Cosmic Analysis

Edward Santos
on behalf of the Tracker Group

Overview

- 1 - Introduction
  - Datasets collected
- 2 - Tracker Sanity
  - Dead Channels, Mapping, Efficiencies
- 3 - Further Analysis
  - Position Resolution, Event Rates
- 4 - Software Tools Developed & Requests for the Future

(1) Dataset Collected

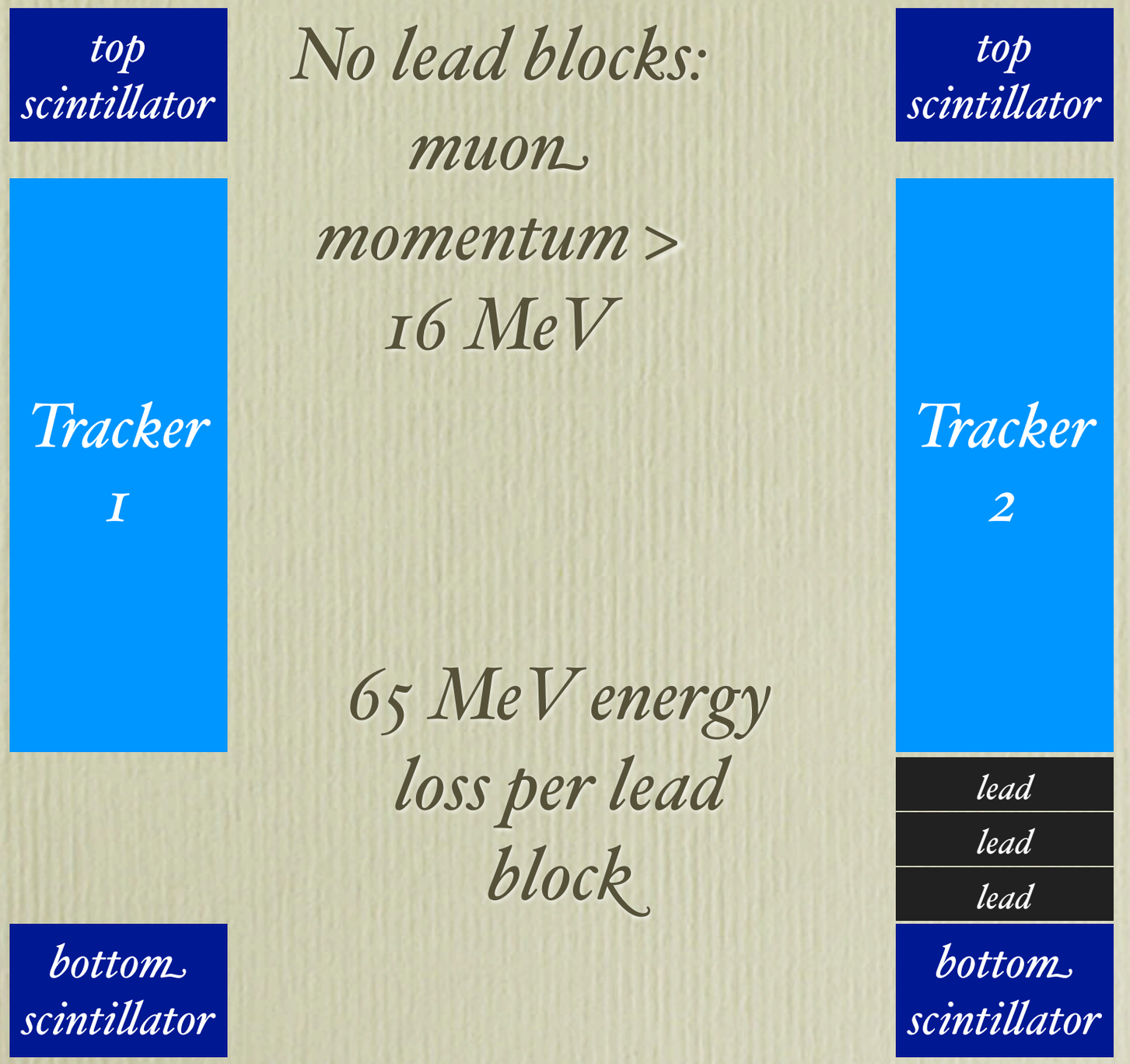
- Prior to Tracker Workshop (15 Dec 2011)
- ~27 Gb of data in multiple configurations

  debugging work on hardware/software/mapping

- 2.3 Gb + 549 Mb After Tracker Workshop

  state-of-the-art data

(1) Dataset Collected



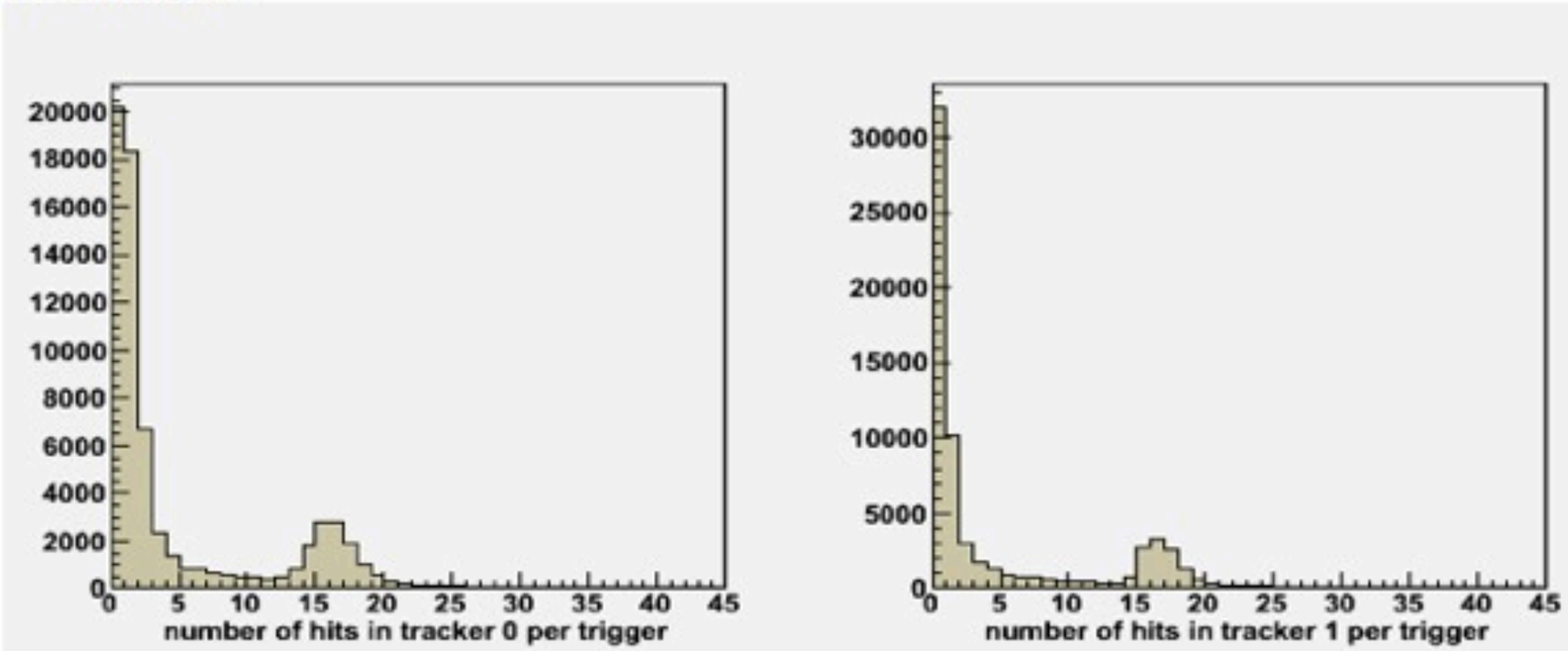
range of muon energies accepted:
> 16 MeV
> 81 MeV
> 146 MeV
> 211 MeV

(2) Tracker Sanity

One of our first results...

