

Status Report

Cosmics with the ALPIDE Telescope

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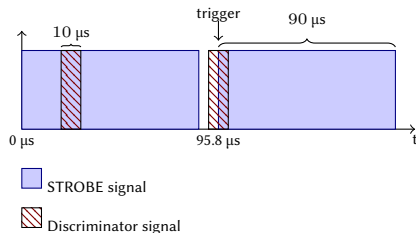
September 22th, 2020

Back in May...

- Limited access to GSI
- Set up the telescope to be pointed towards the sky and record cosmics
- At first **no scintillators** available

Method of operation

- Use a NIM signal generator to create artificial triggers for the chips.
- Trigger every $\sim 100\ \mu\text{s}$
- That way no event should be missed



Back in May...

PROs

- Running "without" external trigger possible
- Thin time slices makes it really unlikely to detect two muons at the same time, especially from similar angles.

CONS

- $> 10\,000$ Events per second (mostly empty)
- 4.4 MB per second of Data written to the disk
- EUDAQ 1 crashed often at filesizes > 5 GB \rightarrow Runtime limited to ≈ 18 min

Taking Cosmics

Took 380 runs á 14-18 minutes in total over the course of several days

A	B	C	D	E	F	G	H	I	J	K
date	time started	time ended	time duration	participant	Runnumber	Event limit	moved to disk?	VCASN/VCASN2	ITHR	comments
	19:00:31	19:14:57	14min	David	429	9	yes	103/115	90	NO OUT OFF SYNC
	19:16:05	19:30:31	14min	David	430	9	yes	103/115	90	
	19:31:37	19:46:03	14min	David	431	9	yes	103/115	90	
	19:47:09	20:01:35	14min	David	432	9	yes	103/115	90	
	20:02:42	20:17:09	14min	David	433	9	yes	103/115	90	DAQ boards stay busy, no out of sync, still started run
	20:18:14	20:32:42	14min	David	434	9	yes	103/115	90	
	--	--	--	David	435	9	deleted	103/115	90	Stopped run manually, no crash
5/16/2020	9:58:11	10:12:37	14min	Felicitas	436	9	yes	103/115	90	
	10:13:41	10:28:04	14min	Felicitas	437	9	yes	103/115	90	
	10:29:10	10:43:31	14min	Felicitas	438	9	yes	103/115	90	
	10:44:37	10:58:59	14min	Felicitas	439	9	yes	103/115	90	
	11:00:05	11:14:25	14min	Felicitas	440	9	yes	103/115	90	
	11:15:32	11:29:52	14min	Felicitas	441	9	yes	103/115	90	NO OUT OFF SYNC (DAQ Boards stay busy -> reconfigure)
	11:30:58	11:45:17	14min	Felicitas	442	9	yes	103/115	90	
	11:45:40	11:59:57	14min	Felicitas	443	9	yes	103/115	90	NO OUT OFF SYNC
	-	-	-	Felicitas	444		deleted	103/115	90	
	12:45:39	12:59:54	14min	David	445	9	yes	103/115	90	
	13:00	13:15:08	14min	David	446	9	yes	103/115	90	
	13:16:14	13:30:22	14min	David	447	9	yes	103/115	90	
	13:31:27	13:45:36	14min	David	448	9	yes	103/115	90	
	13:45:59	14:00:06	14min	David	449	9	yes	103/115	90	NO OUT OFF SYNC
	14:01:14	14:15:23	14min	David	450	9	yes	103/115	90	DAQ boards stay busy, no out of sync, still started run
	14:16:28	14:30:36	14min	David	451	9	yes	103/115	90	
	14:31:41	14:45:47	14min	David	452	9	yes	103/115	90	
	14:46:53	15:00:57	14min	David	453	9	yes	103/115	90	
	15:02:03	15:16:08	14min	David	454	9	yes	103/115	90	

