35ton Sim/Reco/Analysis Meeting 10/14/2015

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Measuring Purity Offline

- Drift velocity of ionization electrons;
- Electron Lifetime

(*work in progress*).

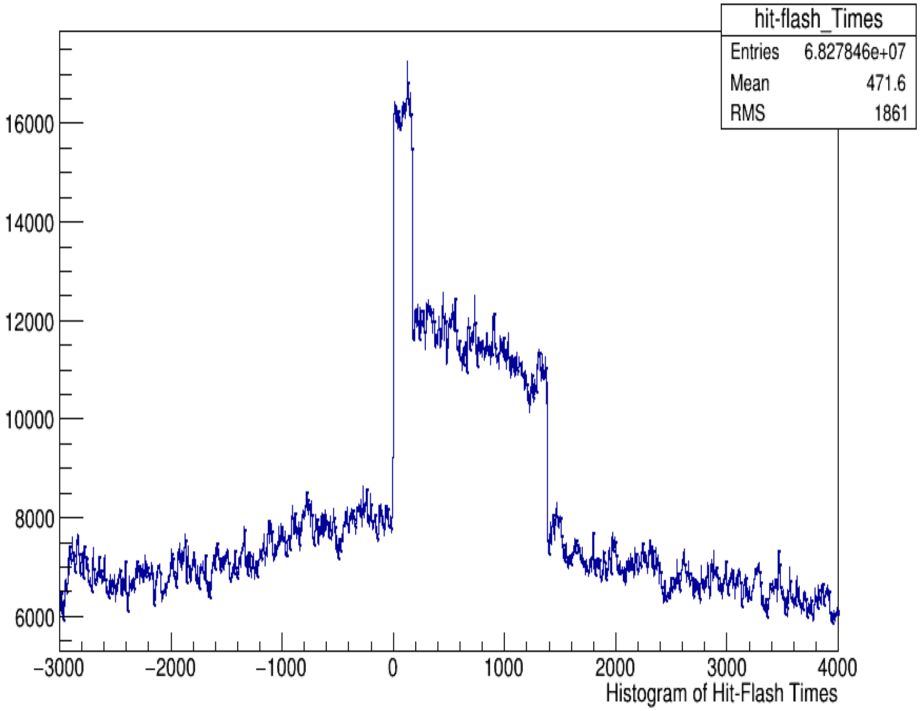
Electron Lifetime

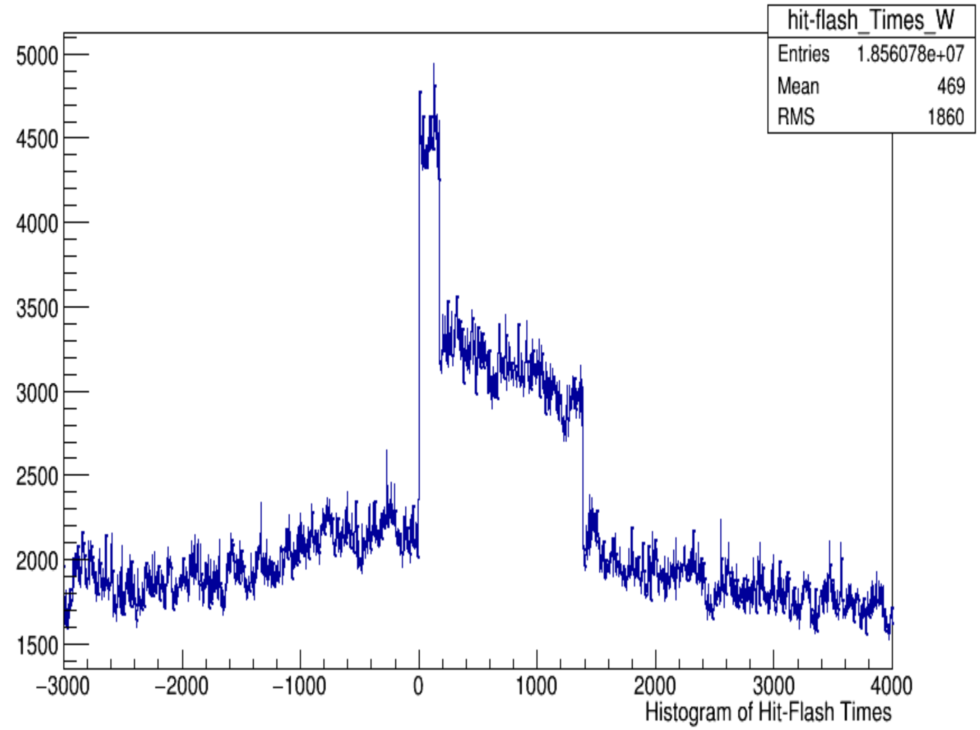
- The electron lifetime τ_{ele} is inversely proportional to the attenuation of the ionization charge signal produced by the particle energy deposition, $\lambda = 1/\tau_{ele}$;
- The attenuation is a function of the drift distance from the wire planes;
- $Q = Q_0 \exp(-d/\lambda) = Q_0 \exp(-(t-t_0)v_{drift}/\lambda)$;
- $\ln Q = -(v_{drift}/\lambda)t + const.$

