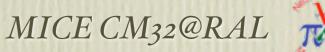
### **Cosmic Analysis**

### Edward Santos on behalf of the Tracker Group







#### • 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







## (I) 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



## (I) Dataset Collected

top scintillator	No lead blocks: muon	top scintillator	
	momentum > 16 MeV		range of muon energies accepted:
Tracker I		Tracker 2	> 16 MeV > 81 MeV
	65 MeV energy		> 146 MeV
	loss per lead block	lead lead lead	> 211 MeV
bottom_ scintillator		bottom_ scintillator	i Graju
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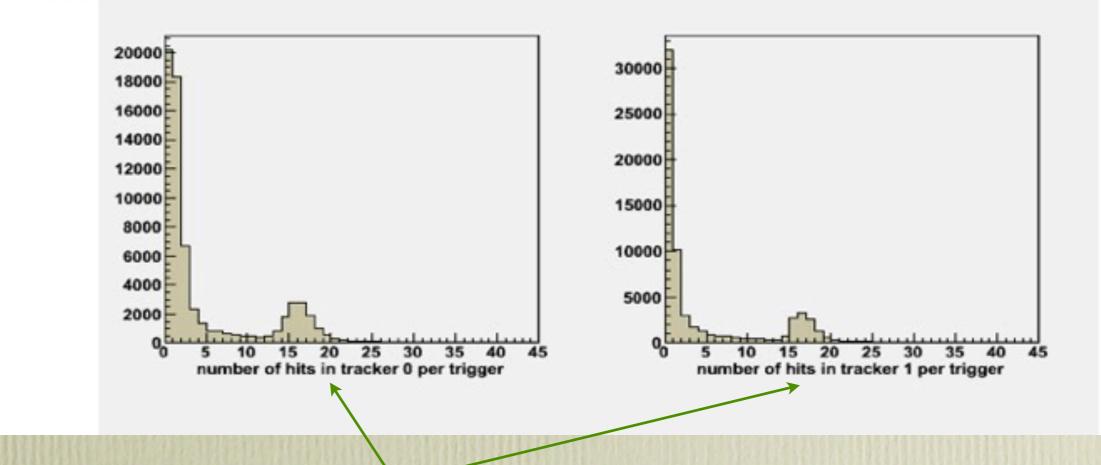
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# (2) Tracker Sanity

### One of our first results...

#### 5 Oct Sept - 11 Oct

#### Triggers in both trackers again



15 digits = 1 good particle event!

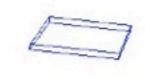




# (2) Mapping

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problems in station5, planes 1 and 2... Looks like a flipped waveguide. However, we uncovered it in Dec and it. seemed alright...



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

(only showing tracker 1)

