



Sparking DOMs in ORCA4 Data

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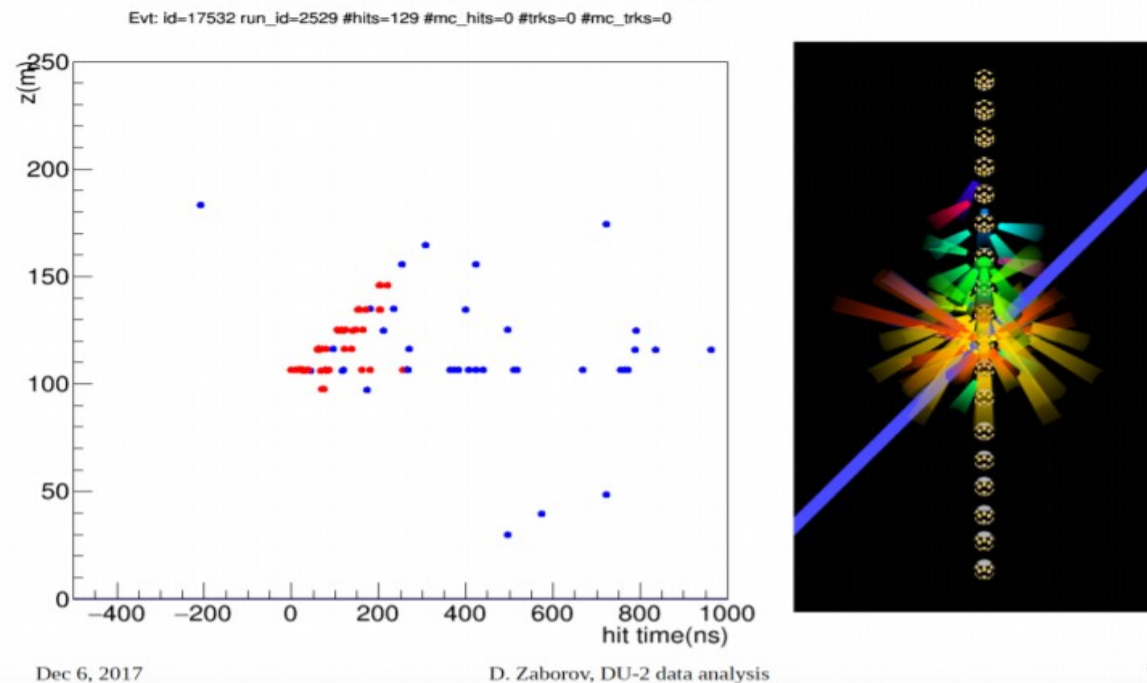


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Sparking DOM problem

- Jannik Hofestadt and Dorothea Samtleben
Report on problems with data from ORCA-DU2(KM3NeT DUANA 2019 001)
March 12, 2019
 - PMT/DOMs signals with max. ToT (255 nsec) and repetitive hit pattern
 - Large signal on neighbouring DOMs
 - Different pattern on different DOMs

Example of strange event



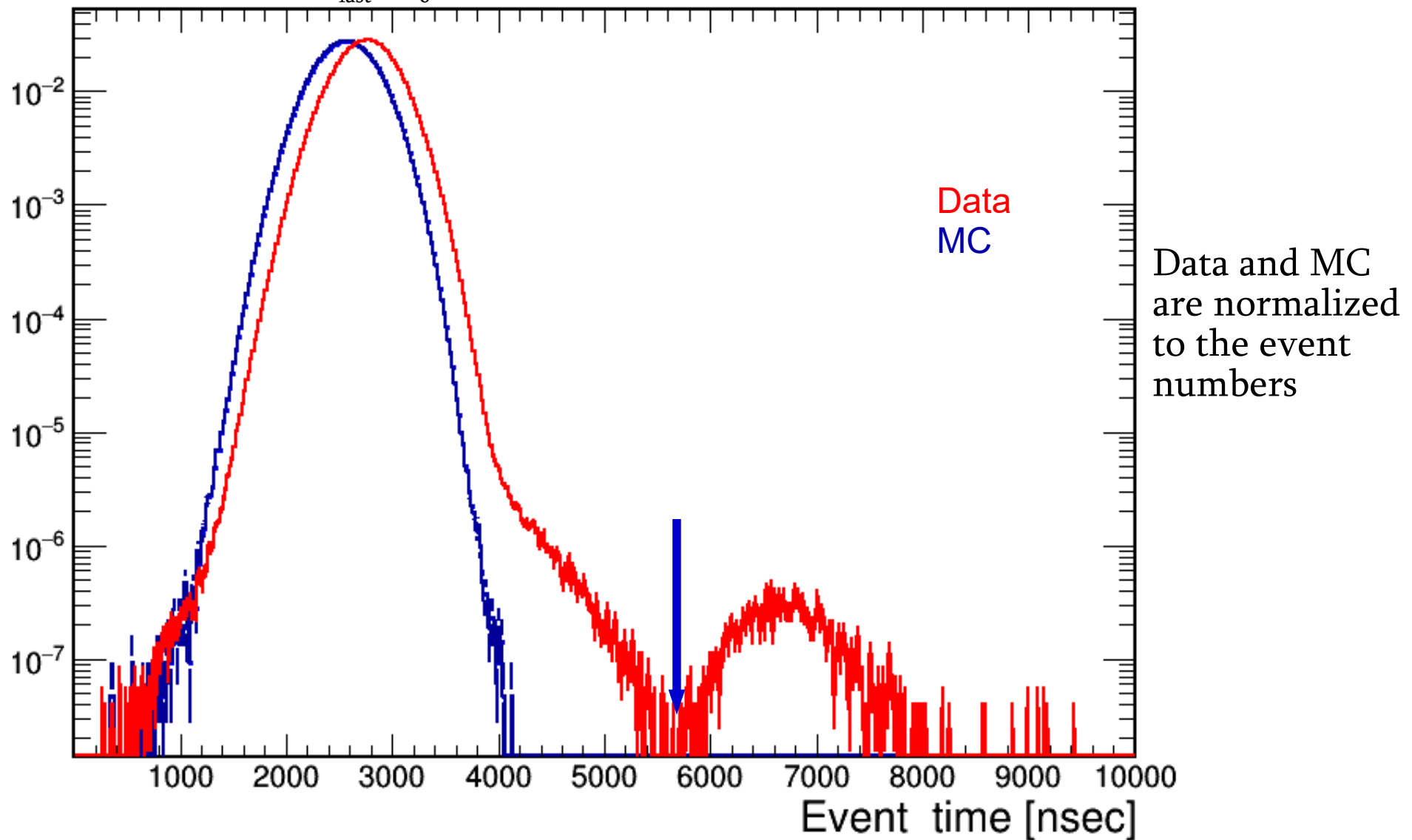
How to identify “sparking DOMs“ in the ORCA4 data?

