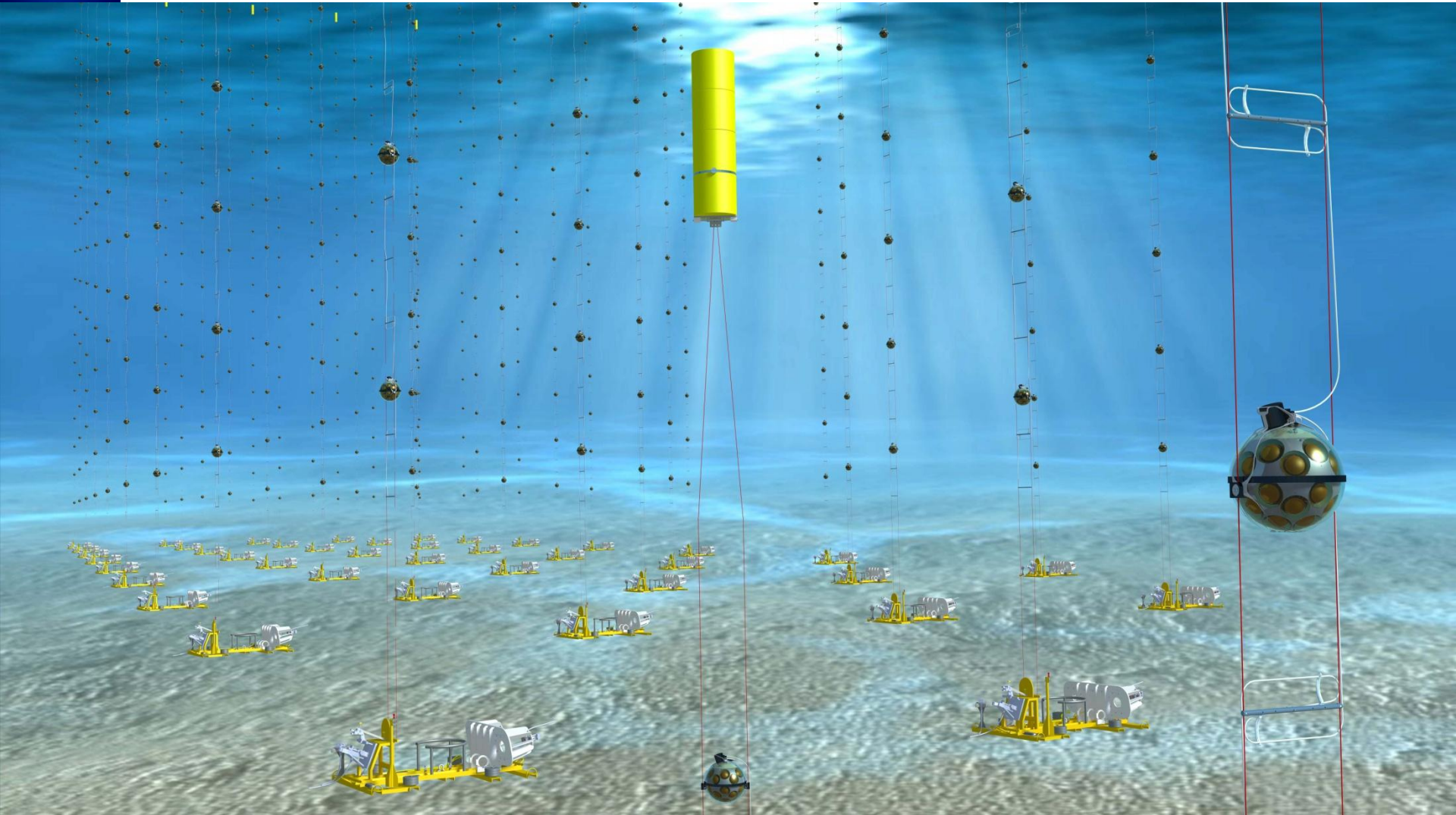
- Acceptance test for the incoming components ;
- Validated and standardized integration procedures;
- Each production step is completed by functional and acceptance tests. Those results are summarized in the “ID Card” of the DU
- All processes are defined according to the KM3NeT QAQC program which defines strict rules to be followed during the integration steps

