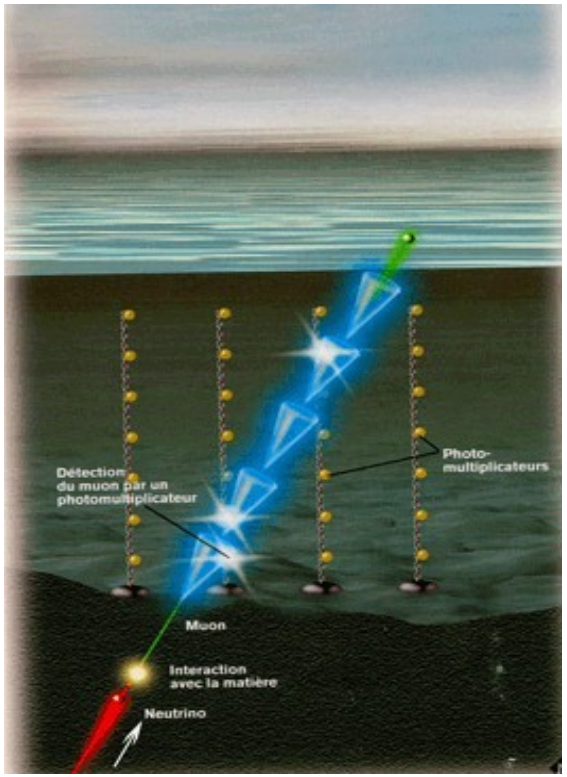
Evaluation of the effect of optical background on the ANTARES track reconstruction

