NEMO

The goals of the mechanical development for the KM^3

The main goals of the work made by the NEMO collaboration to optimize the design of an ultra deep water submarine neutrino detector were the followings:

- ✓ **Reduce the cost to instrument a km^3 detector by means of;**
  - ➢ Use of towers, that permit to enlarge the spacing between the vertical structures
  - ➢ Realization of a modular layout for the detector;
  - ➢ Utilization of composite material;
- ✓ **Reduce the maintenance costs of the detector by means of:**
  - ➢ Study of innovative connection methods;
- ✓ **Simplify the deployment operations of a 3D structure;**
- ✓ **Avoid mechanical stresses on the electro-optical cables during the deployment and the lifetime of the detector;**

WHY TO USE TOWER STRUCTURES

A tower structure seems to have good capabilities of local tracks reconstruction with respect to a string like structure

It permits to reduce the number of vertical structures

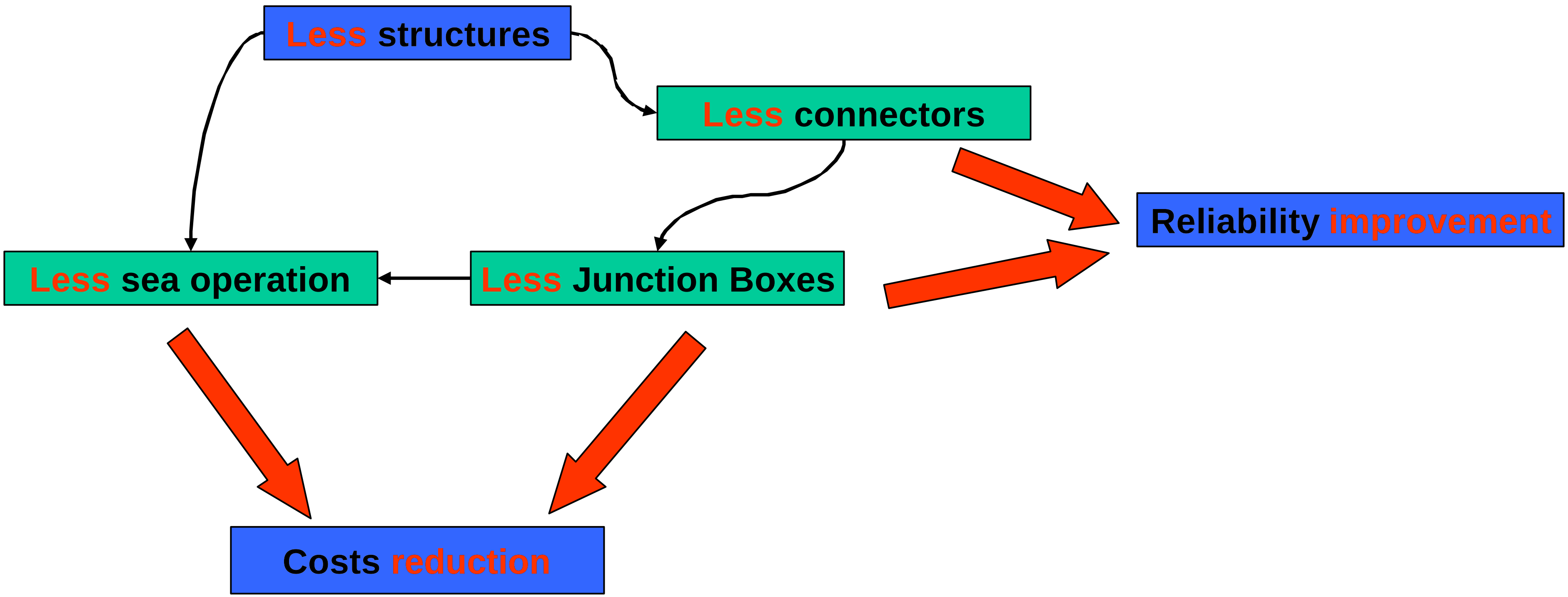
(see P.Sapienza talk)

64 ¸ 80 towers allow to obtain ~ a 2 km^2 effective area

The same area can be achieved only with a detector made by 400 ¸ 500 strings having a spacing of 60m