Drift velocity of ionization electrons

- Calculating the differences of all the flash times and hit times of a big number of tracks one can statistically determine the velocity of the electrons drifting towards the anode;
- Time differences calculated from associated hits and flashes are more frequent. Time differences corresponding to the short drift distance is twice more probable;
- Using the maximum time difference t_{drift} for a drift distance (APA – CPA distance - d_{drift}), we have $v_{drift} = d_{drift}/t_{drift}$. For a uniform electric field E = 500 V/cm this velocity is expected to be 1.6 mm/μs.

Drift velocity of ionization electrons





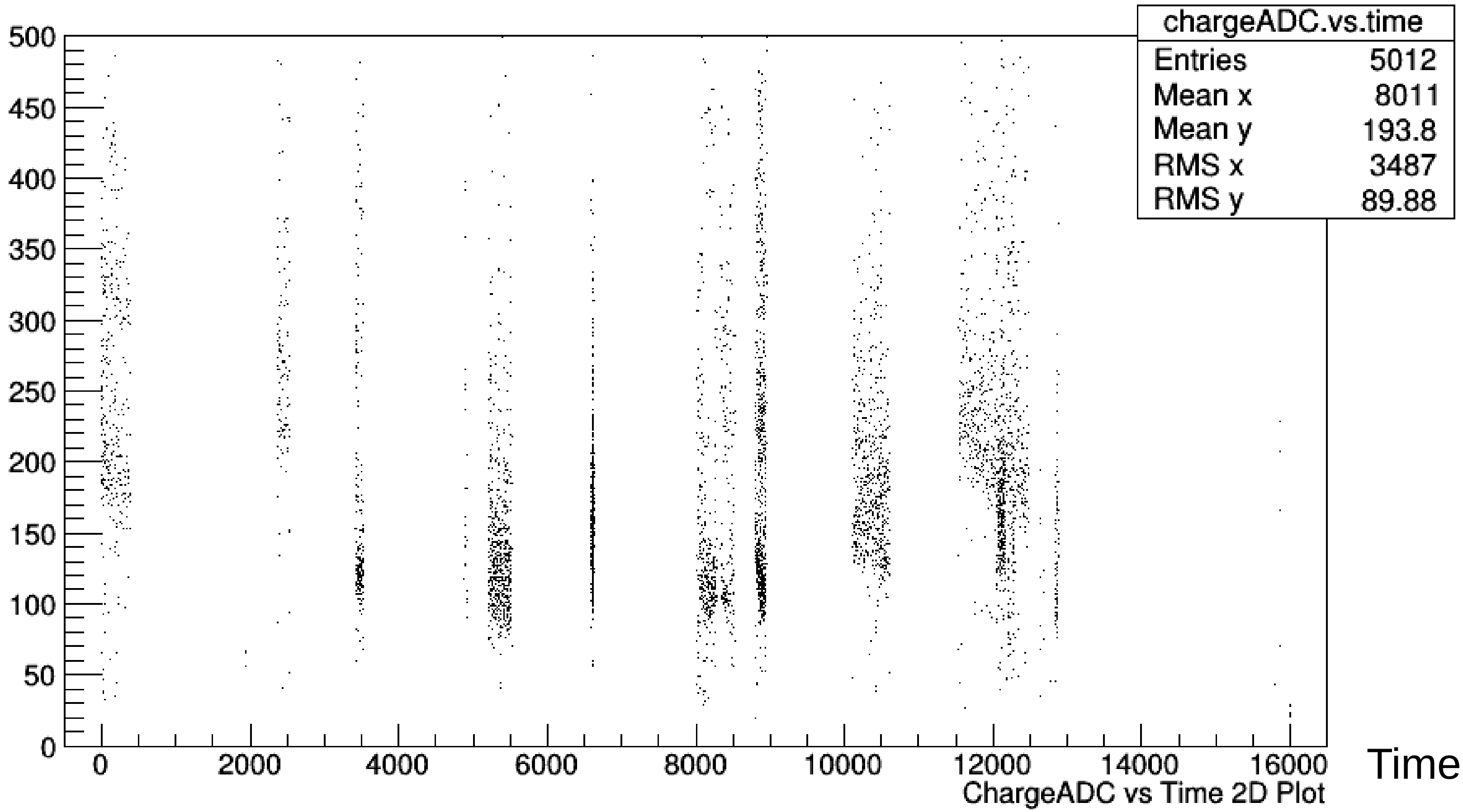
DocDB 7550, Russ Rucinski

Detector Module				
Centerline distance CPA to APA short drift side	0.302		m	from May 2014 TPC model file
Centerline distance CPA to APA long drift side	2.258		m	from May 2014 TPC model file
Short Drift Distance	272	271.6	mm	APA "X" (collection) plane centerline to CPA centerline
Long Drift Distance	2228	2224.6	mm	APA "X" (collection) plane centerline to CPA centerline
Numer of APA's	4	4		2 long APA's on side plus stacked APA in center

Short Drift v_{drift} = 272mm/190μs = 1.43mm/μs

Long Drift v_{drift} = 2228mm/1382μs = 1.6mm/μs

Simulation – One event

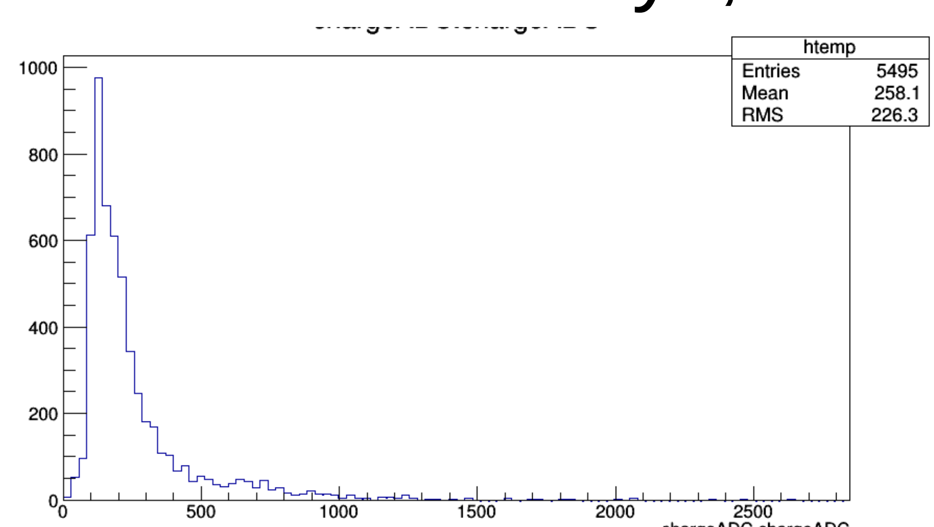


Time (µs)

