Status of testbeam telescope data analysis

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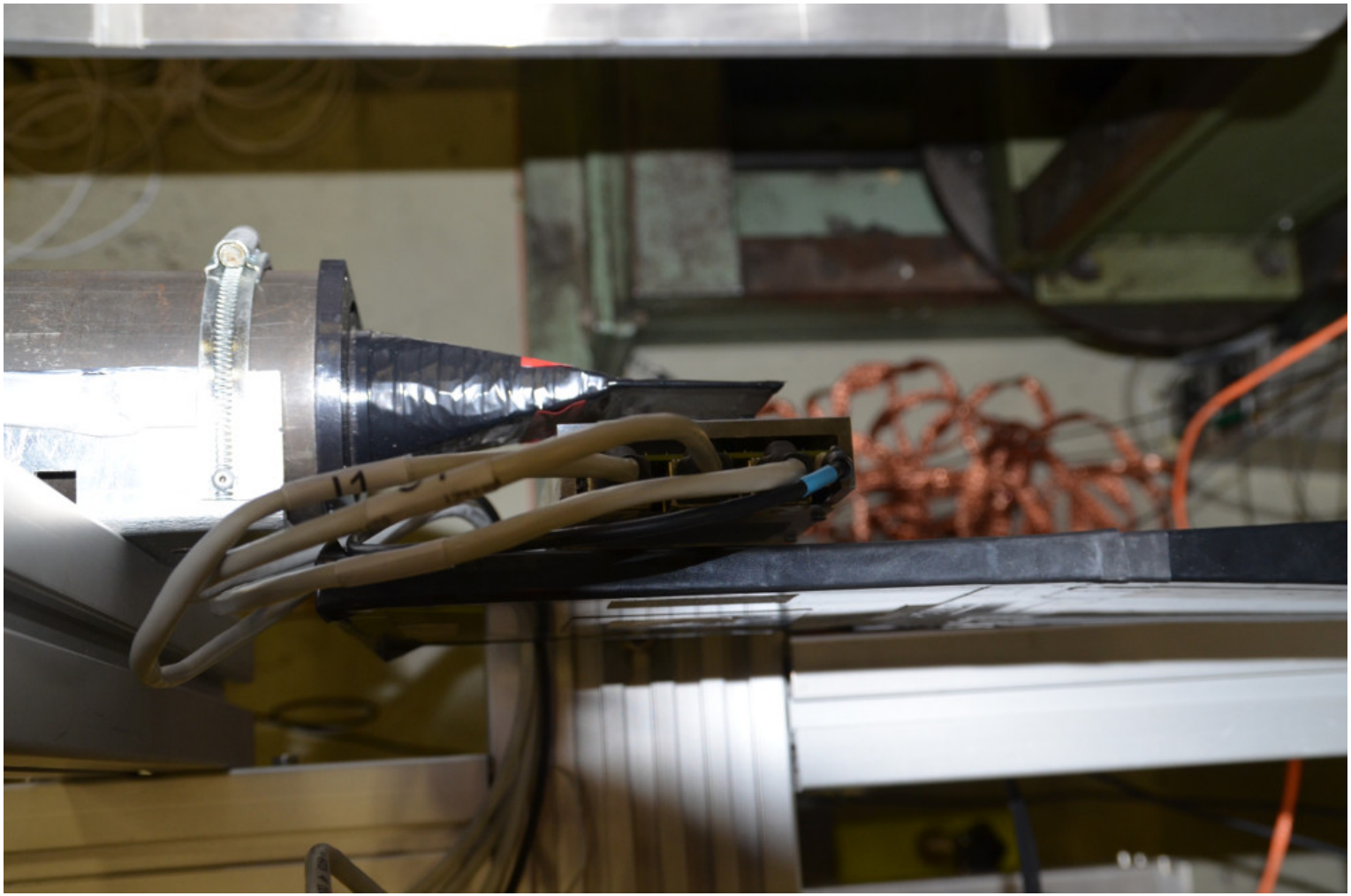
Outline

Overview of telescope and trigger system
Alignment procedure & results
Tracking algorithm & results
Conclusions and Outlook

Overview of the system

Overview of the system



The trigger system

- The two scintilators (front and rear) are set to coincidence
- Those in turn are set to anti-coincidence with the hole scintilator
- An additional option: using cherenkov detectors to select particle type ($e, e + \mu$,or hadrons)
- Note: the read time of the MIMOSA boards is slow ($450\mu s$). This causes multiple track events

Analysis: steps & goals

1. Clustering (using TAF framework)
2. Alignment
3. Tracking (track finding)
4. The ultimate goal: use the tracks to extrapolate hits to LumiCal pads, and match these hits to hits received from LumiCal sensors

Alignment procedure

For all hit combinations on 3 given planes (1-2-3 or 2-3-4):