Start with events where DOM/PMT signals are maximum (255 nsec)

- Do sparking DOMs and “long time events“ detected in ORCA4 data have the same origin?
- Are these events linked to a certain type of physics events, not described in the KM3NeT MC?
- We dont have MC description of these phenomena
- We have considered the events, where atmospheric- μ is crossing the ORCA DOM(s) as a possible source of sparking/long time signals in ORCA4 data
- Large ionization in the HV region of the PMT caused by atm- μ going trough the DOM could trigger large signals (and afterpulses)

ORCA4 Data/MC Comparison: Event Time

Events time: $\Delta t = (t_{\text{last}} - t_0)$ t -time of the hits

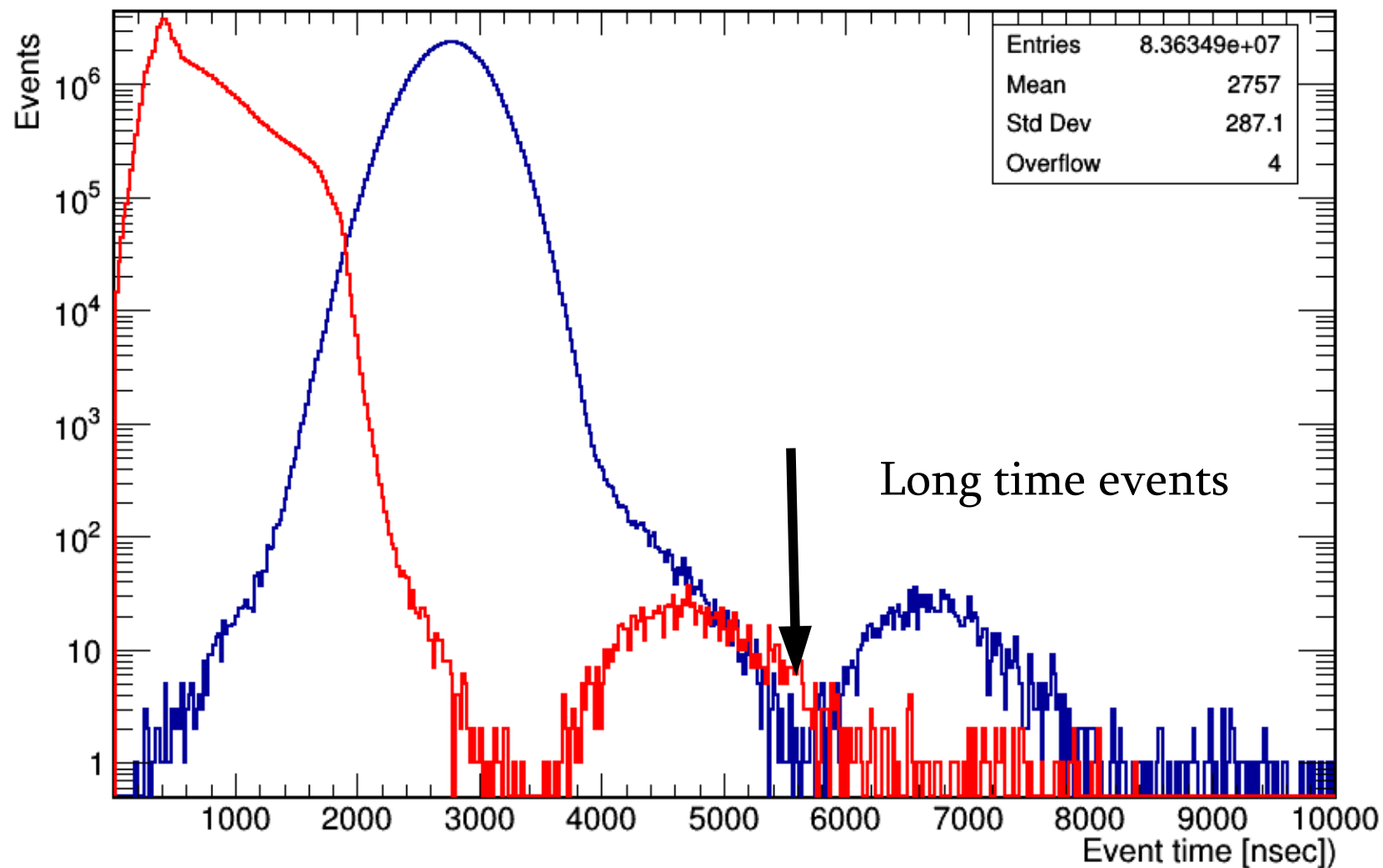


“Long time events“: $\Delta t > 5600$ nsec: 1429 (1.7×10^{-5} off data)

Long time events in the ORCA4 data

All processed/reconstructed events: 83 634 895 (8.4×10^7 events)

