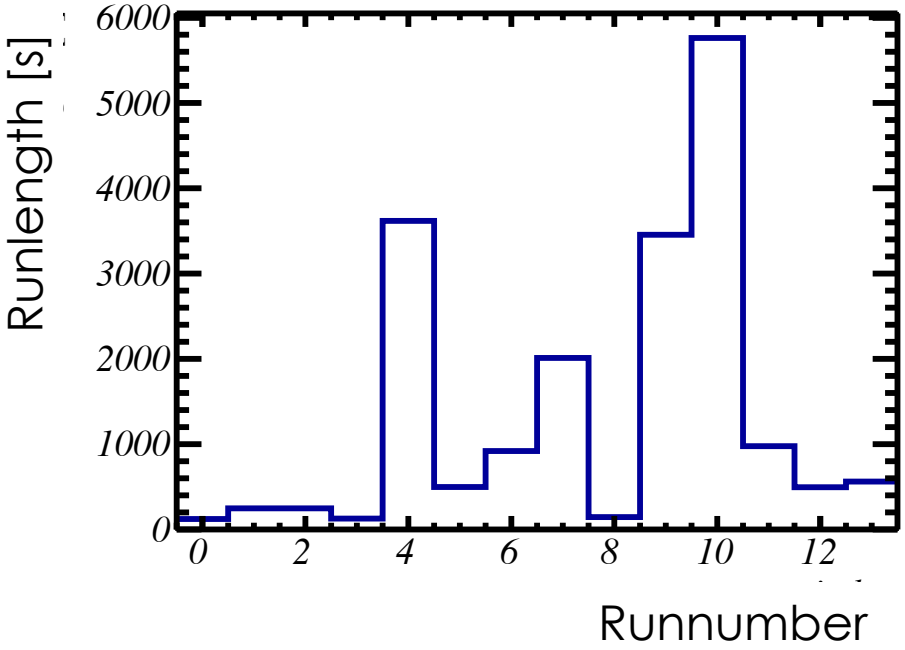
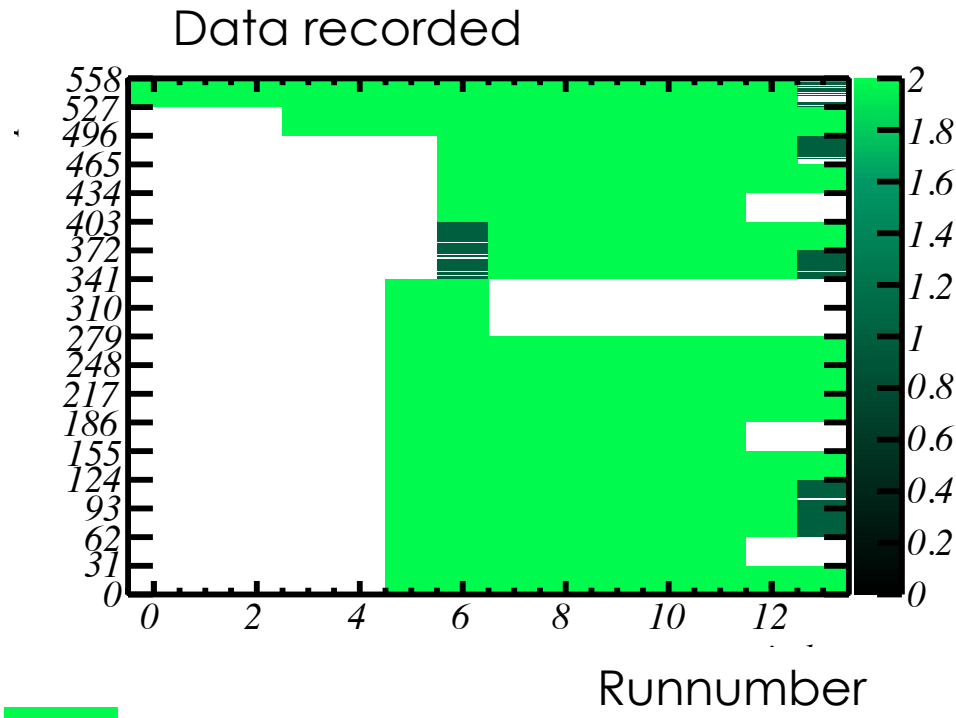
DU-2: First Data

Outline

- First data
- Calibration
- Reconstruction
- Outlook

First data: Runs taken





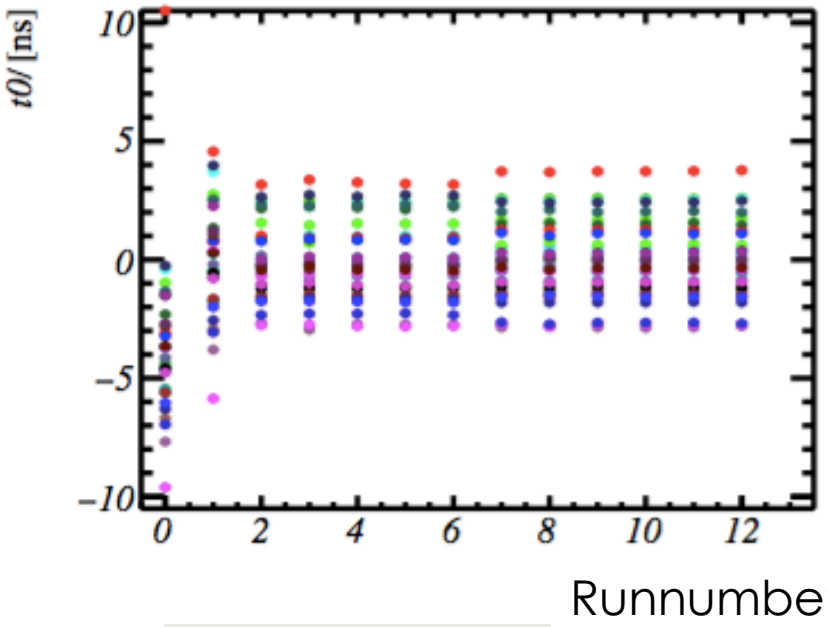
DOM OK.

