Atmospheric neutrinos with the first KM3NeT/ORCA data and prospects for measuring the atmospheric neutrino flux

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KM3NeT

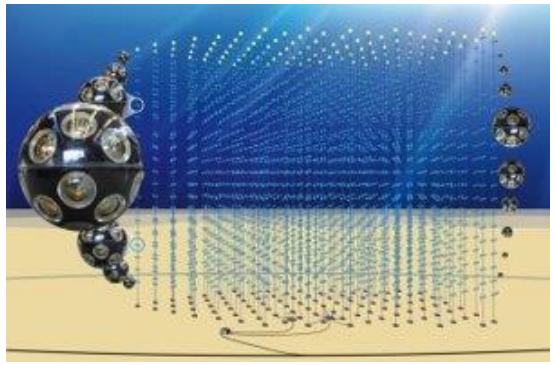
DEMOKRITOS

Nikhef

CENTRE DE PHYSIQUE DES PARTICULES DE MARSEILLE
CPPM

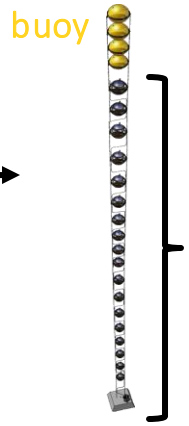
The KM3NeT/ORCA detector

- 40 km offshore Toulon, France, at a depth of 2450 m
- ORCA: Oscillation Research with Cosmics in the Abyss → Main goal: Determine the Neutrino Mass Ordering



115 DUs

Detection Units



18 DOMs

Digital Optical Modules

→ 31 • 3" PMTs

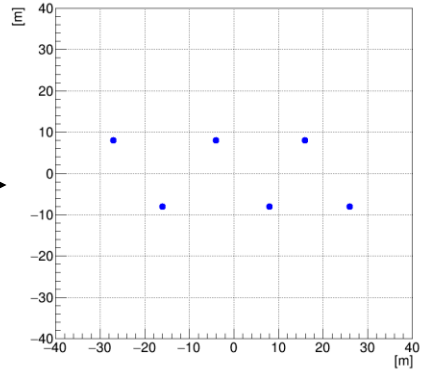
Neutrino Detection from Cherenkov radiation induced by the daughter particles

Sensitivity in an energy range above a few GeV; measurement of the atmospheric neutrino flux in that range → *Test of Cosmic Ray models*

Current Status:

- 6-Detection Unit configuration (ORCA6) since January 2020
- Instrumented volume of ~ 136 kton

DU footprints →



Selection of atmospheric neutrino events

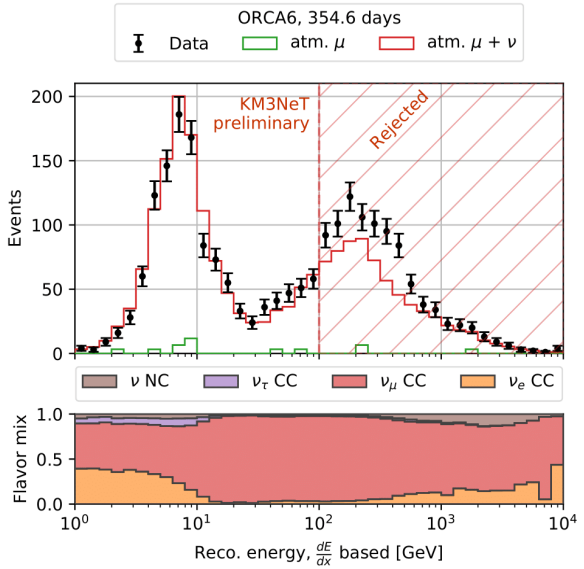
- Data collected from February 2020 to March 2021
- 92% time efficiency with respect to the full time period

} ***Data sample equivallent to 354.6 days***

Monte Carlo (MC) simulation for atmospheric neutrino and muon events - Events reconstructed under the track hypothesis

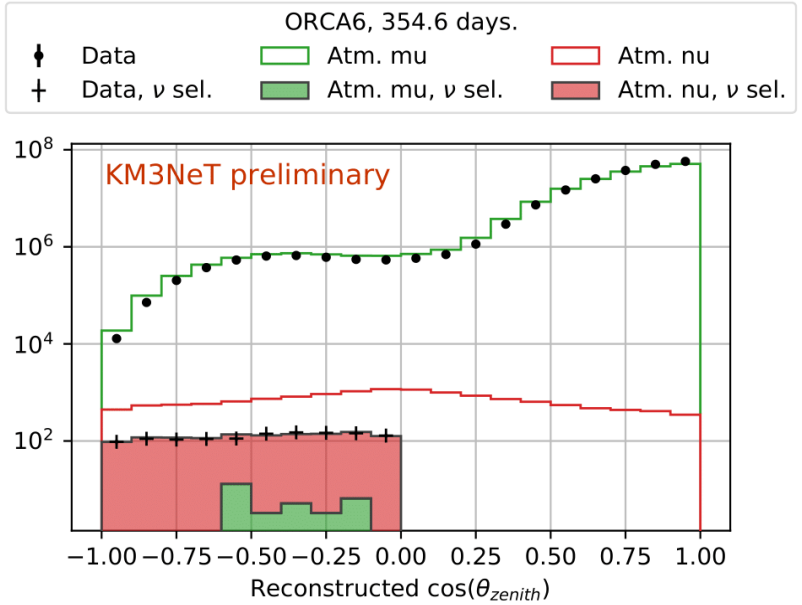
Several selection criteria to discriminate the neutrino events from the background:

- Upgoing reconstructed events
- Agreement between the track hypothesis and signal-like hits
- Reconstruction quality
- Containment



A final cut to account for the (at the moment) limited detector volume:

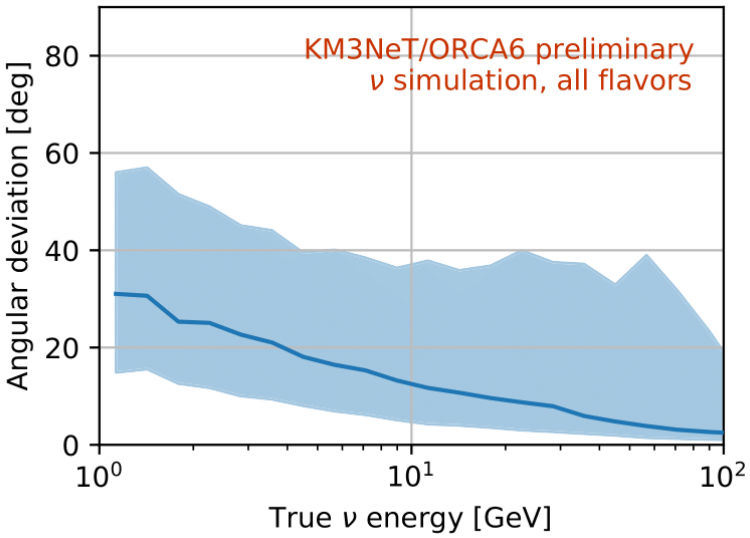
$E_{reco} < 100$ GeV



After applying all cuts:

- 1247 data events
- 1240 ± 35 MC atmospheric neutrino events
- 31 ± 10 MC atmospheric muon events

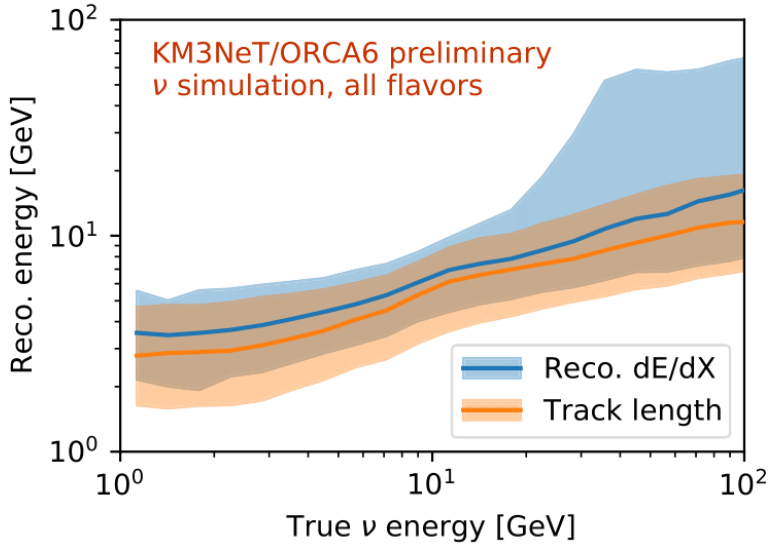
Resolution of the neutrino sample and prospects for an atmospheric neutrino flux measurement



Good angular resolution

$\Delta\omega < 20^{o}$ for $E_{true} > 4$ GeV
$\Delta\omega < 10^{o}$ for $E_{true} > 20$ GeV

$\Delta\omega$: angle between the true (MC) and reconstructed track



Energy reconstruction performance limited by the instrumented volume

Additional DUs are about to be deployed; Energy reconstruction to be improved, key point for the measurement of the atmospheric neutrino flux

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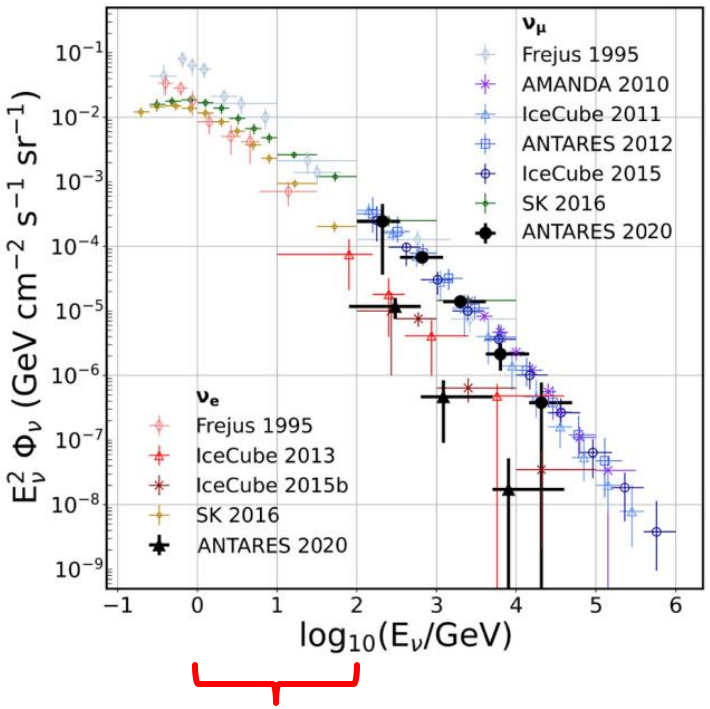

room for improvement , especialy for the 10-100 GeV range