DU production and deployment: a video impression

<https://www.youtube.com/watch?v=mrSBCB5G3z0&feature=youtu.be>

The Future

At the end..... THE VIEW FROM THE SEA



DU production validation: Results (I)

2 DUs in ARCA site and 1 DU in ORCA site have been deployed

ARCA-DU1 (nominal inter DOM 36 m)



ORCA-DU1 (nominal inter DOM 9m)

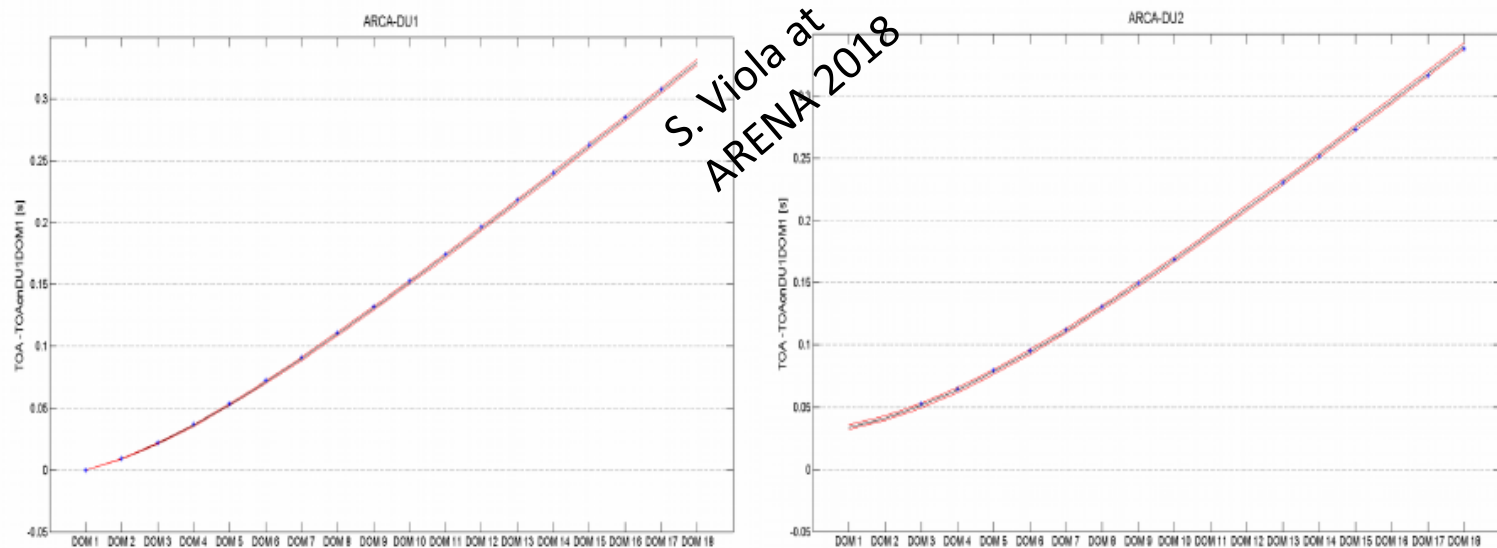


Distance inferred after the ROV inspection

DU production validation: Results (II)

The movement of the DUs due to underwater currents is monitored thanks to “internal” piezo-electric Digital Acoustic Receivers (DAR) glued from the inside to the glass sphere of each KM3NeT Digital Optical Module (DOM)

Time Difference of Arrival (TDoA) measurements in situ are in agreement with the values expected considering the nominal positions of the internal DARs and the typical sound velocity profile.



Figures show the median values in six hours of the difference between ToAs to each DOM operating in ARCA-DU1 (left) and ARCA-DU2 (right) and ToAs to the lowest DOM of DU1. Blue dots represent experimental measurements, the band enclosed by the two red lines refers to the expected time difference, assuming the DUs perfectly vertical and considering the position accuracy of the autonomous acoustic beacon and of the DU bases.

Summary and Conclusions

- KM3NeT Collaboration designed an innovative and effective structure for submarine experiment at high depth
- The Collaboration demonstrated to be able to construct, calibrate and operate a Neutrino Detection Unit
- 2 DUs in ARCA site and 1 DU in ORCA site have been successfully deployed
- The production and the acceptance procedure have been qualified by the good functioning of the DU in the sea