DOM with PMTs not taking data

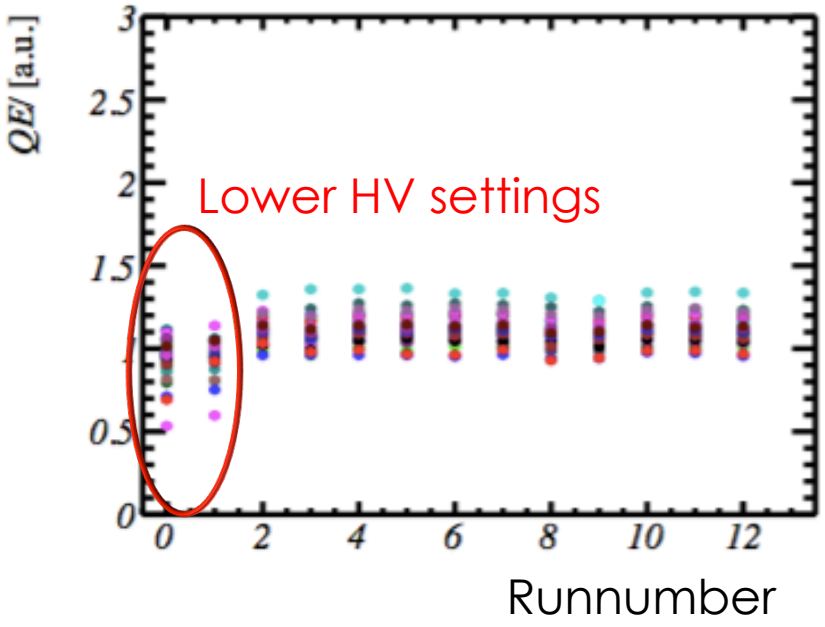
First data: Detector stability

Uppermost DOM (most data), one entry per PMT

PMT t0's

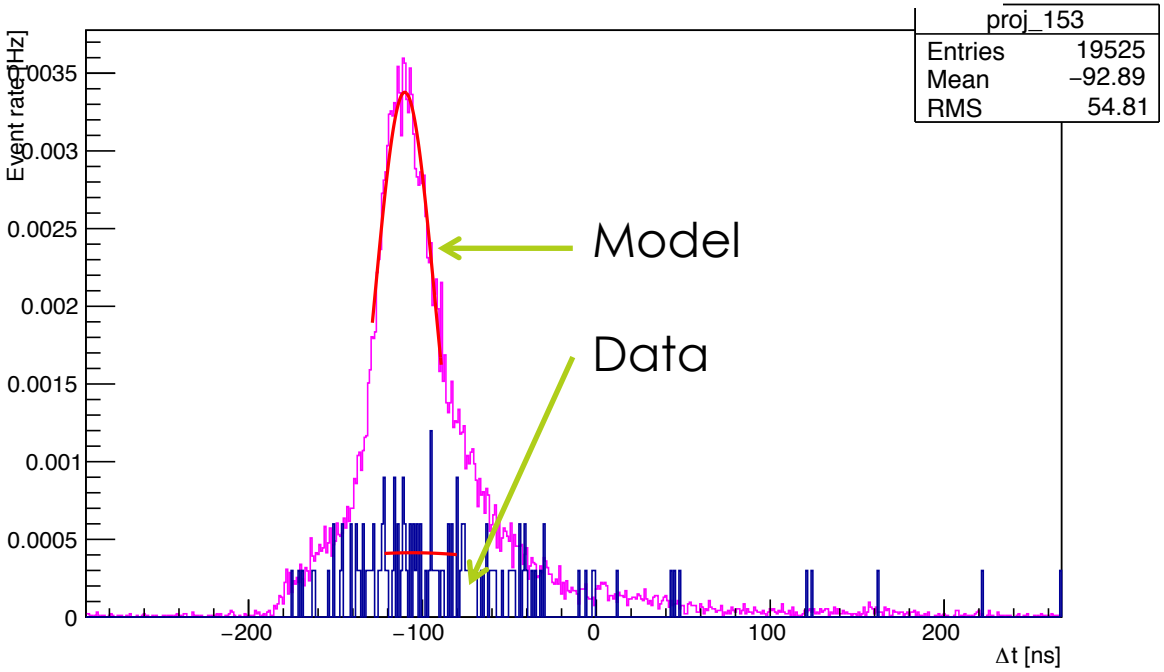


PMT efficiencies



First data: DOM t0's

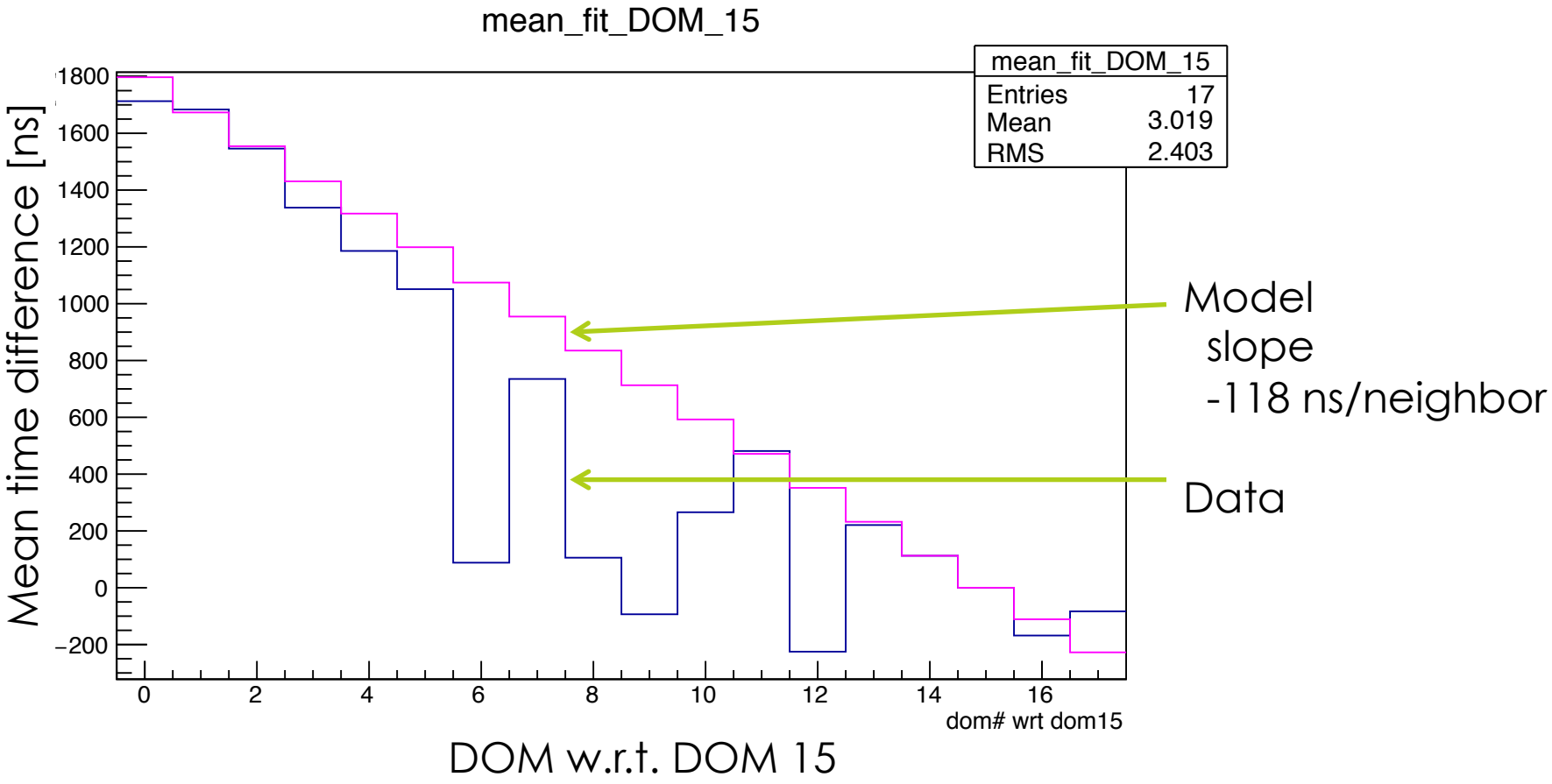
Time difference between coincident light from atm. muons, DOM 17-18:



Normalization wrong:
Model: 4 L1's trigger
Data: 5 L1's trigger

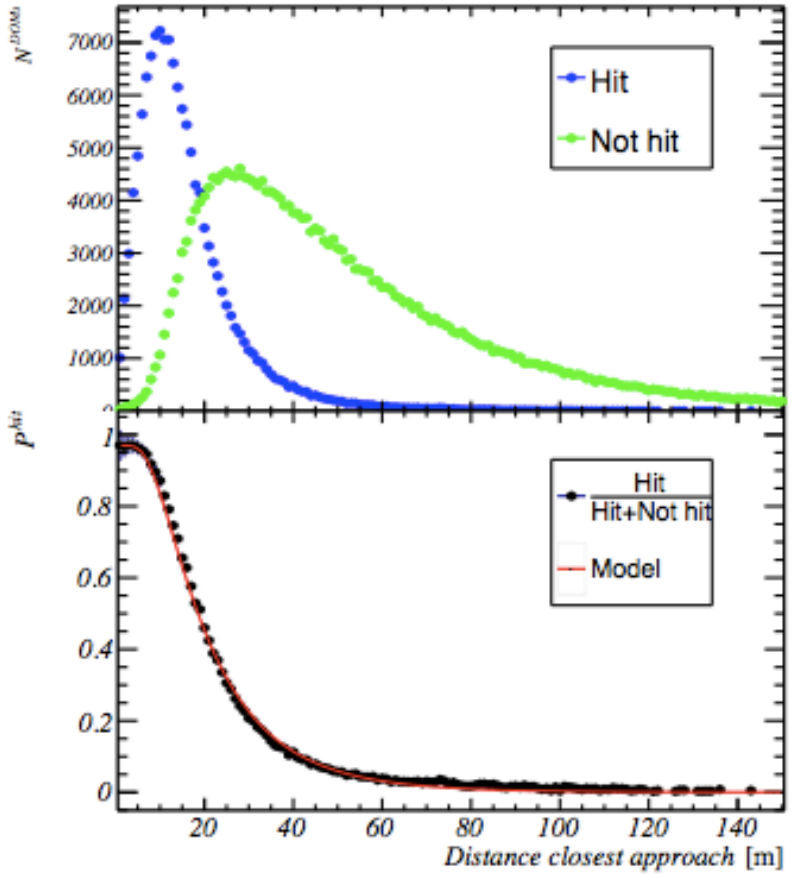
Peak-position approx. right:
model:
-118 ns * 0.3 m/ns = 35.4 m

First data: DOM t0's



Reconstruction

Probability DOM is hit/not hit (L1)



Model:

$$P^{hit} = a\,(1 - \exp(-\hat{n}_i))$$

$$\hat{n}_i = \frac{b}{\rho_i} \cdot \exp(-\frac{\rho_i}{l_{att.}})$$

ρ_i = The distance of closest approach

Figure 4: Upper plot: The number of hit and not hit DOMs. Lower plot: the probability that a DOM is hit, i.e. the number of hit DOMs decided by the total number of DOMs in each bin. Both as function of the distance of closest approach ρ

Probability Time of first hit

First L0 hit on a DOM, within 50 ns of a L1-hit on that DOM:

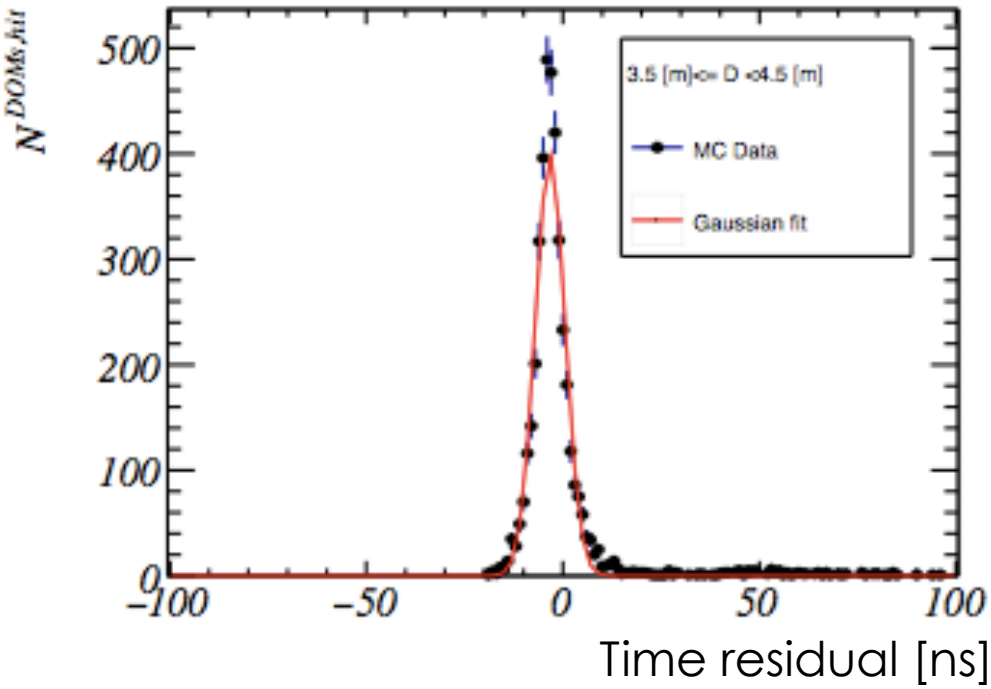


Figure 2: Time difference between a selected hit and the expected hit time for all DOMs within 3.5 and 4.5 meters from the true muon track.

Probability Time of first hit

Bias due to selecting first hit on a DOM
closer to track -> more hits -> earlier selected hit