The gain is a great costs reduction and reliability improvement compared with an “homogeneous lattice” detector having similar performances

STRUCTURE REDUCTION EFFECTS



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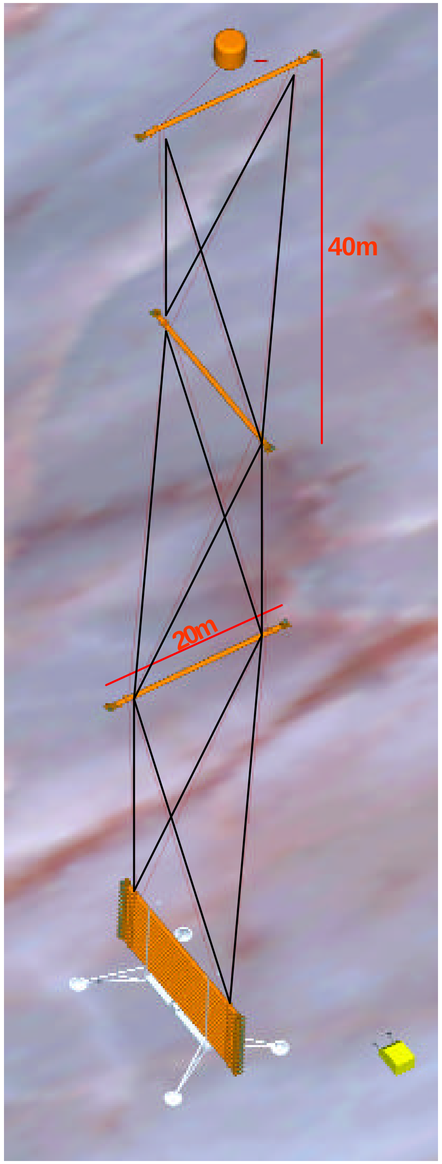
Current configuration of the NEMO proposal for a tower



The supports for the PMT are made of pipes in Glass Reinforced Plastic (GRP) interconnected by means of synthetic fiber ropes.

The employ of a composite material allow a great costs reduction for the raw material supply

Using commercial measures, GRP pipes can be found at very low costs.

The diameter of the pipes is 0.45m and its thickness is of 5.9 mm. The length of a storey is 20m

Each level of the tower is distanced with respect to the previous and the next one of 40m.