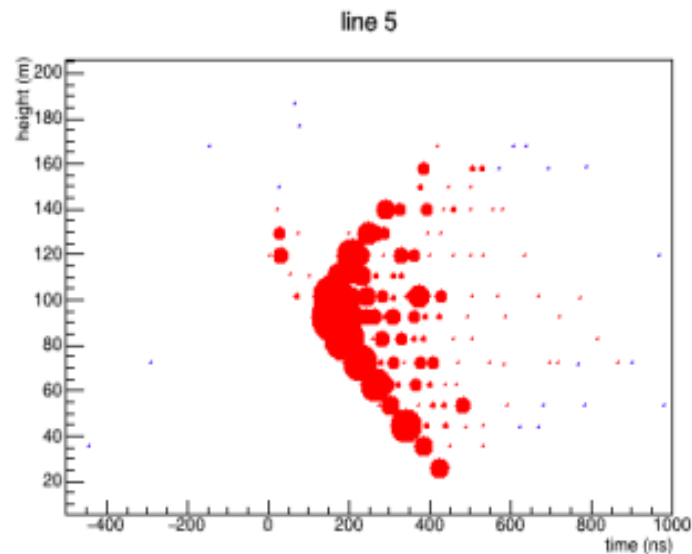
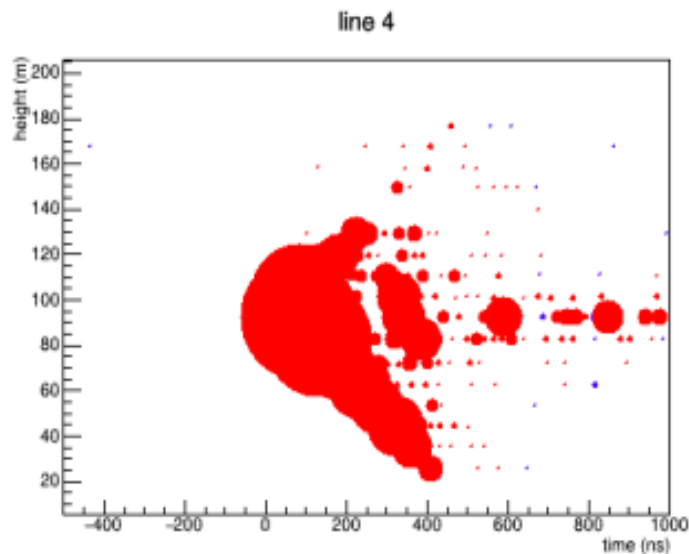
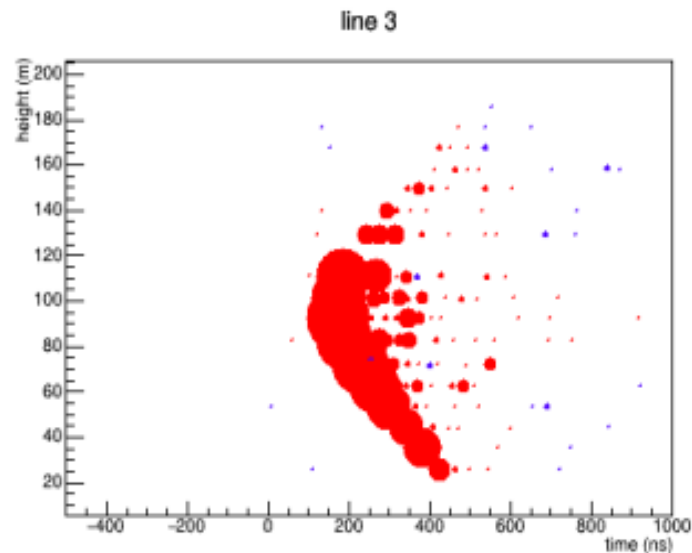
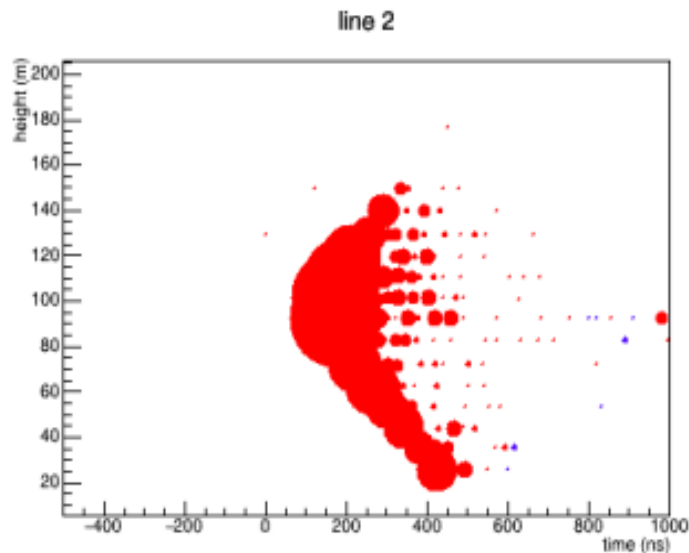
Events $\Delta t > 5600$ nsec: 1429 (1.7×10^{-5} off data)