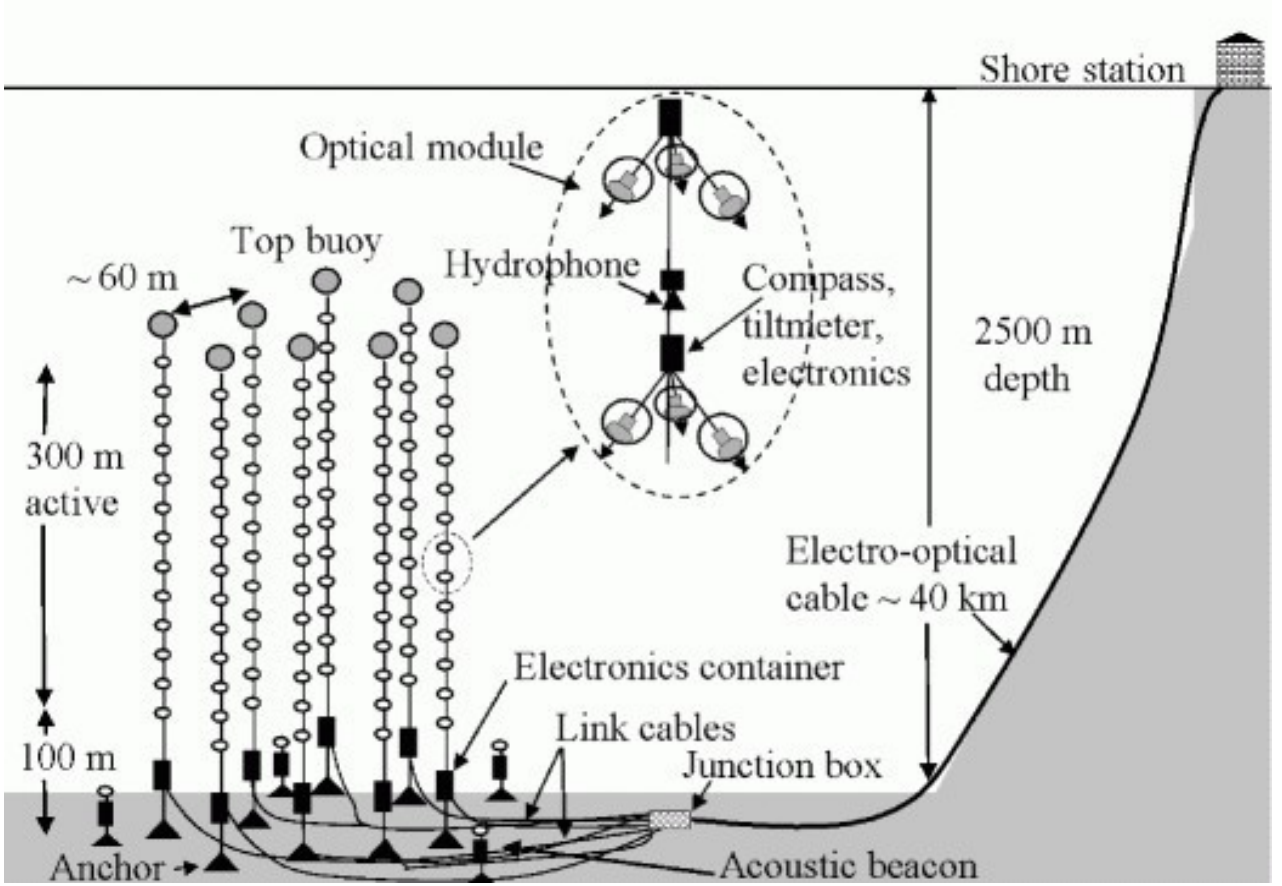
Ekaterina GRACHEVA - LAMBARD

The ANTARES

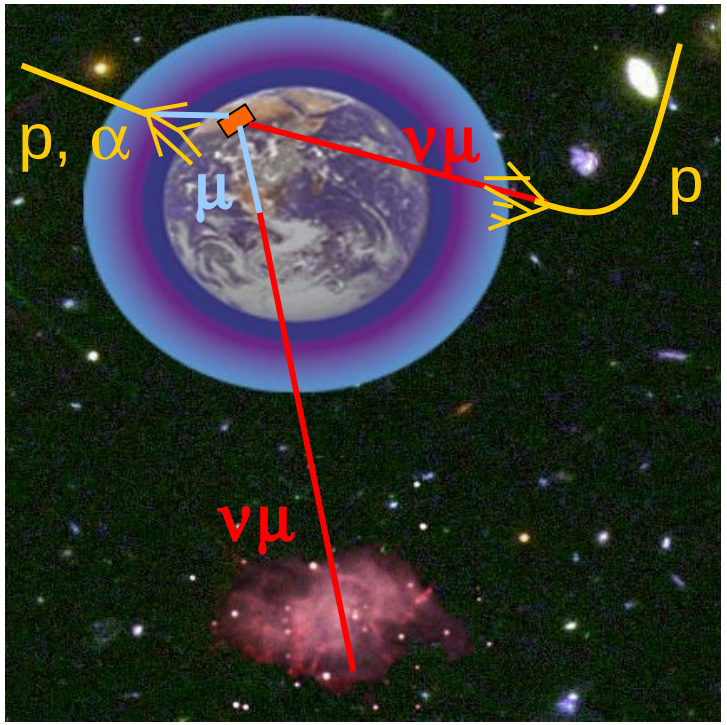


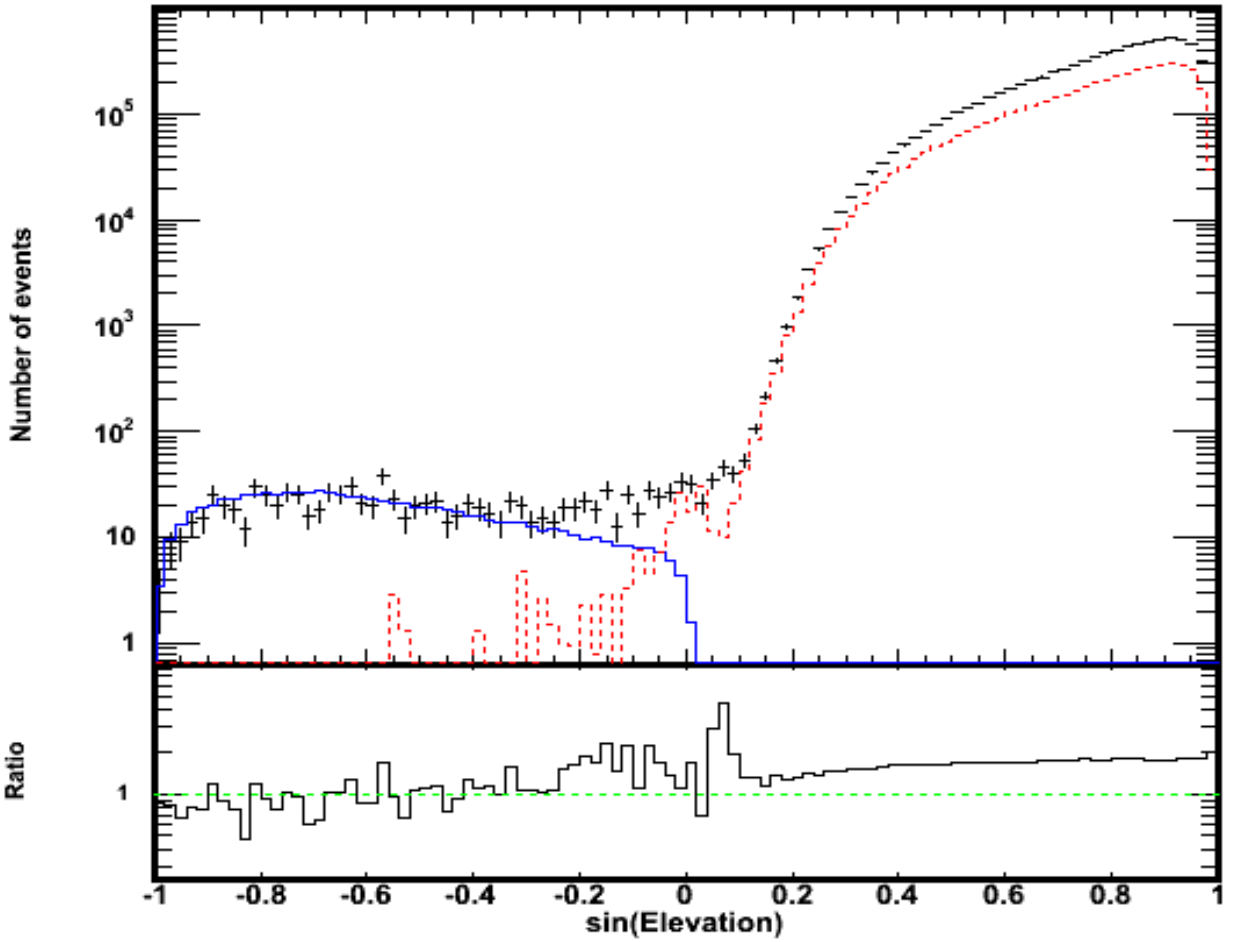
Muon from neutrino is registered by its Cherenkov light in sea water.

Detector is situated 40 km far from Toulon. It consists of 12 vertical lines of 25 floors. Each floor contains 3 optical modules "watching" downwards, 45° to the horizon.