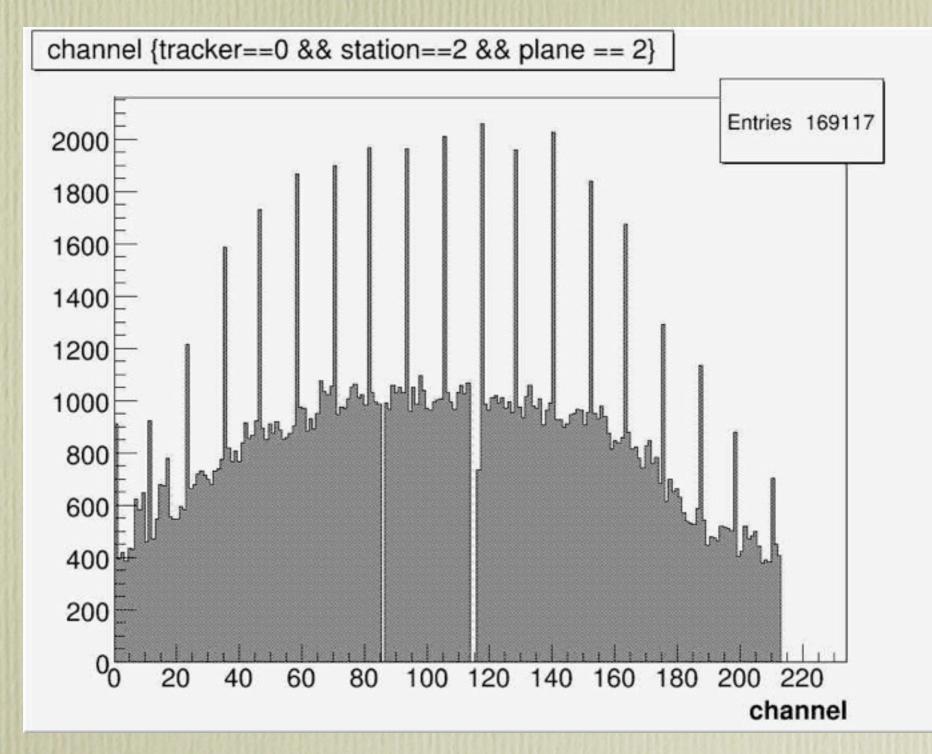


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## (2) Dead Channels



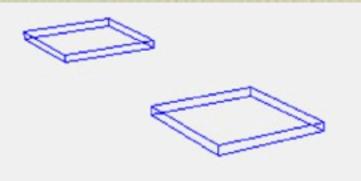
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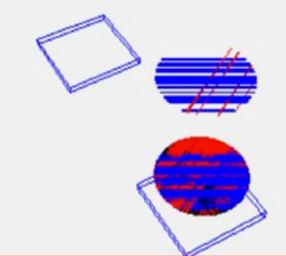
# (2) Dead Channels - tracker 2

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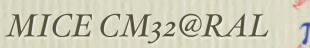
LED installed inside the tracker coffin will help on\_ the dead channel search.



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



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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

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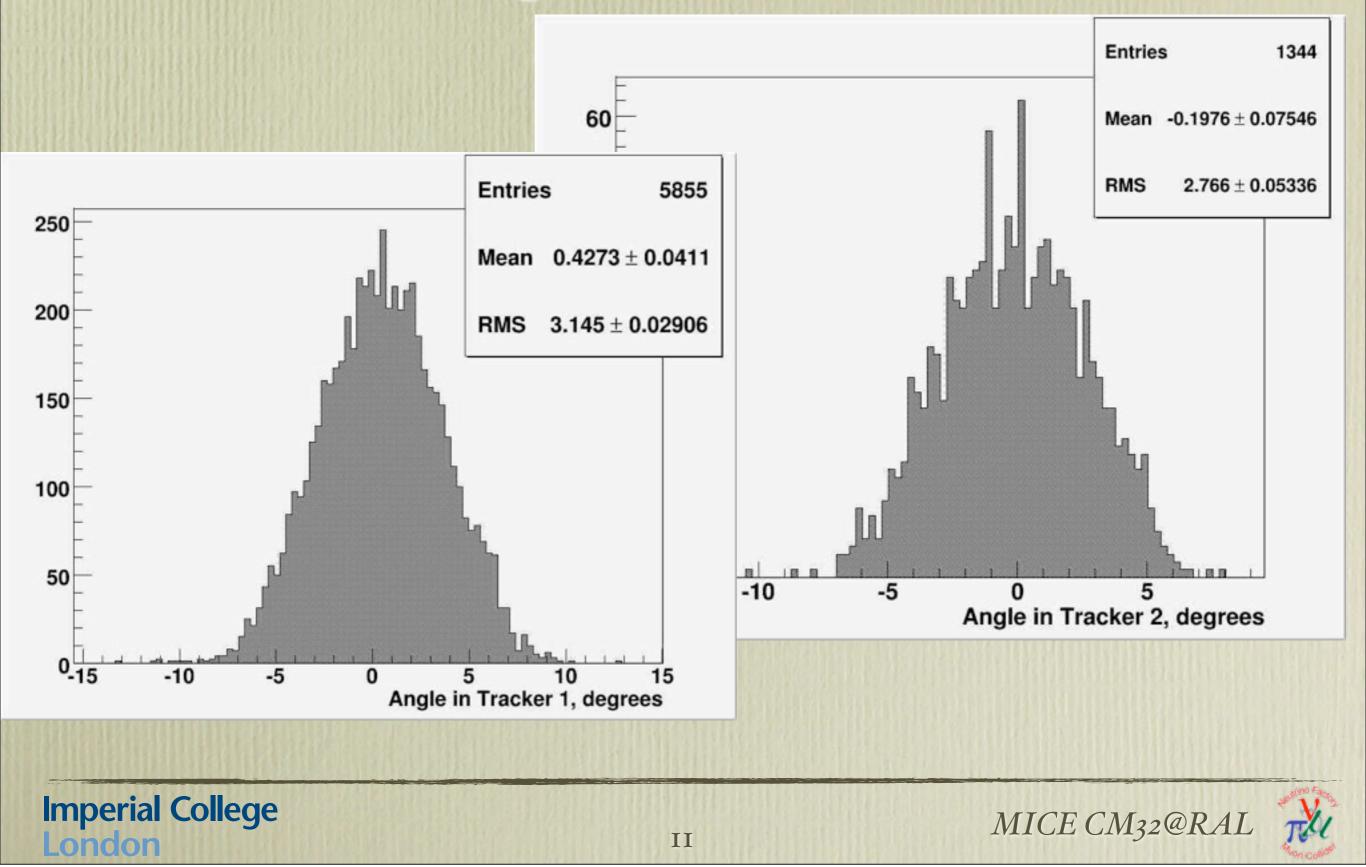
# (3) Angle distribution

