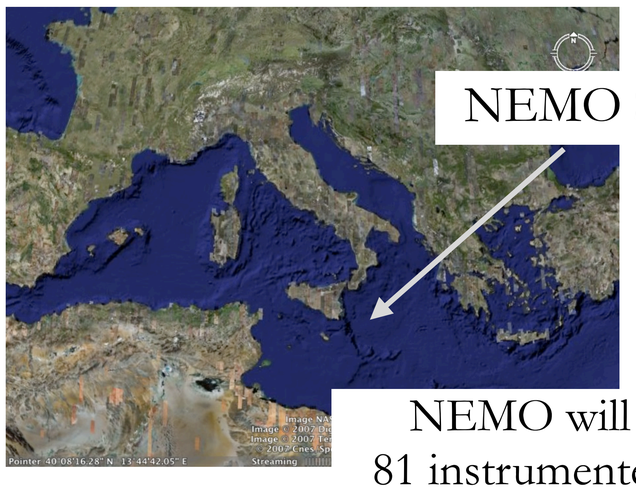
A. Bersani, on behalf of the NEMO Collaboration

INFN Sezione di Genova, via Dodecaneso 33, I-16146 Genova, Italy

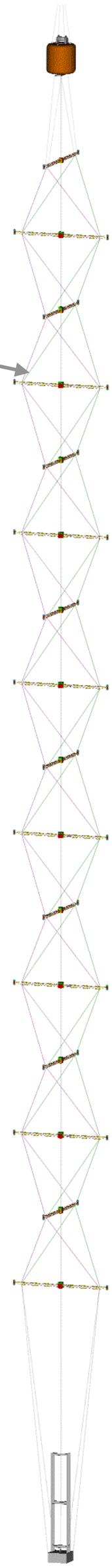
A new Direction-Sensitive Optical Module to be employed in Deep-sea Neutrino Telescopes.

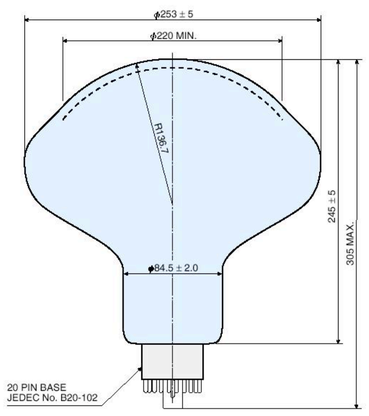
Abstract

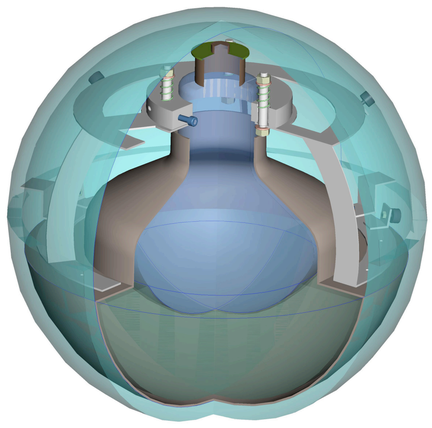
The NEMO (NEutrino Mediterranean Observatory) Project studies new technologies for the construction of a km^3-scale neutrino telescope in the Mediterranean Sea, in the KM3NeT framework. The telescope goal is the investigation of the high energy component of the cosmic neutrino spectrum: this is a promising tool to better understand the mechanisms that originate the extreme energy cosmic rays.
Neutrino energy and direction is reconstructed collecting the Cherenkov light produced in water by the muon coming from a neutrino interacion.
Two prototypes of a new large area (10") 4-anodic photomultiplier, studied by INFN Genova Division, and manufactured by Hamamatsu, on purpose of the NEMO Collaboration, will be used for the first time to detect the direction of the detected Cherenkov light at the NEMO Capo Passero site.



NEMO will feature
81 instrumented towers
- ~ 600 m high
- 16 floor, 4 PMT per floor







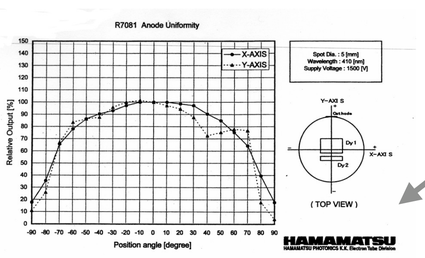
Standard Optical Module Features:

- a 17" pressure resistant glass sphere
- a Hamamatsu R7081-20 10", high gain PMT (or equivalent)
- electronics for readout and signal conditioning

A Direction Sensitive OM is presented here:

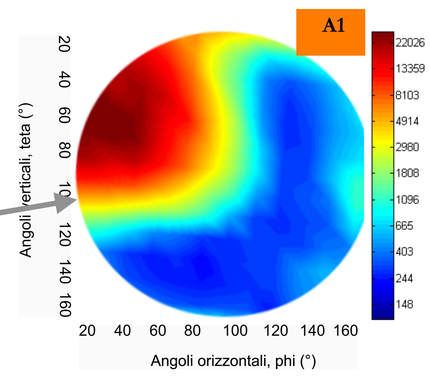
- the same 17" pressure resistant glass sphere
- a 10", 4-anodic, high gain PMT coupled to the sphere with a proper plexiglas light guide,
- redesigned electronics to be compatible with standard readout