5 Oct Sept - 11 Oct

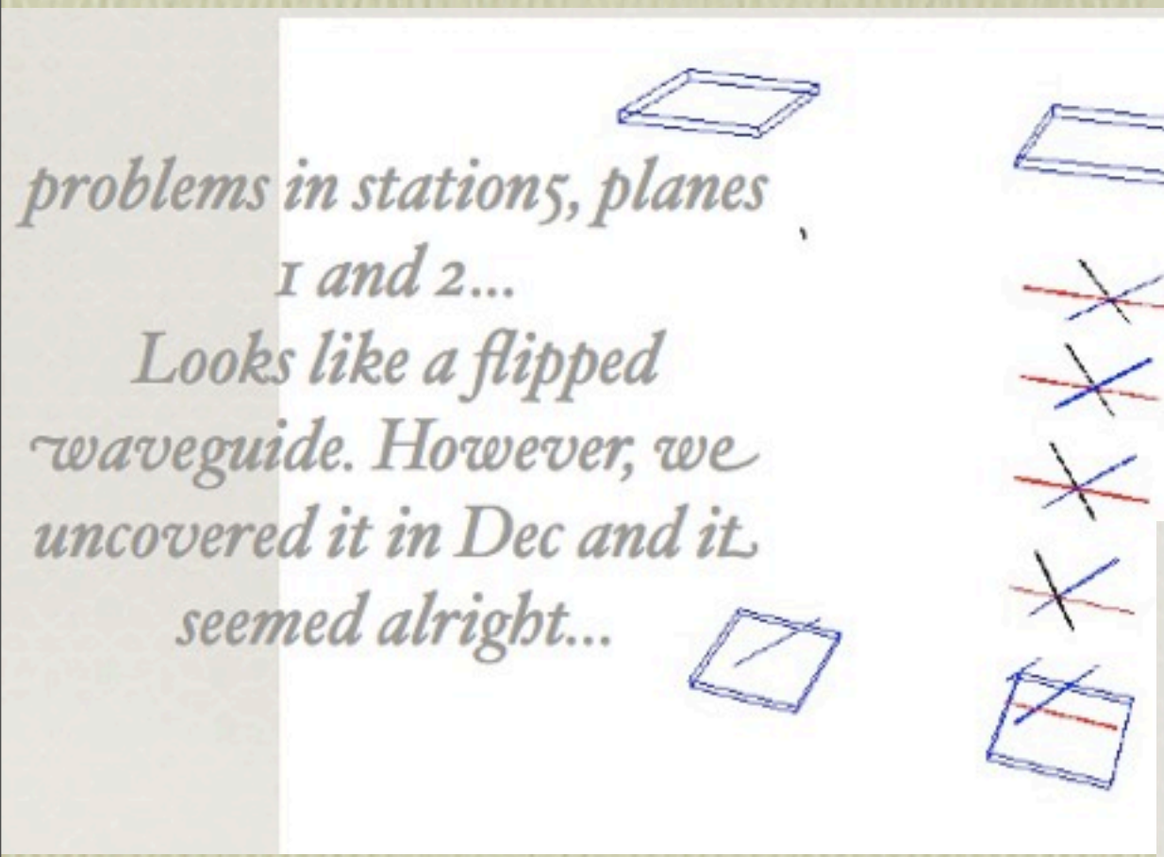
Triggers in both trackers again



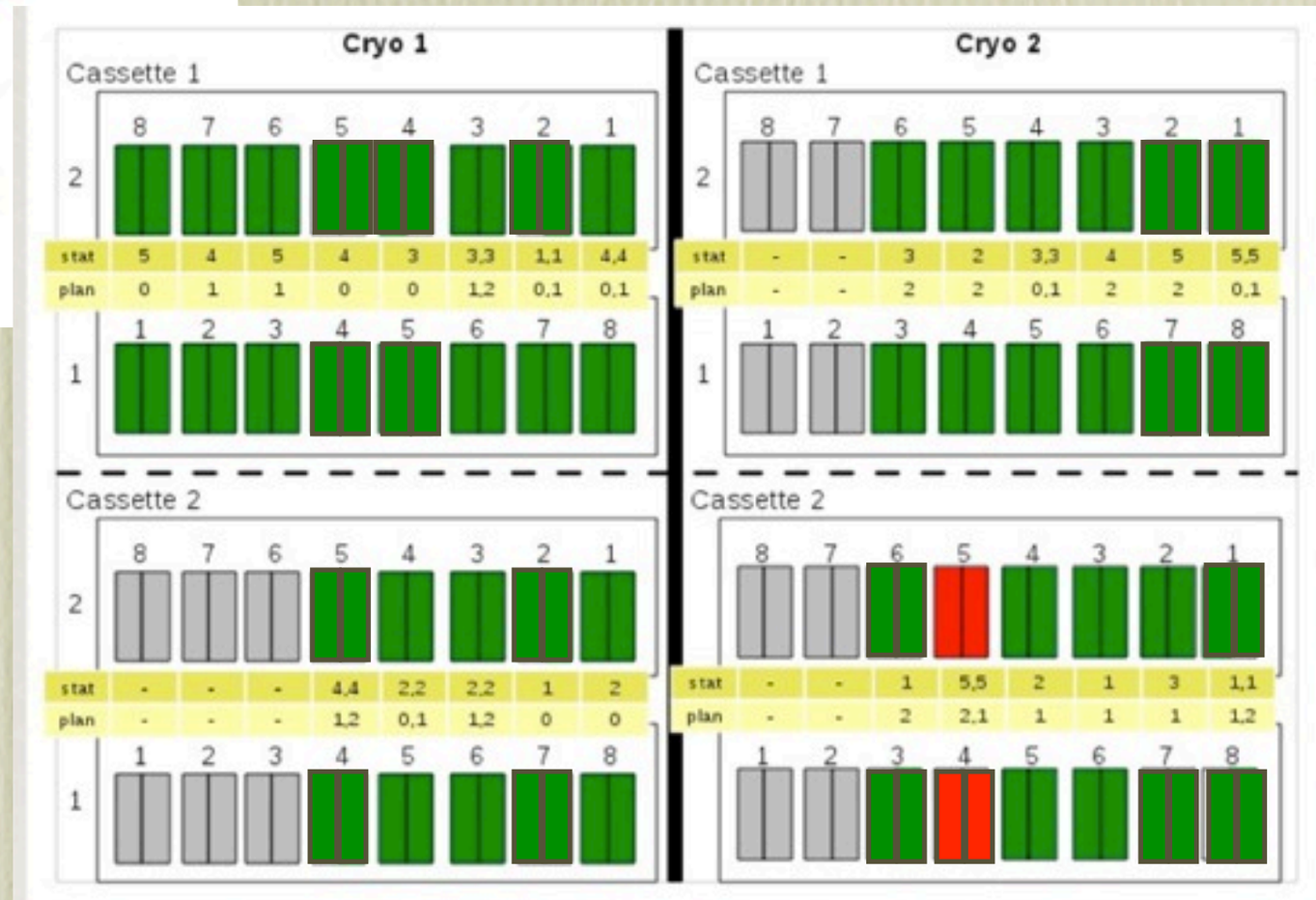
15 digits = 1 good particle event!

(2) Mapping

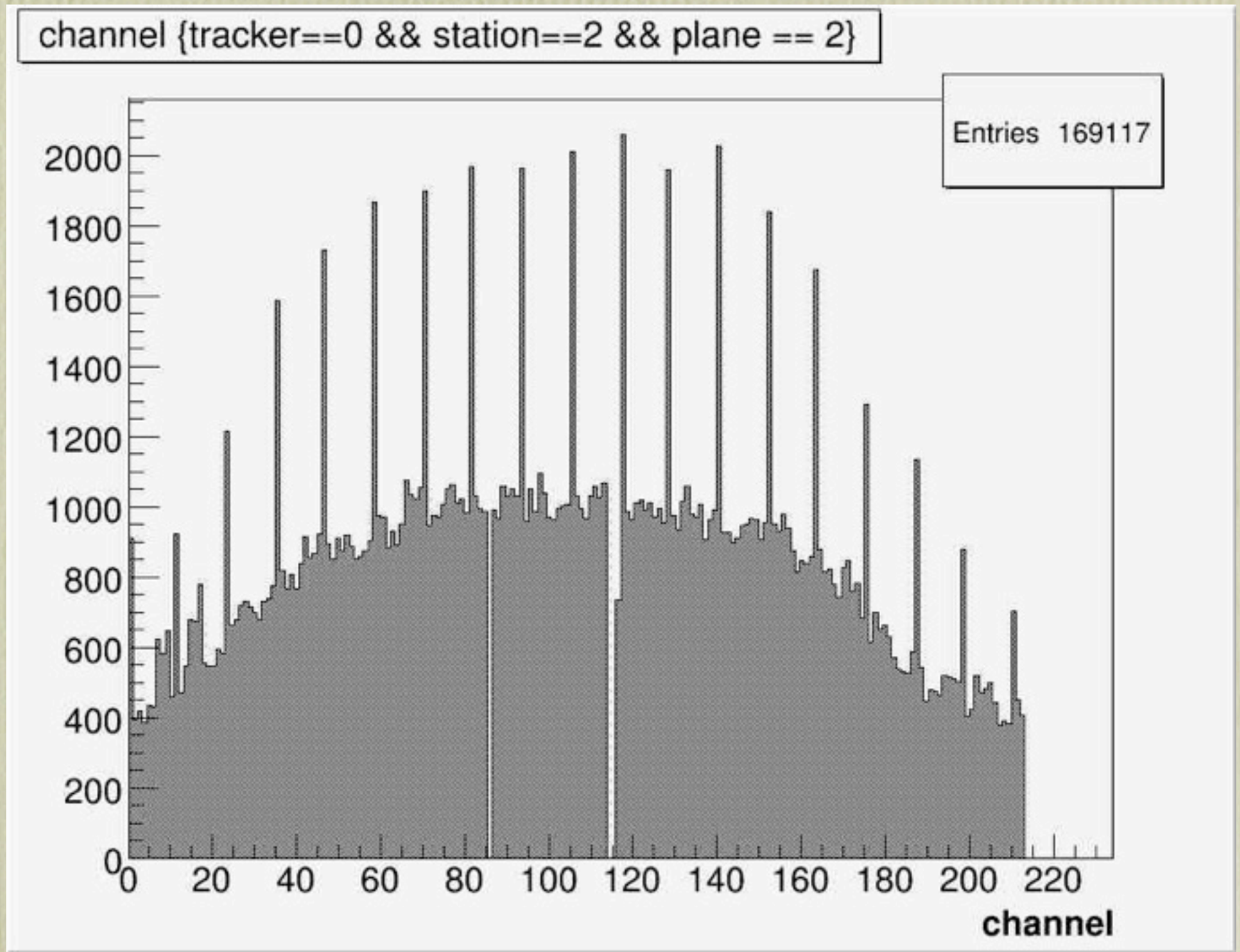
(only showing tracker 1)



Grey - no waveguide attached.
Red - mapping problem
Green - Confirmed mapping.