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

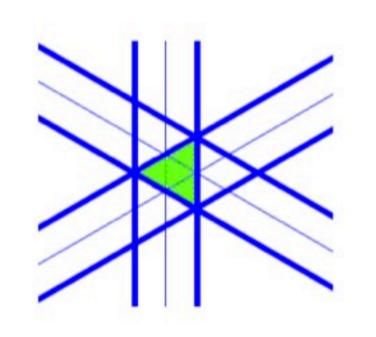
we might extend this to 15° angles (considering top and bottom stations) because of uncertainties on the trigger.

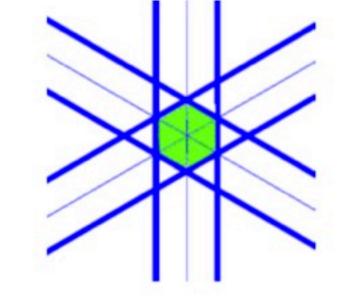


# (3) Angle distribution



# (3) Resolution





station 5 of tracker 1 has different. construction...

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

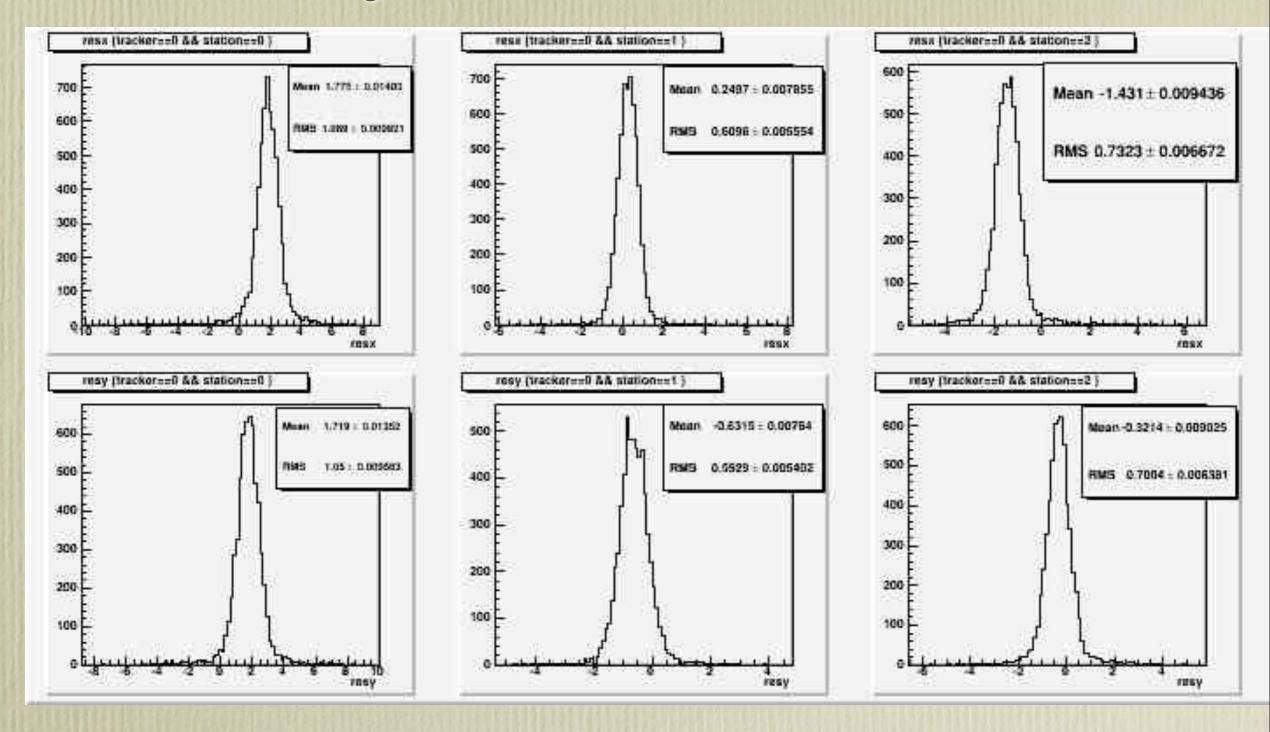
$$\begin{split} [RMS_x]^2 &= \frac{1}{A} \int \int (x-\bar{x})^2 dx dy = \frac{2}{A} \int_{-\frac{\omega}{2}}^{0} x^2 dx \int_{-\frac{\omega}{\sqrt{3}} - \frac{\omega}{\sqrt{3}}}^{\frac{x}{\sqrt{3}} + \frac{\omega}{\sqrt{3}}} dy \\ &= \frac{2}{A} \int_{-\frac{\omega}{2}}^{0} x^2 \left[\frac{x}{\sqrt{3}}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