prodcosmics_dune35t_miliblock_0_20150827T232050_merged.root

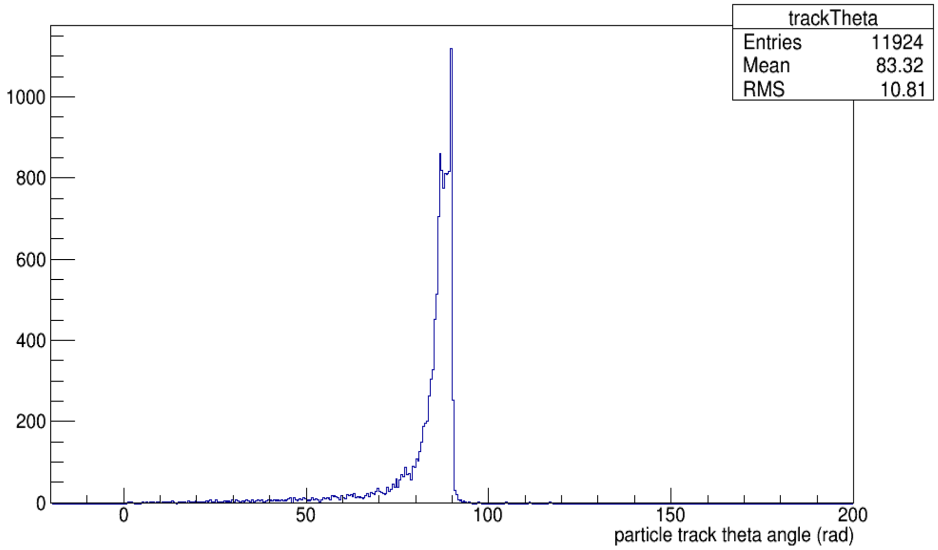
Track selection criteria

- Long tracks → number of wires with hits > (100?);
- Not vertical (parallel to collection wires) and not perpendicular to the wire plane;
- Exclude tracks with associated electromagnetic showers and large number of delta-rays;
- Obtain Gauss-like distribution of charges cutting the Landau tail of the dE/dx depositions. (30% upper and 1% lower)

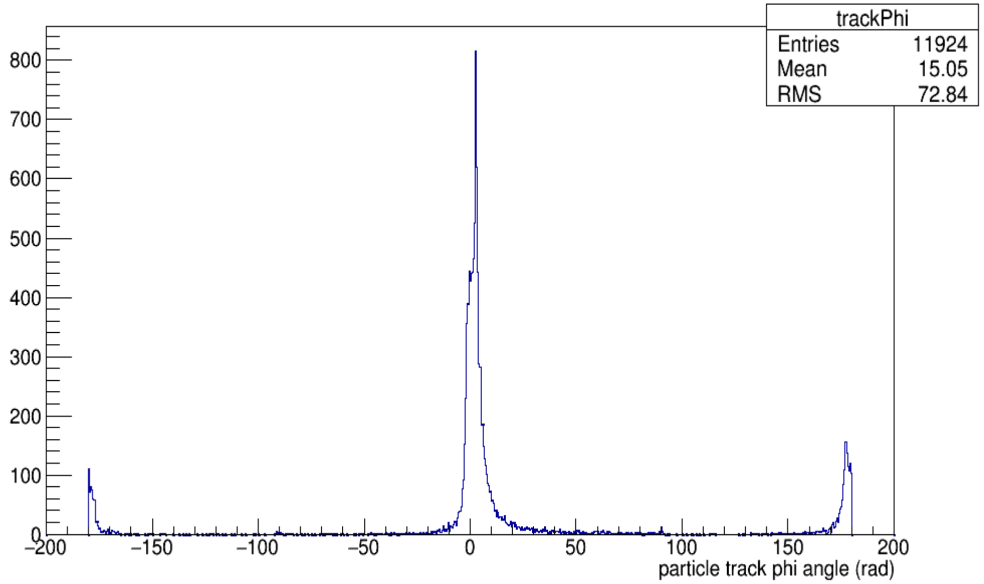


Angles

- After checking the distribution of track directions we realized ->Theta() and ->Phi() were returning fXYZ.front().Theta() instead of fDir.front().Theta().