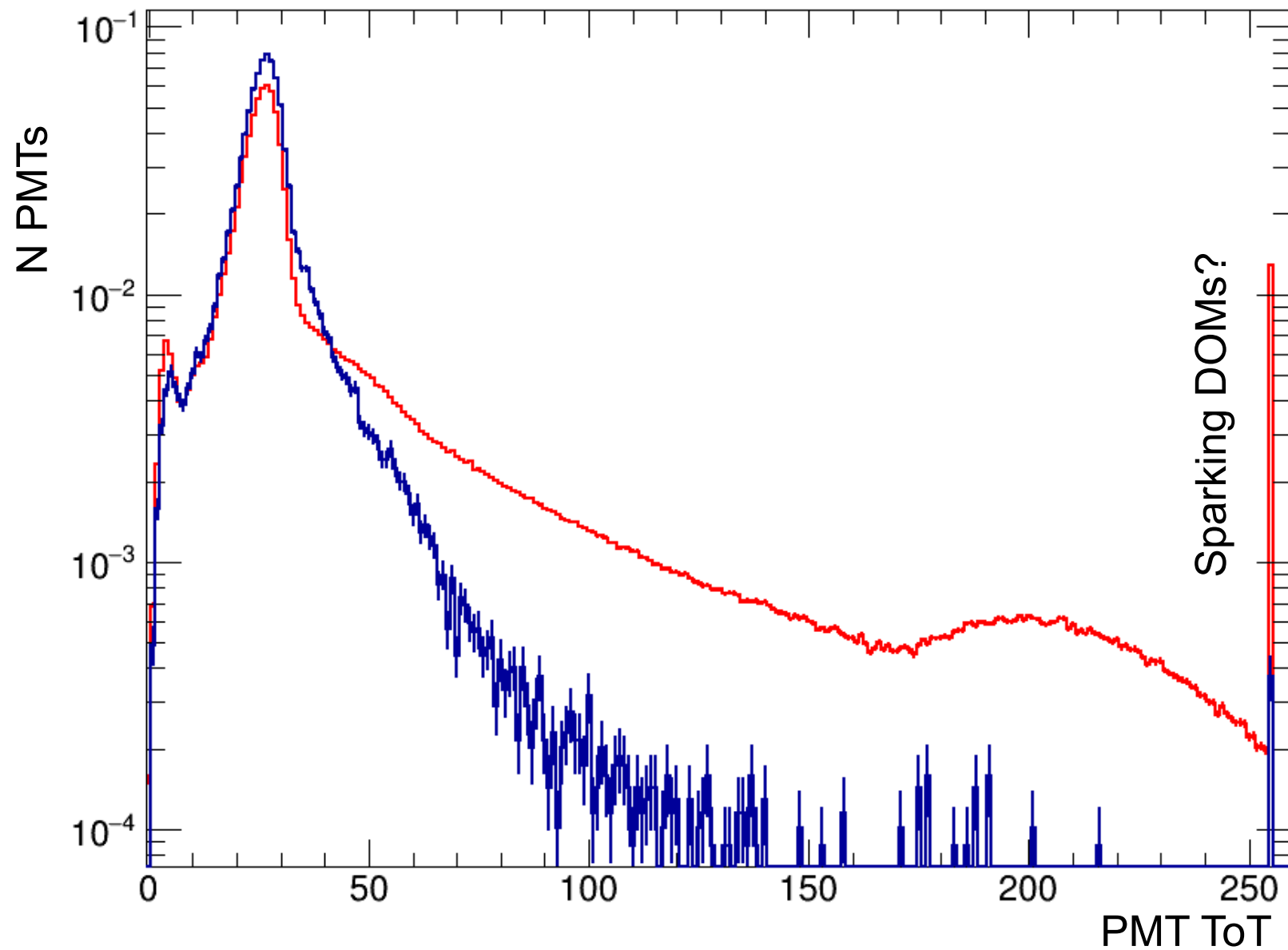
Long time events in the ORCA4 data

Run ID: 6581

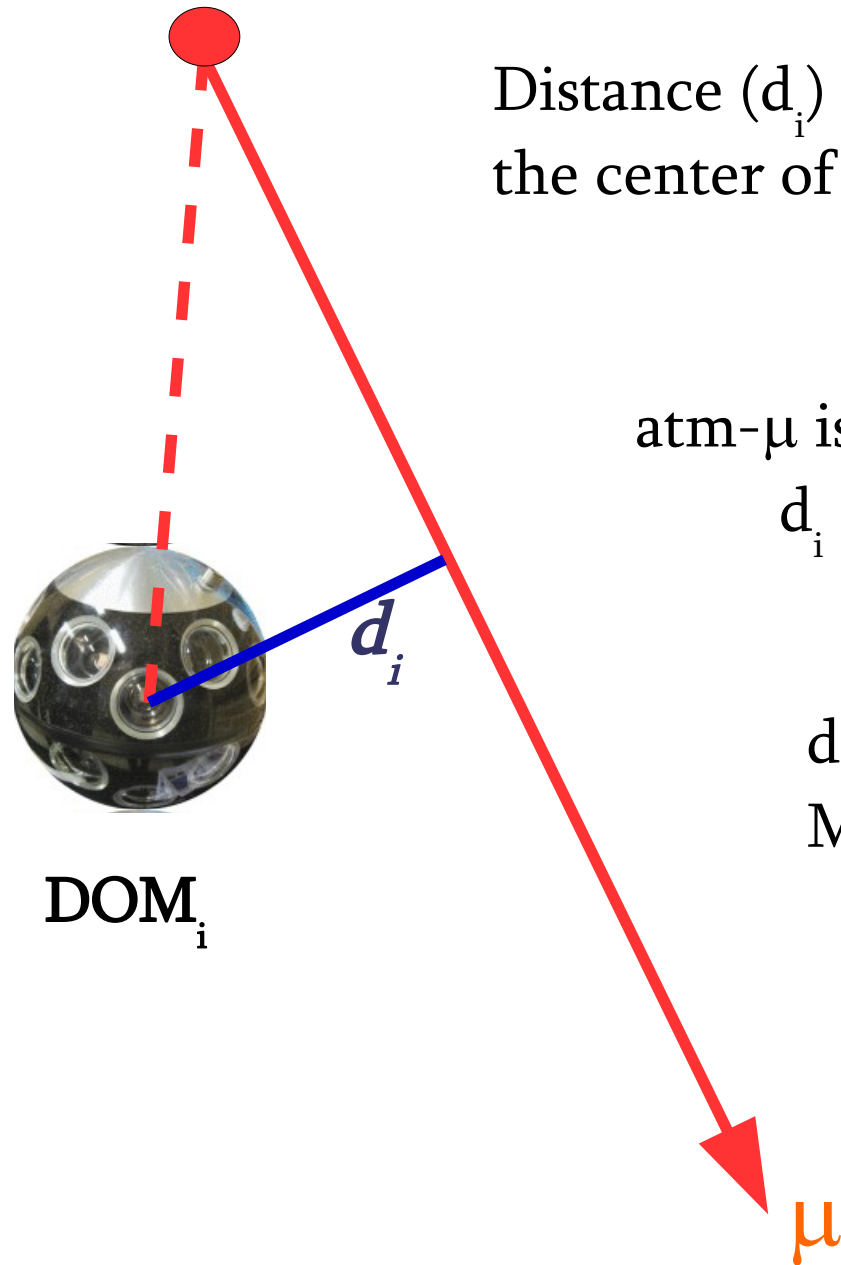
Event ID: 33629



ORCA4 PMT Signals



Distance to DOM



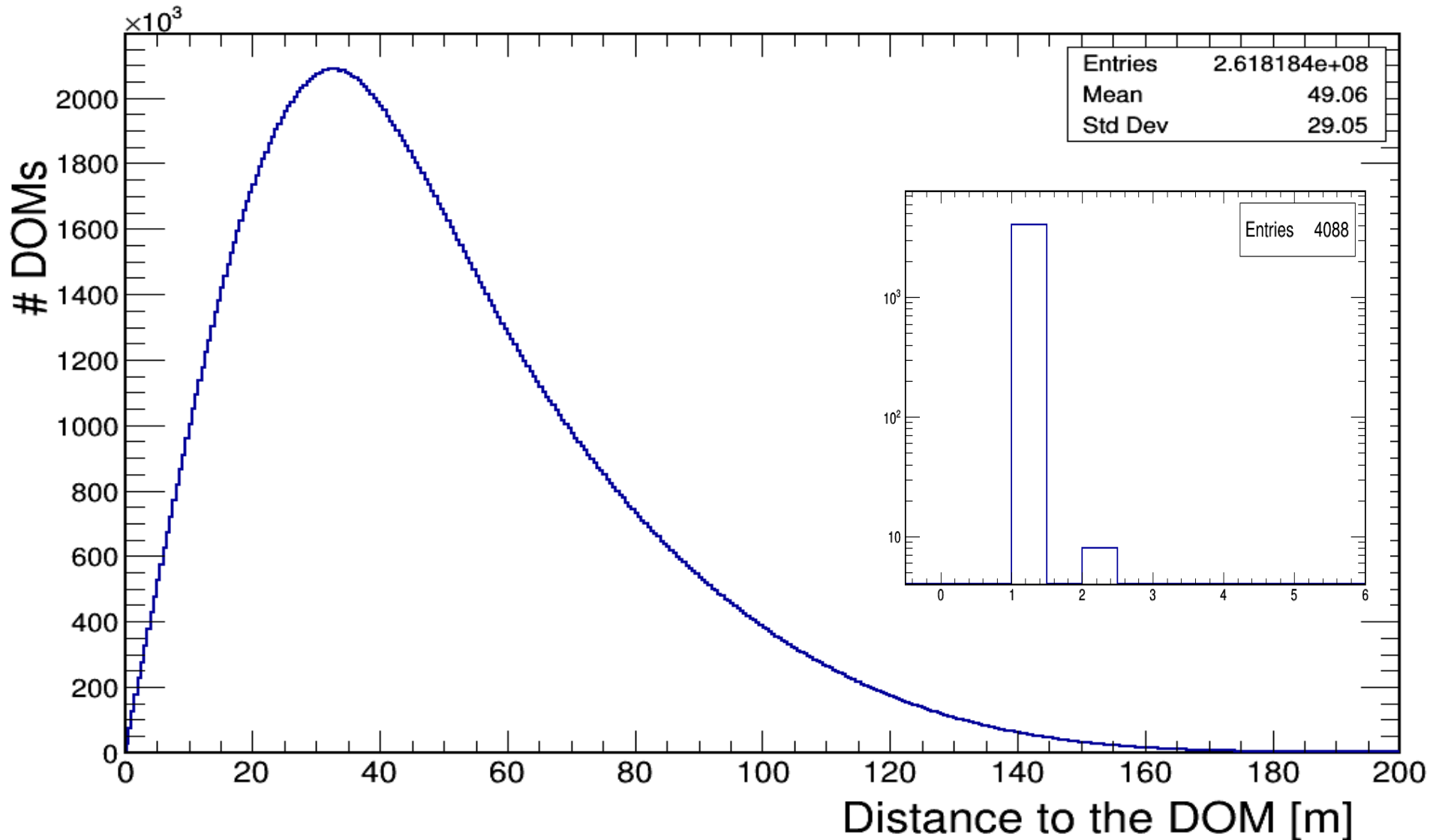
Distance (d_i) between atm- μ track and the center of DOM_i

