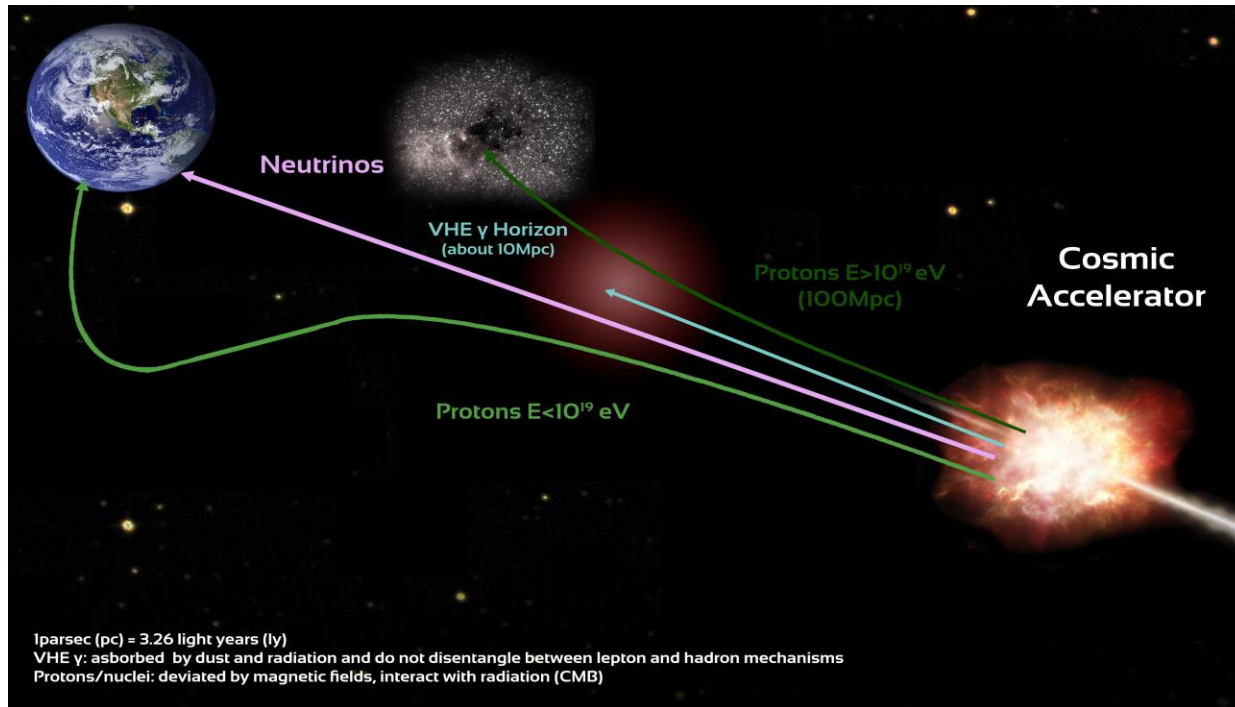




The KM3NeT Neutrino Telescope

Exploring the High Energy universe



ν and γ produced in the interaction of high energy nucleons with matter or radiation

$$N + X \rightarrow \pi^\pm (K^\pm \dots) + Y \rightarrow \mu^\pm + \nu_\mu (\bar{\nu}_\mu) + Y$$