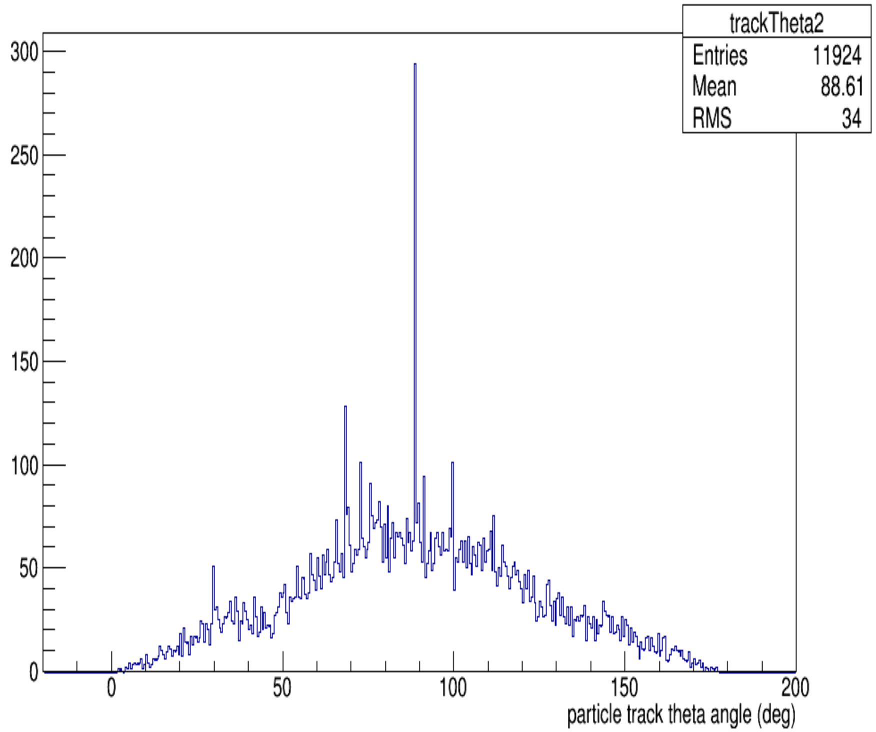
Theta (deg)

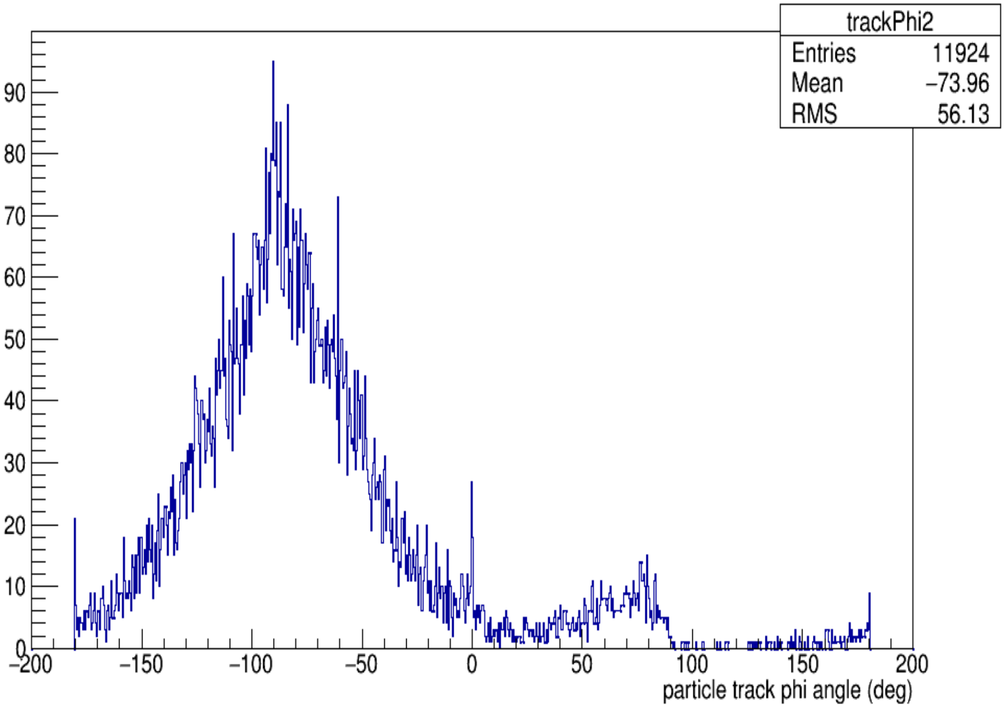


Phi (deg)