atm- μ is crossing DOM_i if
 $d_i < R_{DOM}$ (20 cm)

d_i - was obtained from the ORCA4 MC sample (mupage \rightarrow sirene)

Distance to the DOM

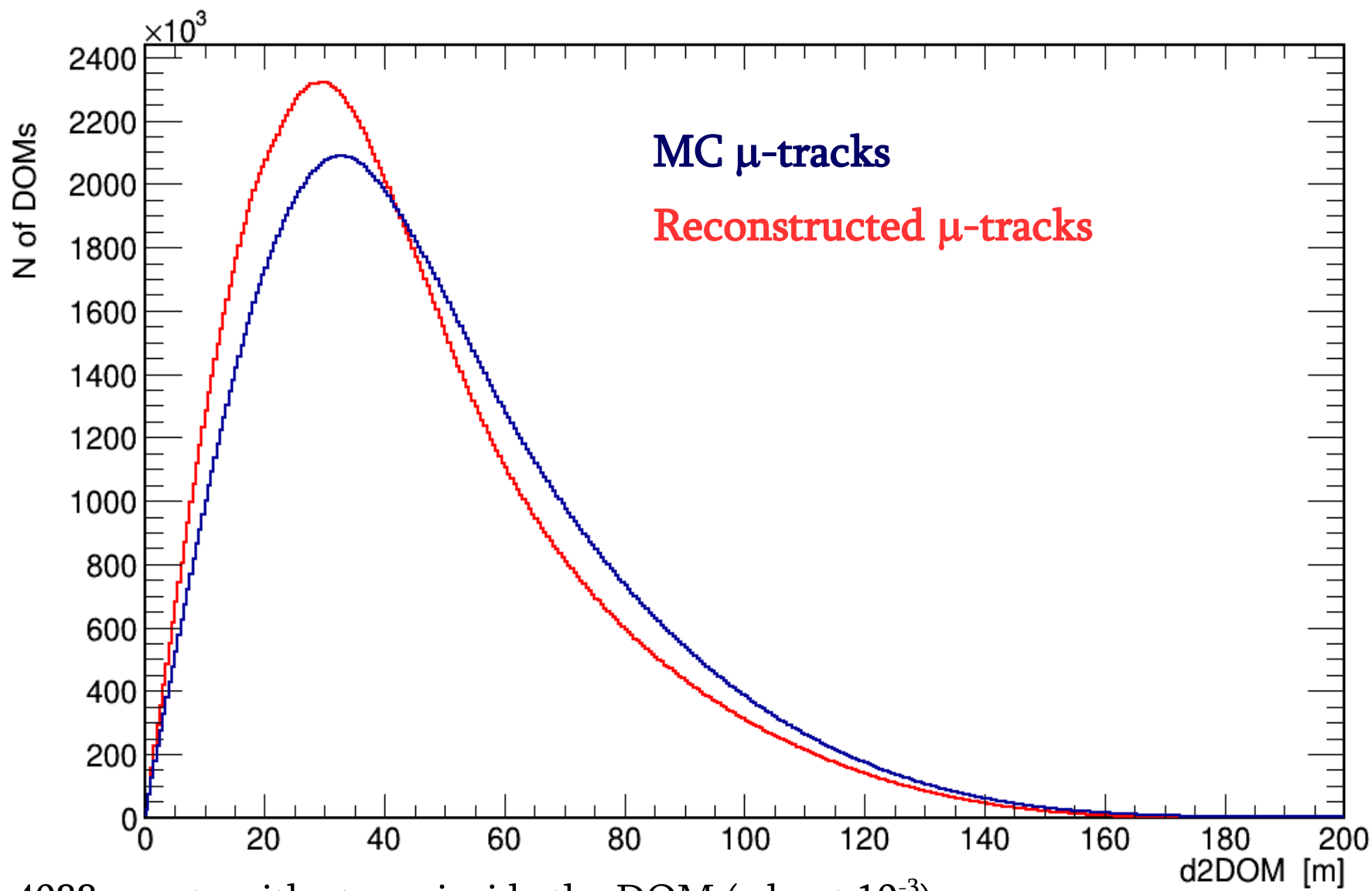
ORCA4 MC: 3.6×10^6 events (MC: mupage-sirene)