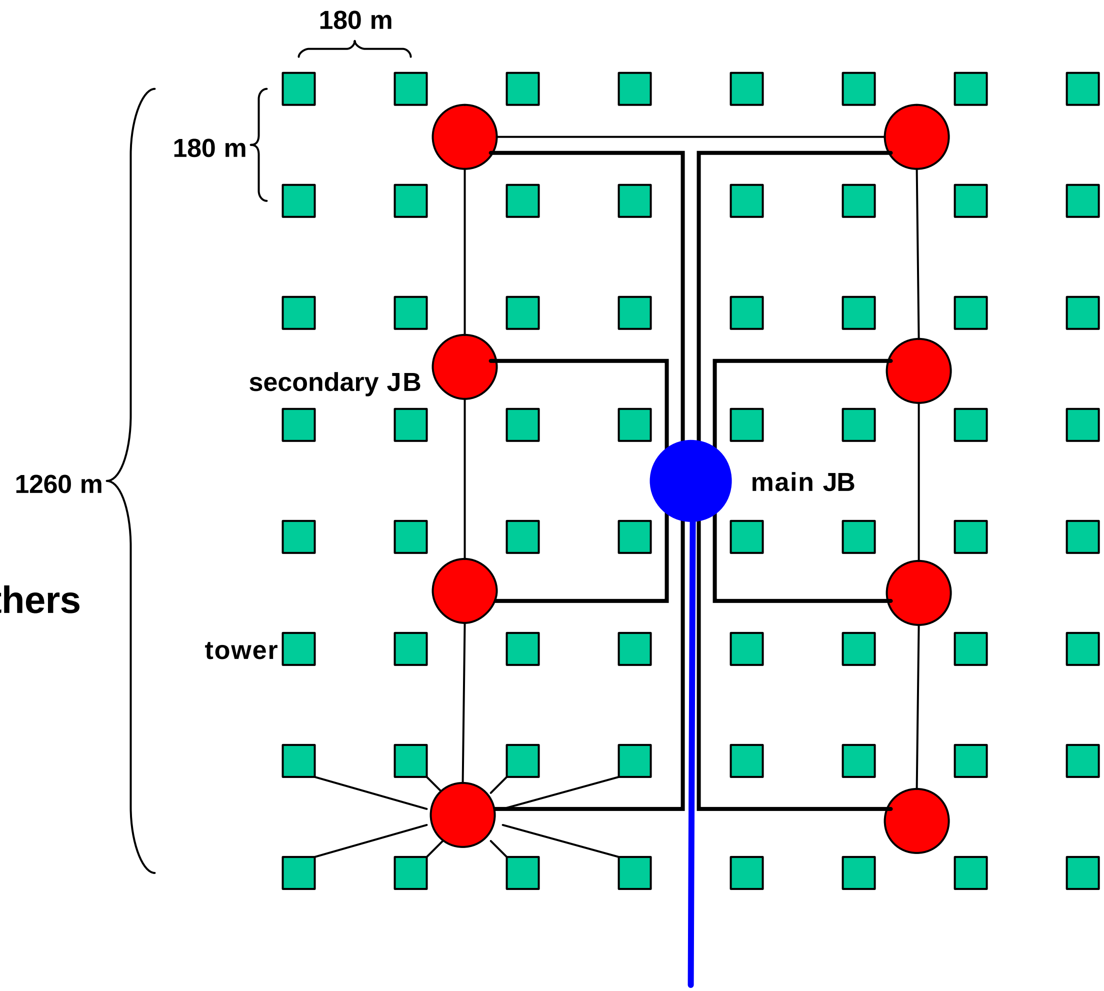
Moreover it is rotated around the vertical axis of 90 degrees.

It is possible to modify, with some boundary conditions, the specific weight of the GRP in order to make the storey neutral in water.

NEMO

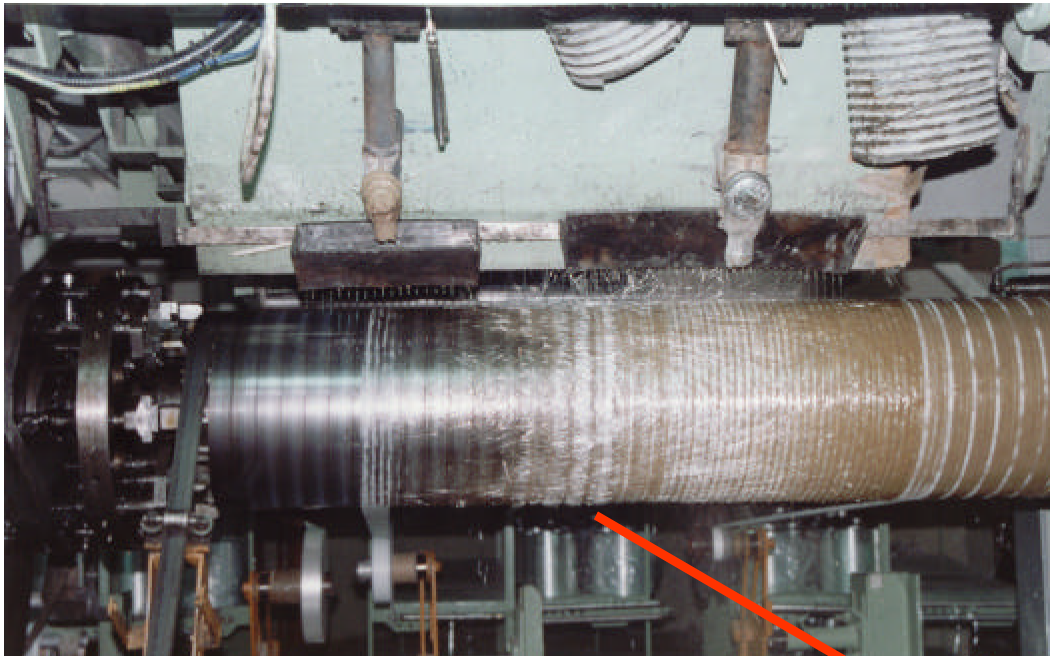
current proposal of general layout for Km^3 detector