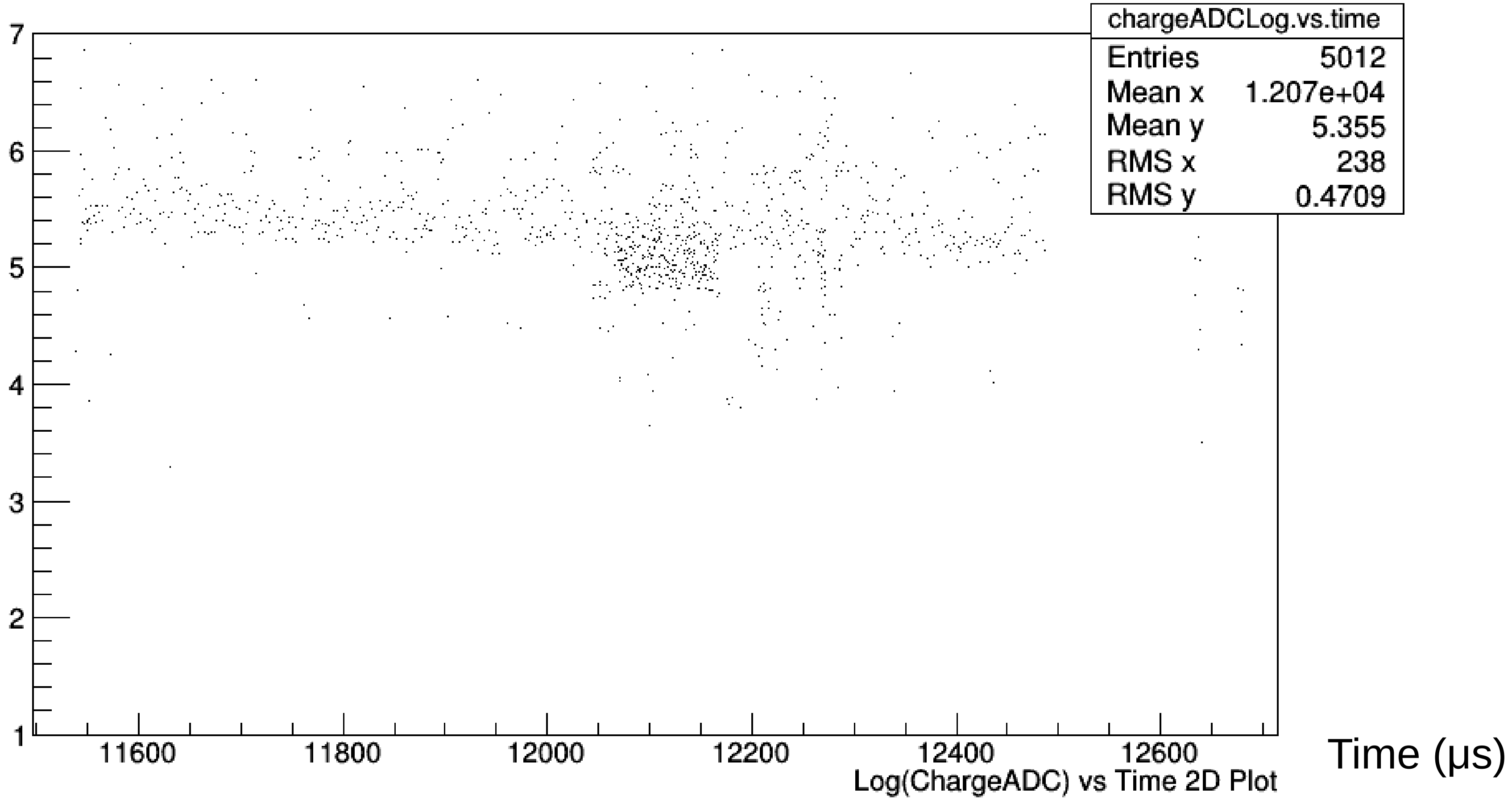
Angles after correction

→ Before correction the Theta() and Phi() were actually returning the angles of the vector pointing from the origin of the coordinate system to the beginning of the tracks; that is not related with the track direction itself.