$$e^\pm \rightarrow \bar{\nu}_e (\nu_e) + \bar{\nu}_\mu (\nu_\mu)$$

$$N + X \rightarrow \pi^0 + Y \rightarrow \gamma \gamma + Y$$

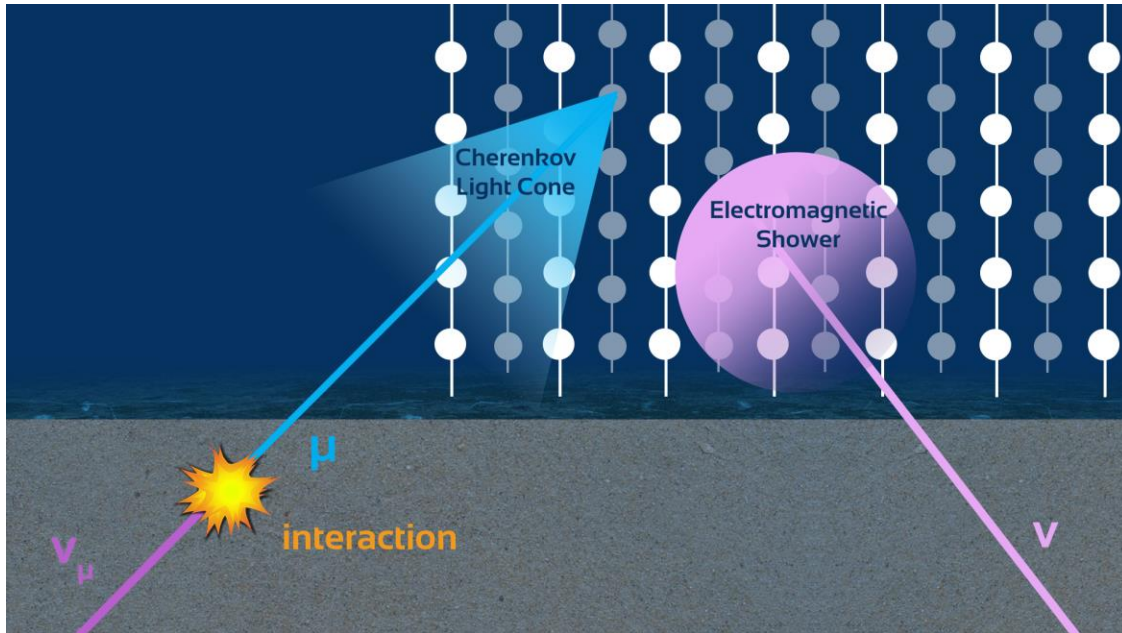
cosmic ray acceleration yields neutrinos and gammas with similar abundance and energy spectra

Neutrinos are unique messengers!

- no interactions with ambient matter or radiation
- no deflection by magnetic fields
- information on the internal processes of the astrophysical sources inaccessible through photons or cosmic rays

You can find more information [here](#)

Underwater Neutrino Telescopes

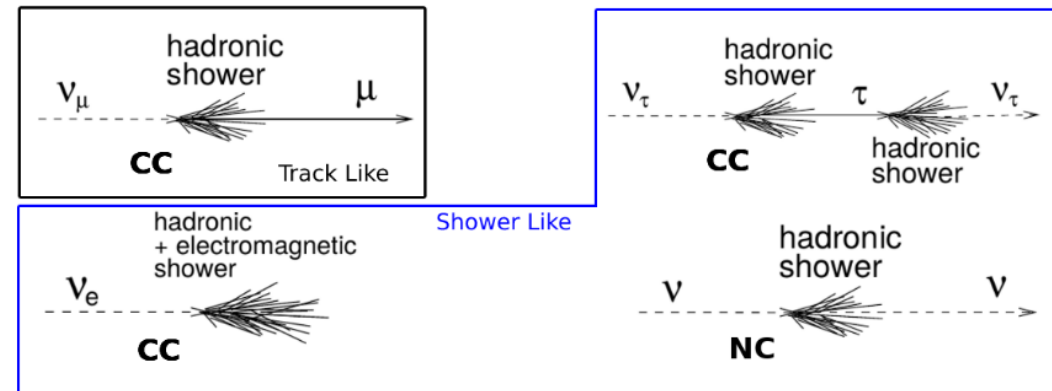


- Upward-going neutrinos interact in rock or water
- Charged particles (in particular muons) produce Cherenkov light in water at 43° with respect to the neutrino direction
- Light is detected by array of photomultipliers
- Muon direction is reconstructed using PMT positions and photon arrival times
- The Earth provides screening against all particles except neutrinos