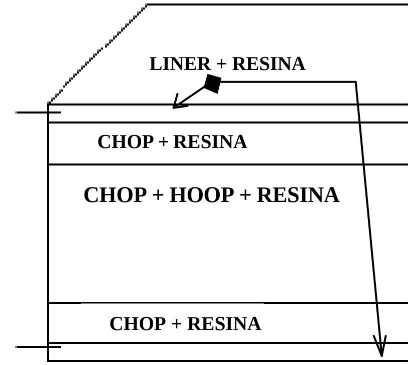
- n. 1 main Junction Box
- n. 8 ¸ 10 secondary Junction Box
- n. 64 ¸ 80 towers
- ~180 m between each row and the others
- ~180 m between each columns and the others
- 16 storeys for each tower
- 64 PMT for each tower
- > 4096 PMT

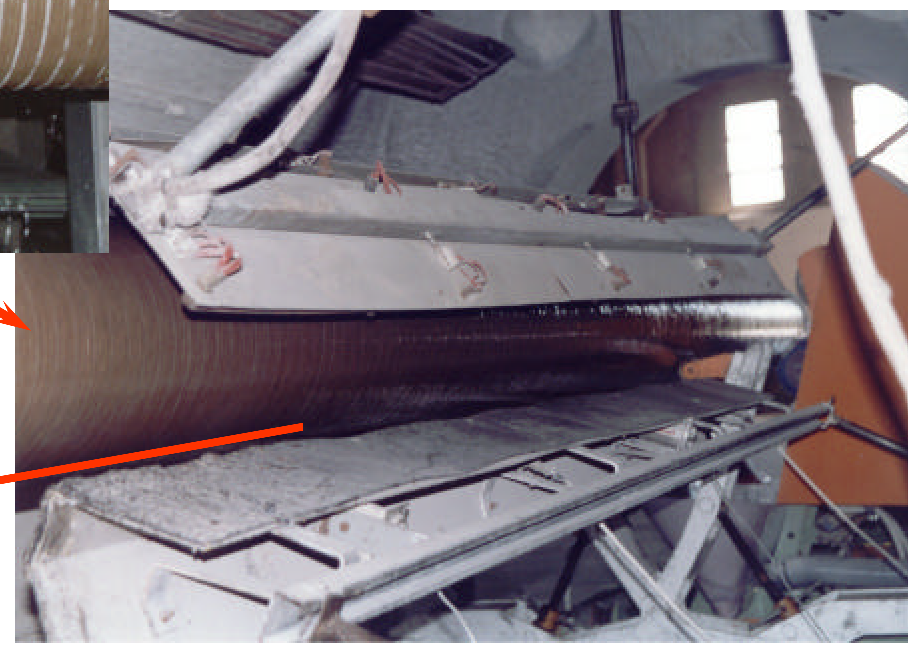


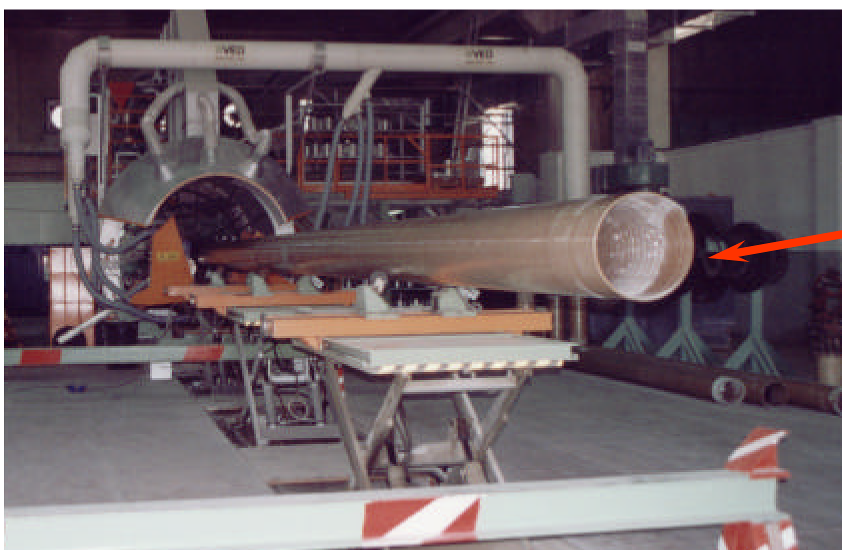
main electro optical cable
- 48 optical fibers
- 3 or 4 electrical conductors