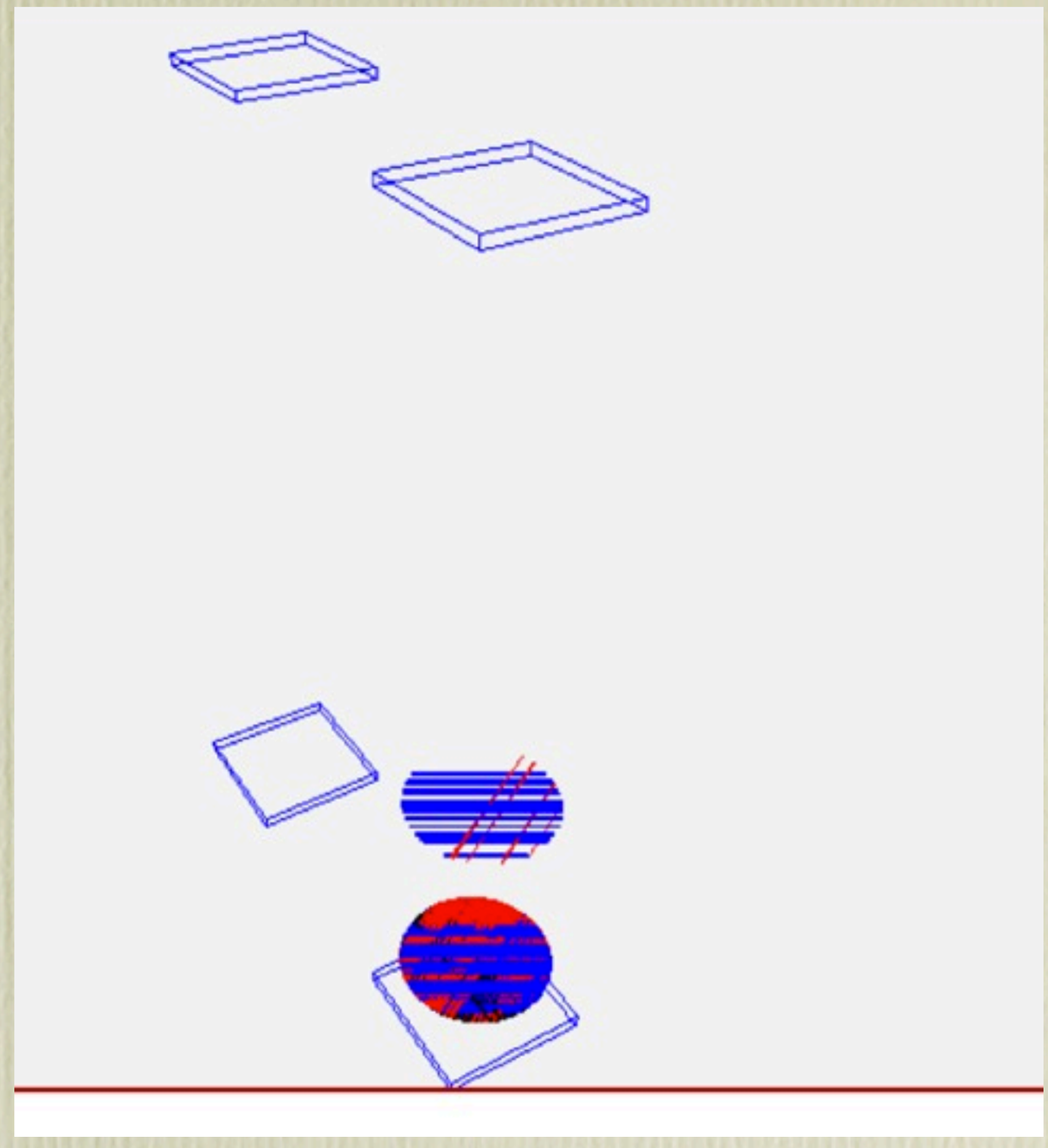
(2) Dead Channels



(2) Dead Channels - tracker 2

LED installed inside the tracker coffin will help on the dead channel search.

(station 5 is here drawn at the bottom...)



(3) Further Analysis

Datasets Pos-Tracker Workshop

Configuration I:

Tracker 1 has no lead blocks;
Tracker 2 has 3 lead blocks.

12714 spills collected

Configuration II:

Tracker 1 has 1 lead block;
Tracker 2 has 2 lead blocks.