Physical backgrounds

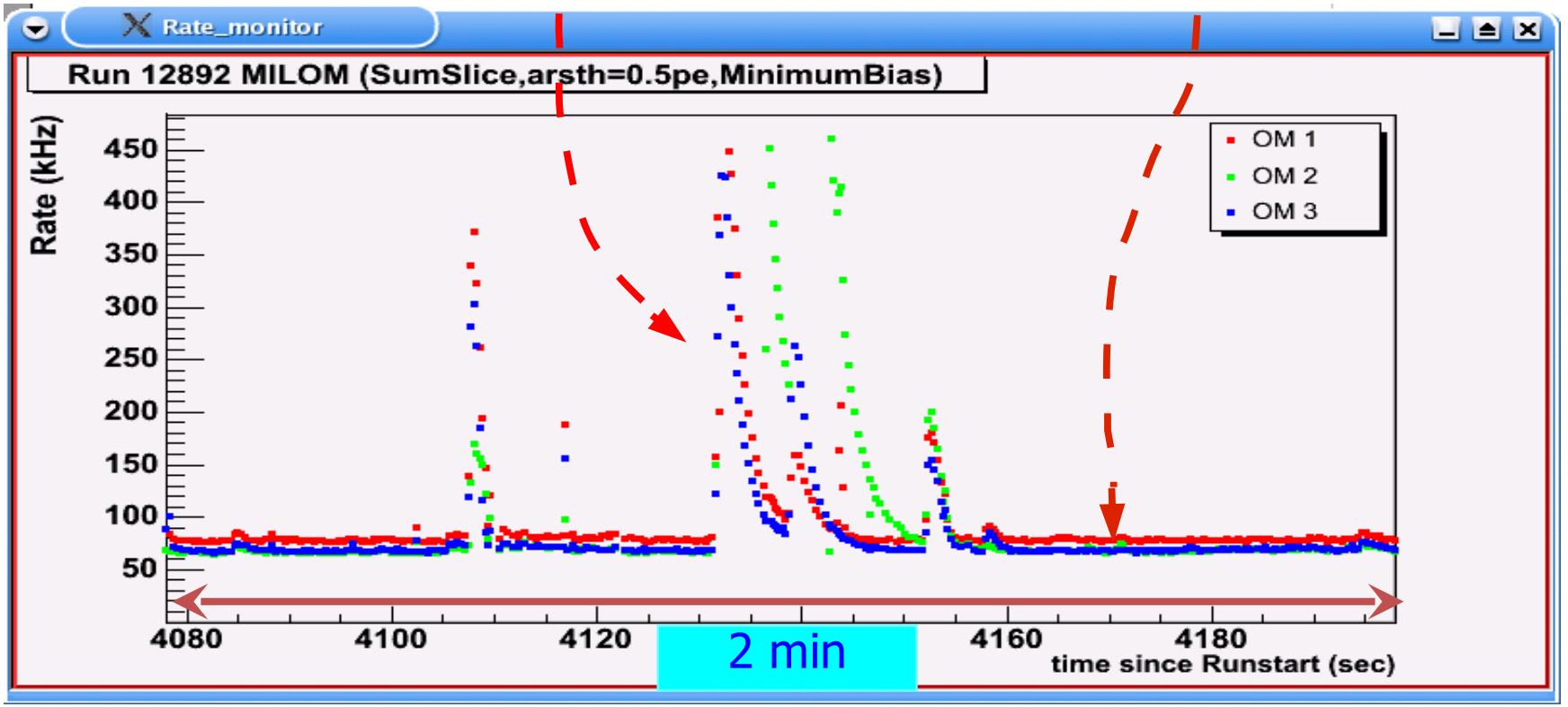




- Downgoing muons
- Upgoing atmospheric neutrinos

Optical background in the sea

- K40 (constant baseline)
- Bioluminescence (random peaks)



Effects of the optical background

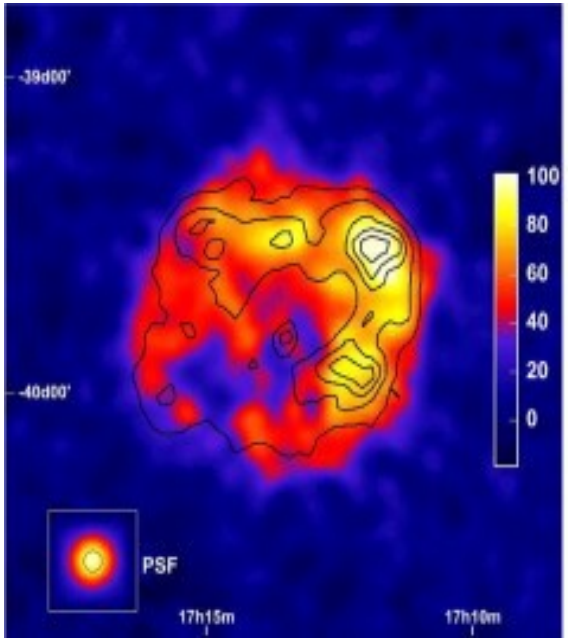
The aim of the present work is to investigate effect of changes of optical background on the main track reconstruction strategy of ANTARES (Aafit) for:

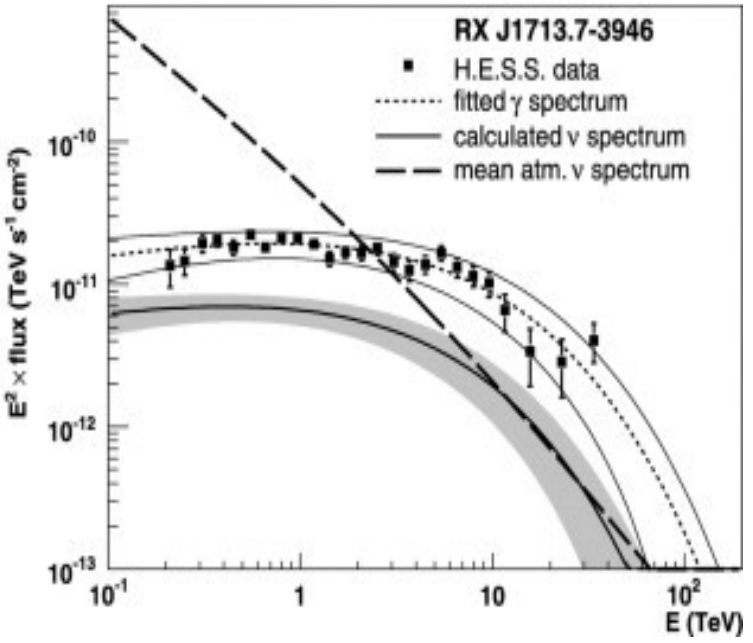
- atmospheric neutrinos
- extragalactic neutrinos
- galactic SN remnant, e.g. RXJ 1713

