Status update

Bogdan BLIDARU

30.04.2020

Outline

- DESY testbeam campaign and analysis
  - Efficiency & fake hit rate
  - Position resolution
  - Straight-track vs General Broken Line fits
- Heavy ion campaign at GSI
  - Analysis, cleaning up the samples
- Laboratory tests with students
  - Threshold & Noise occupancy scans
  - Setup for cosmics
- Next steps

Laboratory tests

• Introducing students to Silicon technology, ALPIDE chips, telescope opearation
• Learn how to undertake measurements (Noise occupancy, Threshold) in order to complement the data from the testbeam
• During Covid times, operate the setup as a cosmics telescope

• Setup done – 10 kHz trigger rate from pulser, 7 planes active
• STROBE controls how much of the time the chip is "active"
• Took some data with STROBE = 50 μs, 90 μs (100 μs trigger).
• What do we expect?

Cosmics

- We expect several planes to be hit. How many? What rate?

$$\frac{d\mathrm{N}}{d\mathrm{A}\, d\Omega\, d\mathrm{t}} = \mathrm{I}_0 \cos^2(\theta) \qquad \frac{d\mathrm{N}}{d\mathrm{t}} = \mathrm{I}_0 \cos^2(\theta)\, d\mathrm{A}\, d\Omega$$

$$\mathrm{I}_0 \cong 70\, m^{-2} s^{-1} sr^{-1}$$

$$\Phi = \int I \cos(\theta)\, d\Omega \qquad \text{If I = fixed, } \Phi = \mathrm{I} \cdot \pi$$

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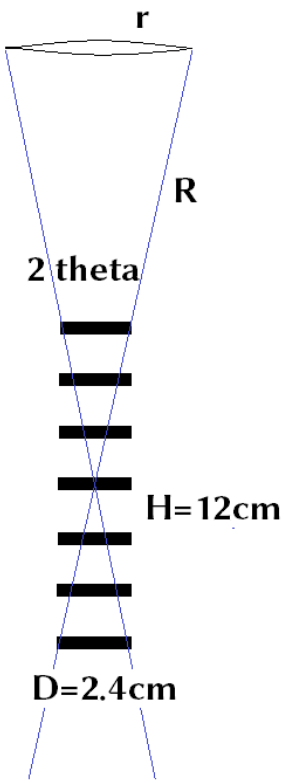
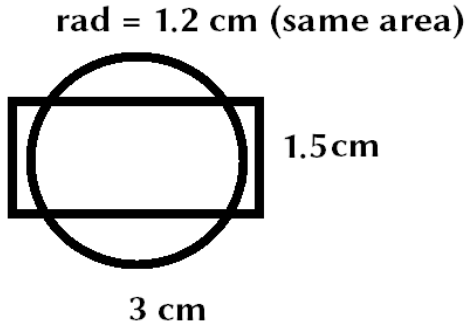
$$\int_{cone} d\Omega = \int_0^{2\pi}\int_0^{\theta} \sin\theta' d\theta' d\phi$$

$$= 2\pi \int_0^{\theta} \sin\theta' d\theta' = 2\pi[-\cos\theta']_0^{\theta} =$$

$$2\pi(1-\cos\theta)$$





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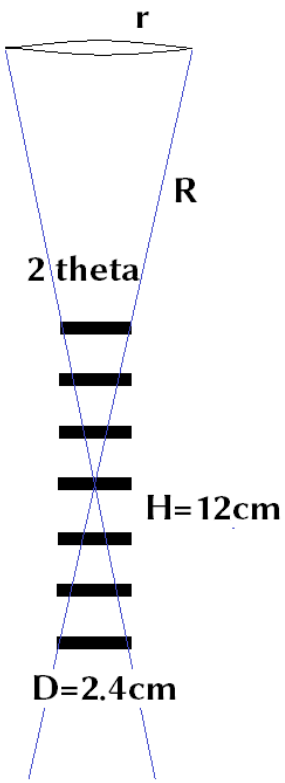
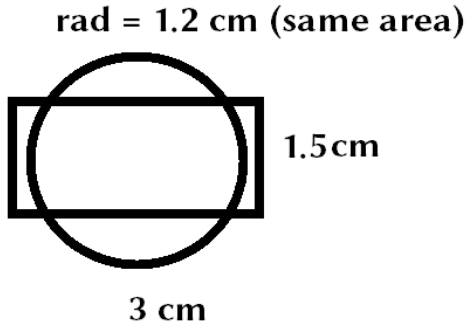
$$\phi(\theta) = 2\pi \int_0^{\theta} (I_v \cos^2\theta)\cos\theta \sin\theta\, d\theta$$