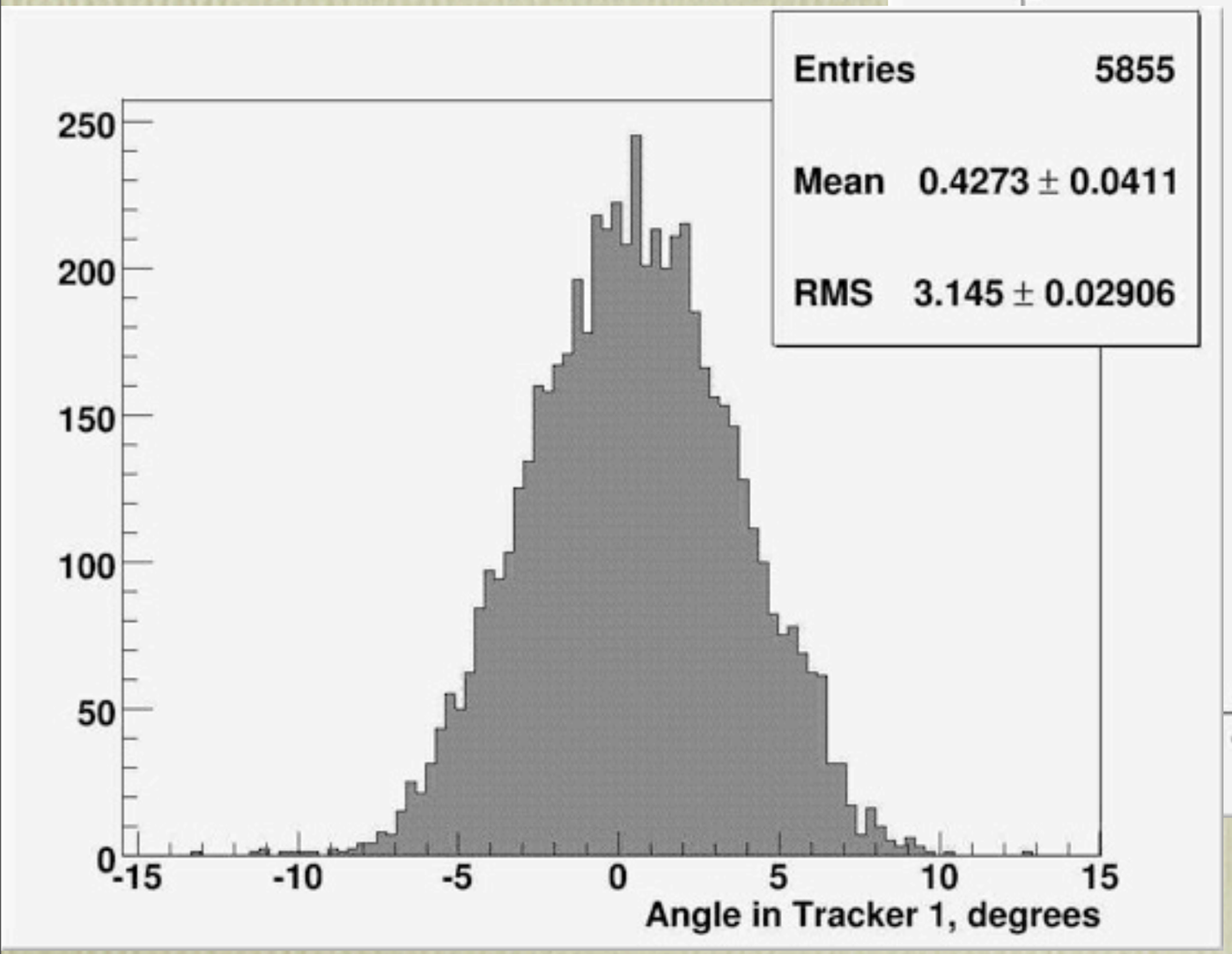
12714 spills collected

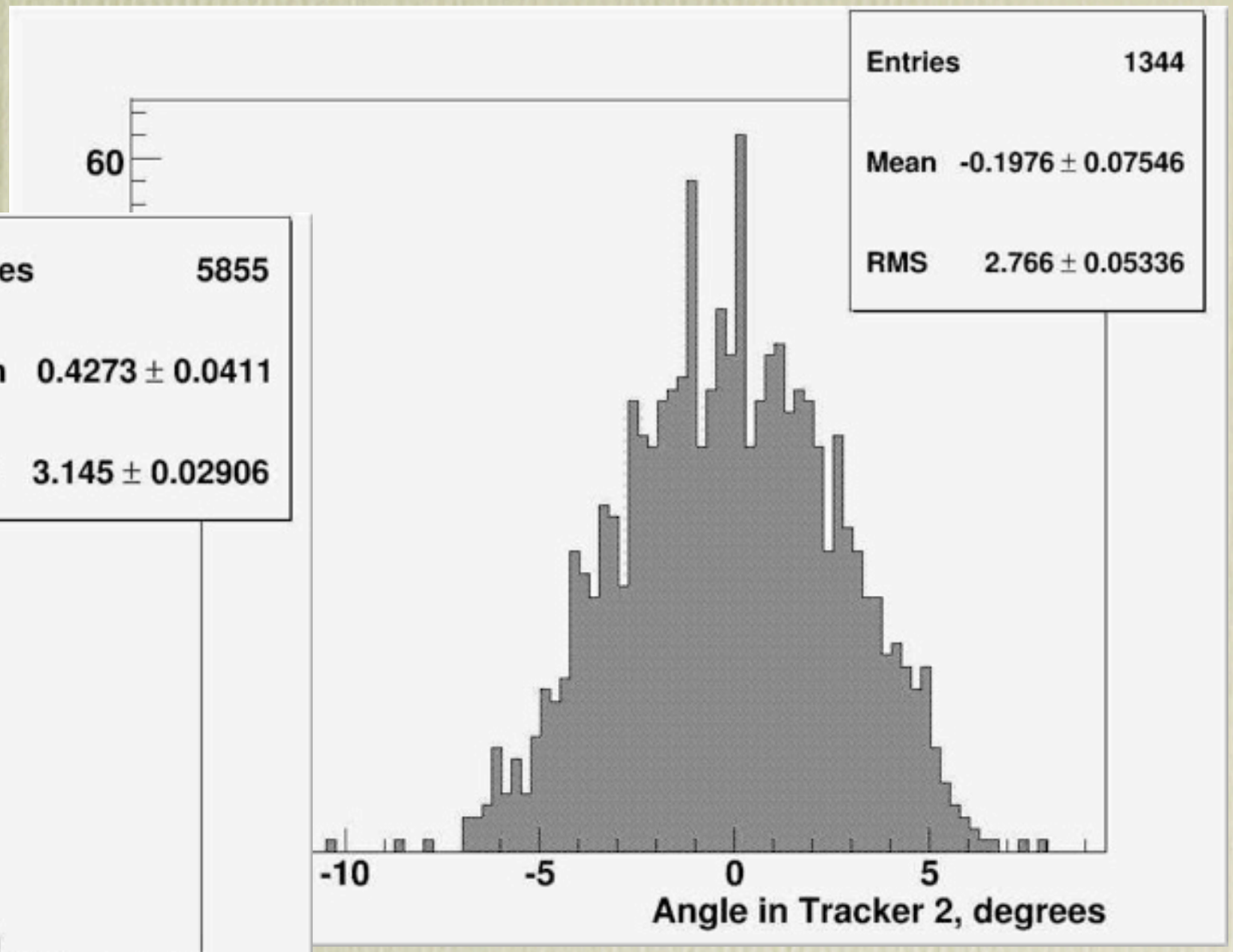
(3) Angle distribution

Acceptance angle dictated by geometry:
7.1° assuming perfect circular triggers...

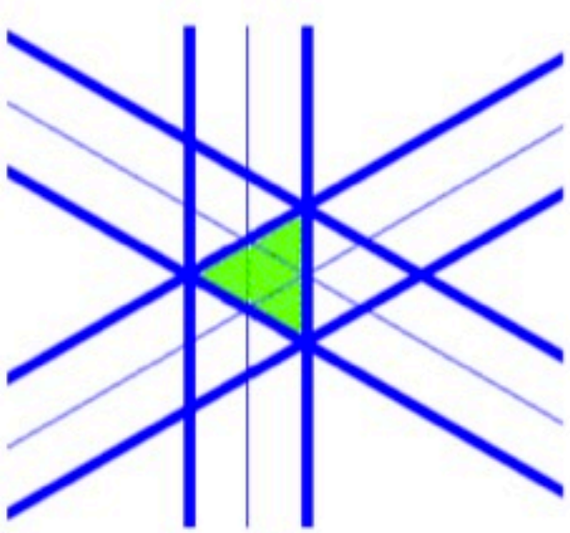
we might extend this to 15° angles (considering top and bottom stations) because of uncertainties on the trigger.

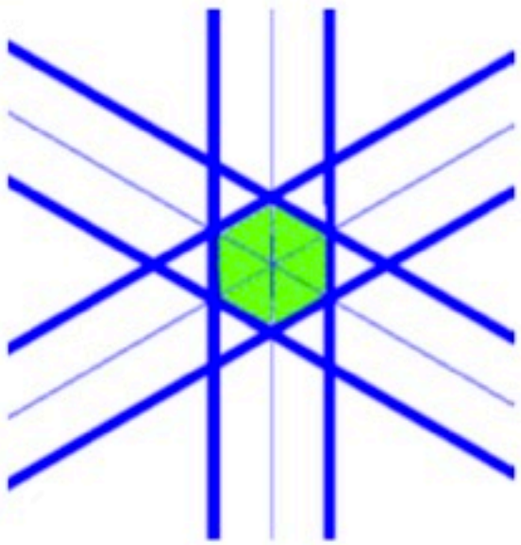
(3) Angle distribution





(3) Resolution



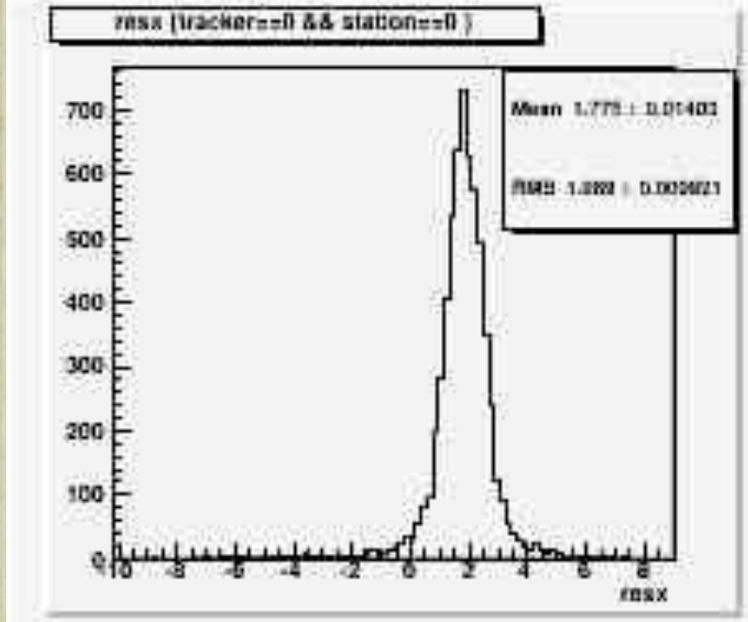


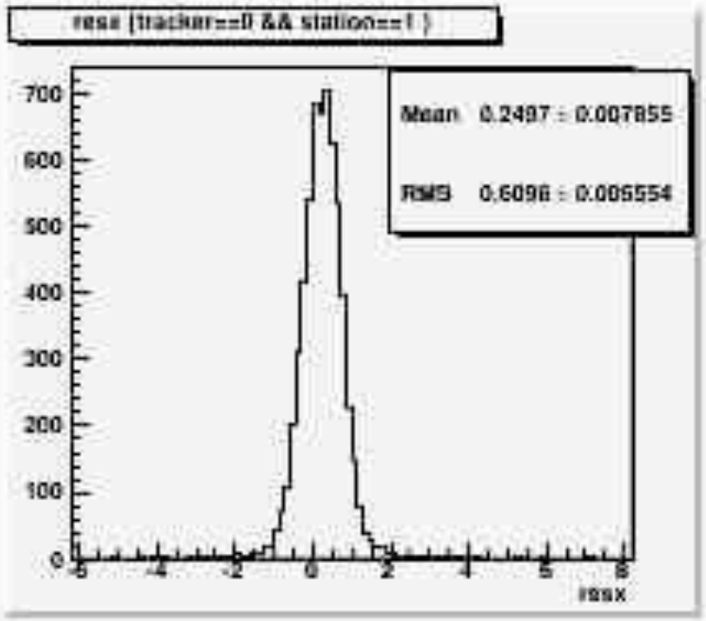
station 5 of tracker 1 has different construction...