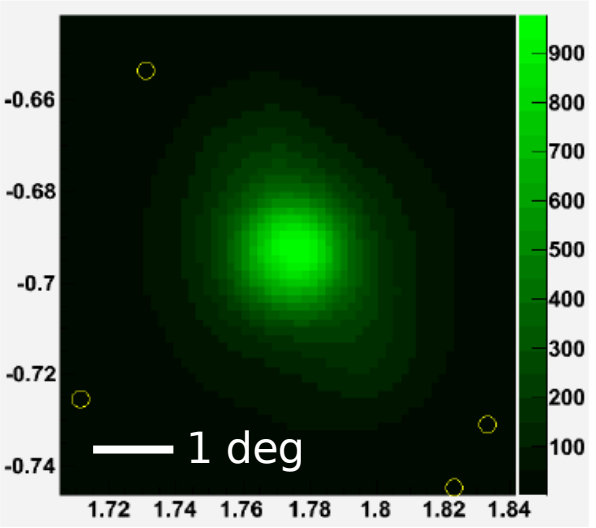
Important parameters are:

- reconstruction efficiency
- angular resolution
- downgoing muon background

RXJ1713.7-3946







Smeared by ANTARES PSF

- Young supernova remnant
- TeV gamma-rays emission (H.E.S.S. experiment)
- Should give 40 muon-type neutrinos per kilometer-squared per year
- Γ=1.7

Monte-Carlo selection

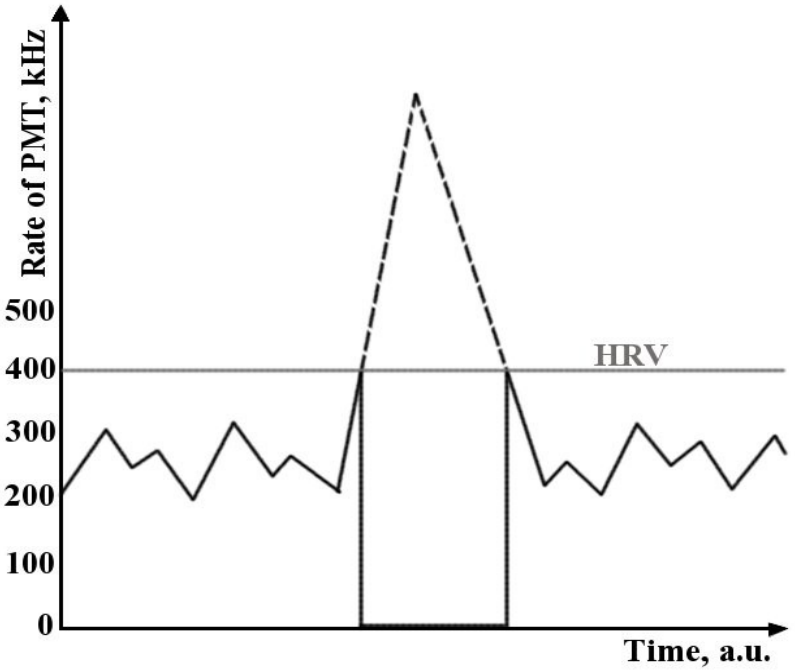
- Dates 10.2008 – 12.2008
- 12 lines period (detector in its full configuration)
- Exclude calibration runs

Interval (kHz)	Number of runs selected	Mean *MeanRate* (kHz)
60-70	66	66.9±2.6
90-120	85	100.9±6.3
180-240	61	213.9±13.6
310-370	28	341.8±15.6
440-540	10	493.8±34.8

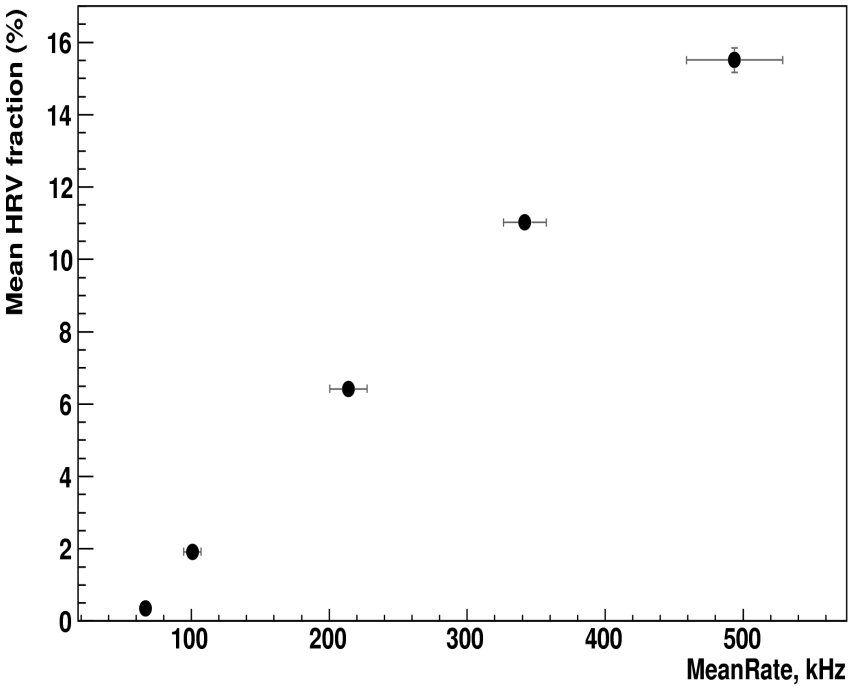
In total, 250 files have been chosen and split into groups according to the MeanRate value.

High Rate Veto

The mechanism of HRV has been introduced to avoid overfilling of the data taking system during periods of high optical background.