$$= \frac{2\pi}{4}(1-\cos^4\theta)\, I_v$$





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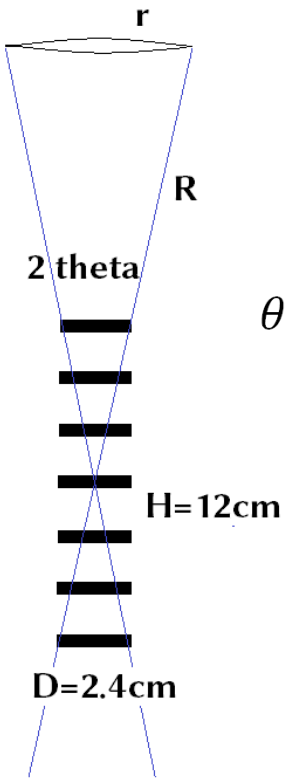
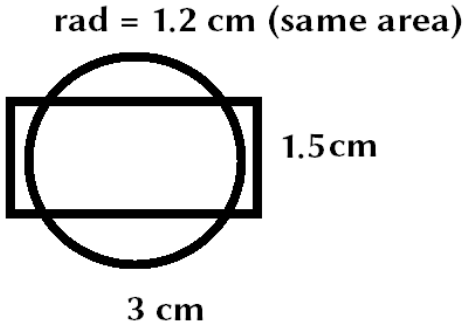
$$Acceptance = \phi(\theta) \cdot \text{Area}$$



$$\theta = 2 \arctan\left(\frac{R_{chips}}{H_{telescope}}\right)$$



7 planes → θ = 11.421° → 0.001135 μ/cm²s
3 planes → θ = 22.62° → 0.004045 μ/cm²s

Cosmics

- Steps : have setup ready (trigger and strobe accordingly)
- Use EUDAQ, prepare run taking
- Output: .raw files (very large; ~2.5GB/10 minutes, mostly empty - headers)
- Move raw files to /dev/sdb2 (5TB HDD attached)
- Translate raw files with Corry (libalpide, eudaq) into human readable .txt files (10% the size of the raw)
- Scripts that extract interesting events out into another separate file (caution: don't mix runs with different settings ☺)
- Analyze data: clustering, alignment, tracking (Corry can help).

Cosmics

• Actually, there are some problems with the detector in terms of event building.

cat cosmics000333.txt | grep -n "pALPIDEfs"
15:--- pALPIDEfs_0 ---
42852:--- pALPIDEfs_0 ---
151557:--- pALPIDEfs_3 ---
167851:--- pALPIDEfs_0 ---
190551:--- pALPIDEfs_0 ---
193329:--- pALPIDEfs_3 ---
376616:--- pALPIDEfs_3 ---
462772:--- pALPIDEfs_0 ---
462777:--- pALPIDEfs_3 ---
523259:--- pALPIDEfs_0 ---
586648:--- pALPIDEfs_3 ---
671371:--- pALPIDEfs_3 ---
688264:--- pALPIDEfs_3 ---
1111973:--- pALPIDEfs_0 ---
1200974:--- pALPIDEfs_0 ---
1247493:--- pALPIDEfs_0 ---
1282186:--- pALPIDEfs_0 ---
1369254:--- pALPIDEfs_0 ---
1466675:--- pALPIDEfs_3 ---
1493378:--- pALPIDEfs_0 ---

cat cosmics000342.txt | grep -n "pALPIDEfs"
15:--- pALPIDEfs_0 ---
119157:--- pALPIDEfs_0 ---
503982:--- pALPIDEfs_0 ---
591275:--- pALPIDEfs_0 ---
902811:--- pALPIDEfs_0 ---
945848:--- pALPIDEfs_0 ---
1606829:--- pALPIDEfs_0 ---
2057270:--- pALPIDEfs_0 ---
2089678:--- pALPIDEfs_0 ---
2762414:--- pALPIDEfs_0 ---
2793594:--- pALPIDEfs_0 ---
2816481:--- pALPIDEfs_0 ---
2840156:--- pALPIDEfs_0 ---
3182590:--- pALPIDEfs_0 ---
3230692:--- pALPIDEfs_0 ---
3242454:--- pALPIDEfs_0 ---
3781499:--- pALPIDEfs_0 ---
3831589:--- pALPIDEfs_0 ---
3877883:--- pALPIDEfs_0 ---
3905572:--- pALPIDEfs_0 ---
4054491:--- pALPIDEfs_0 ---
4072079:--- pALPIDEfs_0 ---