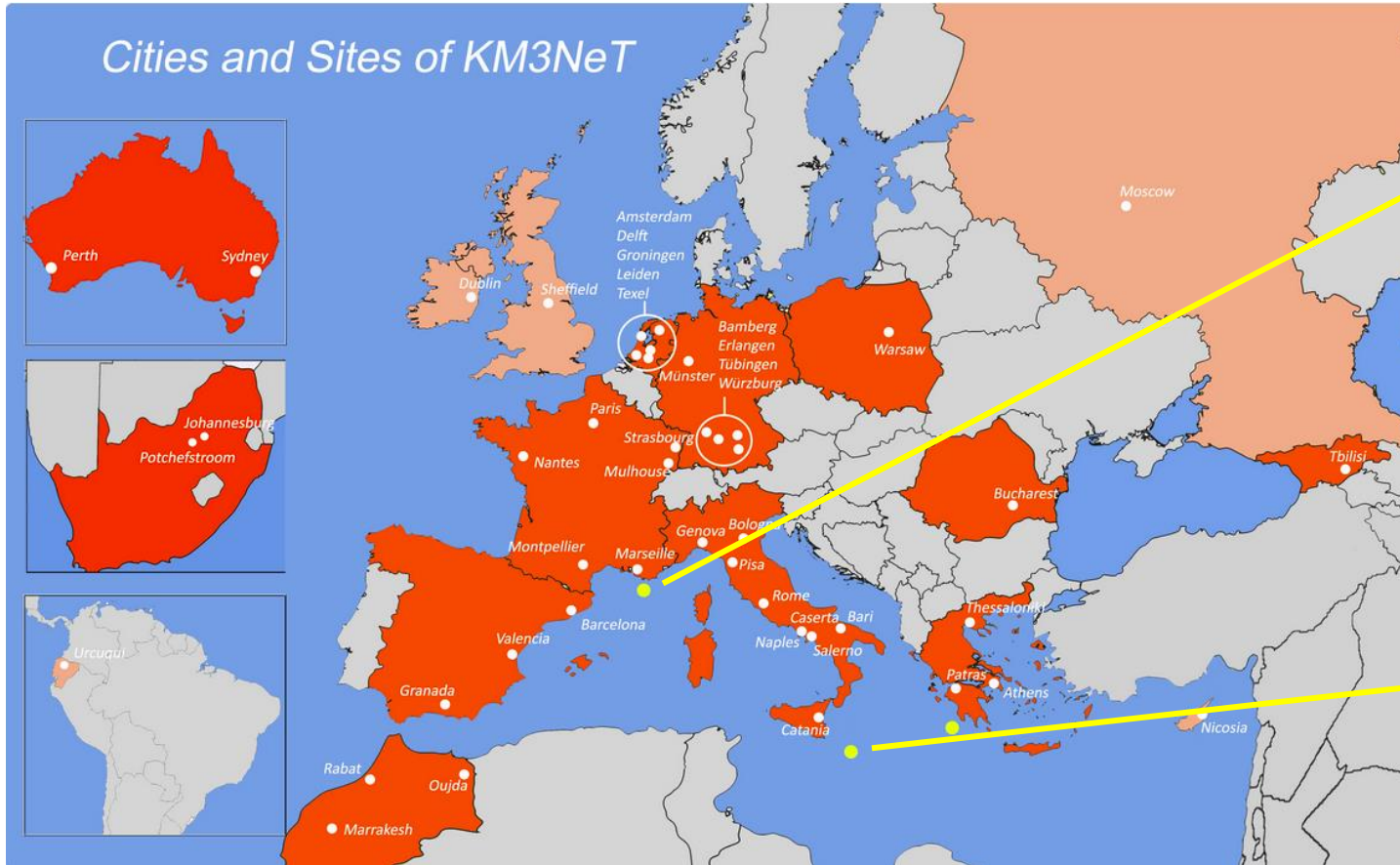
Background sources

- Atmospheric muons & neutrinos: produced by Cosmic Ray interactions in the atmosphere
- Background from ^{40}K decays and from bioluminescence (life forms in the deep sea emitting light)

The different neutrino detection "signatures"



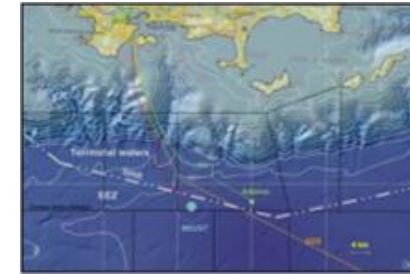
The KM3NeT Collaboration



57 institutes and groups in 47 cities (white dots) in 18 countries (orange) on 4 continents - November 2019

You can see in detail the institutes participating in the collaboration [here](#)