HRV mechanism

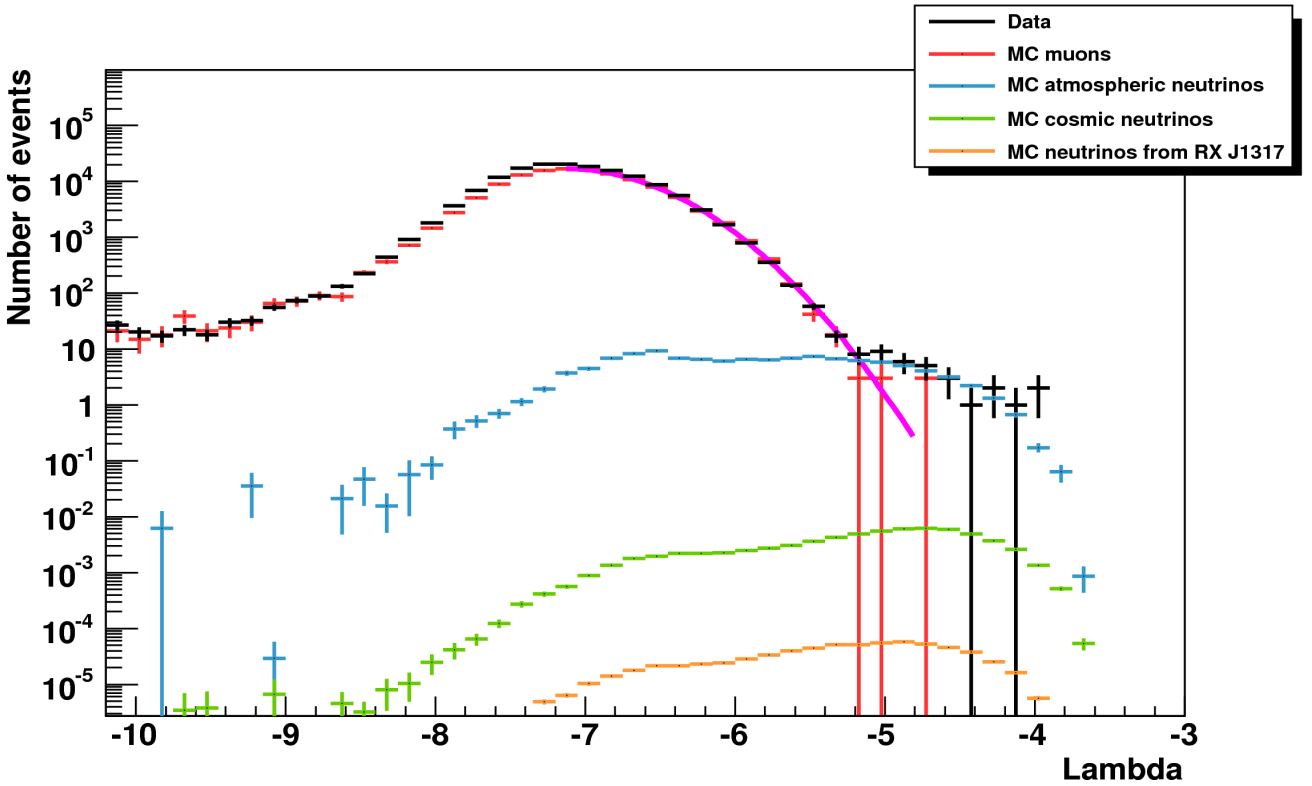


HRV fraction for selected runs

Cut choice

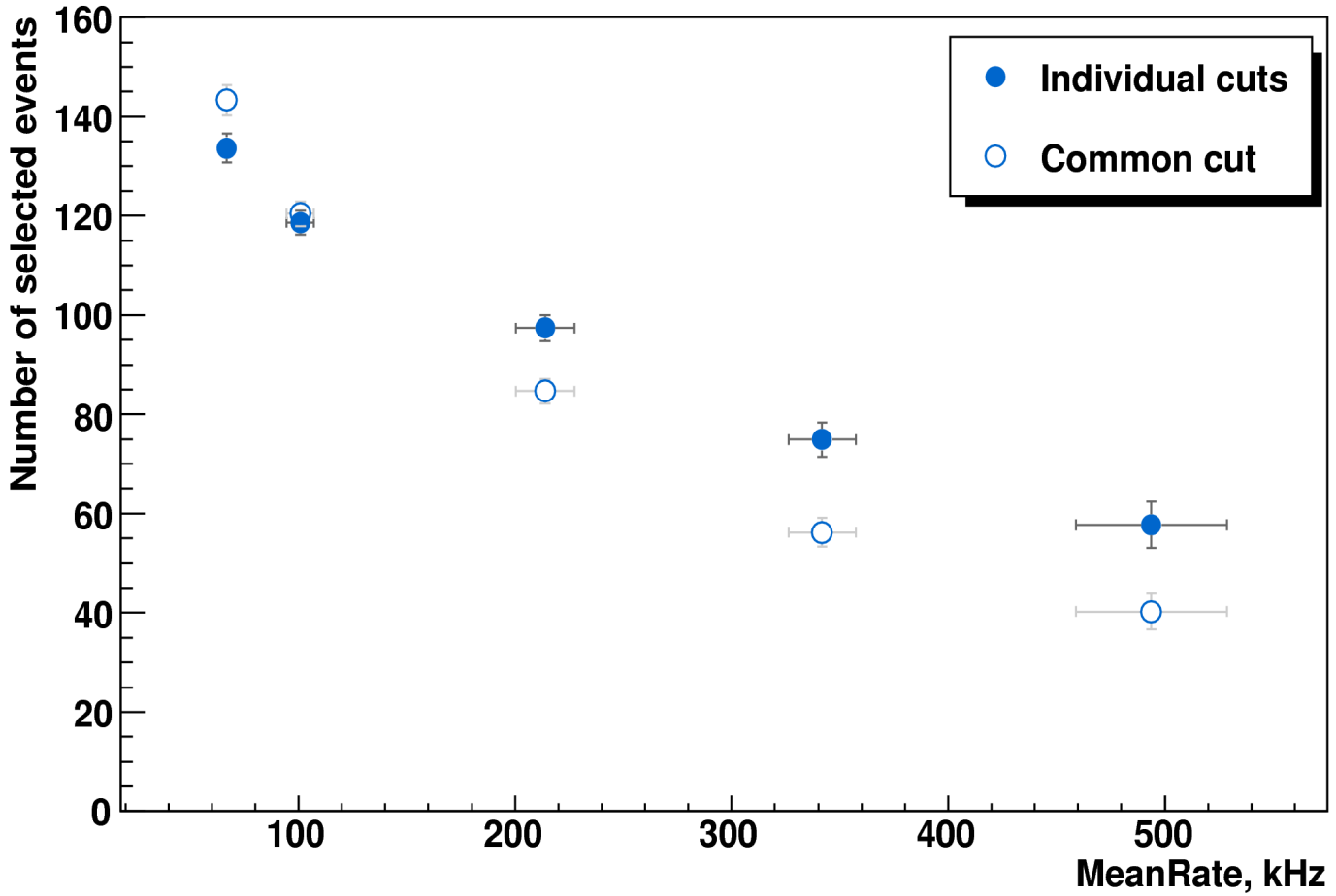
10% muon contamination for atmospheric neutrinos, upgoing particles. Due to the lack of statistics in muons, cut is chosen by fit of muon λ-distribution (λ is a parameter of reco-quality, the higher it is, the better track has been reconstructed).