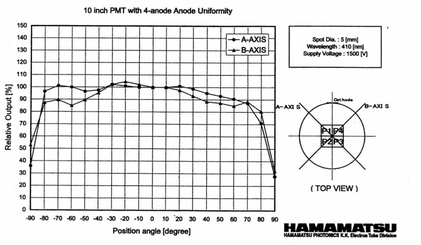
10" 4-anodic Hamamatsu Prototype Performances

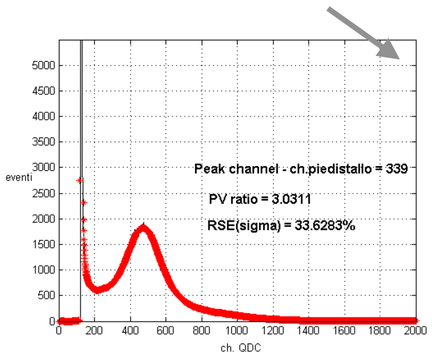


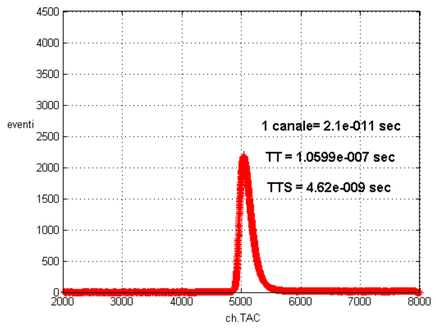
Response was measured at Hamamatsu and INFN LNS:

- ~20% more light than the standard 10" PMT
- a very good focusing was achieved (cross talk ~ 1%)
- peak to valley ratio is slightly better than conventional PMT
- transit time spread is equivalent to single anode PMT



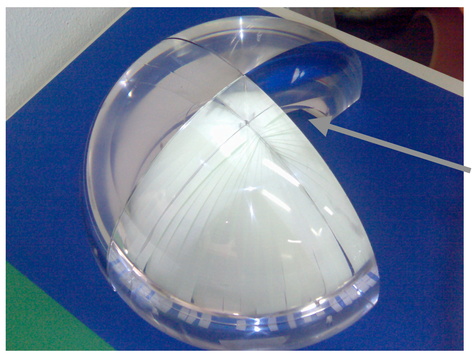




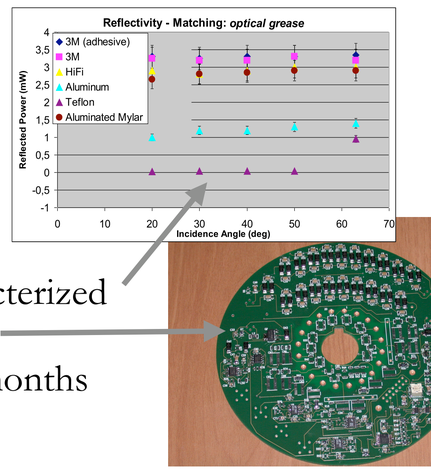


	Detector Requirement	Conventional R7081-20	Multianodic Prototype
Nominal Voltage	< 2000 V	1340 V	1550 V
Gain	5.00E+07	5.00E+07	5.00E+07
Peak to Valley Ratio	> 2	2.8	~ 3
Dark Noise	< 10000 Hz	910 Hz	~1200 Hz
TTS	< 4 ns	3 ns	~ 4 ns

OM Integration is Underway in Genova

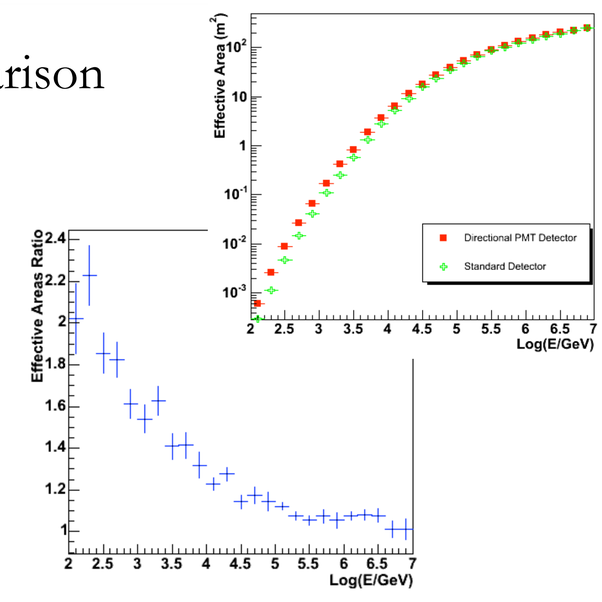


- The light guide was designed and realized
- Several different materials to do the reflective coating were characterized
- A dedicated voltage divider and signal preprocessor was realized
- The prototype OM will be integrated and measured in the next months



Final Performance Comparison

- Several calculations of the effect of the directional OM on the km^3 telescope were done
- A dedicated study to optimize the performaces is needed
- A significant improvement, up to a factor of 2 at low energies, was already achieved



Perspectives and Acknowledgments

- A prototype for a directional OM for undersea neutrino telescopes was developed in Genova INFN Division, in the framework of the NEMO Collaboration, as an R&D for KM3NeT
- Reconstruction code optimization is underway, and preliminary results are very encouraging
- Two prototypes will be installed in NEMO Capo Passero site
- This work was realized in collaboration with INFN LNS
- We thank Katia Fratini, Mauro Taiuti, Vladimirt Kulikovsky for the valuable help