Observation of the atmospheric neutrino flux with the first detection units of KM3NeT/ORCA

Luigi Antonio Fusco[1+], Jannik Hofestädt[2], Dimitris Stavropoulos[3]
on behalf of the KM3neT Collaboration

[1] CPPM, Marseille [2] ECAP, Erlangen [3] NCSR Demokritos, Athens
[+] luigi.fusco@cppm.in2p3.fr

The KM3NeT Detector

KM3NeT [1] is the next generation large volume neutrino detector in the Mediterranean Sea.

The **KM3NeT/ORCA** apparatus, currently being constructed off the coasts of Southern France, will be devoted to the study of neutrino physics using atmospheric neutrino oscillations.

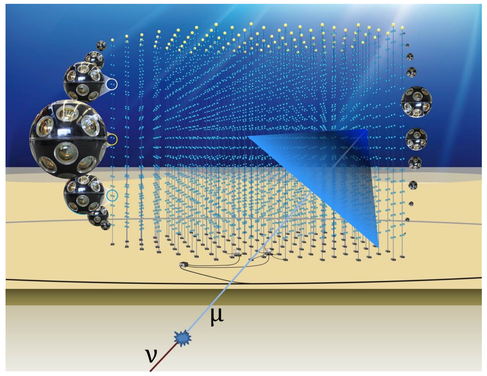
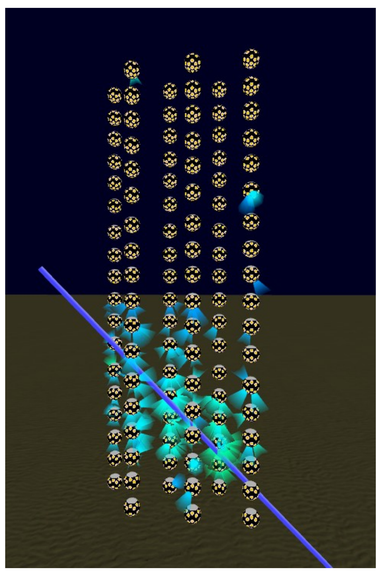


Figure 1. *Artist view of the KM3NeT design building block, made of 115 DUs, with a zoom on the DOMs, the fundamental constituent of the detector apparatus. A neutrino-induced muon producing Cherenkov light is also shown.*

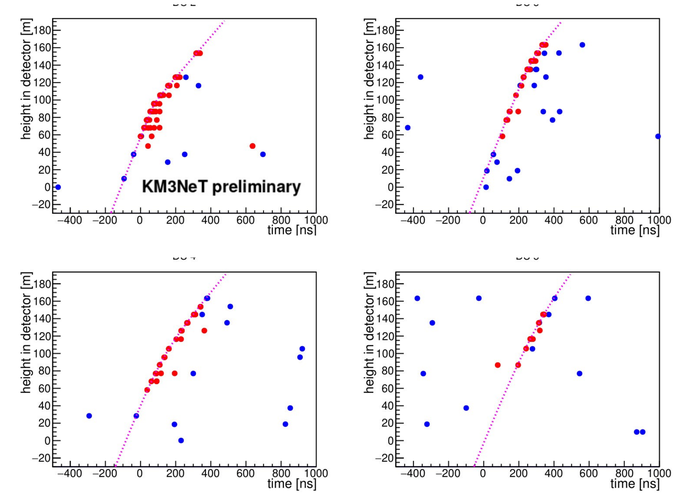


6 Detection Units (**DU**s, vertical strings hosting multi-PMT Digital Optical Modules, **DOM**s) are currently taking data. The final detector configuration will be composed of 115 DUs, over a volume of ~8 Mton

Figure 2. *3-D event display of an event passing through the ORCA6 DU detector. The Cherenkov photons illuminating the PMTs are depticted together with the muon track track.*

Data sample and Neutrino selection

4.5 months of **high-quality KM3NeT/ORCA data** acquired with 4 active DUs between July 2019 and January 2020 have been considered. **Neutrino-induced track-like** events, reconstructed as upward-going, allow for a **99%-pure neutrino sample** with and event rate of **2-3 ν/day**.



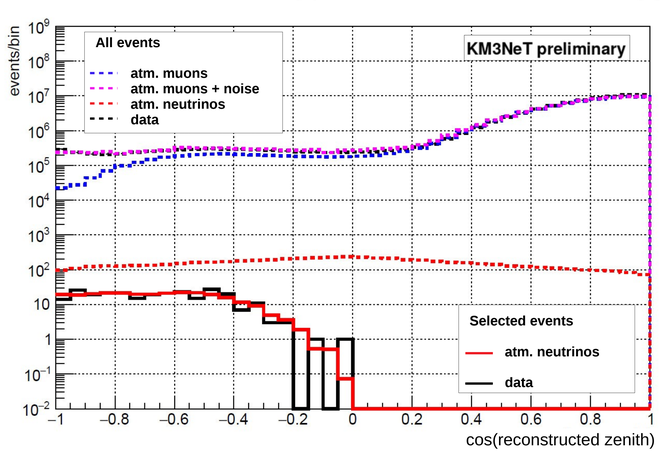


Figure 3. *Top: Hit pattern in z-t for a selected upgoing neutrino event in the 4 ORCA DUs. Bottom: reconstructed zenith distribution before and after selection cuts.*

First neutrino oscillation results

A refined event selection [2] has been used to study neutrino oscillations. **KM3NeT/ORCA** data favours the hypothesis of oscillations at a significance level of roughly 2σ by measuring the zenith-dependent differences in track-like event rates.

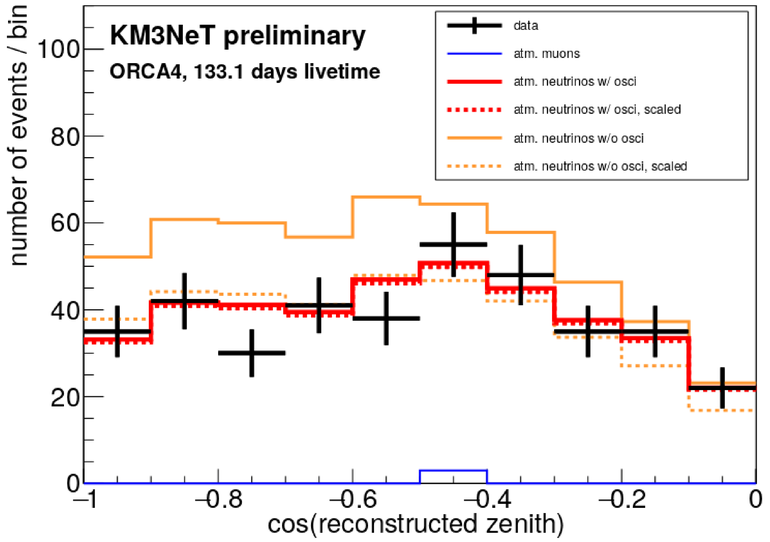


Figure 4. *Effect of neutrino oscillations on the zenith distribution of the selected neutrino sample. Oscillations induce a ~30% decrease in the number of detected events, more evident for vertical upgoing reconstructed zenith.*

Additional data, collected with 6 DUs, is being analysed; events reconstructed as **shower-like** are being included; **Particle Identification** is being implemented, aiming to improve the upcoming studies of neutrino oscillation physics [3].

References

[1] https://www.km3net.org
[2] J. Hofestädt et al. (KM3NeT Collaboration), PoS **(ICRC2019)** 910
[3] B. Strandberg, S. Hallmann (KM3NeT Collaboration), PoS **(ICRC2019)** 1019