- 1.5 TB of Data
- First Analysis showed only ~10 good tracks per run

Cosmic Analysis

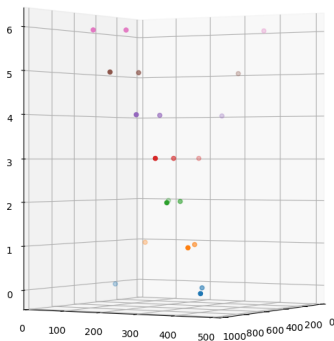
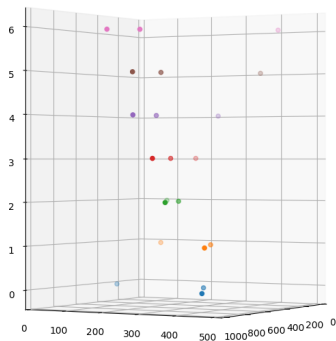
- Corryvreckan fails to do analysis with just a few tracks per run
(no way of using multiple `.raw` files?)
- Used the `[TextWriter]` module to transform RAW data into `.txt` files.
- Reducing filesize from ~4.5 GB to ~200 MB per run

Cosmic Analysis

- Corryvreckan fails to do analysis with just a few tracks per run
(no way of using multiple `.raw` files?)
- Used the `[TextWriter]` module to transform RAW data into `.txt` files.
- Reducing filesize from ~4.5 GB to ~200 MB per run
- Compression program stores only non-empty events.
- Reduces size of `.txt` files to ~90 kB
- Further analysis in python

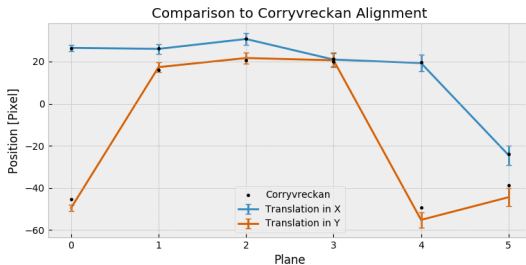
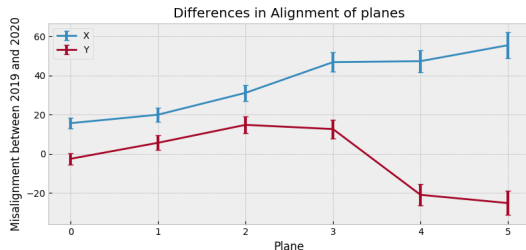
Cosmic Analysis

- First visualization attempts
- Plane alignment with testbeam data from 2019 → **inaccurate**. (planes seem to have shifted)



- Taking Closer look at alignment

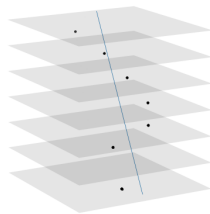
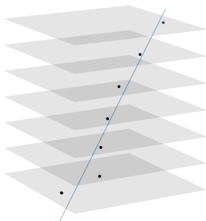
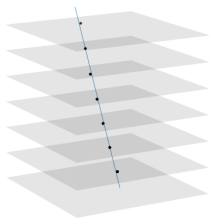
Cosmic Analysis



- Disalignment of planes to over 1.8 mm (after transport)
- Generally, testbeam alignment from 2020 closer to cosmic setup than from 2019
- simple translation algorithm and comparison with the alignment that corryvreckan suggests (second figure)
- Goal: Do alignment with cosmic data

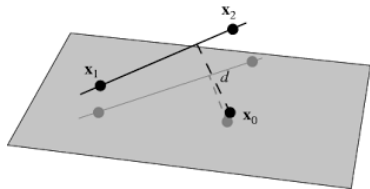
Cosmic Analysis

Implemented a 3D-Fitting algorithm in python:



Using numpy's Singular value decomposition `np.linalg.svd`

→ Calculating χ^2 (goodness of fit) "by hand"



$$d^2 = \frac{|x_1 - x_0|^2 |x_2 - x_1|^2 - [(x_1 - x_0) \cdot (x_2 - x_1)]^2}{|x_2 - x_1|^2}$$

Cosmic Analysis

Event analysis

- With simple considerations estimate muon rate traversing a certain number of planes
- Evaluate data and compare to estimations

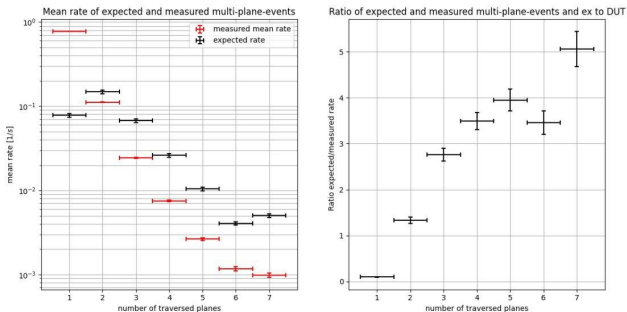


Figure: Comparison of estimated and measured muon rate

June event analysis

- Find reasons for overestimation
- Differences in measured hit rate per plane
- possible dependency on Thresholds