4088 events with atm- μ inside the DOM (about 10^{-3})

Distance to the DOM (MC vs Reconstruction)

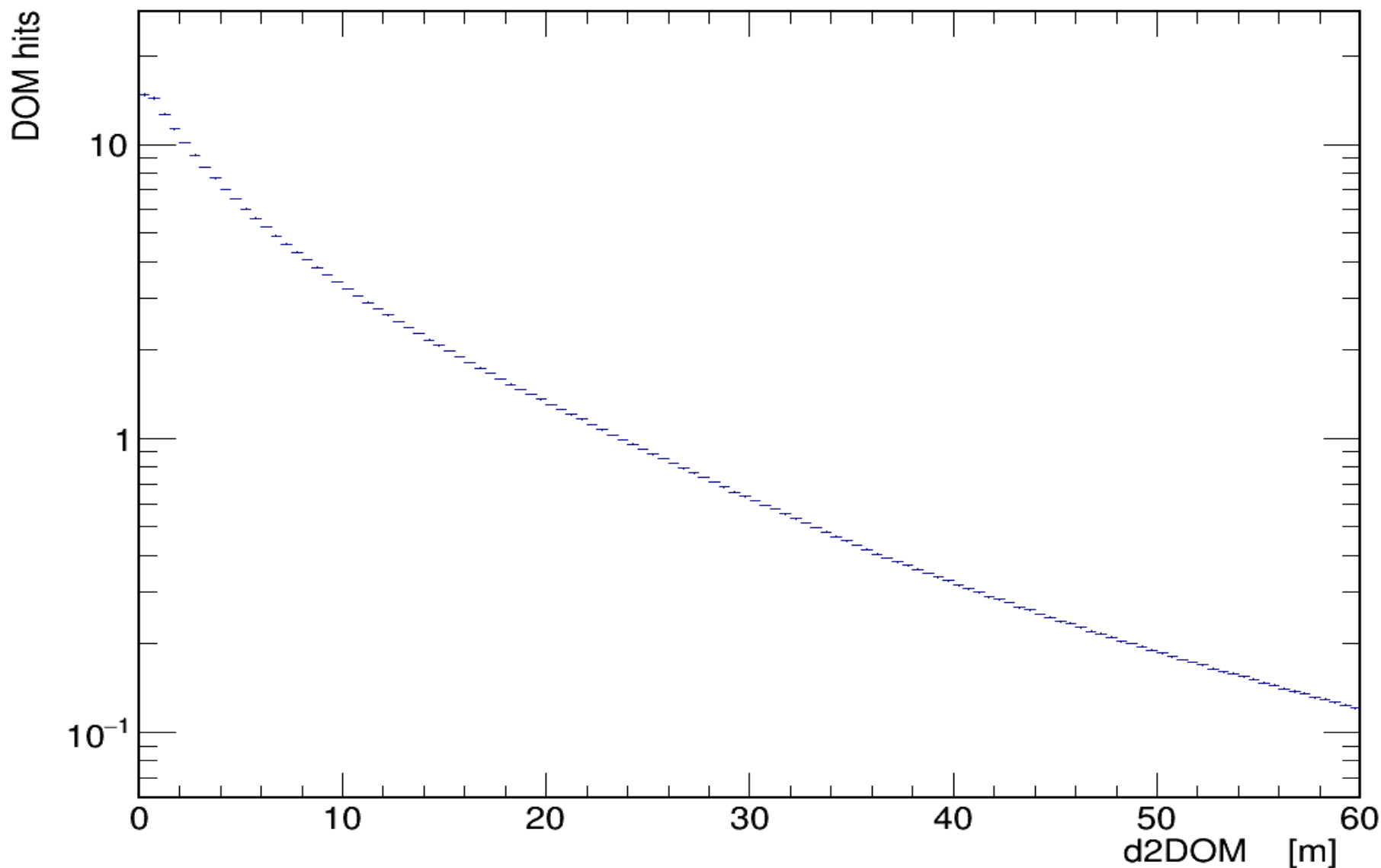
ORCA4 MC: 3.6×10^6 events (MC: mupage-sirene)



4088 events with atm- μ inside the DOM (about 10^{-3})
6366 events with the reconstructed MC-track