Preliminary selection



Still need to improve the selection of tracks and hits. Fit the best straight line with respect to the logarithm of the distribution. See next slide for the work conducted by the ICARUS collaboration.

ICARUS result – arXiv:1409.5592v3

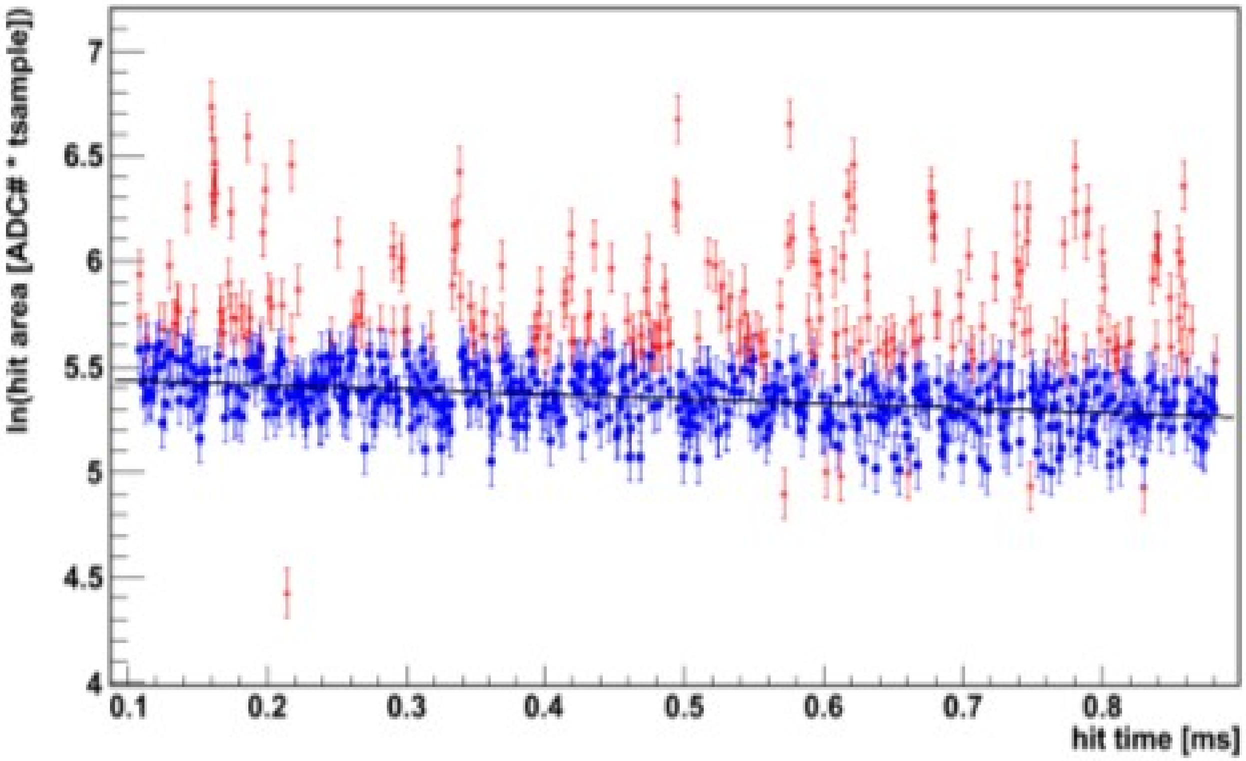


Figure 3. Pulse hit area as a function of the drift time for the track shown in Figure 1; in red star the ∼ 230 hits that are removed by the truncation method, in blue circle the ∼ 510 surviving hits. The linear fit of the logarithm of the hit signal vs. drift time used to extract the electron signal attenuation is also shown (black line): for this event $\lambda_T = (0.212 \pm 0.022)\ \mathrm{ms}^{-1}$.