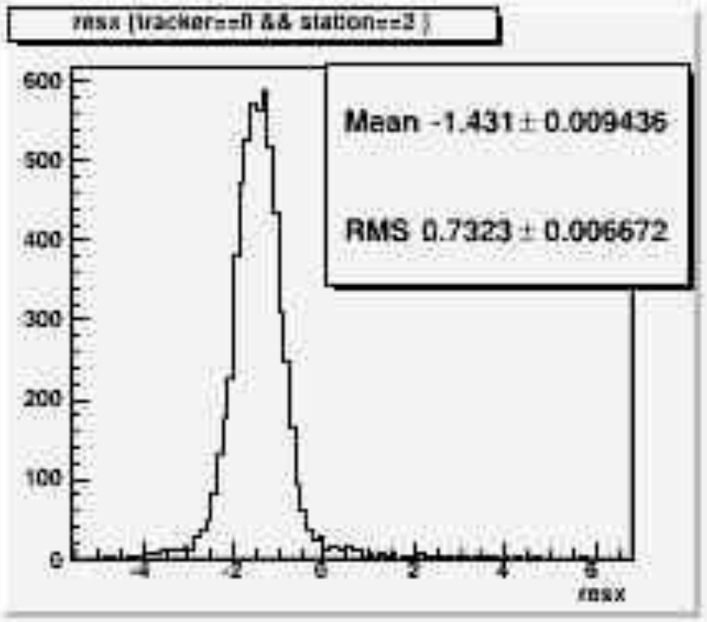
$$\sigma_x = \sigma_y = \frac{\omega}{3\sqrt{2}} = 384.4\,\mu\text{m}$$

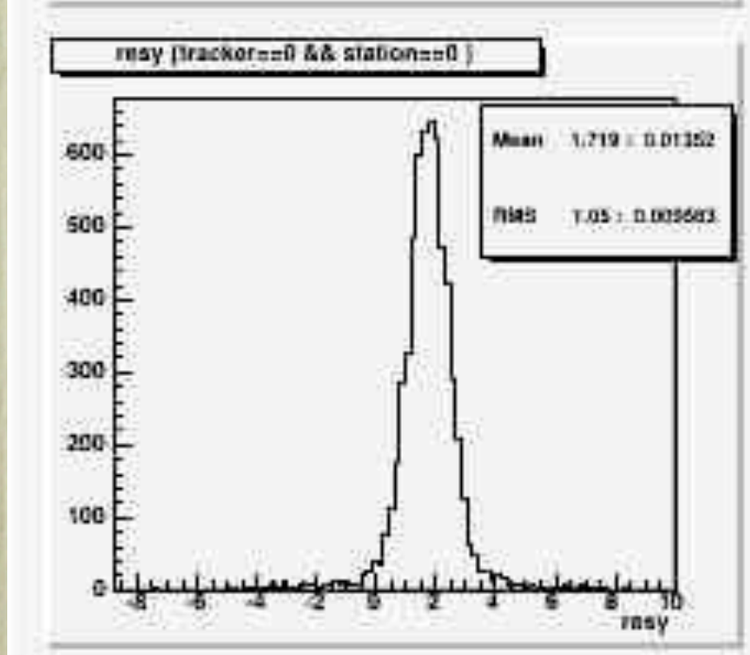
$$\begin{aligned}
[RMS_x]^2 &= \frac{1}{A}\int\int (x-\bar{x})^2 dxdy = \frac{2}{A}\int_{-\frac{\omega}{2}}^{0} x^2 dx \int_{-\frac{x}{\sqrt{3}}-\frac{\omega}{\sqrt{3}}}^{\frac{x}{\sqrt{3}}+\frac{\omega}{\sqrt{3}}} dy \\
&= \frac{2}{A}\int_{-\frac{\omega}{2}}^{0} x^2\left[\frac{x}{\sqrt{3}}+\frac{\omega}{\sqrt{3}}\right]dx = \frac{4}{A\sqrt{3}}\int_{-\frac{\omega}{2}}^{0}(x^3+x^2\omega)dx \\
&= \frac{4}{A\sqrt{3}}\left[-\frac{1}{4}\frac{\omega^4}{16}+\frac{1}{3}\frac{1}{8}\omega^4\right] = \frac{\omega^4}{2A\sqrt{3}}\left[\frac{1}{3}-\frac{1}{8}\right] \\
&= \frac{5\omega^4}{16.3.\sqrt{3}}\frac{2}{\sqrt{3}\omega^2} = \sqrt{52}\frac{\omega}{6} = 429.8\,\mu\text{m}
\end{aligned}$$