ORCA - Oscillation Research with Cosmics in the Abyss



Low-energy studies of atmospheric neutrinos

ARCA - Astroparticle Research with Cosmics in the Abyss



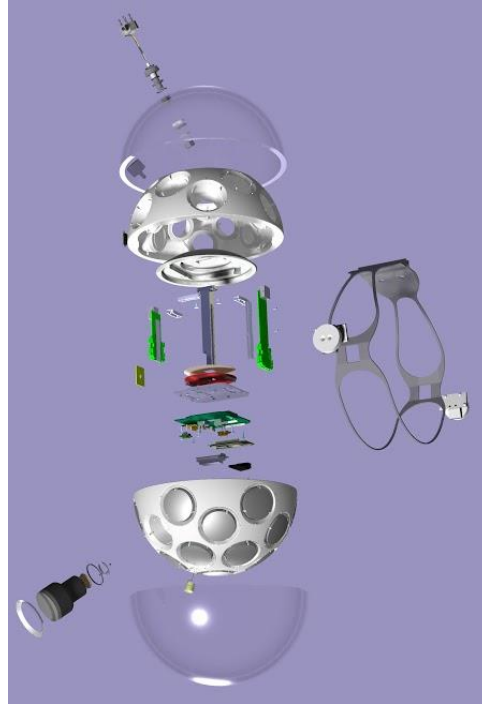
High-energy neutrino astrophysics

The detector components



- Glass sphere
- Cooling system
- Power Board + CLB
- Pressure gauge
- Nanobeacon
- Octopus Boards
- Acoustic sensor
- PMT support structure (3D printed)
- PMTs + reflector rings
- Base Boards
- Penetrator
- SFP
- Fibre tray

Digital Optical Module (DOM)



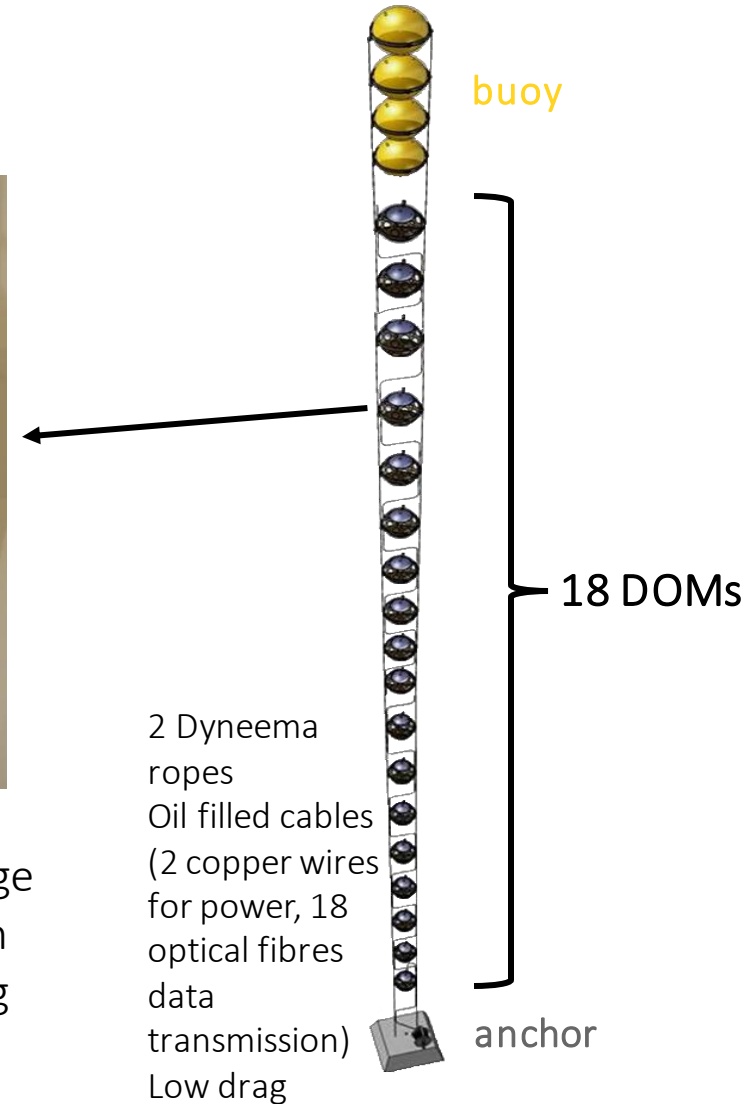
[Here you can find more information about the KM3NeT DOM](#)

17" glass sphere equipped with 31 3" PMTs



Uniform angular coverage
Directional information
Digital photon counting
Wide angle of view

Detection Unit (DU)