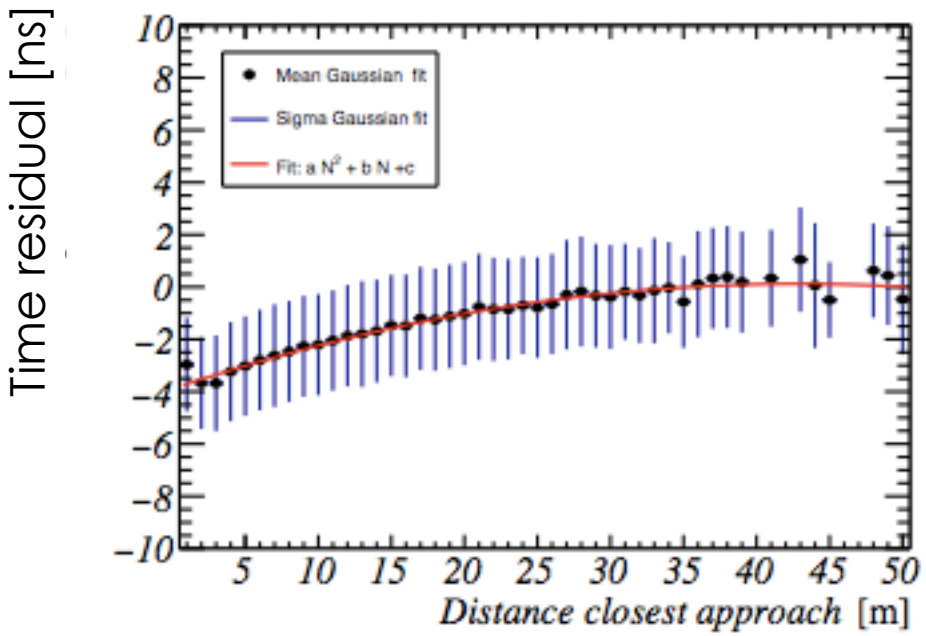


Figure 3: Fitted mean and sigma of the time-difference-slice in each ρ-slice.

Reconstruction: Coordinate system

$\vec{r}_\mu$ = The vector from the origin to the point where the muon passes the z=0-plane

t_μ = The time of the muon passing through the z=0-plane

$\hat{d}_\mu$ = The muon track direction relative to $\vec{r}_\mu$

$= [\sin(\theta_\mu)\cos(\phi_\mu), \sin(\theta_\mu)\sin(\phi_\mu), \cos(\theta_\mu)]$

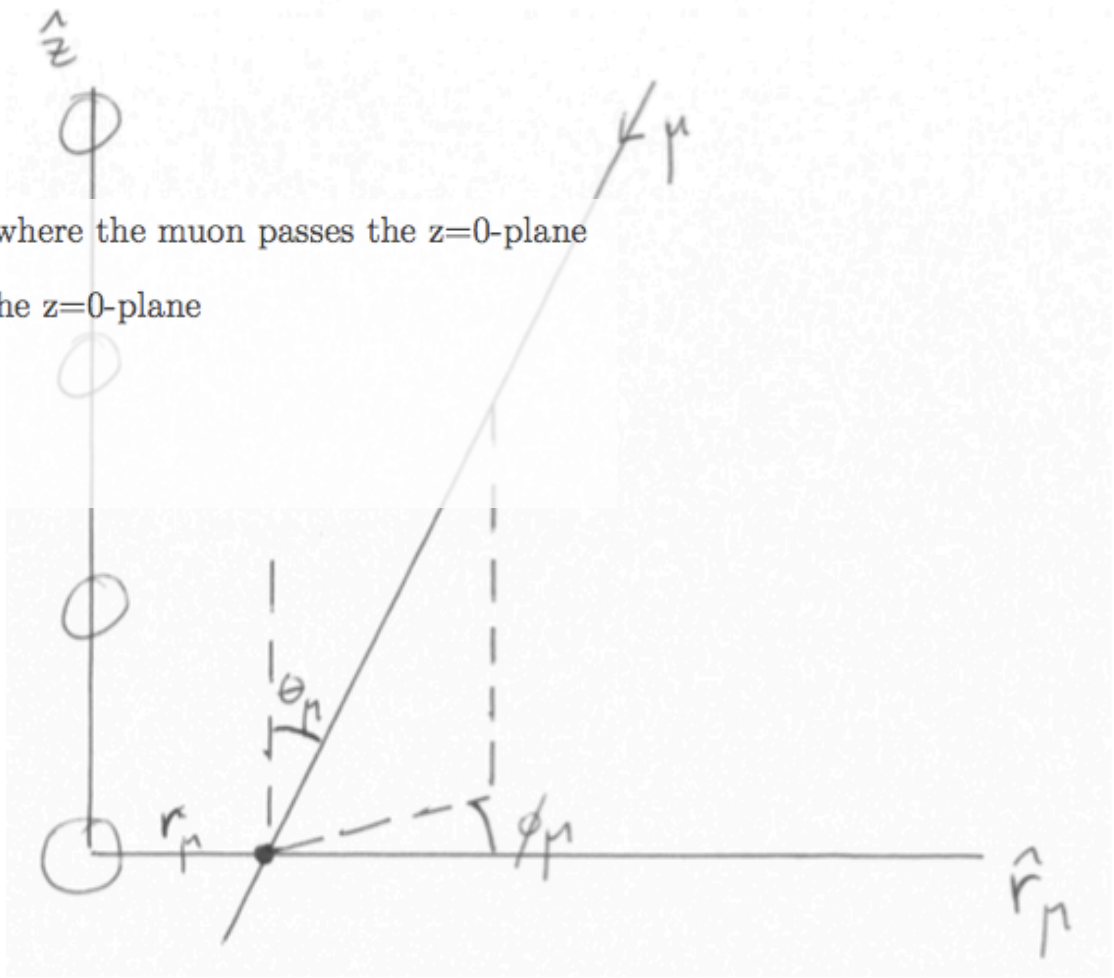
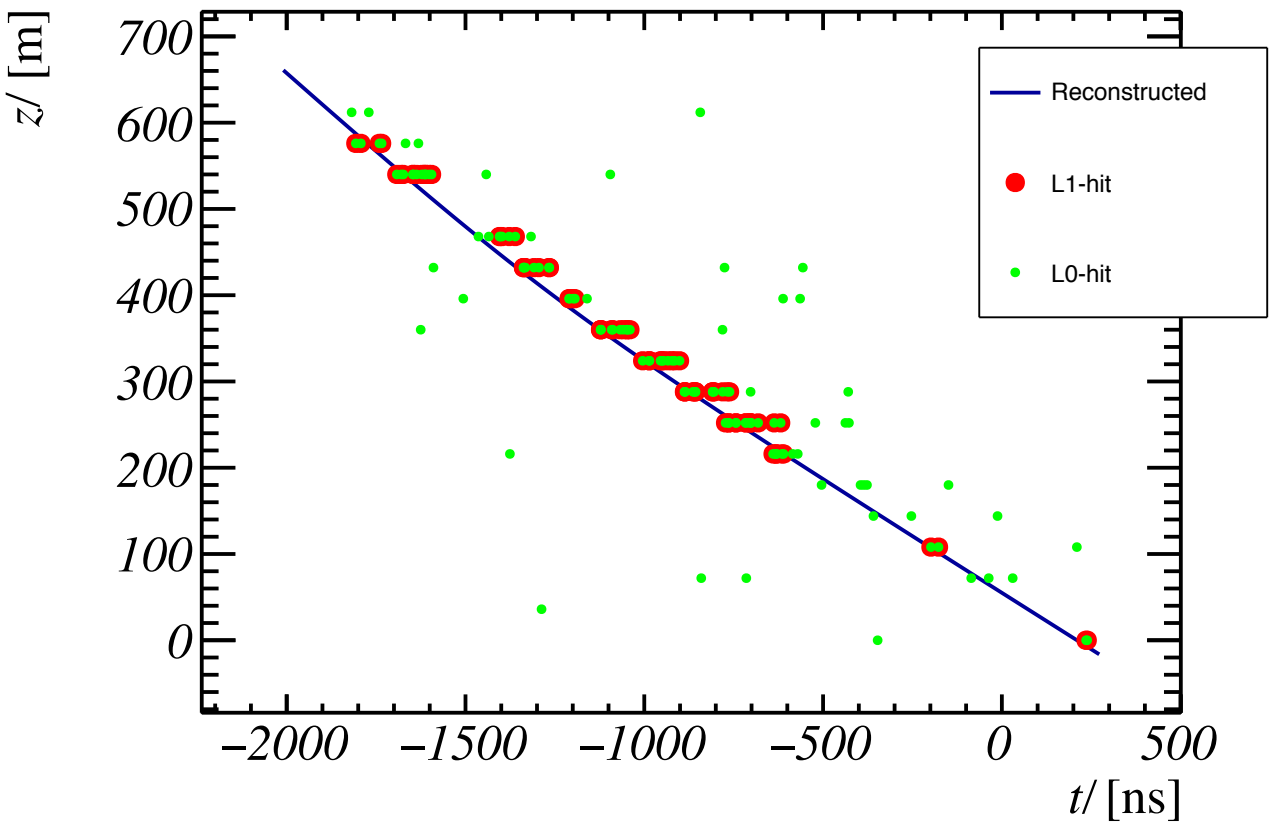