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(3) Resolution



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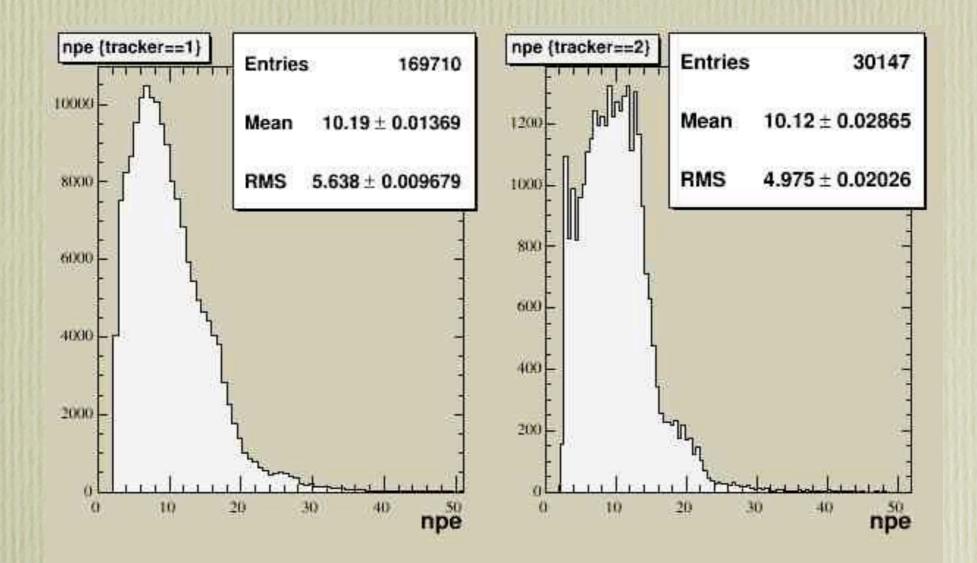
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### (3) Further Analysis - Light Yield