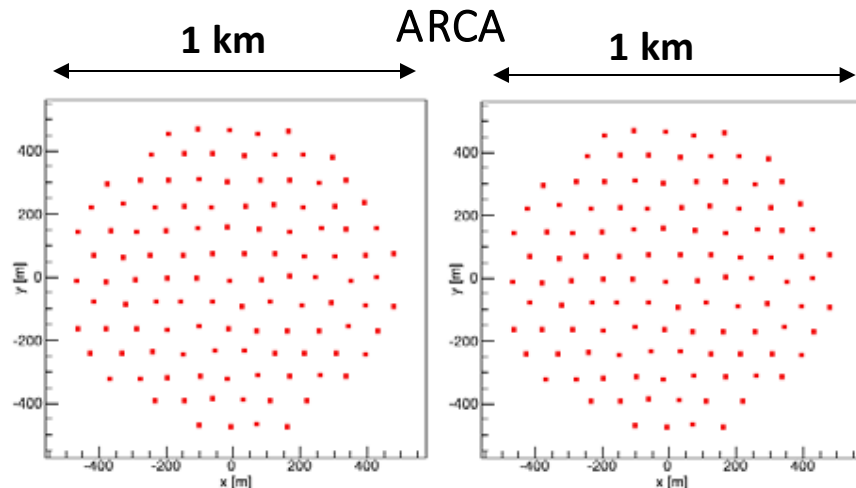
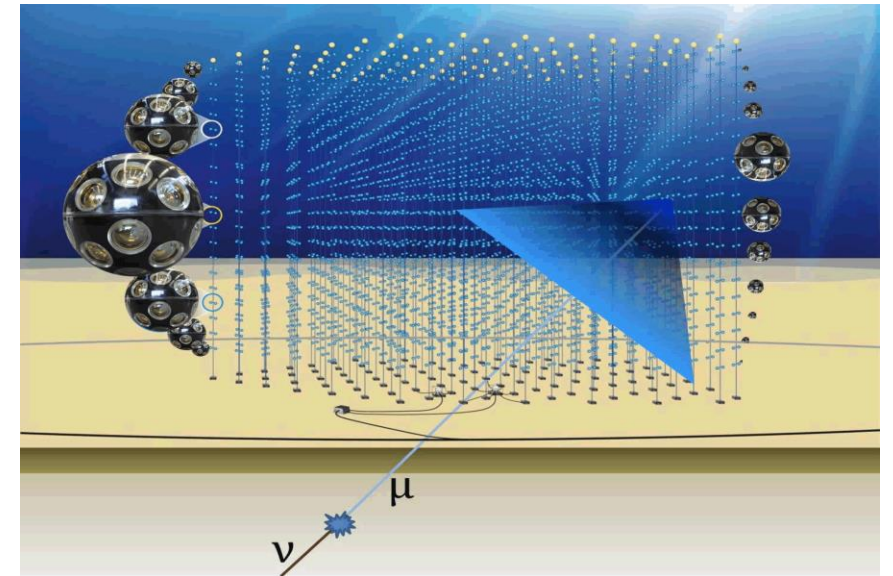


The KM3NeT detectors

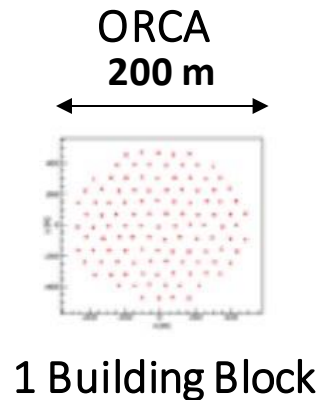
ARCA: Observe high energy (>TeV energy regime) neutrinos from astrophysical sources