Figure 1: Coordinate system of a track used in this work

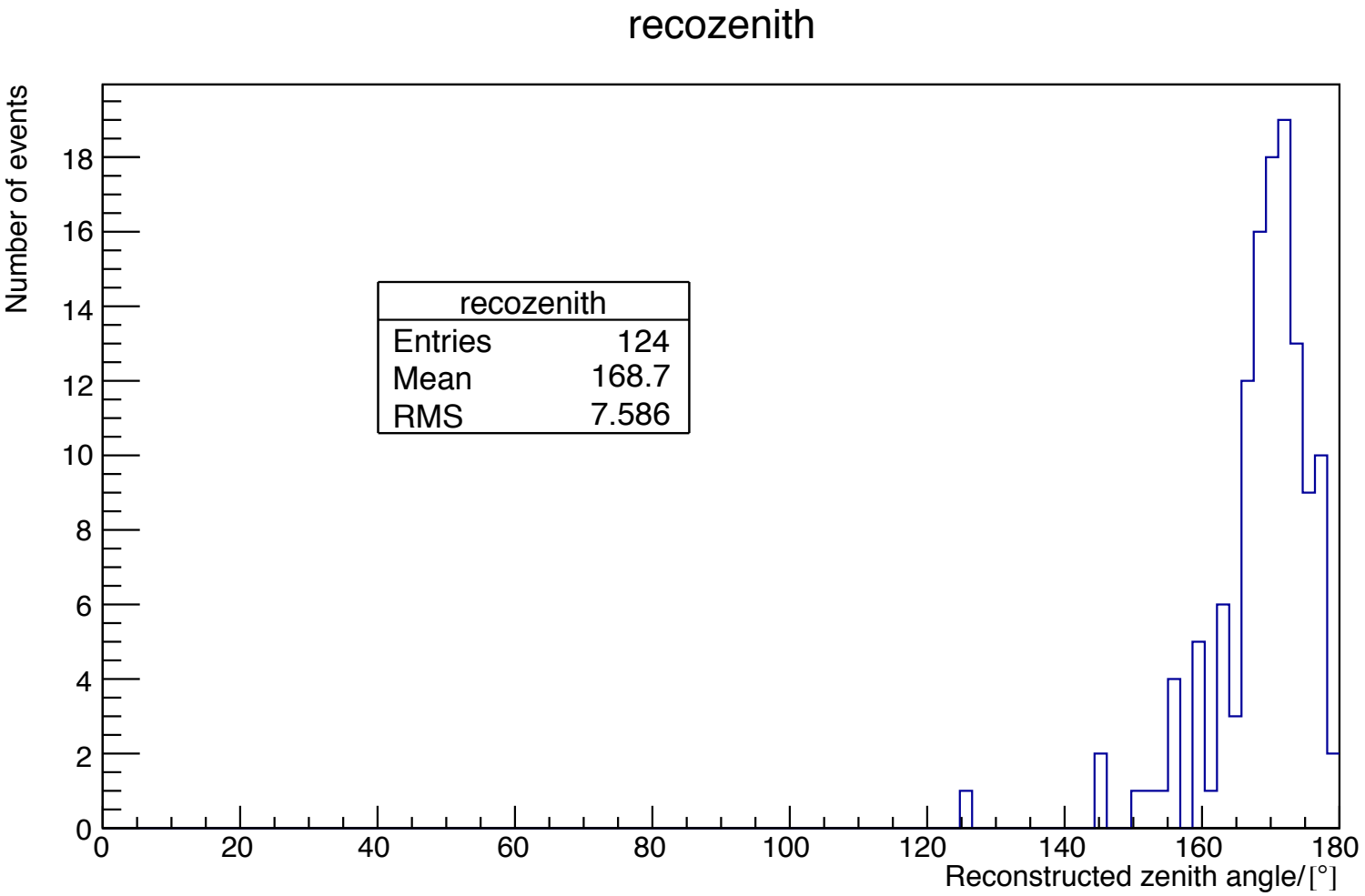
Reconstruction: Algorithm

- Scan over directions and r
- 20000 directions * 500 distances
  - 18 * 10 million evaluations per event
- Pre-calculate Phit and expected hit time
  - Only ±1 second per event