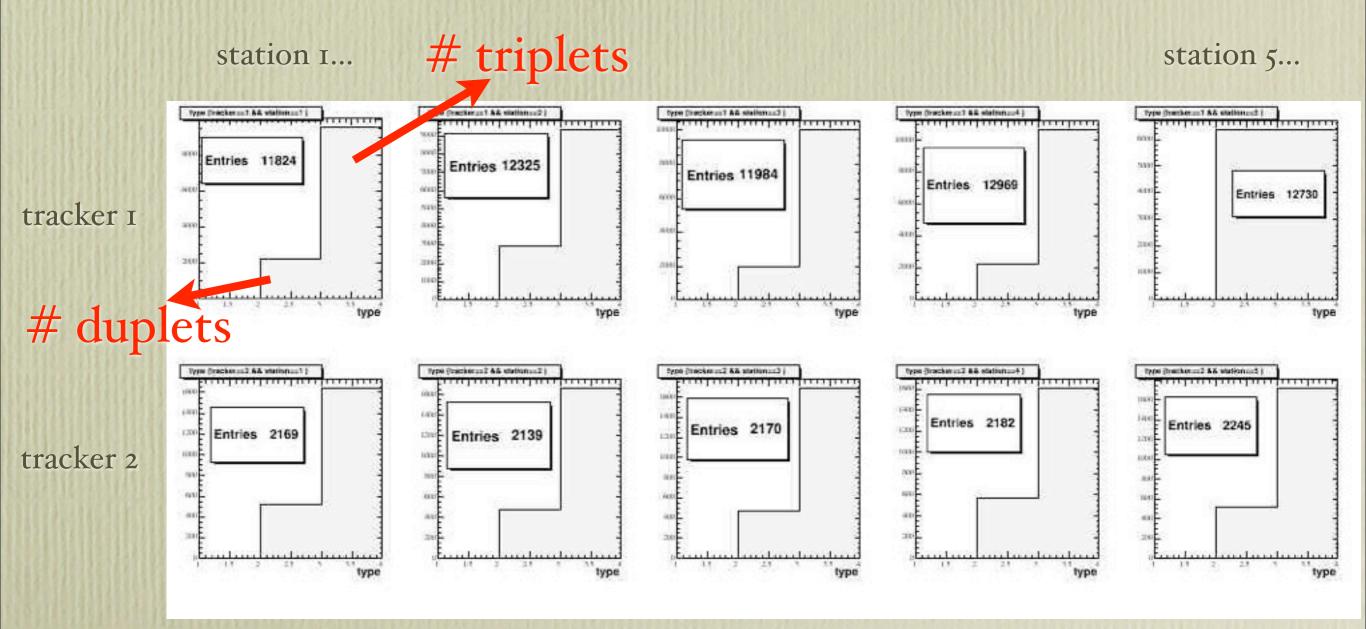
**Configuration** I





# (3) Efficiency of triplet recon

Configuration I



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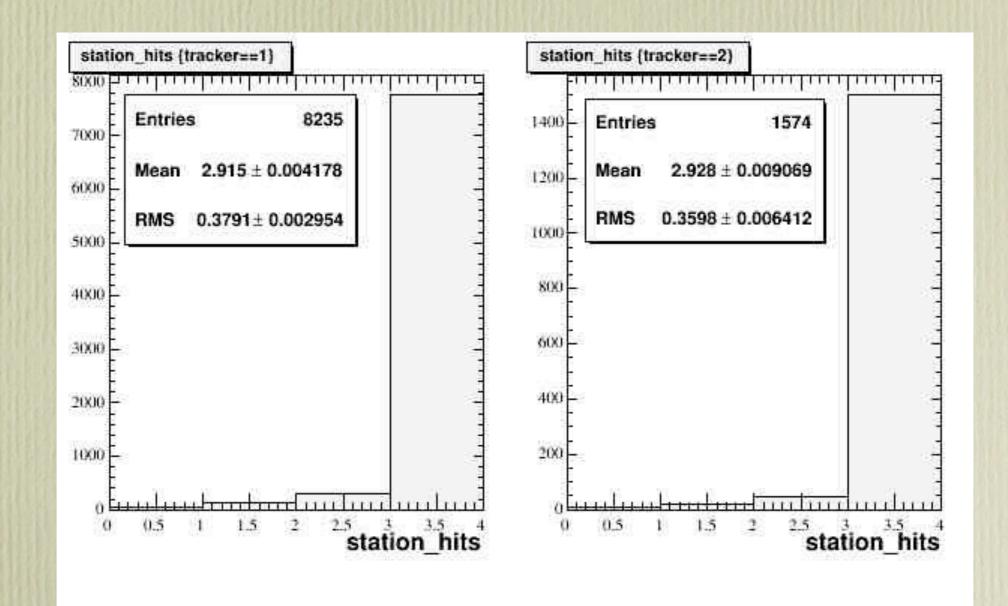
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### (3) Efficiency of spacepoint finding

Configuration I





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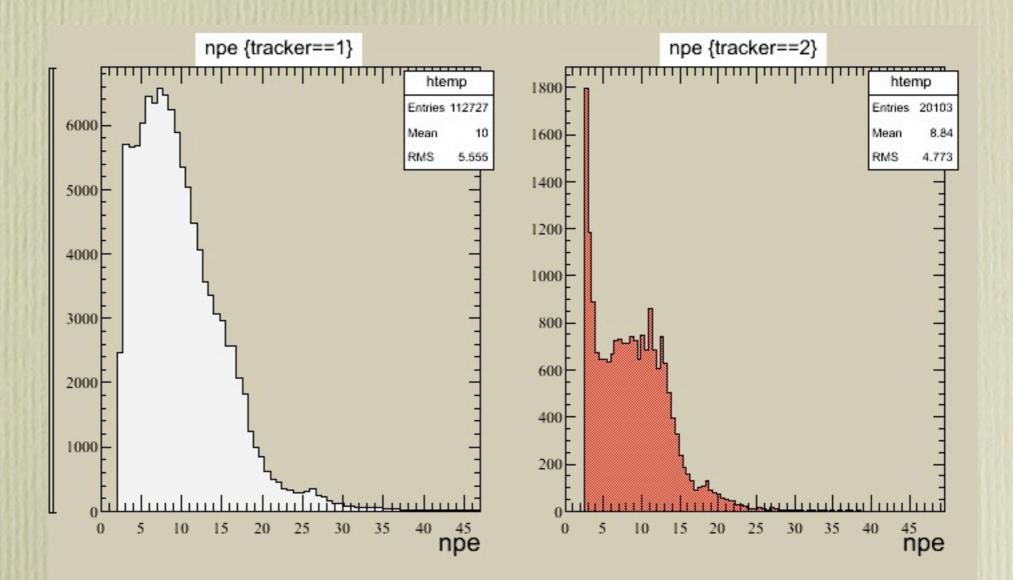
### Probability of producing signal in a channel: 91 %