The pipe production method used by the VED company







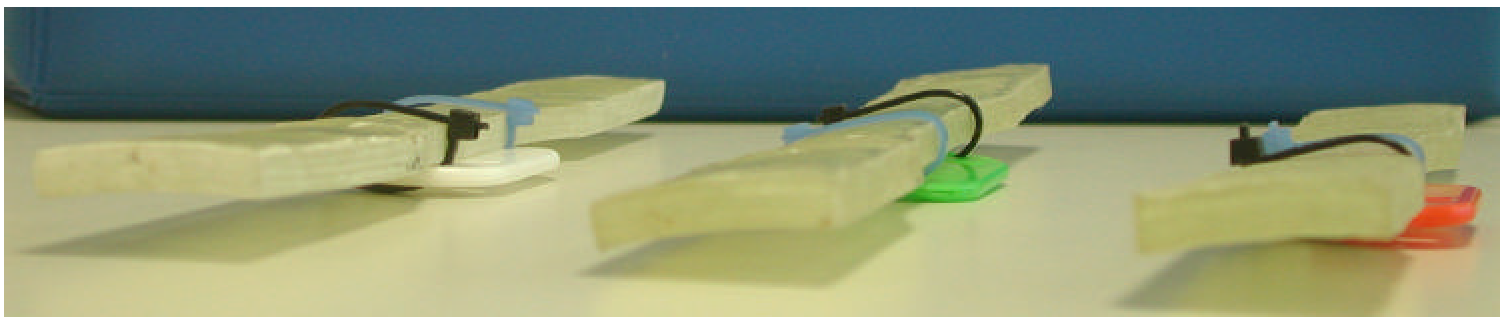


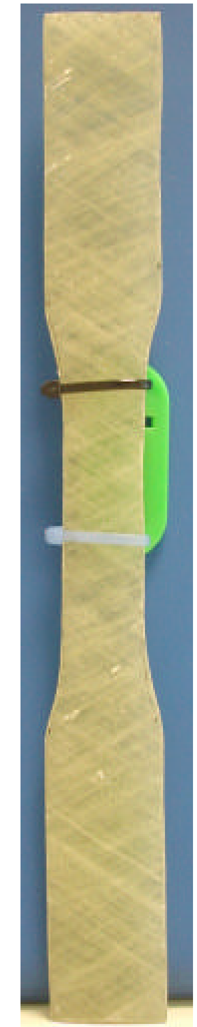
Studies on the behavior of the GRP in ultra deep sea water

Three different kinds of GRP samples were immersed for several months at 3000 m depth in sea water

After the recovery the samples were weighted to estimate the water absorption

Moreover they were subjected to load tests to estimate any changing in mechanical resistance