Example:
60 kHz



Efficiency of reconstruction

Atmospheric neutrinos

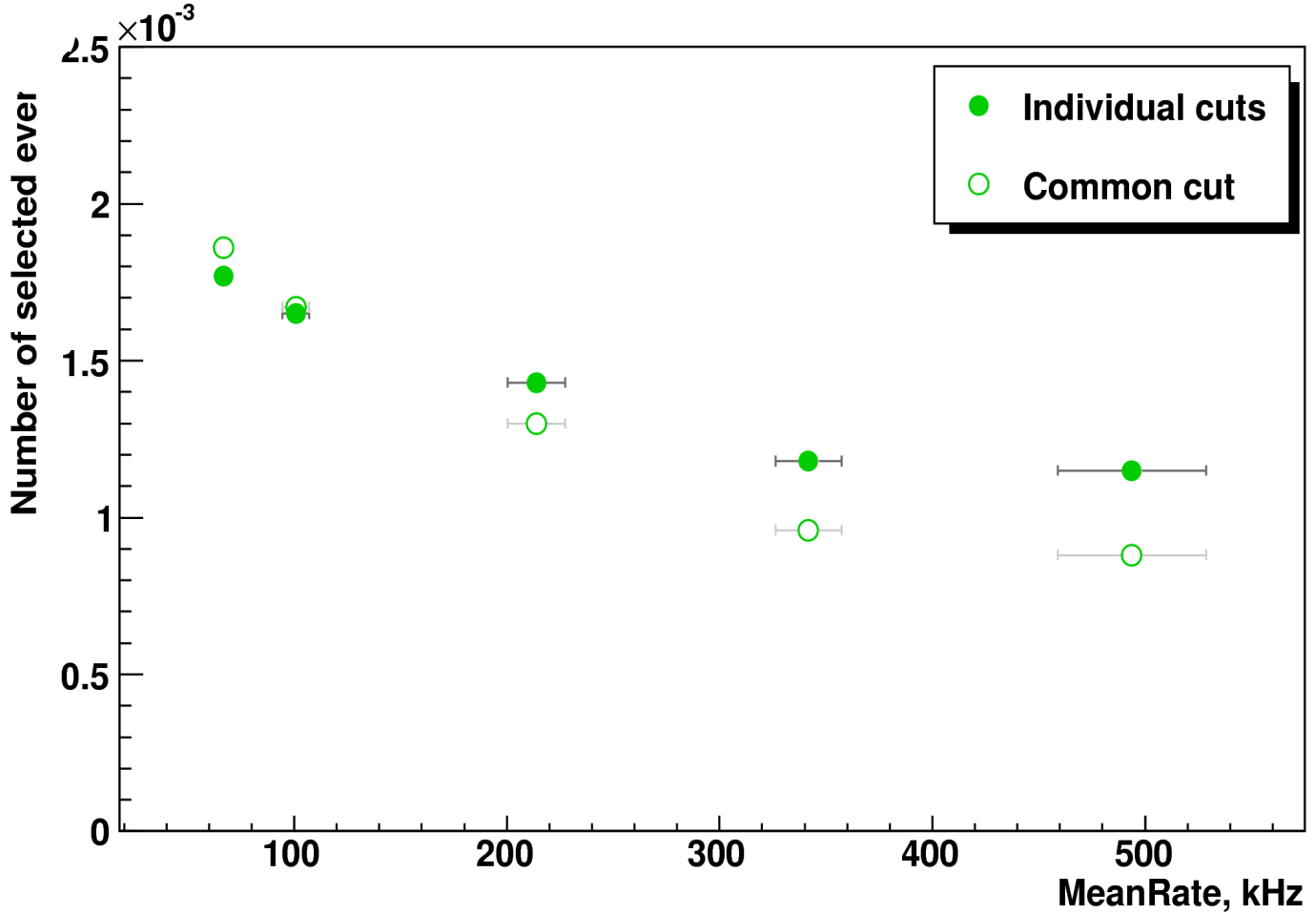


In case of individual cut muon contamination is well-controled and in high-rate period efficiency is better.