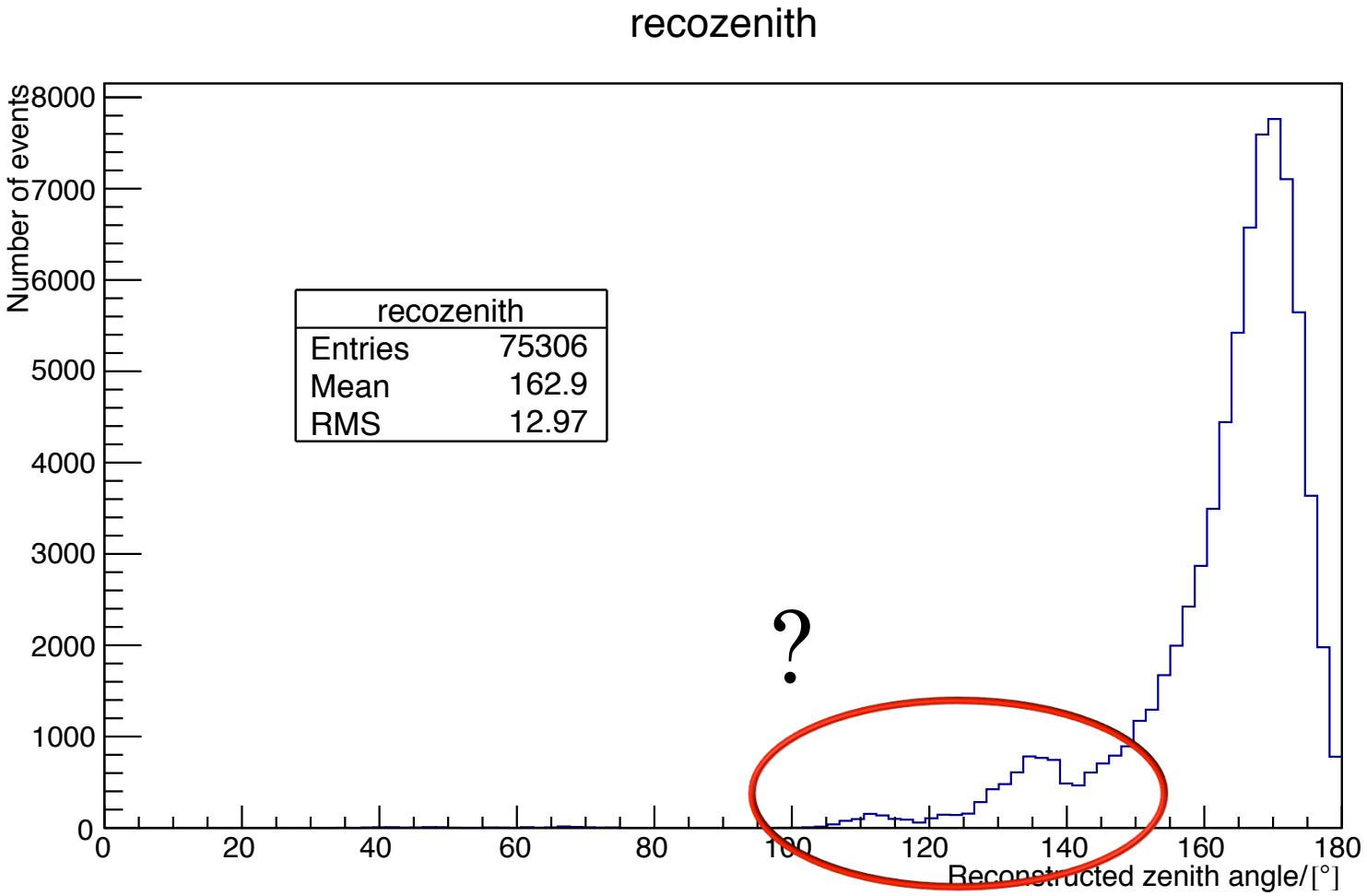
Reconstruction: First results



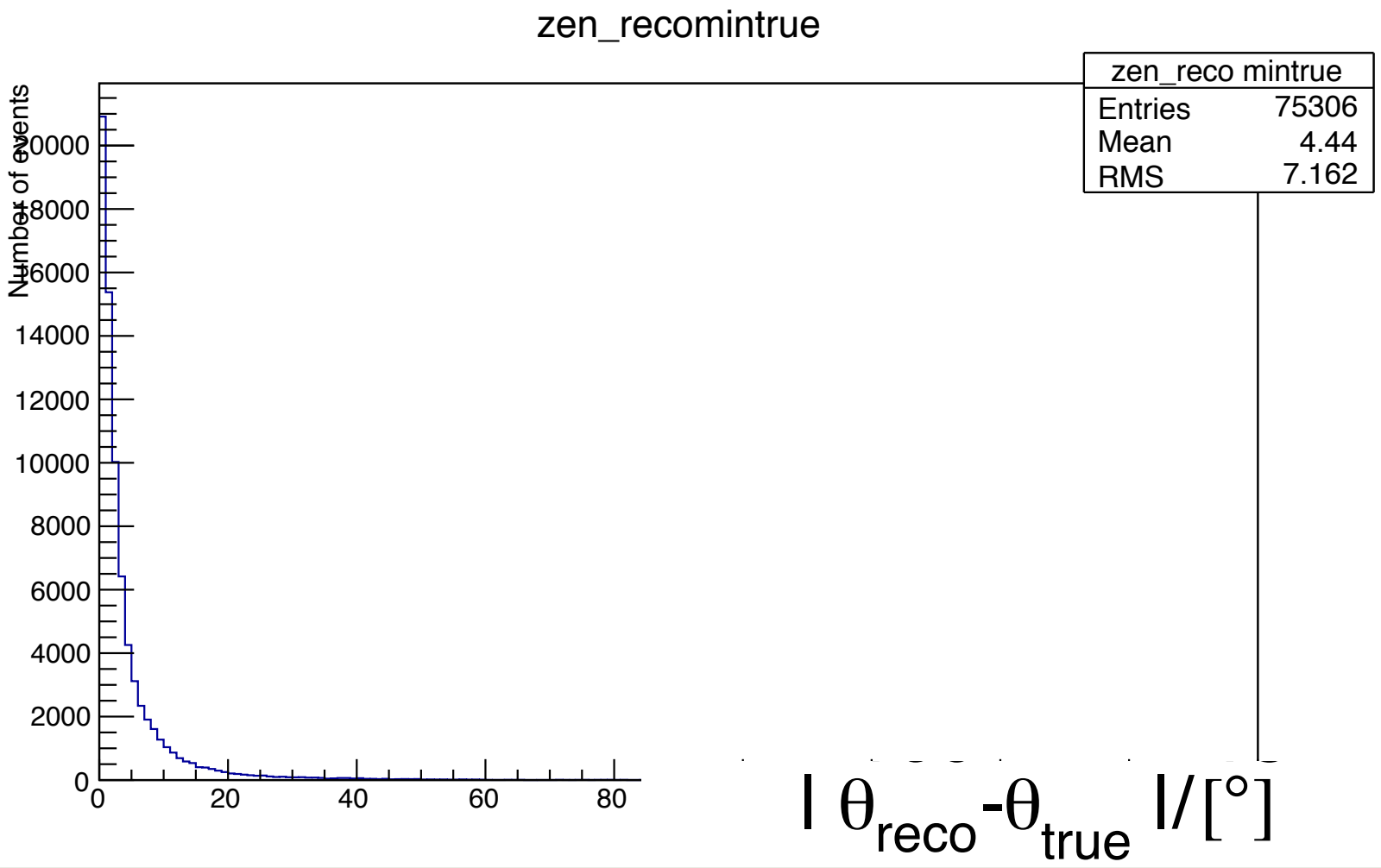
Data: Zenith distribution



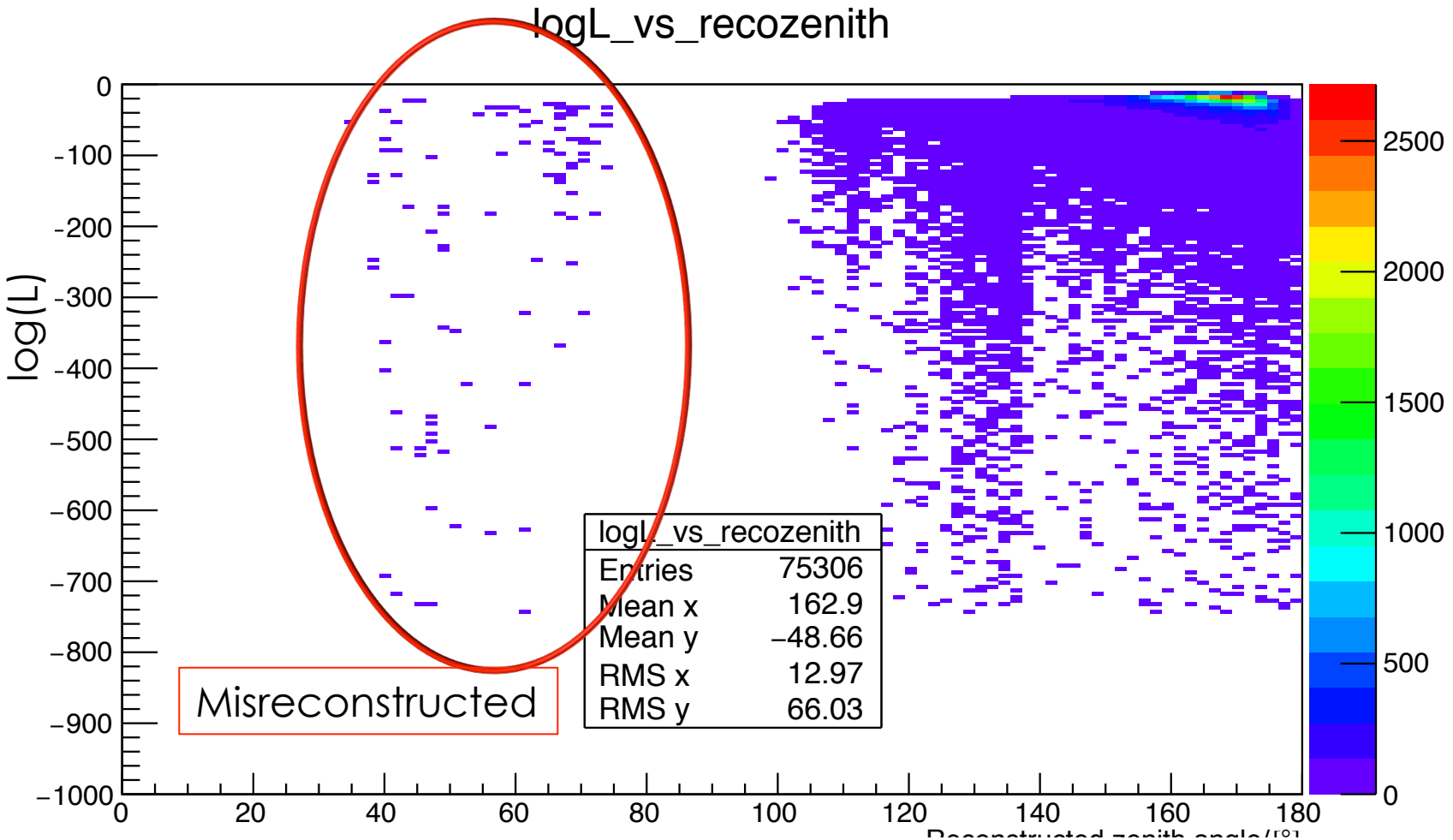
MC: Zenith distribution



MC: Error in zenith angle



