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# Background Suppression for a Neutrino Telescope

HEP

8 - 10 May 2014

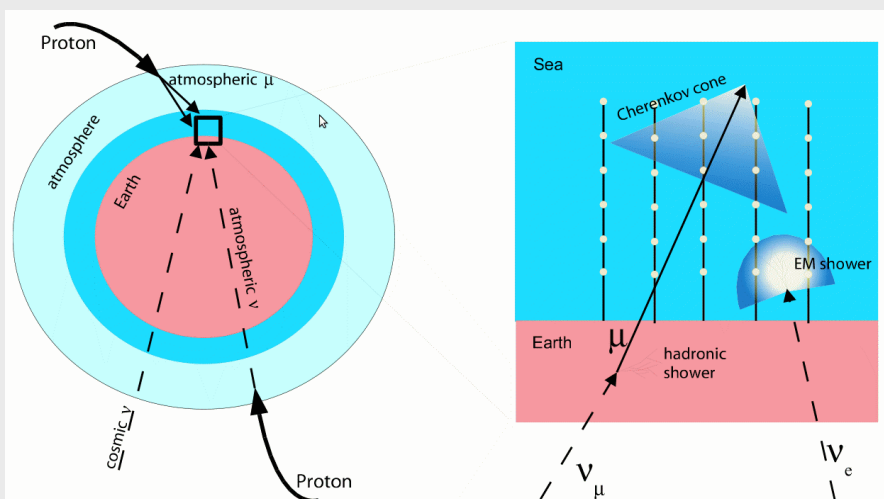
Naxos

Pikounis Konstantinos

# Introduction - Motivation

Recently the IceCube Neutrino Observatory published the detection of several high energy Neutrino events, two of those with energies  $\sim 1\text{PeV}$ .

All these events have their vertices in the instrumented volume.



This study focuses on high energy events.

In order to reduce the background from atmospheric muons, neutrinos are required to have interacted inside the instrumented volume.

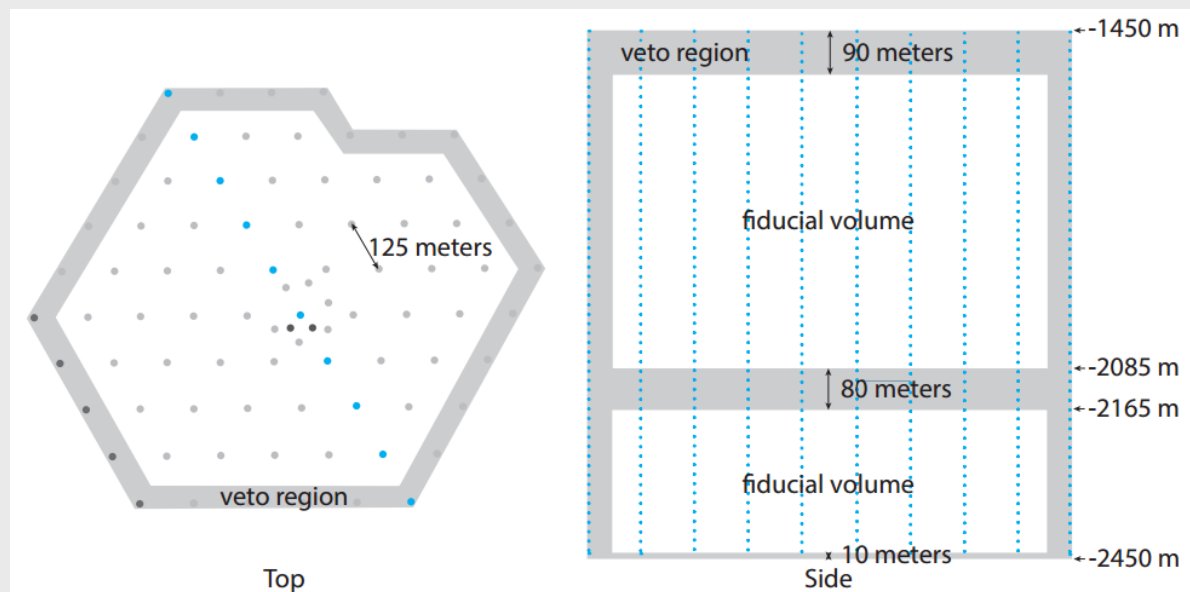
# IceCube Vetoes

Veto regions:

- All border strings
- Optical Modules (OMs) in upper 90 meters
- Lowest OMs

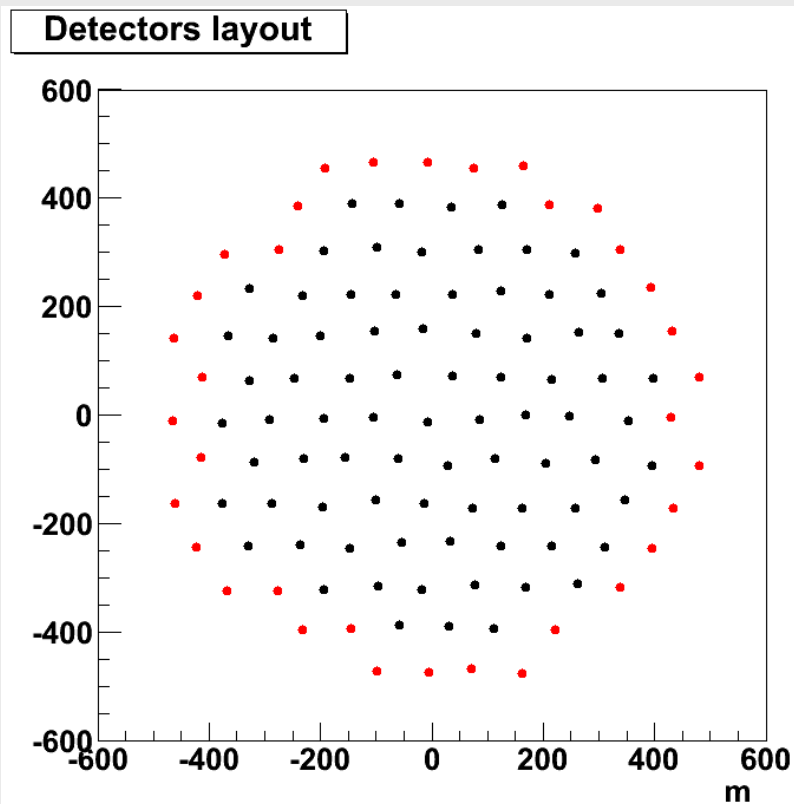
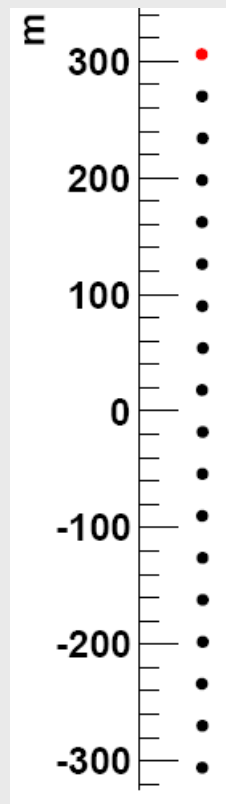
Rejecting events when:

- First hit in any veto region
- OM with largest charge in border string
- Vertex not contained in the detector



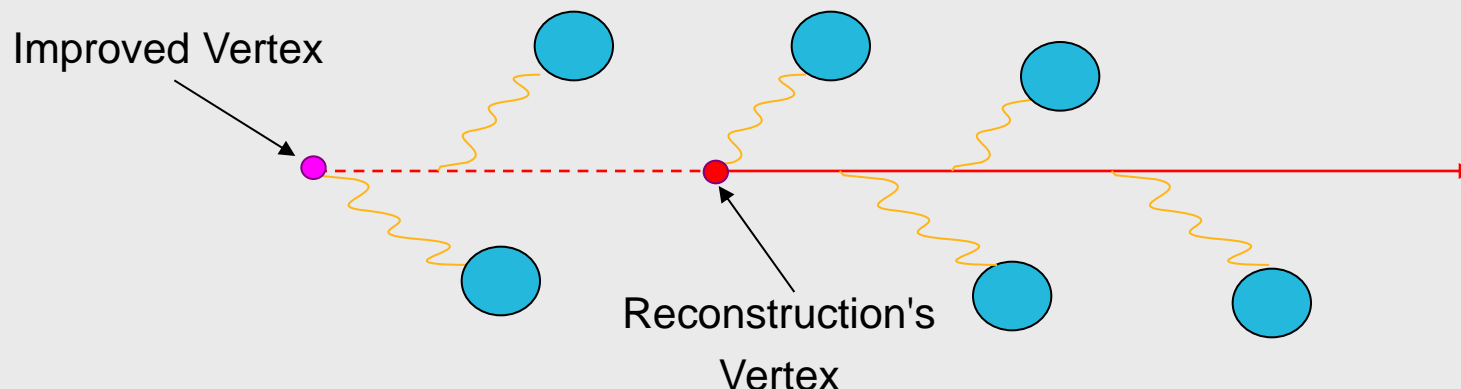
# Applied Vetoes

- Veto region considered for KM3NeT geometry:
  - all border strings in red dots
  - only upper OMs
- Previous mentioned rejection criteria are also applied.