For individual cuts efficiency decrease is 57%

Efficiency of reconstruction

RXJ1713 neutrinos

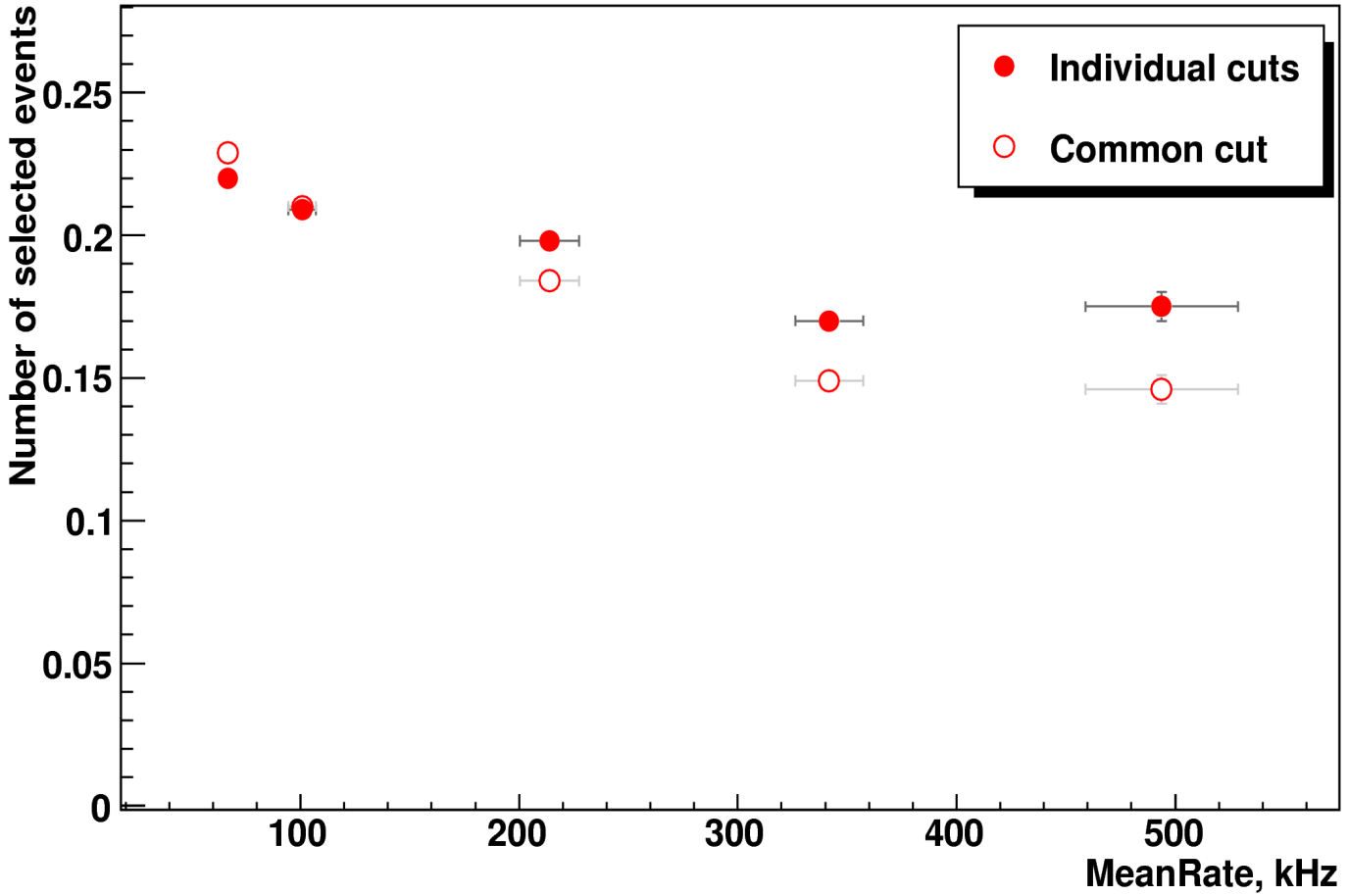


In case of individual cut muon contamination is well-controled and in high-rate period efficiency is better.