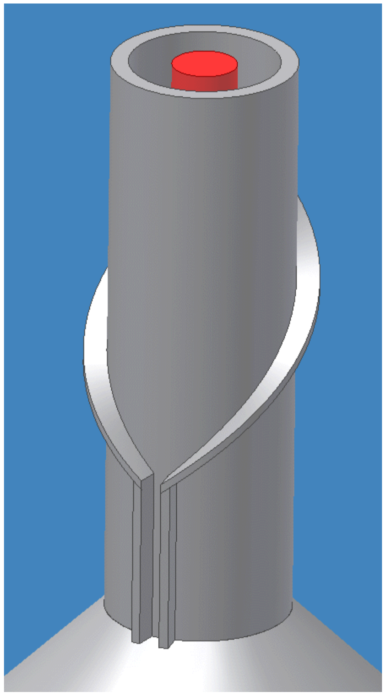


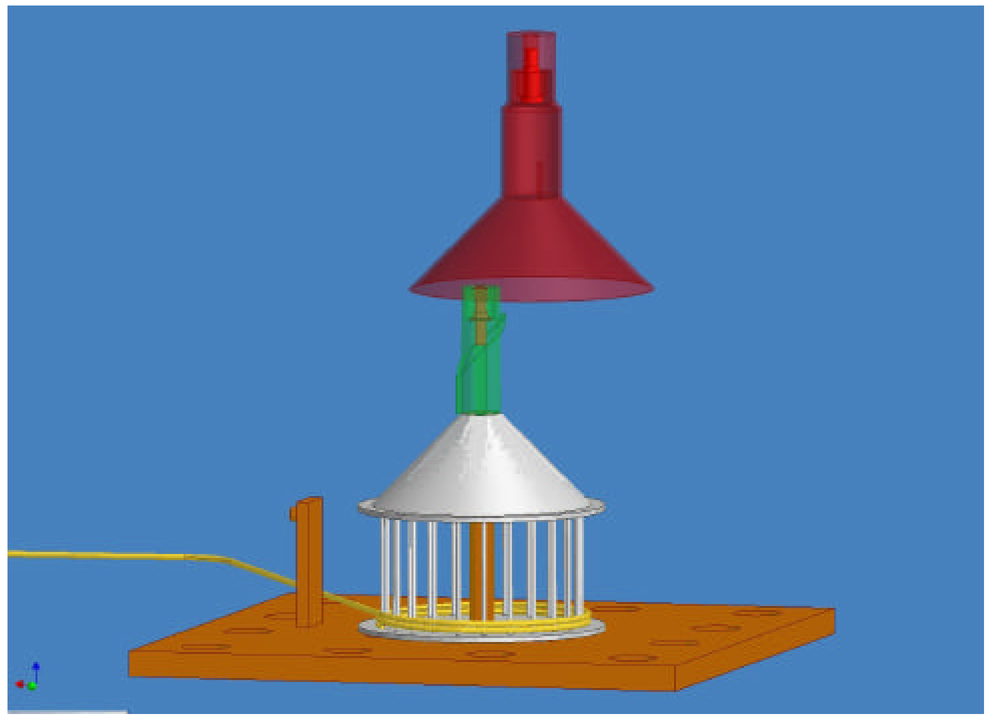
The samples were obtained by cutting a commercial GPR pipe

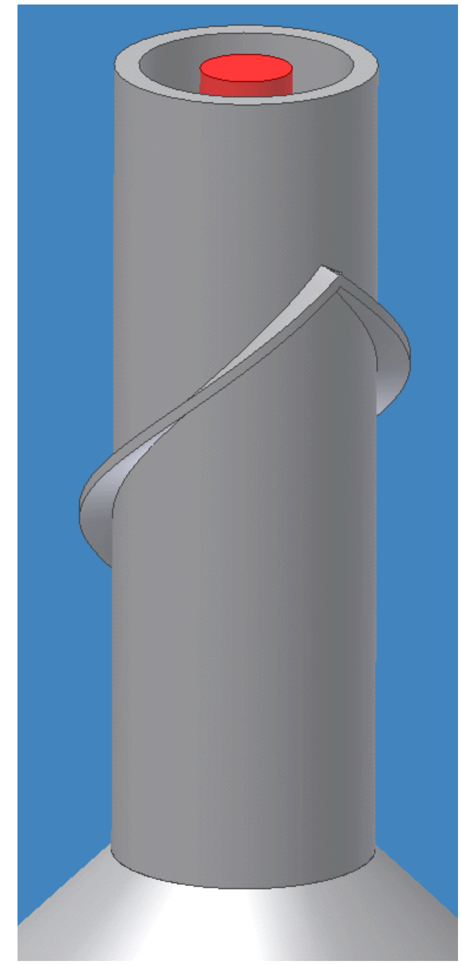
The samples differed for the external coating treatment:

- white one was not closed with a protective liner on the cutting surfaces;
- green one was closed with a protective liner on the cutting surfaces;
- red one was covered with an extra layer of protective liner on the entire external surface.