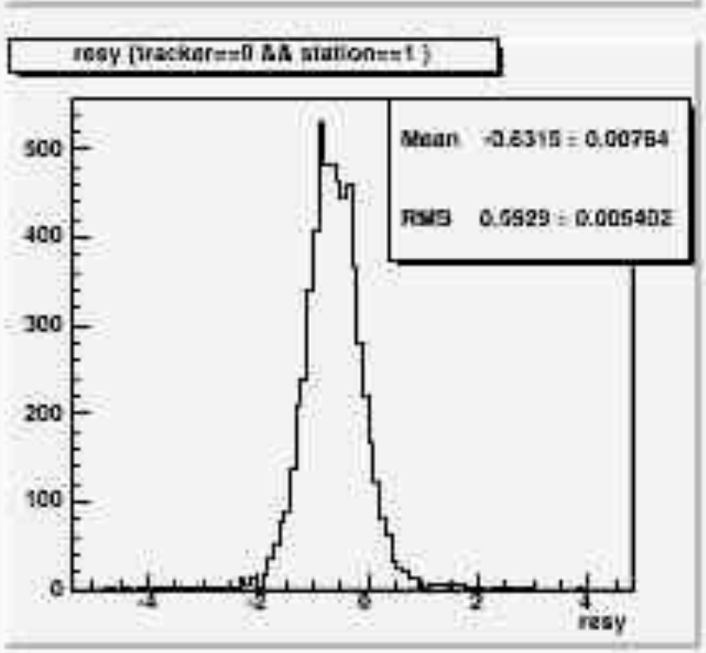
(3) Resolution

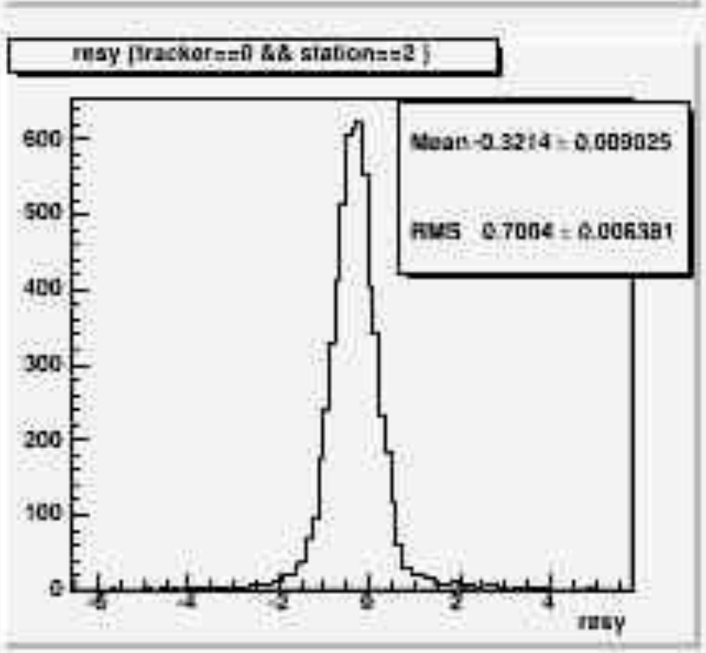






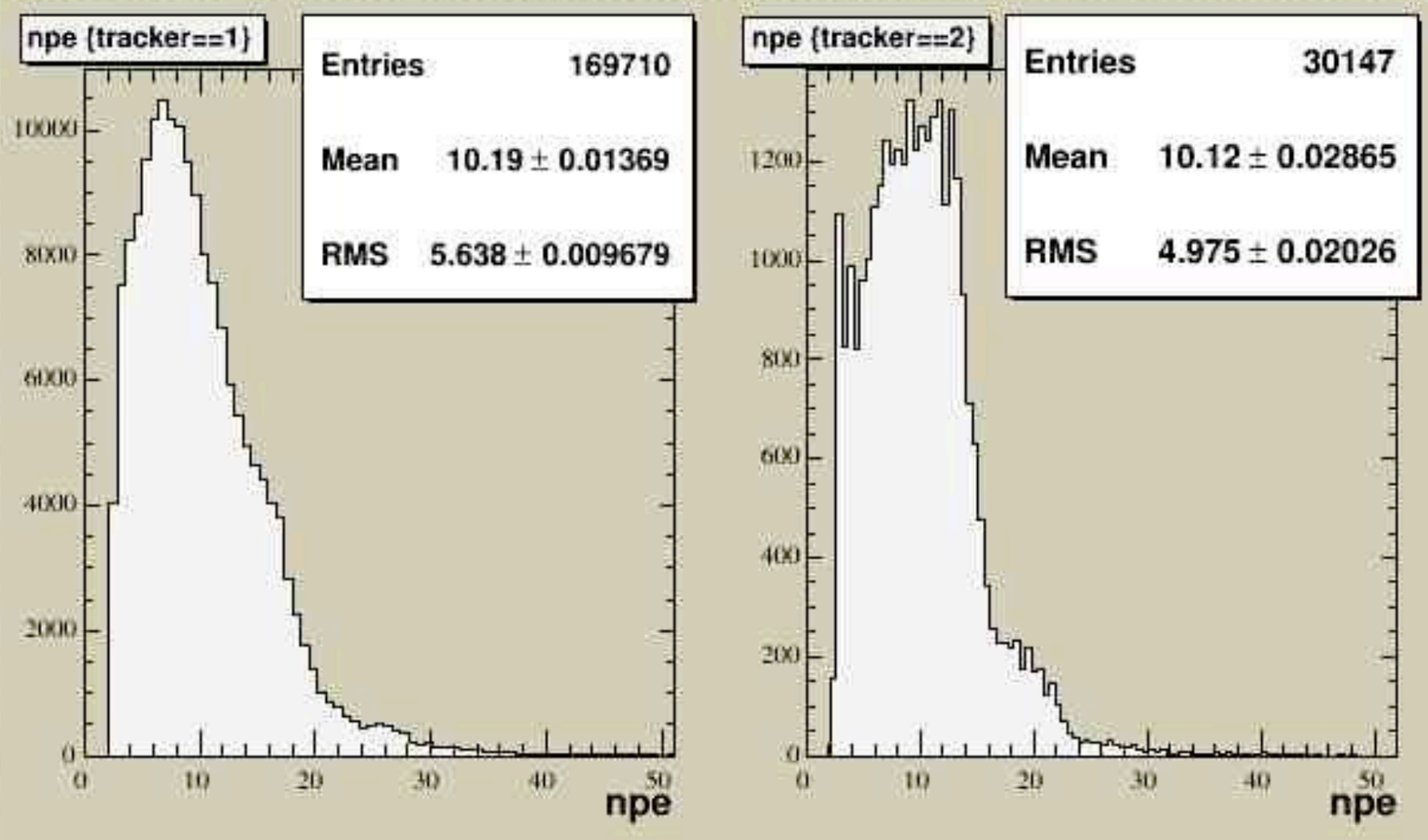






(3) Further Analysis - Light Yield

Configuration I



(3) Efficiency of triplet recon

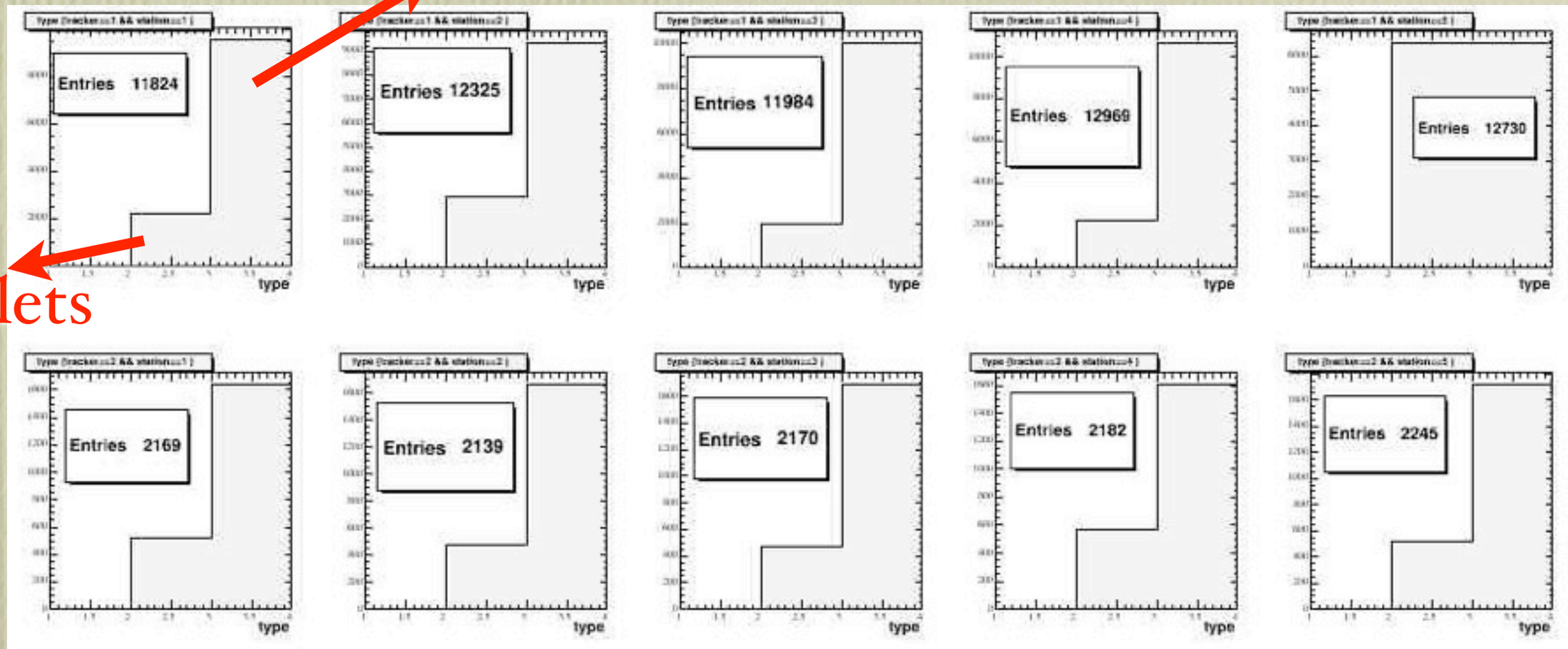
Configuration I

station 1…

triplets

station 5…

tracker 1

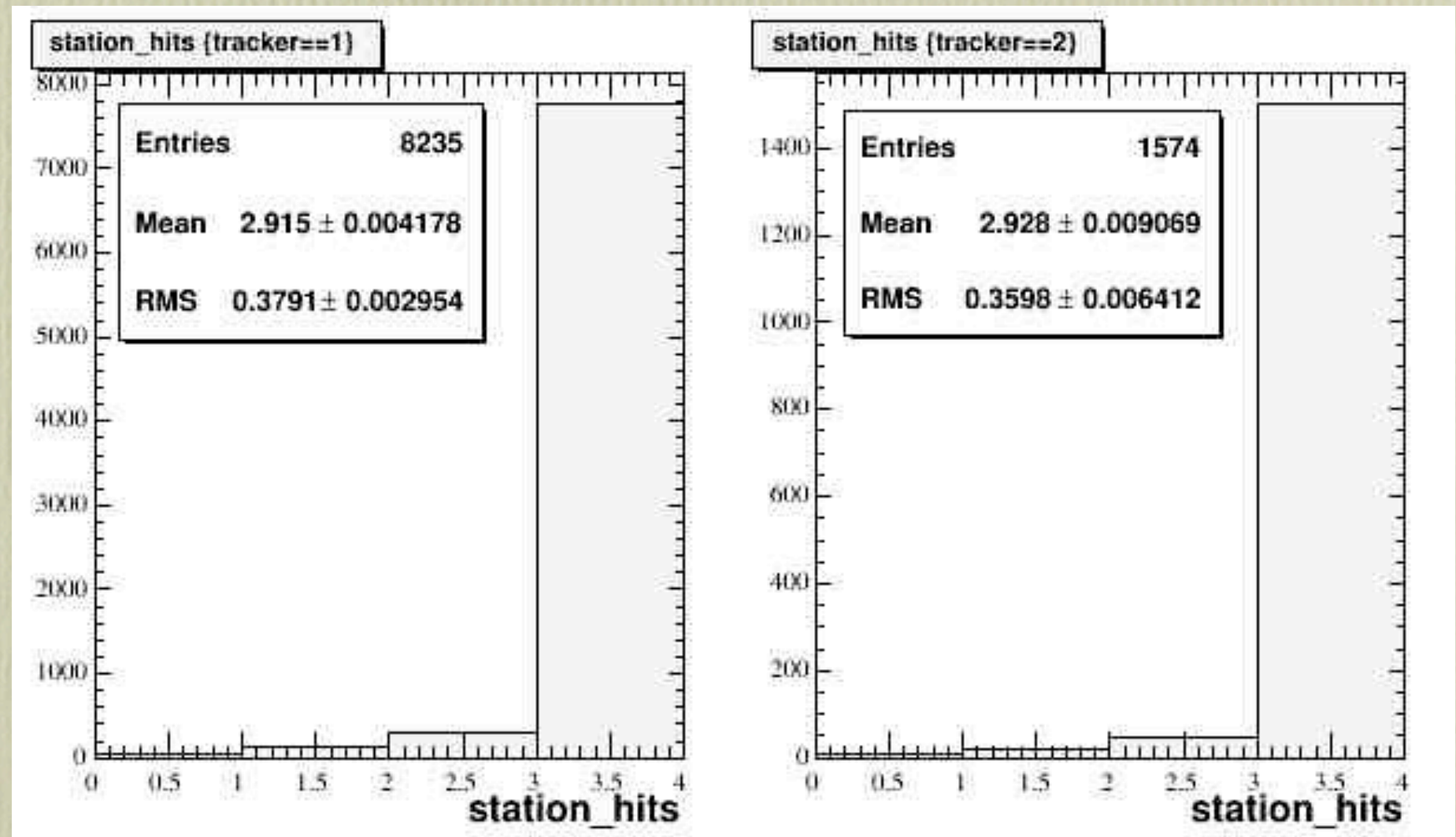