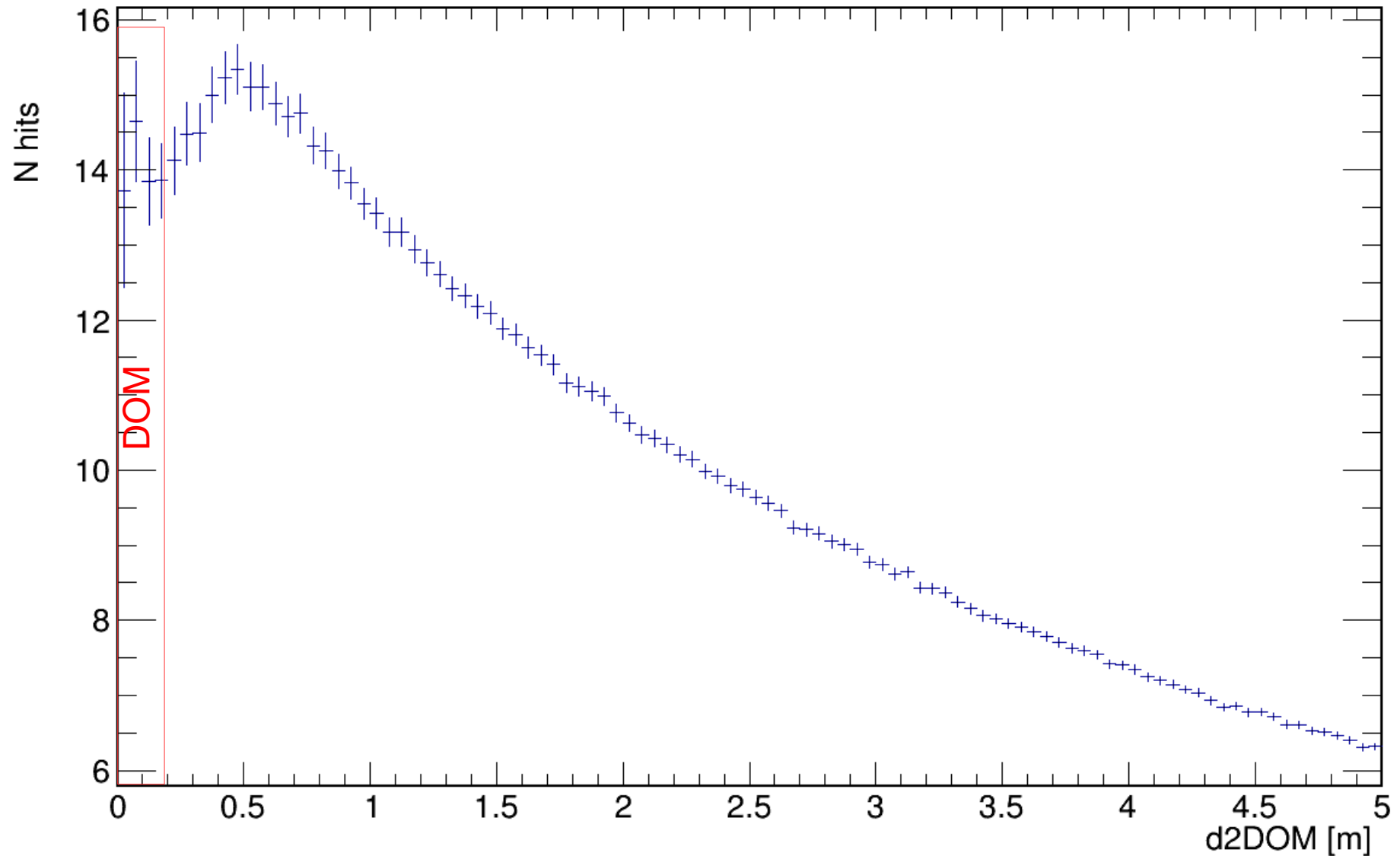
DOM hits vs d2DOM

Statistics: 3.6×10^6 events (MC: mupage-sirene)