### Probability of producing a space point: 98.4 %





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

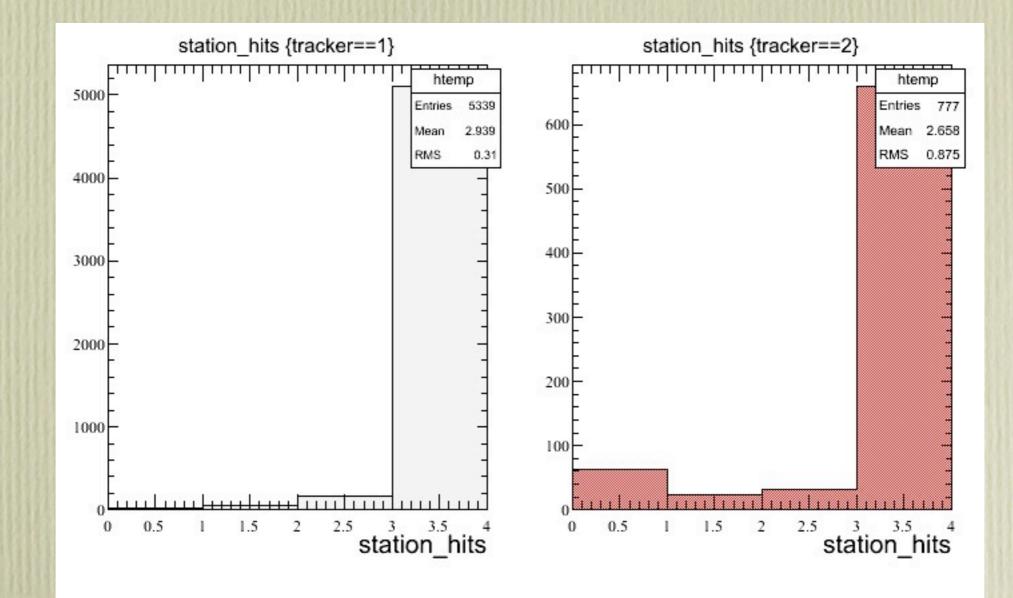




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#### Configuration II - corrupted dataset for tracker 2 (cryostat failure)

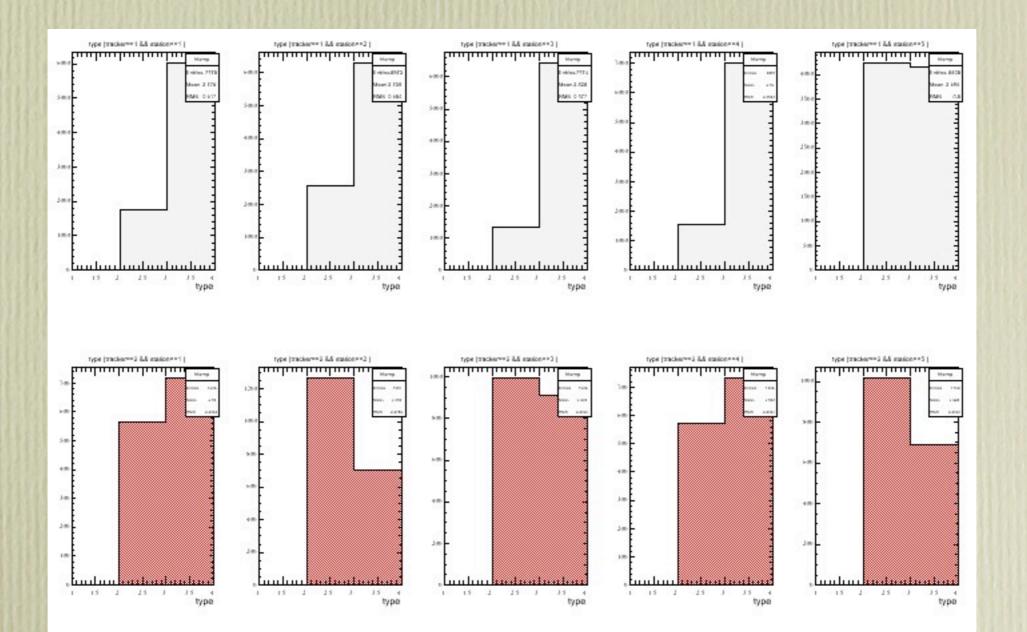




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#### Configuration II - corrupted dataset for tracker 2 (cryostat failure)