duplets

tracker 2

(3) Efficiency of spacepoint finding

Configuration I



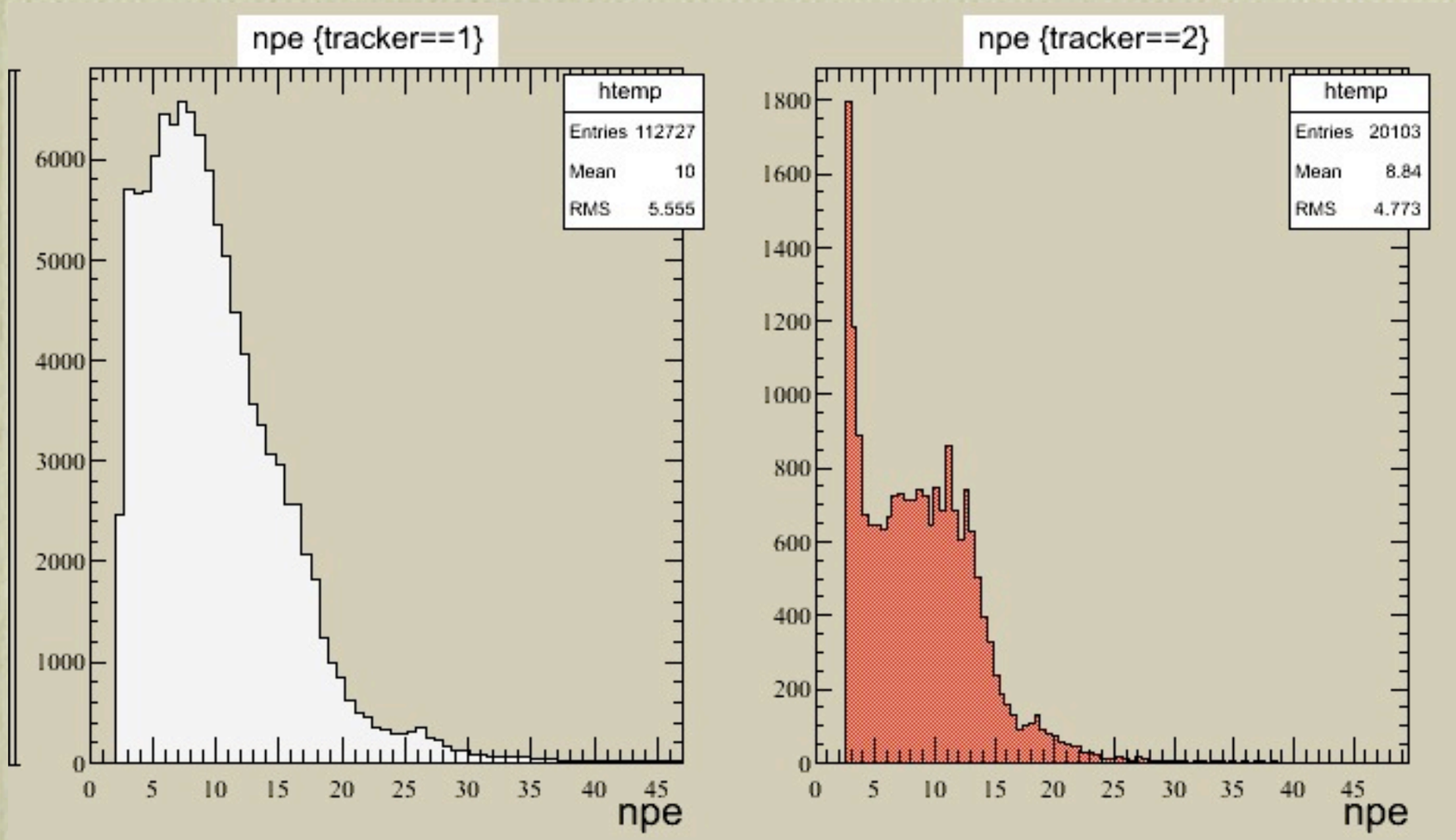
(3) Efficiencies

Probability of producing signal in a channel: 91 %

Probability of producing a space point: 98.4 %

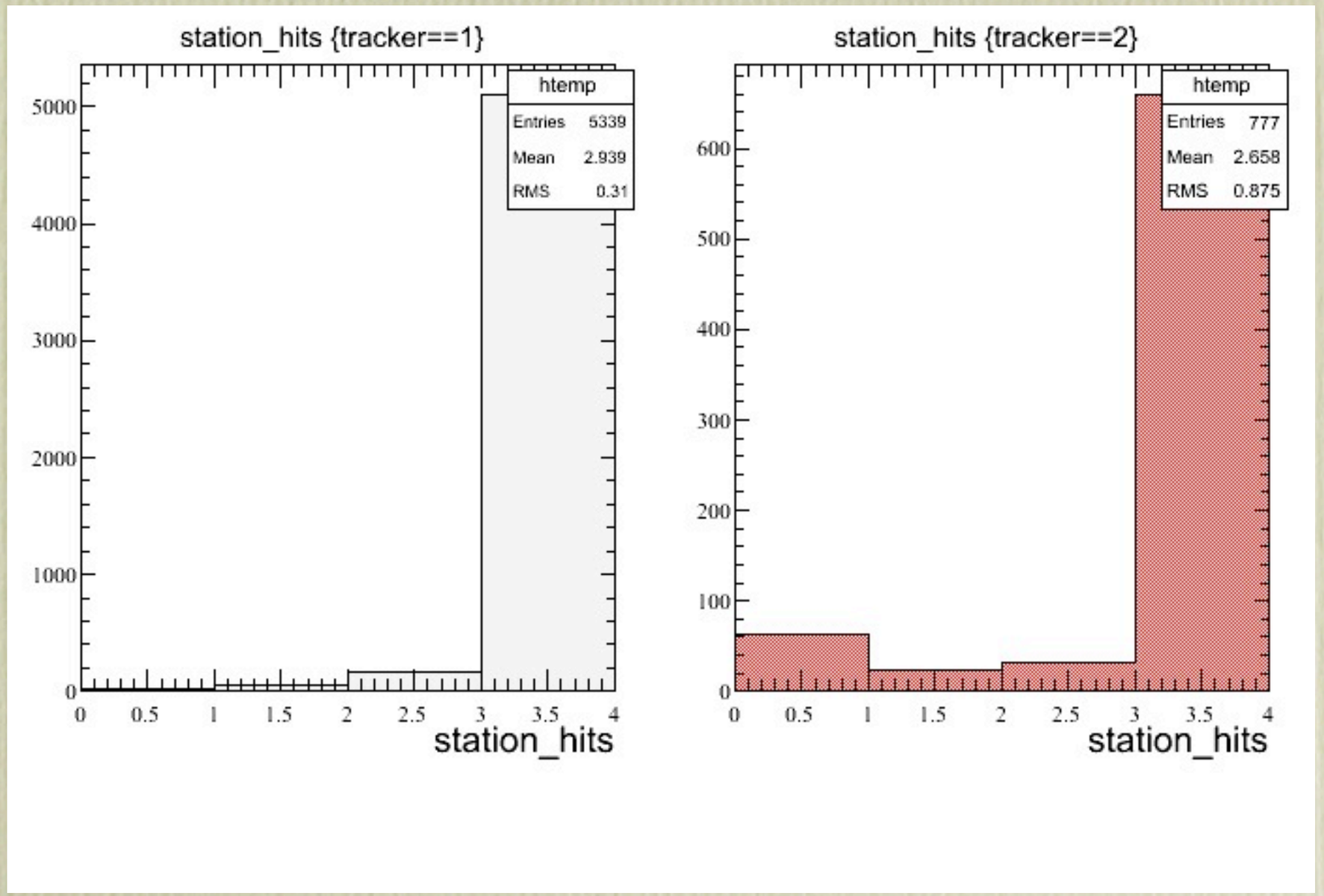
(3) Further Analysis

Configuration II - corrupted dataset for tracker 2 (cryostat failure)