ORCA: Determine the ordering of the neutrino mass eigenstates

- Building Block:
- 115 DUs
 - 18 DOMs / DU
 - 31 PMTs / DOM



2 Building Blocks

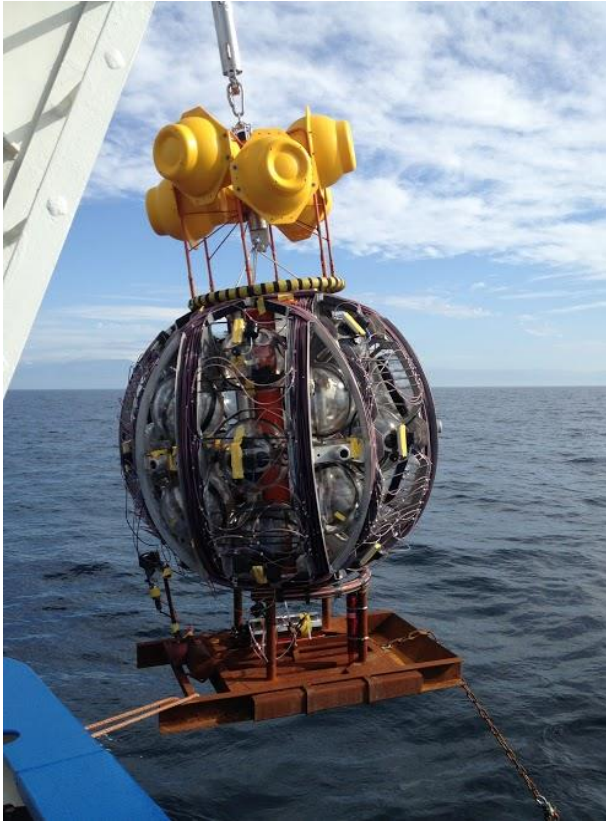


1 Building Block

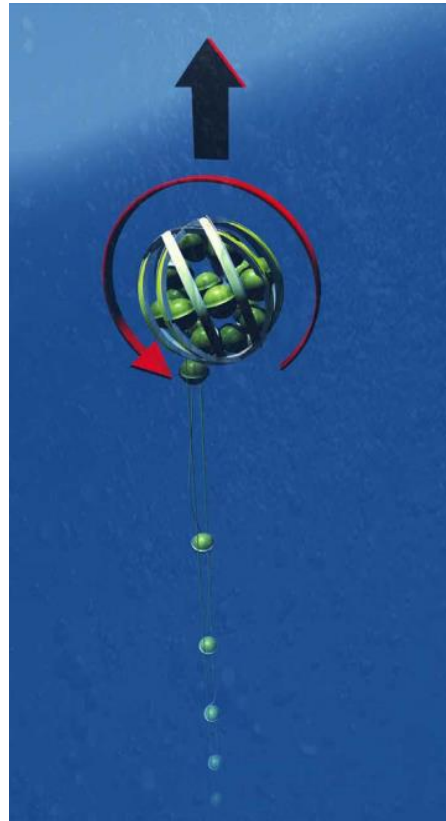
	ARCA	ORCA
DU spacing	~ 90 m	~ 20 m
DOM spacing	~ 36 m	~ 9 m
Depth	3400 m	2475 m

Installation method

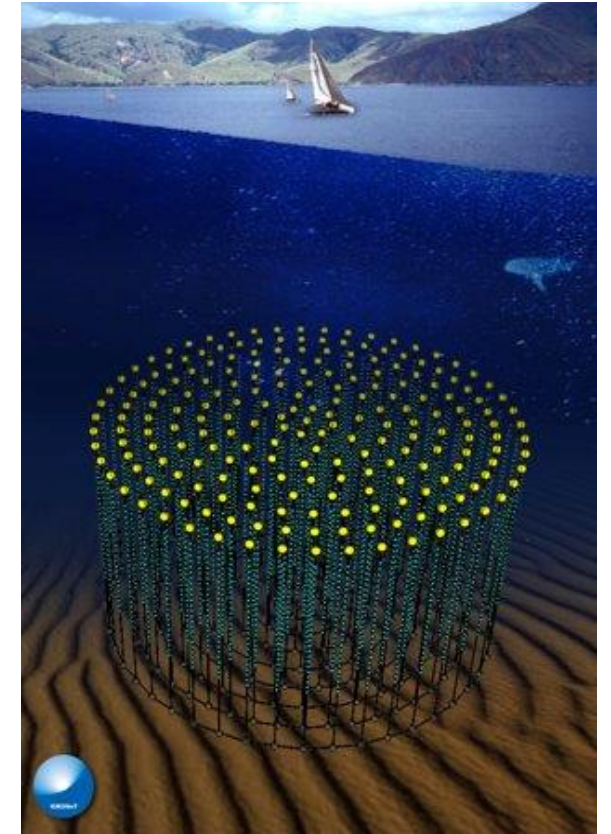
Launcher of DOMs



DU unfurling



X 115



Rapid deployment
Autonomous unfurling
Multiple DUs per sea campaign
Easy recovery – floats to the surface for recycling

You can see a LOM in action [here](#)

Artistic impression of a Building Block

Concerning the data...

Event: The set of information recorded by the infrastructure in a certain time interval, when the criteria that have been set for an event of interest, e.g. the detection of a neutrino interaction near the detectors, are satisfied.

Reconstruction: The process of determining the particle track (vertex position, direction etc.) as well as other parameters such as the particle energy, using the signals recorded in the event.

*[Here](#) you can see some
reconstructed event displays in
the current (9/2020) ORCA
detector that consists of 6 DUs*