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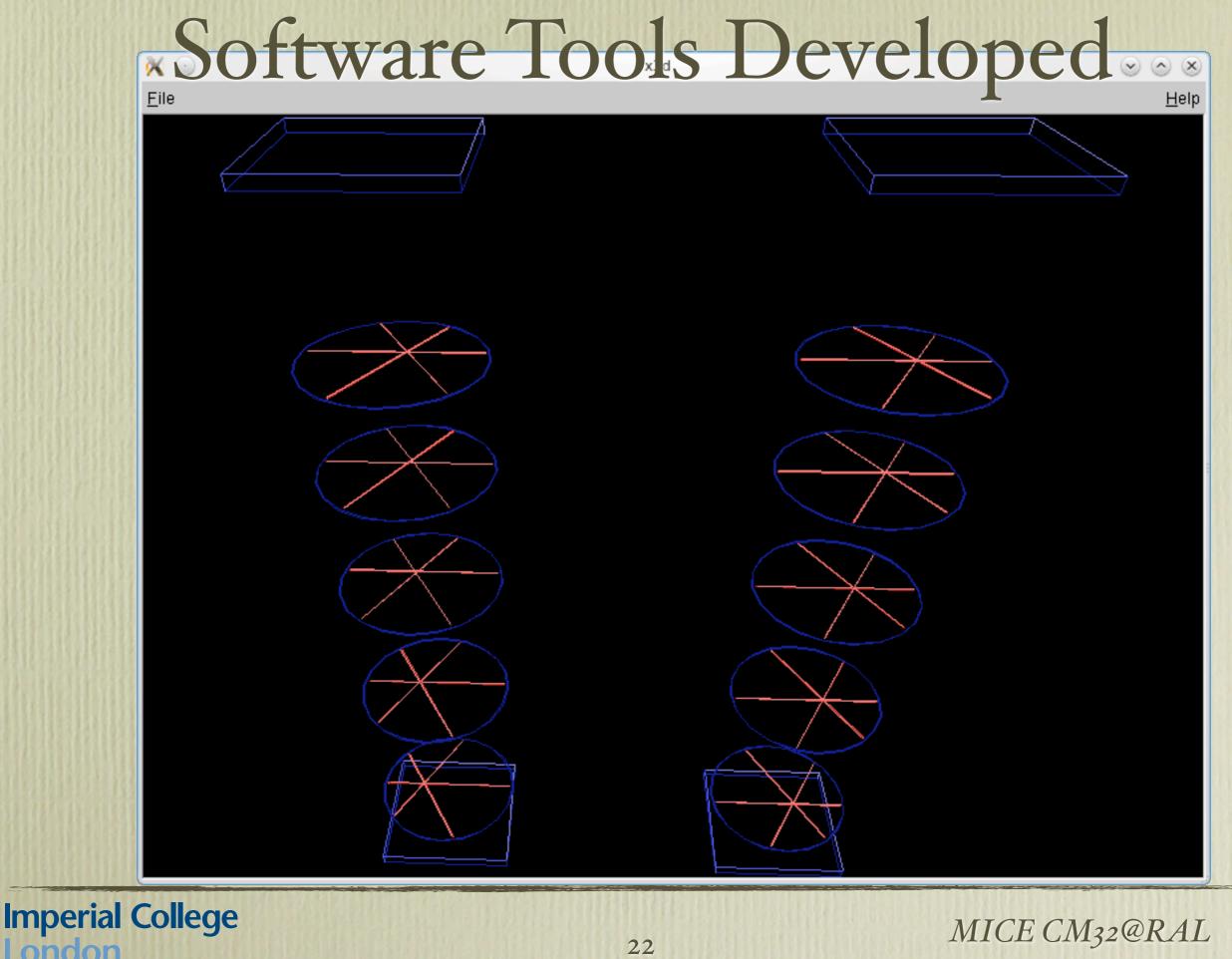
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# Software Tools Developed

- 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.





### 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.



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### 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.



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# 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.

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• TDC Calibration - no time info so far.