cat cosmics000327.txt | grep -n "pALPIDEfs"
15:--- pALPIDEfs_0 ---
311220:--- pALPIDEfs_4 ---
570664:--- pALPIDEfs_4 ---
613965:--- pALPIDEfs_3 ---
618484:--- pALPIDEfs_4 ---
697352:--- pALPIDEfs_4 ---
841198:--- pALPIDEfs_4 ---
943349:--- pALPIDEfs_0 ---
954156:--- pALPIDEfs_3 ---
1093100:--- pALPIDEfs_3 ---
1446126:--- pALPIDEfs_1 ---
1448476:--- pALPIDEfs_3 ---
1499879:--- pALPIDEfs_1 ---
1506194:--- pALPIDEfs_0 ---
1506198:--- pALPIDEfs_1 ---
1524399:--- pALPIDEfs_3 ---
1538117:--- pALPIDEfs_4 ---
1619473:--- pALPIDEfs_1 ---
1671265:--- pALPIDEfs_3 ---
1841400:--- pALPIDEfs_4 ---
1846426:--- pALPIDEfs_3 ---

Cosmics

- Possible reason: low threshold; changed to higher one, works.

- Fast check by line number

```
9884105:--- pALPIDEfs_3 ---
9908309:--- pALPIDEfs_6 ---
9962503:--- pALPIDEfs_1 ---
9963309:--- pALPIDEfs_0 ---
9984538:--- pALPIDEfs_4 ---
9984540:--- pALPIDEfs_5 ---
10002632:--- pALPIDEfs_4 ---
10002643:--- pALPIDEfs_5 ---
10104825:--- pALPIDEfs_5 ---
10104911:--- pALPIDEfs_6 ---
10216880:--- pALPIDEfs_5 ---
10216884:--- pALPIDEfs_6 ---
10409177:--- pALPIDEfs_0 ---
10464527:--- pALPIDEfs_0 ---
10486203:--- pALPIDEfs_5 ---
10551490:--- pALPIDEfs_0 ---
10561953:--- pALPIDEfs_5 ---
10570602:--- pALPIDEfs_5 ---
10584356:--- pALPIDEfs_4 ---
10627453:--- pALPIDEfs_0 ---
10627455:--- pALPIDEfs_1 ---
10627458:--- pALPIDEfs_2 ---
10627461:--- pALPIDEfs_3 ---
10627463:--- pALPIDEfs_4 ---
10627468:--- pALPIDEfs_5 ---
10627471:--- pALPIDEfs_6 ---
10713614:--- pALPIDEfs_2 ---
10713617:--- pALPIDEfs_3 ---
10751447:--- pALPIDEfs_1 ---
10751449:--- pALPIDEfs_2 ---
10754677:--- pALPIDEfs_5 ---
10821371:--- pALPIDEfs_0 ---
10861771:--- pALPIDEfs_3 ---
10919316:--- pALPIDEfs_0 ---
10939703:--- pALPIDEfs_2 ---
10939705:--- pALPIDEfs_3 ---
10939708:--- pALPIDEfs_4 ---
```

→ Plane 6 only

→ Planes 4,5

→ All planes!

→ Planes 2, 3, 4

- Get event by calling data[line_number – 4]