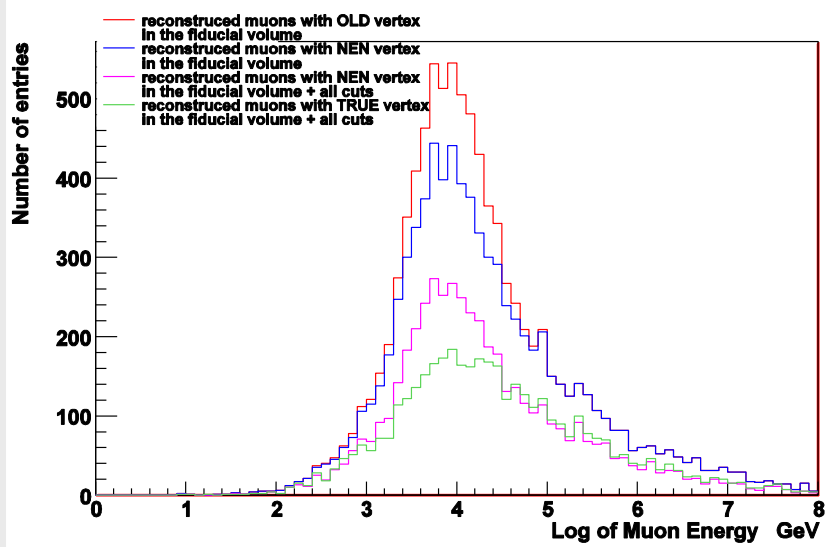
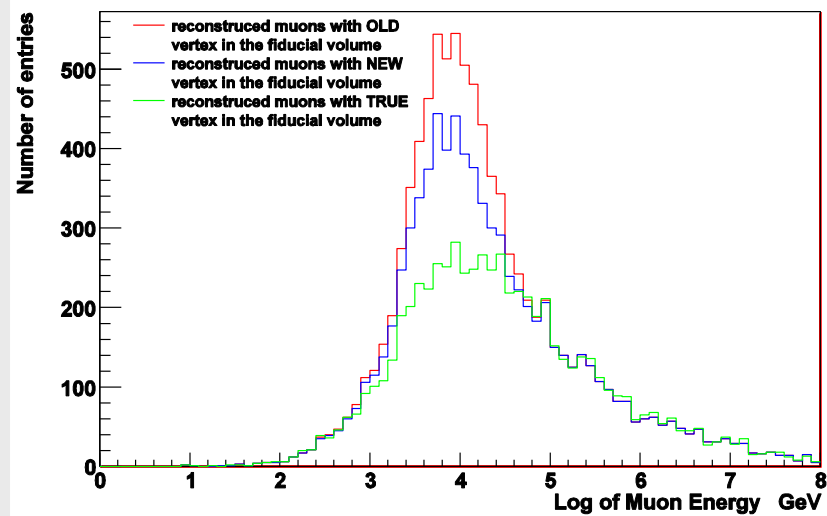
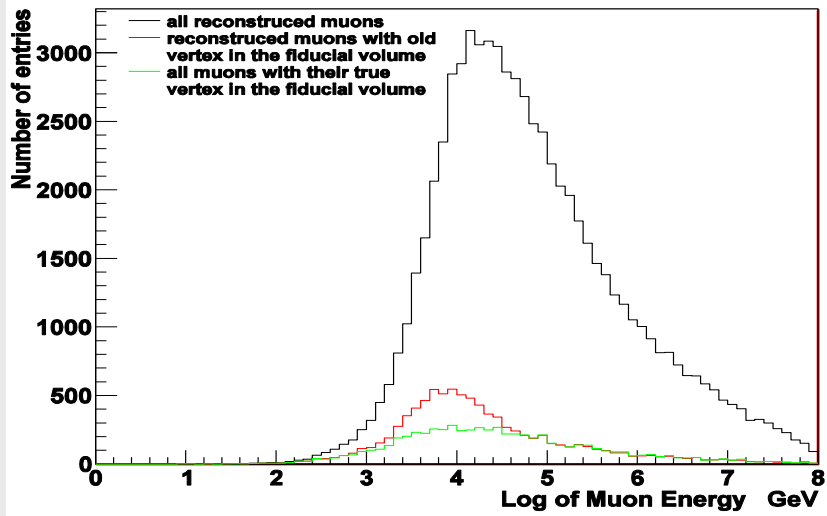
# Improving the vertex finding

- Reconstruct the events.
- Use the vertex improvements mentioned by L. Drakopoulou.