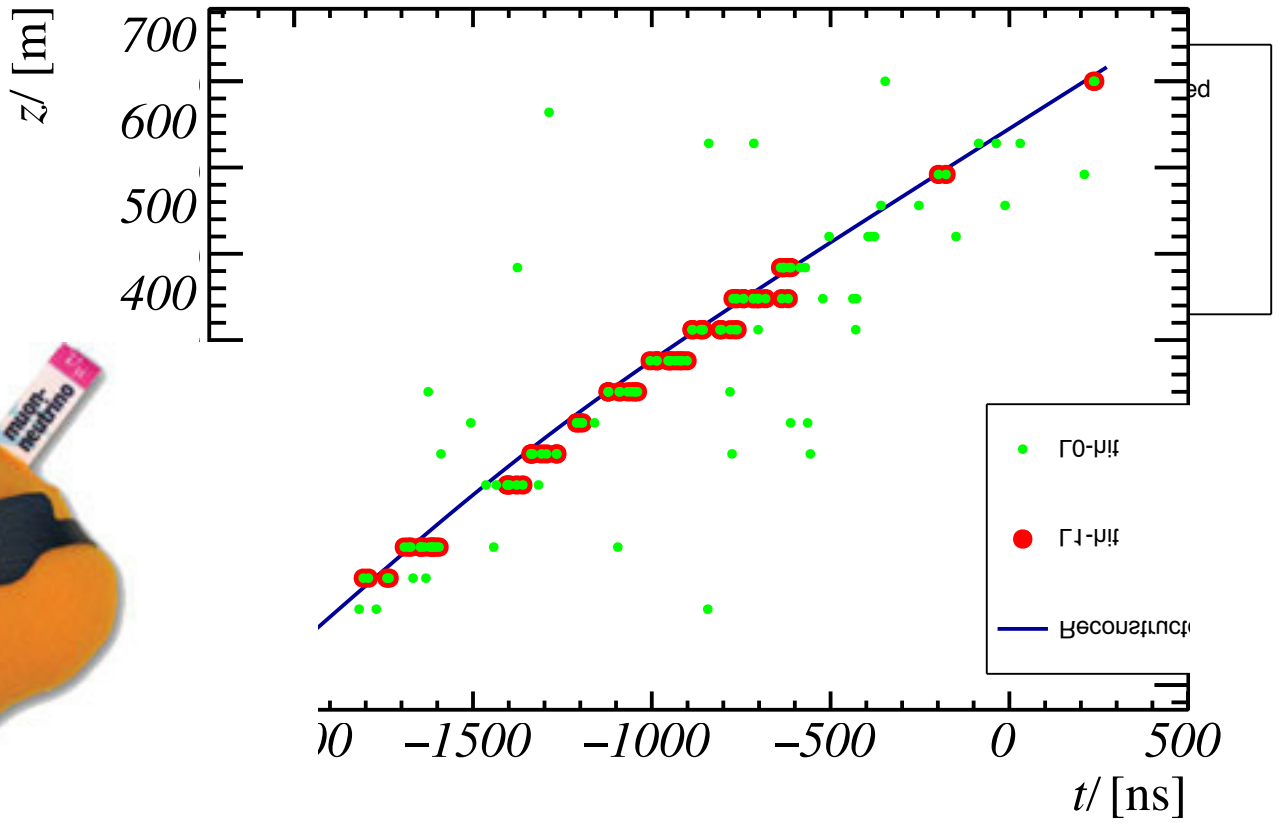
MC: log(L) distributie



Outlook

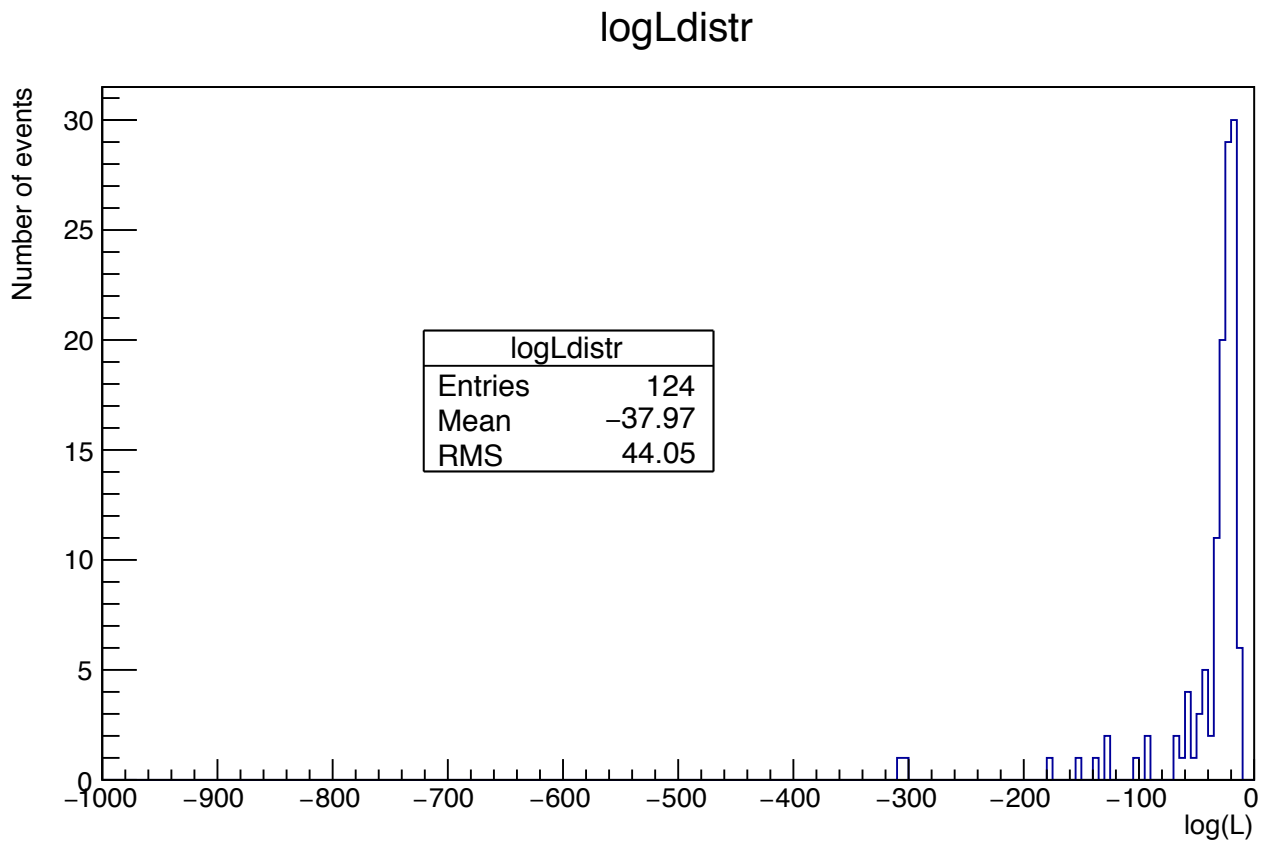
- Still a lot of work to do
  - Calibration
    - Parameters and error estimation
  - Reconstruction
    - Cuts agains misreconstructed tracks