- Events are separated by an event header

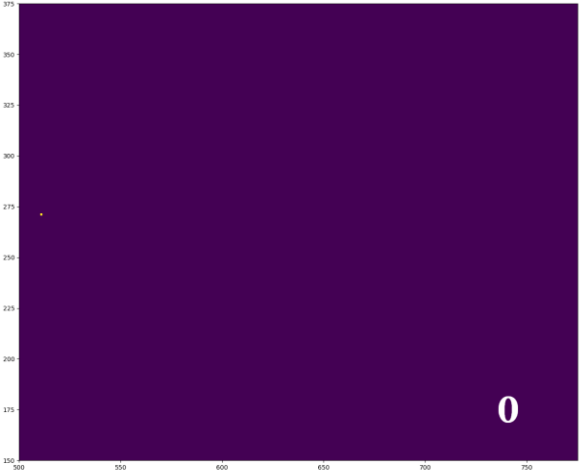
=== event ===

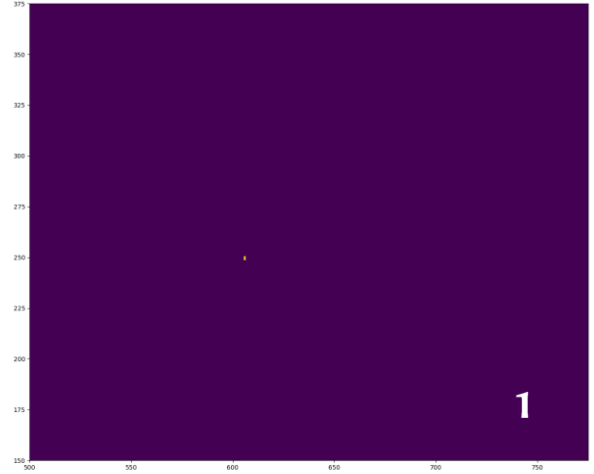
and individual sensors by the type marker:

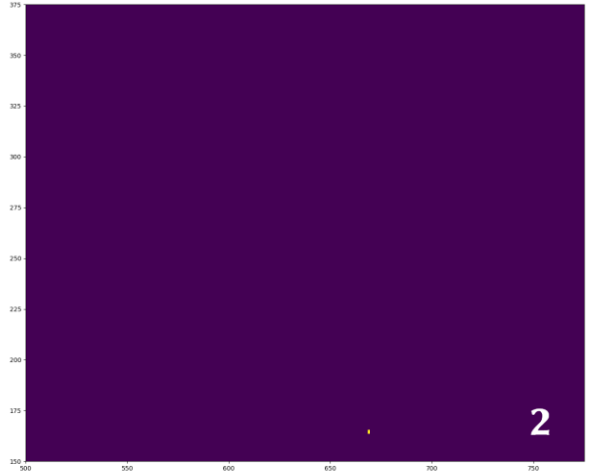
--- plane ---

- Most events are empty
- 1-2 events in 10 min run with all 7 planes active

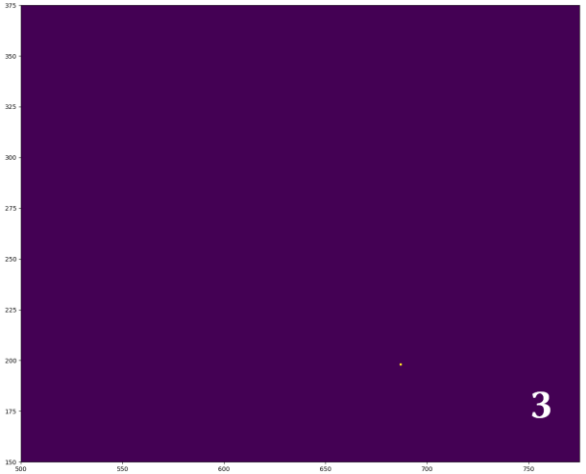
```
=== 3541916 ===
Start: 4.80374e+19
End:   4.80374e+19
=== 3541917 ===
Start: 4.80374e+19
End:   4.80374e+19
=== 3541918 ===
Start: 4.80374e+19
End:   4.80374e+19
--- pALPIDEfs_0 ---
Pixel 511, 271, 1, 1, 4.80374e+19
--- pALPIDEfs_1 ---
Pixel 606, 249, 1, 1, 4.80374e+19
Pixel 606, 250, 1, 1, 4.80374e+19
--- pALPIDEfs_2 ---
Pixel 669, 164, 1, 1, 4.80374e+19
Pixel 669, 165, 1, 1, 4.80374e+19
--- pALPIDEfs_3 ---
Pixel 687, 198, 1, 1, 4.80374e+19
--- pALPIDEfs_4 ---
Pixel 757, 173, 1, 1, 4.80374e+19
Pixel 756, 173, 1, 1, 4.80374e+19
Pixel 756, 174, 1, 1, 4.80374e+19
Pixel 757, 174, 1, 1, 4.80374e+19
--- pALPIDEfs_5 ---
Pixel 739, 270, 1, 1, 4.80374e+19
Pixel 739, 271, 1, 1, 4.80374e+19
--- pALPIDEfs_6 ---
Pixel 721, 369, 1, 1, 4.80374e+19
Pixel 721, 370, 1, 1, 4.80374e+19
Pixel 722, 370, 1, 1, 4.80374e+19
=== 3541919 ===
Start: 4.80374e+19
End:   4.80374e+19
=== 3541920 ===
Start: 4.80374e+19
End:   4.80374e+19
```