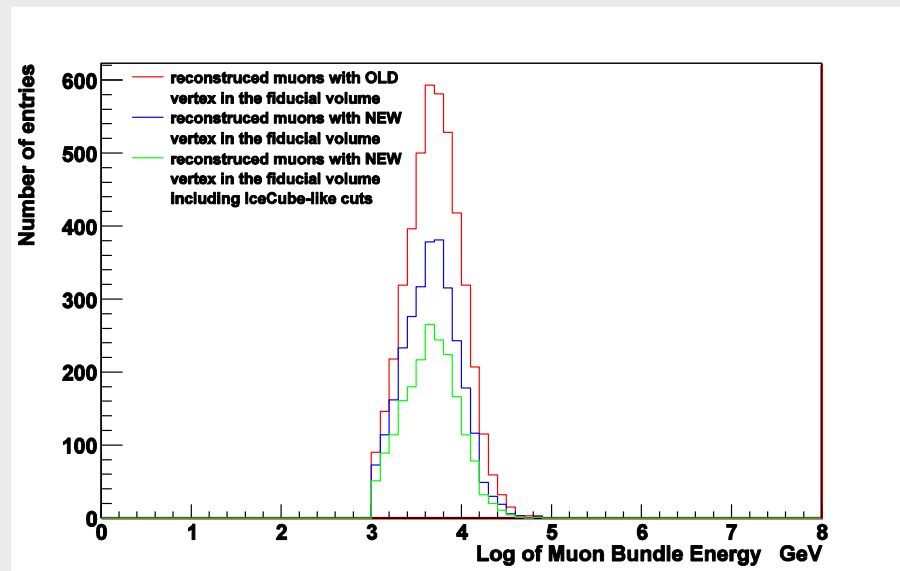
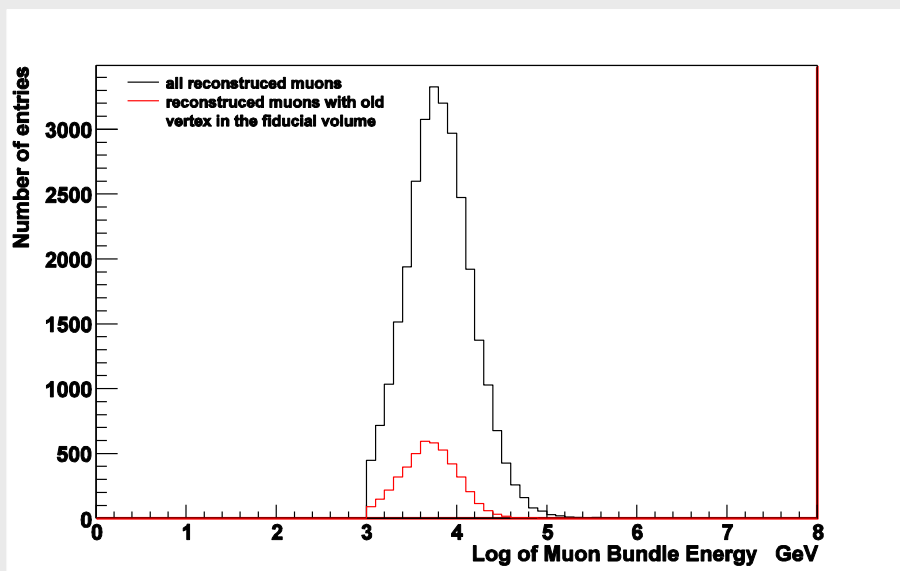
- Investigate if the hits on OMs “behind” the reconstructed vertex are consistent with the track hypothesis.
- Use slightly more relaxed criteria comparing to the reconstruction.
- Reject events with their improved reconstructed vertex outside a fiducial volume.