    - Data-MC comparison
    - Test model parameters (Phit, hit-time distr)

Outlook

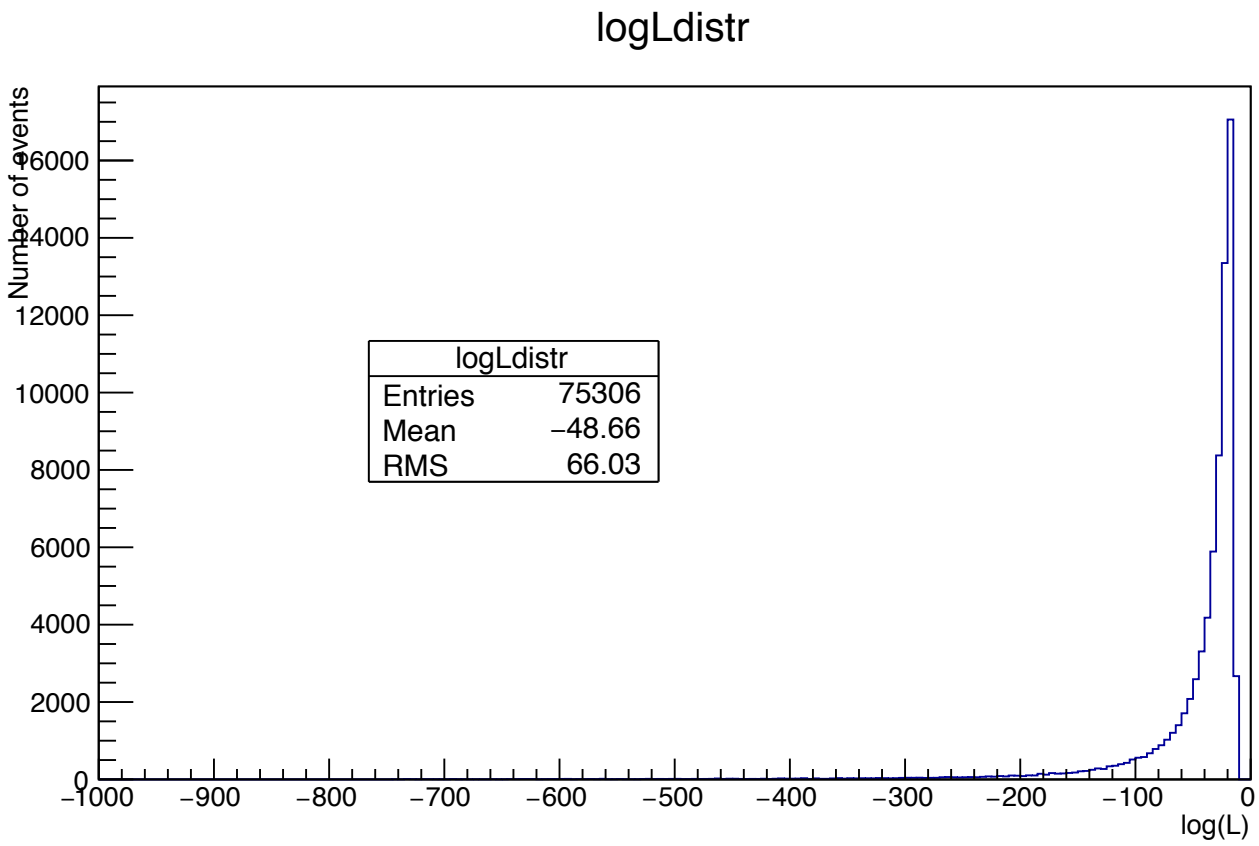


Backup

log(L) distribution data



log(L) distribution MC



Number of reconstructed events