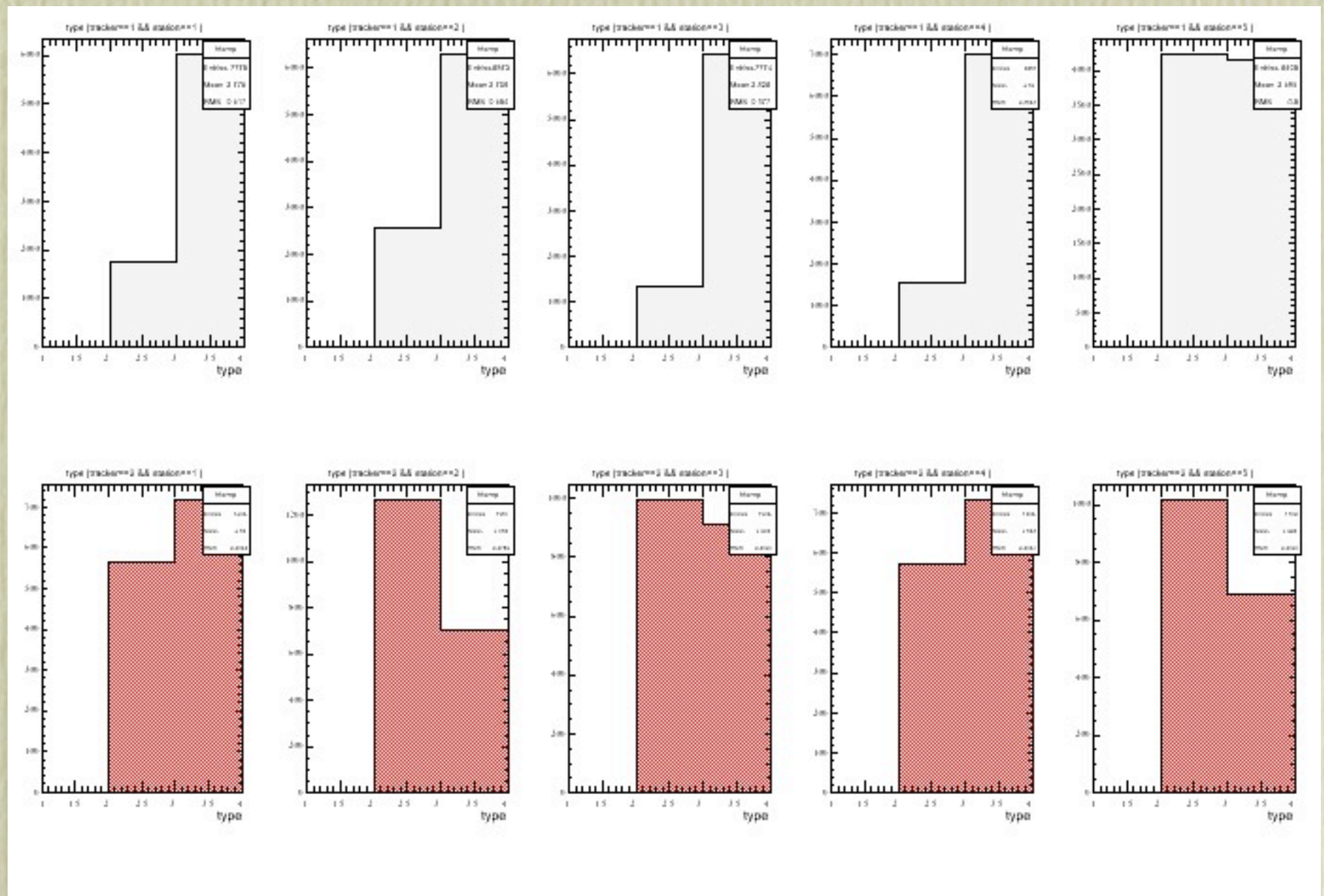
(3) Further Analysis

Configuration II - corrupted dataset for tracker 2 (cryostat failure)



(3) Further Analysis

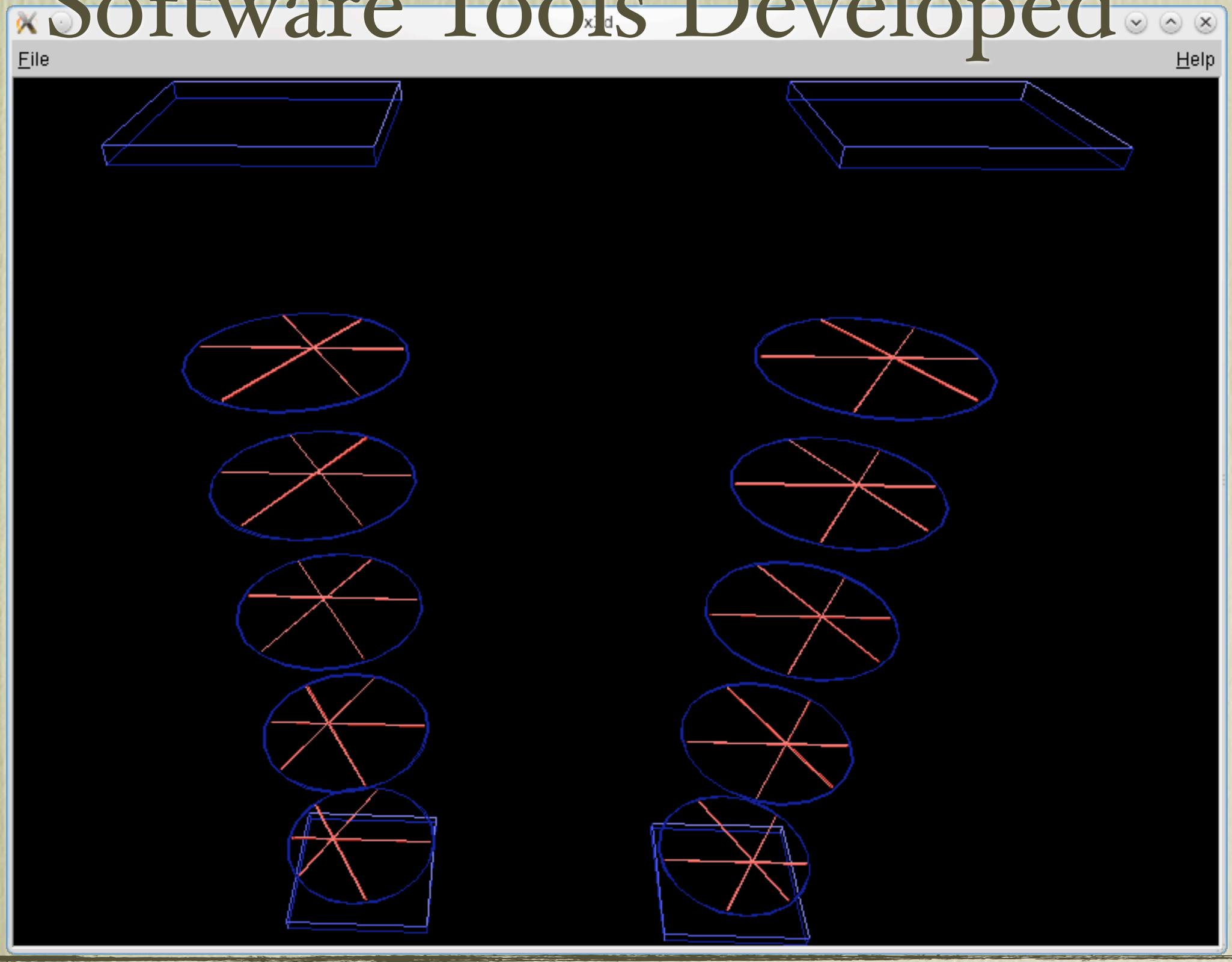
Configuration II - corrupted dataset for tracker 2 (cryostat failure)



Software Tools Developed

- Tracker Recon Code re-factored twice:
  - integrated in MAUS, structure properly discussed and implemented.
  - working from unpacking (YK) to 5-space-point event straight fitting; tested and documented up to space-points.
- Analysis runs on a Reducer - show live plots while spills are processed and root trees saved to disk.
- Tracker Event Viewer - crucial for sorting out the mapping.
- Error Log coming up - needs coordination with Online & Software Groups.

Software Tools Developed



Summary

In short:

- The trackers are sane. (Even though some analysis issues need attention.)
- The cosmic run was a great opportunity for training!
- The software came a long way.

September: wrong mapping, hacked unpacking, poorly developed stand-alone analysis code...

Today: event viewers, online analysis with reducers... overall reliability improved.

Summary

In short:

- The trackers are sane. (Even though some analysis issues need attention.)
- The cosmic run was a great opportunity for training!
- The software came a long way.

September: wrong mapping, hacked unp one

Today: event viewers, analysis with reducers... overall reliability improved.

The Future

- Discriminators - will ease the software work a lot... we shouldn't have to look at 8000 channels per tracker event.
- ADC Calibration - issues here have clear effect on the light yield distributions.
- TDC Calibration - no time info so far.

The Future

- Error handling

Errors

All numbers are computed as:

$$\frac{\#\text{ of occurrences of the error}}{\text{number of spills processed}} * 100$$

evt with more than 80 digits	daq misses tracker 0	daq misses tracker 1	diff number of events in both	daq tracker 0 is null	daq tracker 1 is null	bank lengths don't match	1st event in tracker 0 isn't null	1st event in tracker 1 isn't null
1855 (601 bMb, 20 Dec)								
2.0	16.8	33.5	65.6	4.2	72.3	0.7	0	0.01
1862 (432 Mb, 1 Jan)								
2.9	12.5	36.0	70.9	35.1	127.1	10.6	0.01	0.02
1863 (1.4 Gb, 9 Jan) - just before shutdown								
3.0	13.3	36.3	73.6	24.6	118.9	8.8	0.01	0.04
1901 - (688 Mb) right after restart								
3.5	14.0	36.6	83.7	10.6	122.2	0.07	0	0

The Future

- Error handling