# Applying vetoes to CC events



Events to accept	Events to reject
True vertex in fiducial <b>6500</b>	True vertex out <b>3142</b>
New vertex out <b>653</b>	New vertex in fiducial <b>2037</b>

# Applying vetoes to Atmospheric Muons with bundle energy > 1 TeV



Reco vertex required in the fiducial volume

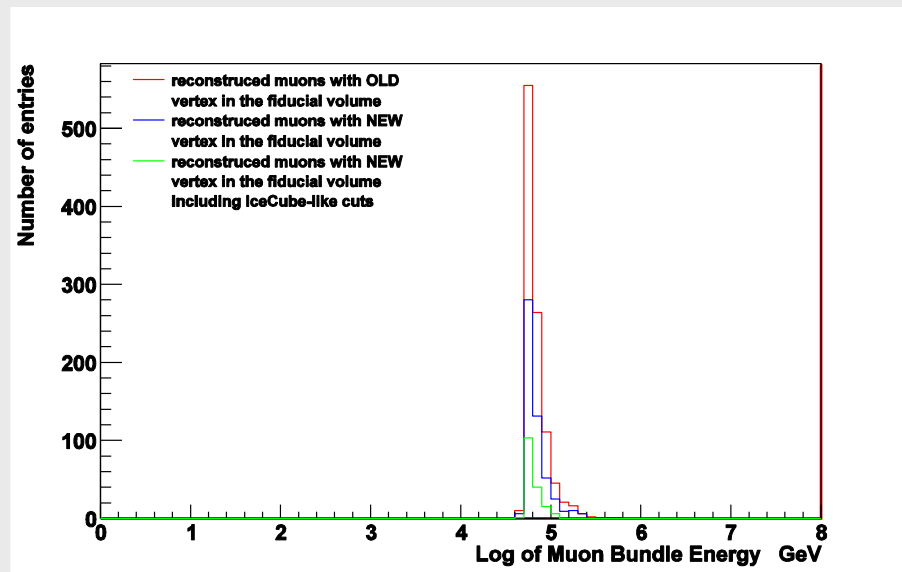
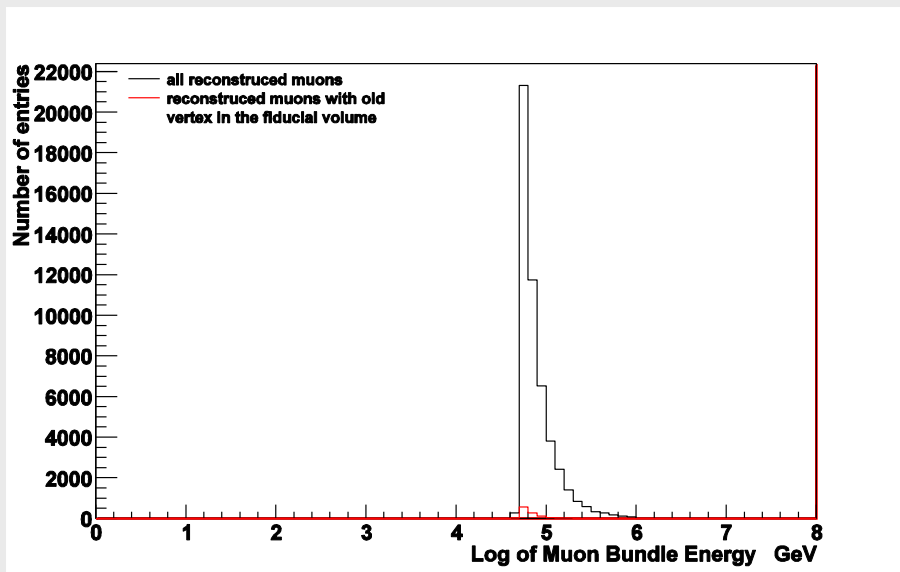
$$\frac{4.545}{29.345} = 84,5 \text{ \% reduction}$$

Improvements with new cuts

$$\frac{2.895}{4.545} = 36,3 \text{ \% further reduction}$$

$$\frac{1972}{4545} = 56,6 \text{ \% further reduction}$$

# Applying vetoes to Atmospheric Muons with bundle energy > 50 TeV



Reco vertex required in the fiducial volume

$$\frac{1.033}{49.852} = 97,9 \text{ \% reduction}$$

Improvements with new cuts

$$\frac{522}{1.033} = 49,5 \text{ \% further reduction}$$

$$\frac{165}{1.033} = 84,0 \text{ \% further reduction}$$





# Conclusion

First results are promising, study is ongoing and further results are expected.

- Regarding atmospheric muon background, accomplished reduction:
  - 57 % of the remaining low energy muons.
  - 84 % of the remaining high energy muons.
- Managed to discard 35 % of the Neutrino events which had the old vertex inside the fiducial volume but their true vertex outside.

NC events will be included to the analysis.



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# Thank You!