Atmospheric neutrino candidates from the first detection units of the KM3NeT/ARCA detector

Anna Sinopoulou
INPP, NCSR “Demokritos”

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• The KM3NeT/ARCA detector

• Objective & motivation

• *Analysis performed at INPP*

• *Description of atm. muon background & atm. neutrino candidates*

• Conclusions
The KM3NeT-ARCA detector

KM3NeT is a research infrastructure in the Mediterranean Sea that will host neutrino detectors.

The ARCA detector will consist of 2 blocks with 115 Detection Units (DUs) each, with 90 m distance between them.

The DU is a vertical slender string equipped with 18 Digital Optical Modules (DOM) 36 m distant. Each DOM consists of 31 3” PMTs.
KM3NeT-ARCA: First Data

Data from the first 2 KM3NeT/ARCA DUs presently analyzed.

Currently the detector is in the construction phase and its configuration is too small to allow the detection of astrophysical neutrinos.

Atm. Muons & Atm. Neutrinos constitute the background for neutrino telescopes.
Data events are reconstructed and compared with the reconstructed events of atmospheric muon & neutrino MC. This is a necessary step for checking, controlling and verifying the detector operation in both hardware and software.

Analysis focuses on:

1. Finding and optimizing requirements for selecting well reconstructed events
2. Finding selection criteria to identify neutrino event candidates

Analysis based on reconstructed events and triggered hits
As expected most of the events are reconstructed as downgoing (flux of atmospheric muons).

The bulk of events with coszen < 0 are considered as misreconstructed atmospheric muons.
• Topological, statistical and reconstruction quality requirements were investigated.
• Due to the current detector configuration – the height of each DU is \( \sim 600 \text{m} \) while the distance between the 2 DUs is 90m – zenith dependence.

A final sample of 6 topological, 1 statistical and 2 reconstruction quality requirements is applied.
 Zenith distribution – Final Sample

- Misreconstructed events (atm.muons as upgoing) are suppressed by \(99.9992\%\) in the final sample.
- The reconstruction quality (\(\Delta\theta\)) is improved for both atm.muons and atm.neutrinos to 51\% (24\% before) and 45\% (14\% before) respectively.
- **Upgoing atmospheric neutrinos**: \(\cos\text{zen} < -0.8\).
Atm. Neutrino event candidates

**KM3Net preliminary**

**ARCA2, 53.2 days livetime**

**Neutrino Candidates for cos(zen) < 0.8:**

- **Data:** 6
- **ν MC:** 3.3
- **μ MC:** 0
DOMs with hits
DOMs with triggered hits

event=4319, run=5009, #hits=74, cos(zenith_reco)=-0.932

DU 1

DU 2
Conclusions

• Data from the first 2 KM3NeT/ARCA DUs presently analyzed. Use the atmospheric background in order to validate the detector performance.

• Events are reconstructed and requirements are investigated and applied for:
  • Selecting well reconstructed events.
  • Finding selection criteria to identify neutrino event candidates.

• The reconstruction quality of the final sample is improved (from 14% to 45% for atmospheric neutrinos). A powerful reduction (99.992%) of misreconstructed events is achieved.

• 6 atmospheric neutrino candidates in 53.2 days from the data of the first 2 KM3NeT/ARCA DUs.

• The results of this analysis were presented in the International Cosmic Ray Conference – ICRC 2019
  https://pos.sissa.it/358/910/pdf
Thank you for your attention!