## The Future

### - Error handling

### Errors

All numbers are computed as: # of occurrences of the error \* 100 number of spills processed

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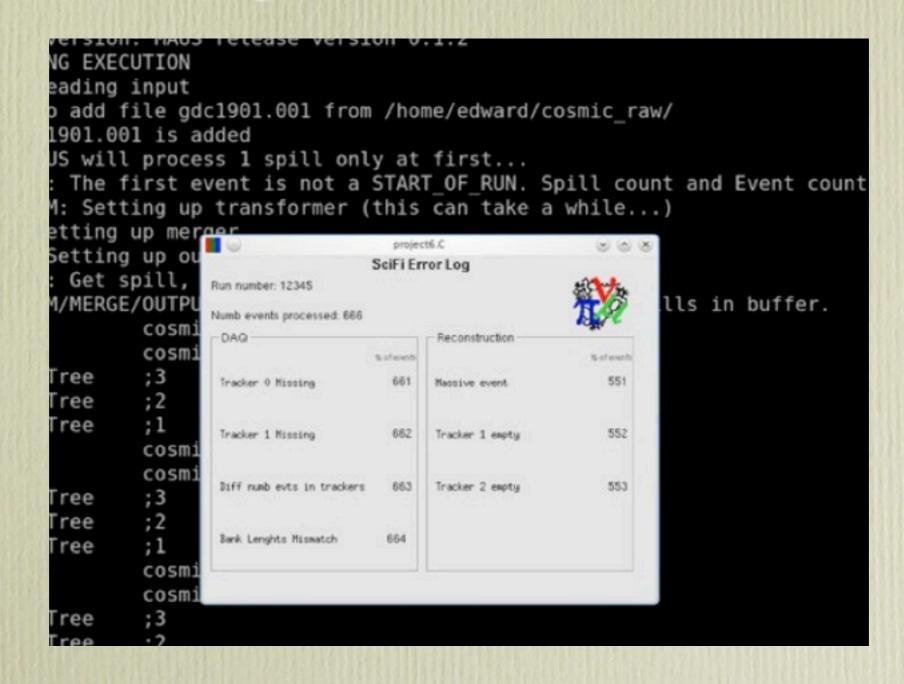
daq misses tracker o	daq misses tracker 1	diff number of events in both	daq tracker o is null	daq tracker 1 is null	bank lengths don't match	1st event in tracker o isn't null	Ist event in tracker I isn't null
		1855 (	(601 bMb, 20	Dec)			
16.8	33-5	65.6	4.2	72.3	0.7	0	0.01
		186	2 (432 Mb, 1 J	an)			
12.5	36.0	70.9	35.1	127.1	10.6	0.01	0.02
	į	863 (1.4 Gb, 9	Jan) - just be	fore shutdow	n		
13.3	36.3	73.6	24.6	118.9	8.8	0.01	0.04
		1901 - (68	8 Mb) right af	ter restart			
14.0	36.6	83.7	10.6	122.2	0.07	0	0
	16.8 12.5 13.3	tracker o tracker i 16.8 33.5 12.5 36.0 13.3 36.3	uaq misses tracker o       uaq misses tracker i       of events in both         16.8       33.5       65.6         16.8       33.5       65.6         12.5       36.0       70.9         13.3       36.3       73.6         1901 - (688)       1901 - (688)	uaq misses tracker o       uaq misses tracker i       of events in both       uaq tracker o is null         16.8       33.5       65.6       4.2         16.8       33.5       65.6       4.2         12.5       36.0       70.9       35.1         13.3       36.3       73.6       24.6         1901 - (688 Mb) right af	daq misses tracker o       daq misses tracker i       of events in both       daq macker o is null       daq macker is null         16.8       33.5       65.6       4.2       72.3         16.8       33.5       65.6       4.2       72.3         12.5       36.0       70.9       35.1       127.1         13.3       36.3       73.6       24.6       118.9         1901 - (688 Mb) right after restart       1901 - (688 Mb) right after restart       118.9	daq misses tracker o       daq misses tracker i       of events in both       daq macker o is null       daq macker i is null       lengths don't match         16.8       33.5       65.6       4.2       72.3       0.7         16.8       33.5       65.6       4.2       72.3       0.7         12.5       36.0       70.9       35.1       127.1       10.6         I south of the second of the	daq misses tracker o       daq misses tracker i       of events in both       daq tracker o is null       daq tracker i is null       lengths don't match       tracker o isn't null         16.8       33.5       65.6       4.2       72.3       0.7       0         16.8       33.5       65.6       4.2       72.3       0.7       0         12.5       36.0       70.9       35.1       127.1       10.6       0.01         1863 (1.4 Gb, 9 Jan) - just before shutdown         13.3       36.3       73.6       24.6       118.9       8.8       0.01

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### The Future

#### - Error handling



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