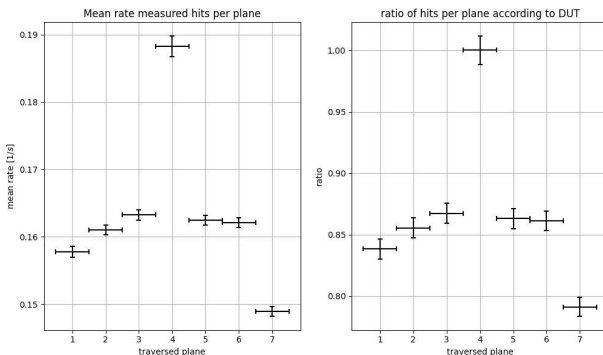


Figure: Mean rate of measured hits

Cosmic Analysis

event analysis

- Non-consecutive events appeared (i.e. planes 1,2,3,4,5,7 registered a hit)
- Corrected mean rate by removing non-consecutive events

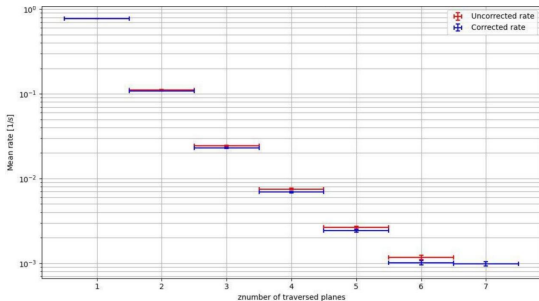


Figure: Mean rate correction by non-consecutive events

Cosmic Analysis

track analysis

- Alignment with data of testbeam june 2020
- Track visualized with 2-dimensional projection
- possibility to classify events as valid or fake track

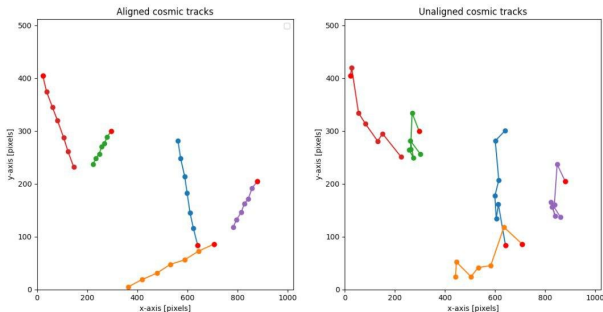
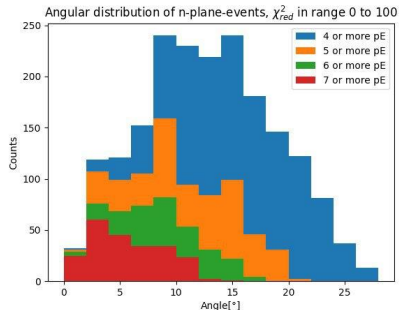
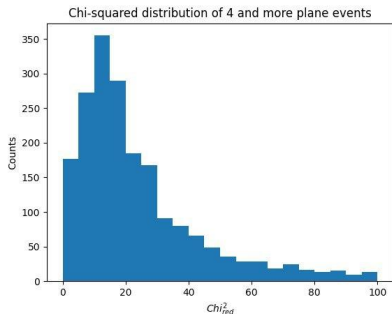


Figure: Alignment with testbeam 2020 data

track analysis

- Fitting the 2D-track projections
- Analysis of χ_{red}^2 -distribution and angular distribution
- still open



Projects

- Alignment

- Trying to achieve better alignment by iterative track fitting (similar to corrvreckan)

- Cosmic Analysis for Thesis

- Comparing angular distribution and rate with theoretical calculations
- Looking at cluster sizes and charge deposit

- The ALPIDE-Telescope

- Now have scintillators again
- Trying to revive the setup in triggered mode (now together)
- As of right now: Eudaq not able to work with low particle rate (maybe you have some input?)