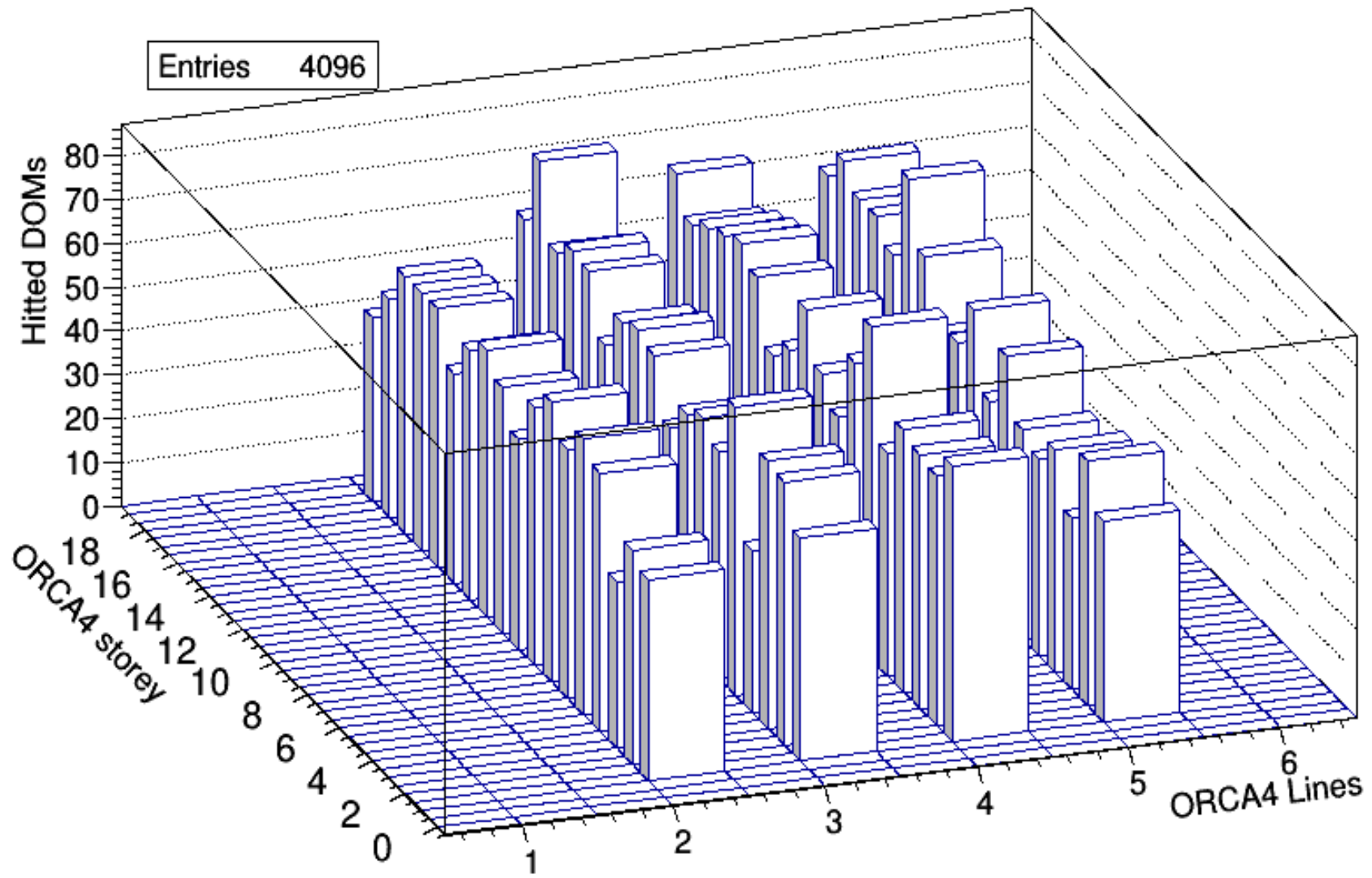


DOM his vs d2DOM

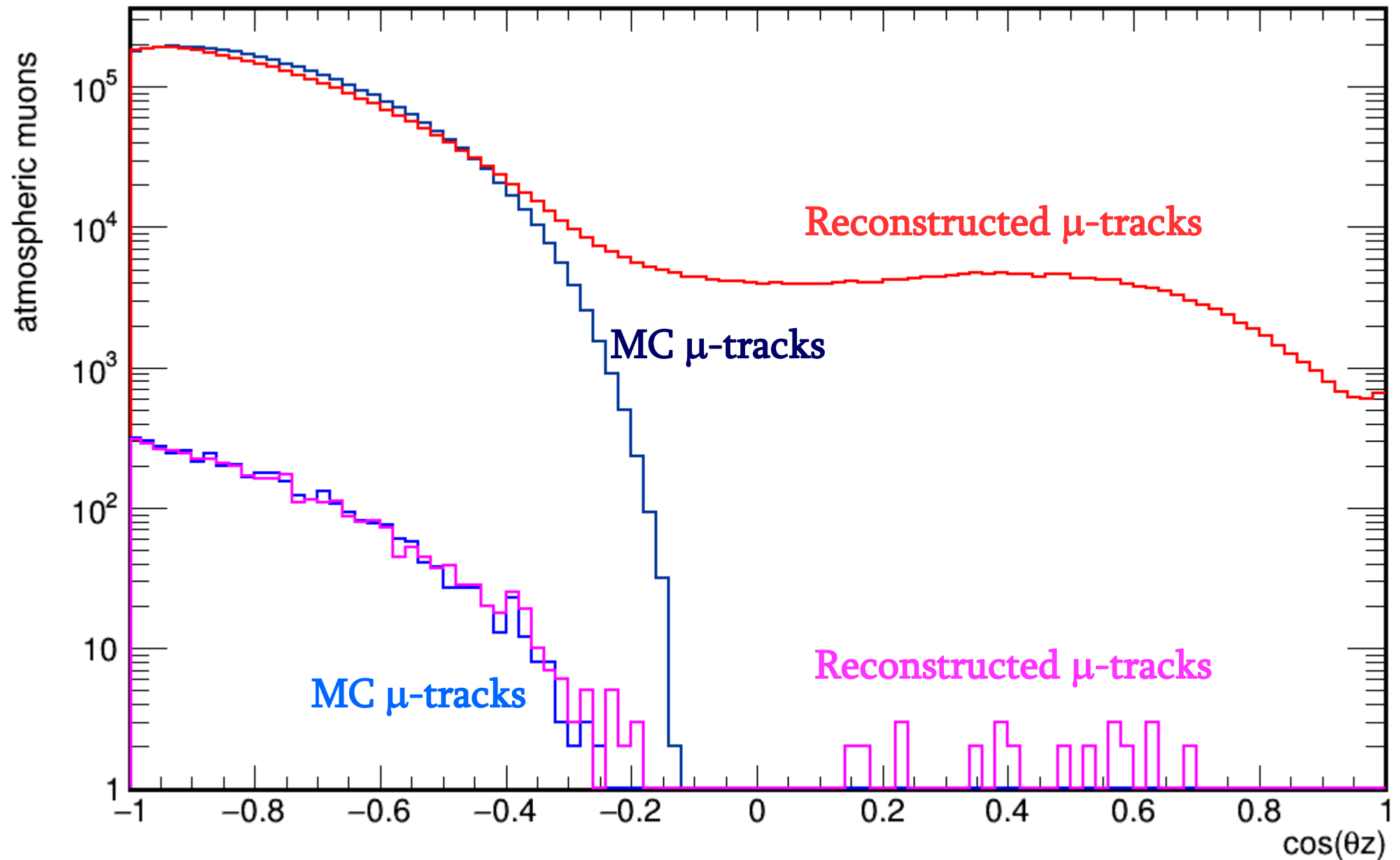
Statistics: 3.6×10^6 events (MC: mupage-sirene)



Hit DOM



Atmospheric muon direction



Summary and Outlook

- Relatively large number of events (about 10^{-3}) atm- μ are hitting the ORCA4 DOMs.
- KM3NeT MC does not include the simulation of DOMs hit by atm- μ
- MC indicates that in the reconstructed tracks initial position is significantly shifted with respect to simulated one. This makes difficult interpretation of the data events
- Additional studies are needed to understand DOMs with the sparks and large signals
- Detailed simulation of DOM response to the atm-muon hitting the PMT in the DOM seems to be necessary
- KM3NeT DOM response to the muons hitting the PMT could be studied in the dedicated experiment with the atmospheric muons or in the μ test-beam.