A possible self connecting system

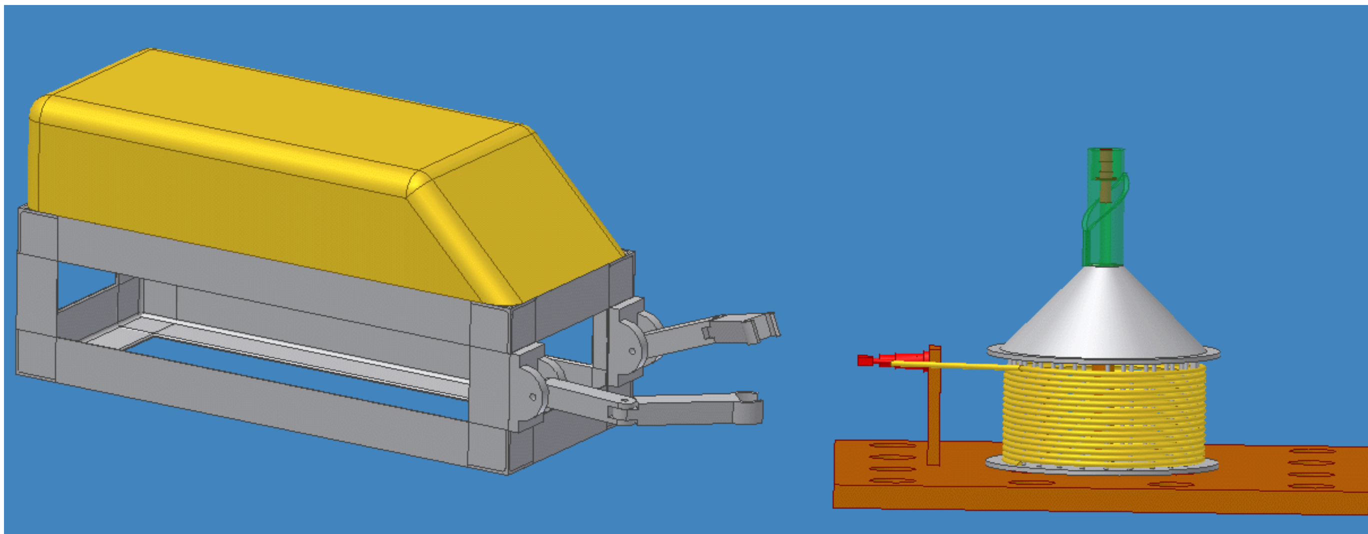




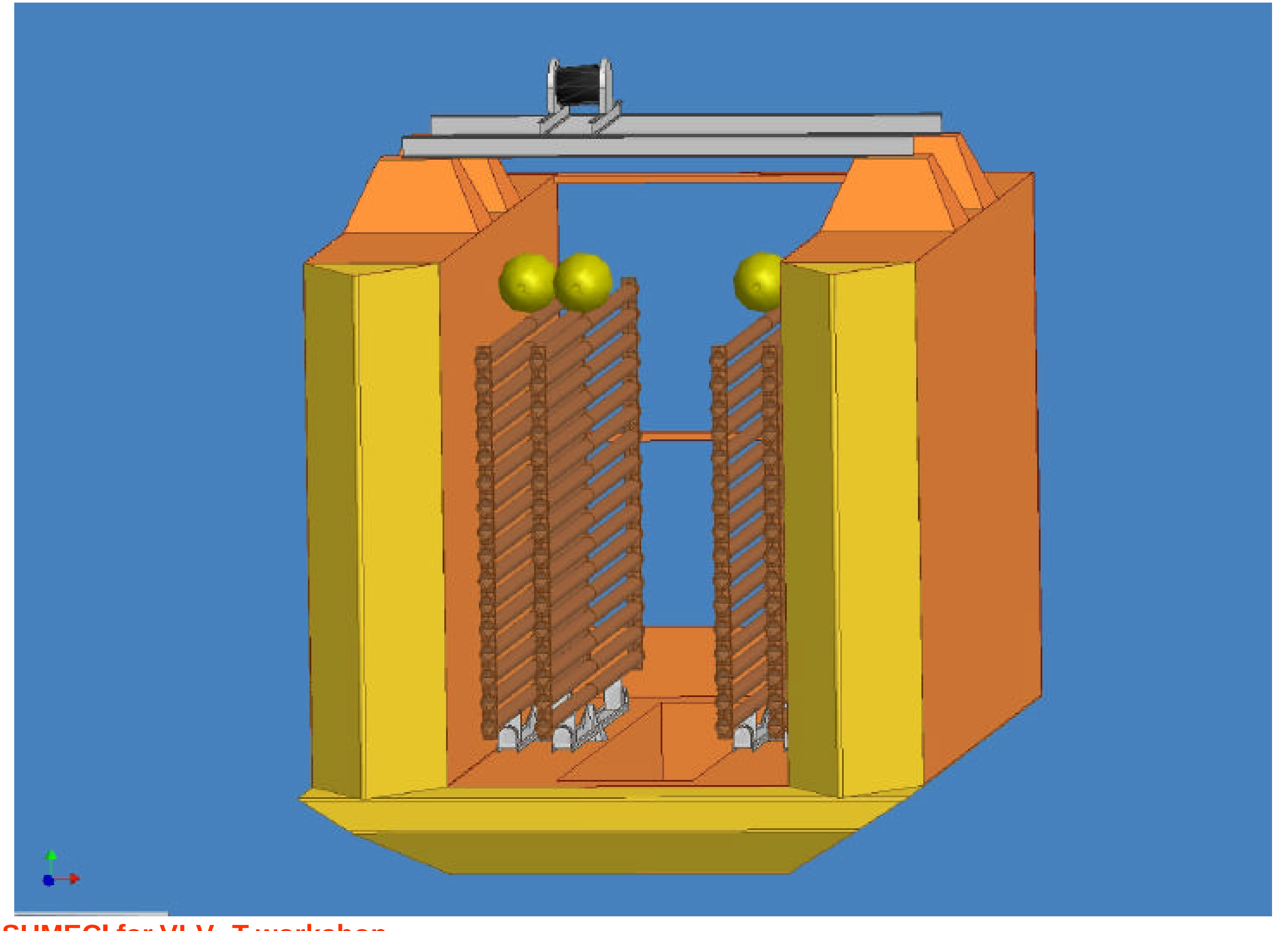


Using the self connecting system ROV operations should be reduced to the installation phase of the underwater network only.

Great advantages could be obtained in terms of costs reduction during the maintenance of the detector.

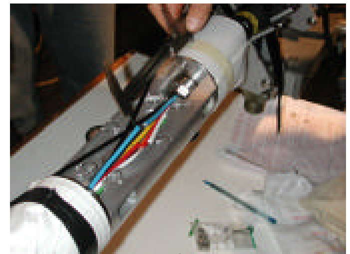


A vessel like the one showed could permit to drop the structures without stress induced by seawaves.



NEMO FASE 1

Shore station at the Catania port



2.330 m double armed cable

20.595 m single armed cable

JB

BU

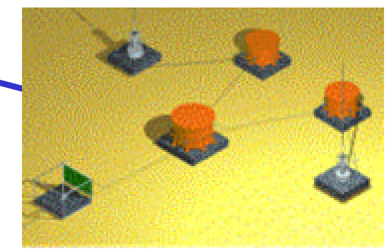
JB

JB

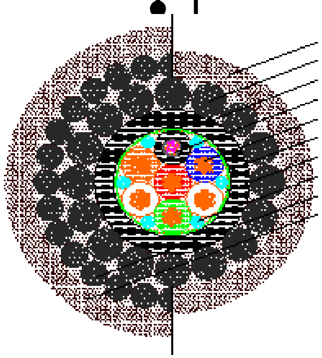
GEOSTAR electro optical cable 5.220 m

NEMO electro optical cable 5.000 m

GEOSTAR



Underwater lab



Cable main features

10 optical fibres standard ITU- T G-652

4 electrical wires Φ 4 mm^2