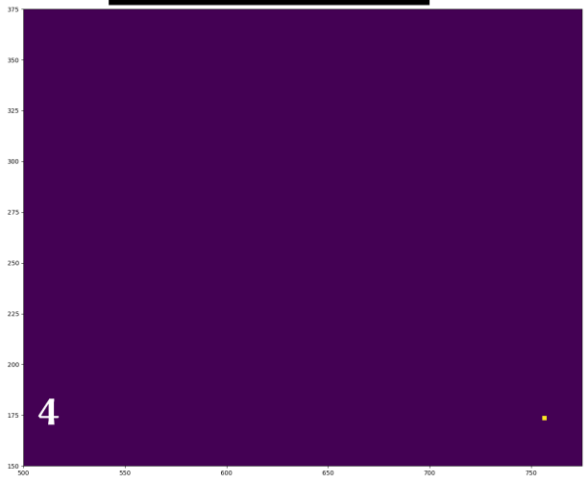


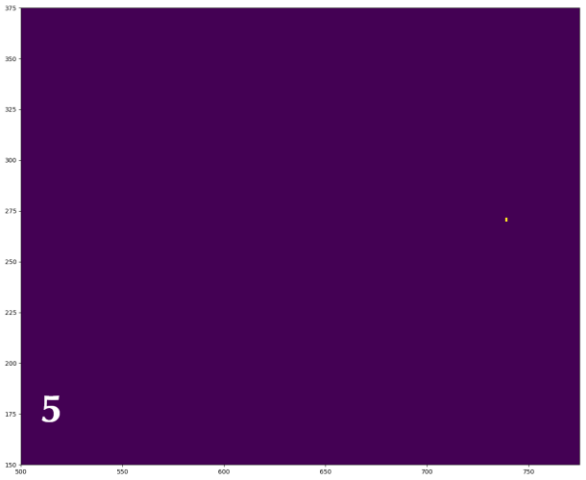


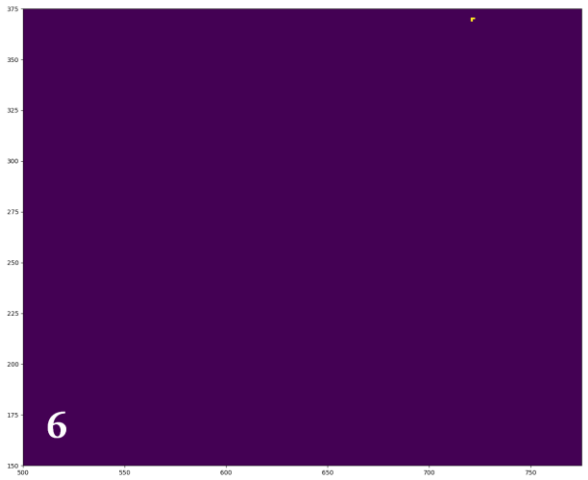

```
=== 3541918 ===
['Start: 4.80374e+19',
 'End:   4.80374e+19',
 '--- pALPIDEfs_0 ---',
 'Pixel 511, 271, 1, 1, 4.80374e+19',
 '--- pALPIDEfs_1 ---',
 'Pixel 606, 249, 1, 1, 4.80374e+19',
 'Pixel 606, 250, 1, 1, 4.80374e+19',
 '--- pALPIDEfs_2 ---',
 'Pixel 669, 164, 1, 1, 4.80374e+19',
 'Pixel 669, 165, 1, 1, 4.80374e+19',
 '--- pALPIDEfs_3 ---',
 'Pixel 687, 198, 1, 1, 4.80374e+19',
 '--- pALPIDEfs_4 ---',
 'Pixel 757, 173, 1, 1, 4.80374e+19',
 'Pixel 756, 173, 1, 1, 4.80374e+19',
 'Pixel 756, 174, 1, 1, 4.80374e+19',
 'Pixel 757, 174, 1, 1, 4.80374e+19',
 '--- pALPIDEfs_5 ---',
 'Pixel 739, 270, 1, 1, 4.80374e+19',
 'Pixel 739, 271, 1, 1, 4.80374e+19',
 '--- pALPIDEfs_6 ---',
 'Pixel 721, 369, 1, 1, 4.80374e+19',
 'Pixel 721, 370, 1, 1, 4.80374e+19',
 'Pixel 722, 370, 1, 1, 4.80374e+19']
```



- Separate event, split into planes, get pixel info, plot.







Outlook

- https://alice-wiki.gsi.de/foswiki/bin/view/Literature/MAPS
  up to date and more info coming ☺

- Perfect Corry analysis and DESY data
- Proceed with heavy ion testbeam analysis

- At home activities: Python, C++ courses
- Matlab work on some GEM data