For individual cuts efficiency decrease is 35%

Efficiency of reconstruction

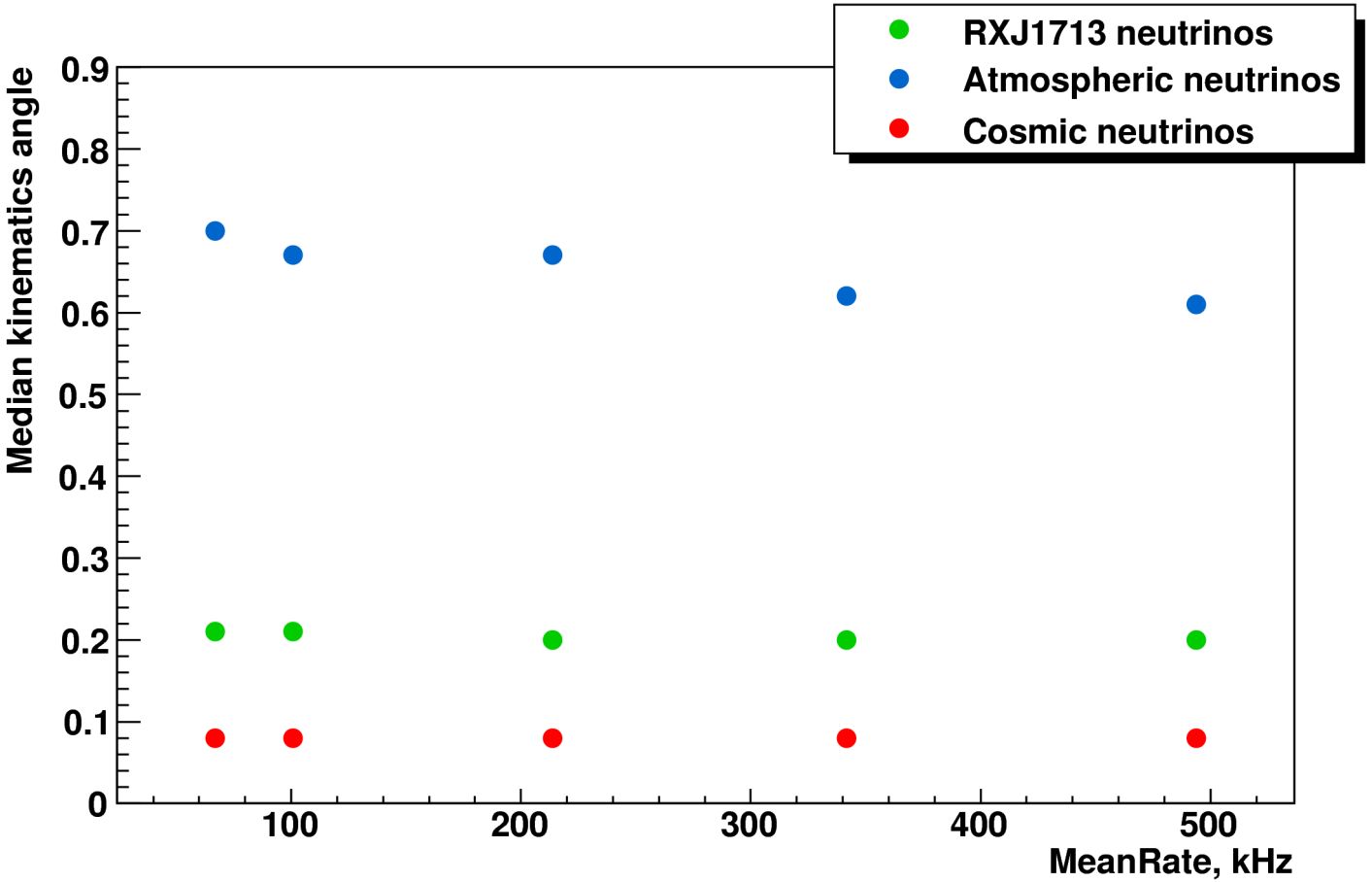
Cosmic neutrinos



In case of individual cut muon contamination is well-controled and in high-rate period efficiency is better.

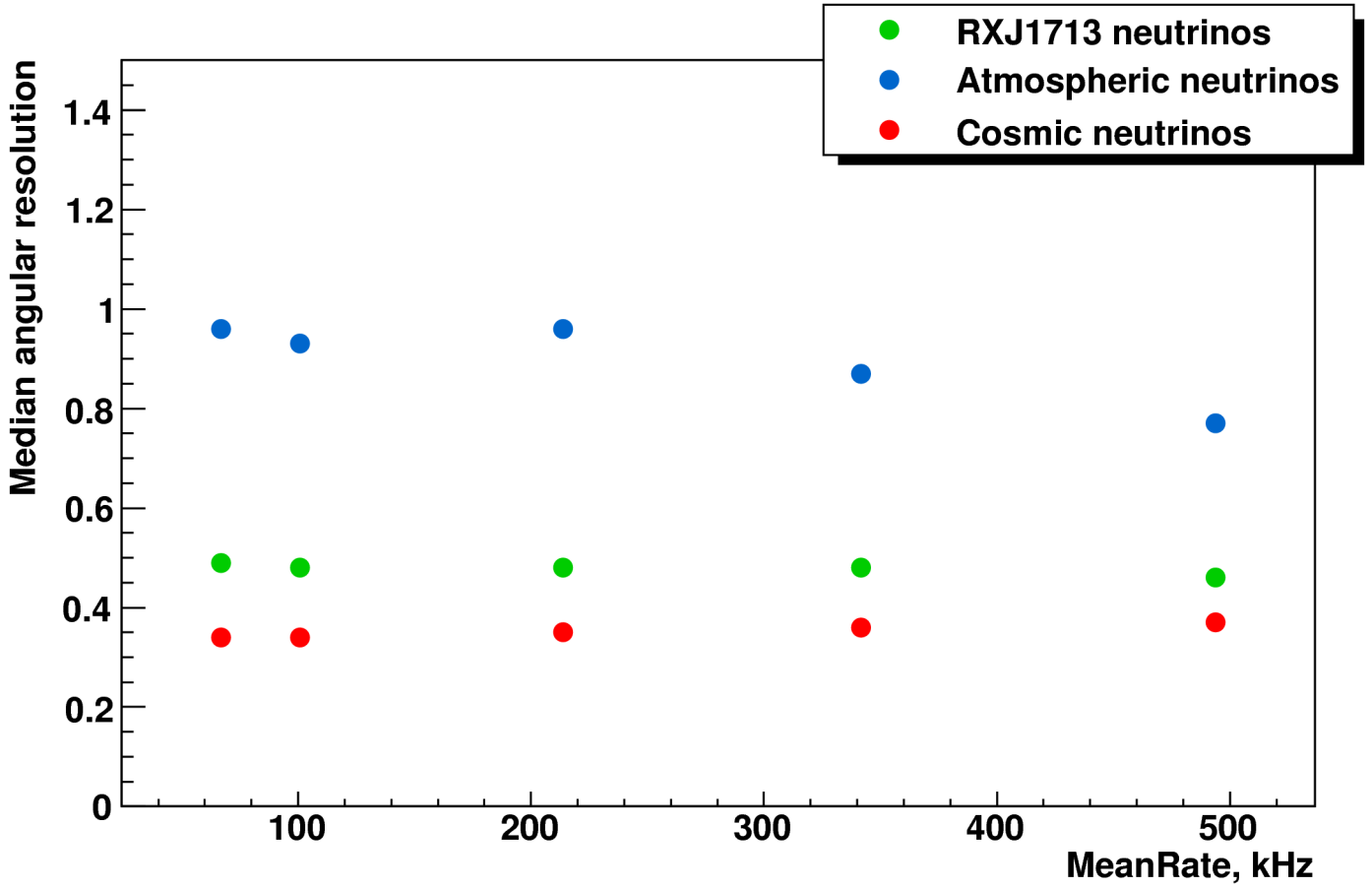
For individual cuts efficiency decrease is 20%

Kinematics



For low-energy neutrinos kinematic angle between primary neutrino and secondary muon is higher, than for high-energy ones.
This should be taken into account speaking about resolution!

Angular resolution



Resolution is stable (and even slightly improves for atmospheric and RXJ1713 neutrinos)

Results & Conclusions

Effect of the optical background around ANTARES detector on the reconstruction ability has been investigated.

Results show efficiency drop of:

- 57% for atmospheric neutrinos
- 20% for cosmic neutrinos
- 35% for RXJ1713 neutrinos

Angular resolution improves for atmospheric and RXJ1713 neutrinos (21% and 6% respectively)and slightly decreases for cosmic neutrinos (9%).

Individual cuts proved to be more successful than one common cut over all runs.

Obtained results show stable performance of the track reconstruction strategy.