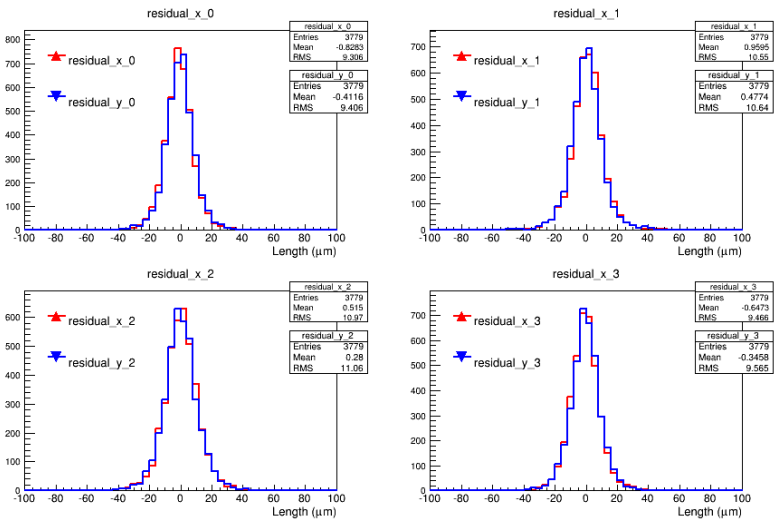
1. A straight line is drawn through the hits in the first 2 planes
2. It is propogated to the 3rd plane
3. If there is an actual hit in the 3rd plane which is close enough to the expected hit (tolerance), this pair is saved
4. A 3X3 matrix **A** is generated, which performs the coordinate transformation: $\begin{pmatrix} x_{exp} \\ y_{exp} \\ z \end{pmatrix} = \mathbf{A} \begin{pmatrix} x_{act} \\ y_{act} \\ z \end{pmatrix}$
5. All hits on the 3rd plane are updated and **A** is returned

Alignment procedure

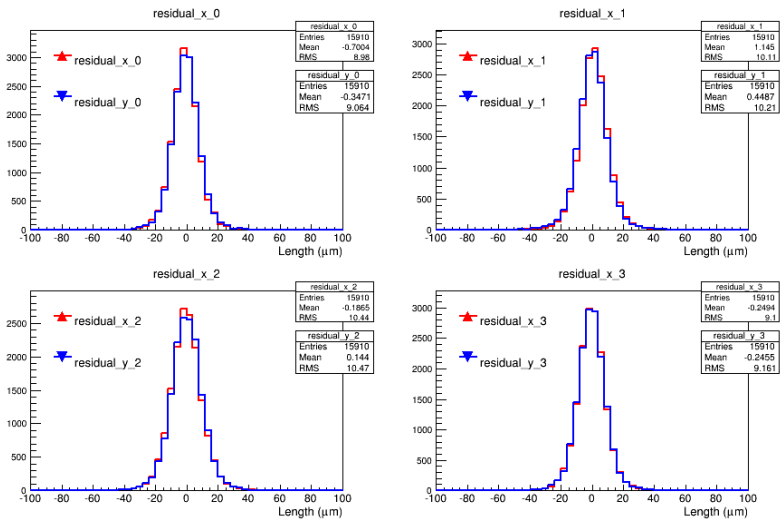
This is repeated many times, each iteration updating the hit positions and **A**.
Next, the tolerance is lowered and the entire above process is performed again.
Eventually, one ends up with the matrix which is the result of all the iterations. One simply has to multiply any hit coordinates in order to get the aligned hit location.
Note: in this manner only planes 3,4 are aligned.

Alignment results

Best seen in hit to track difference (residuals) plots:



(a) Electron runs



(b) Hadron runs

Tracking process

For all hit combinations on the first 2 planes:

1. A straight line is drawn through the two hits
2. It is propogated to the 3rd plane
3. From the hits on the 3rd plane, the one with lowest distance to the expected hit position is selected
4. If this distance is below the fit tolerance, χ^2 minimization is used to find a track from the three points
5. It is propogated to the 4th plane
6. From the hits on the 4th plane, the one with lowest distance to the expected hit position is selected
7. If this distance is below the fit tolerance, associate these 4 points with a track
8. The track parameters are calculated using χ^2 minimization

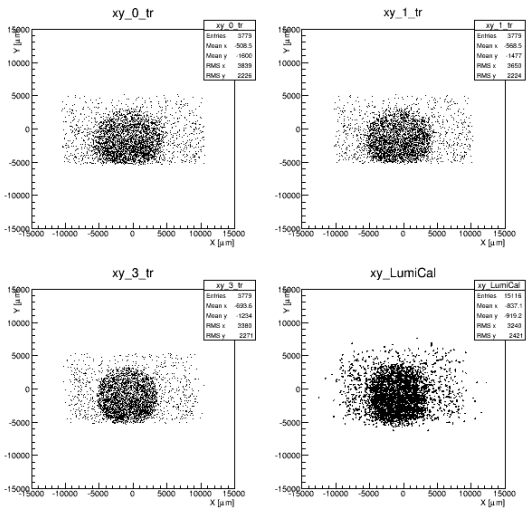
Tracking process

Problems:

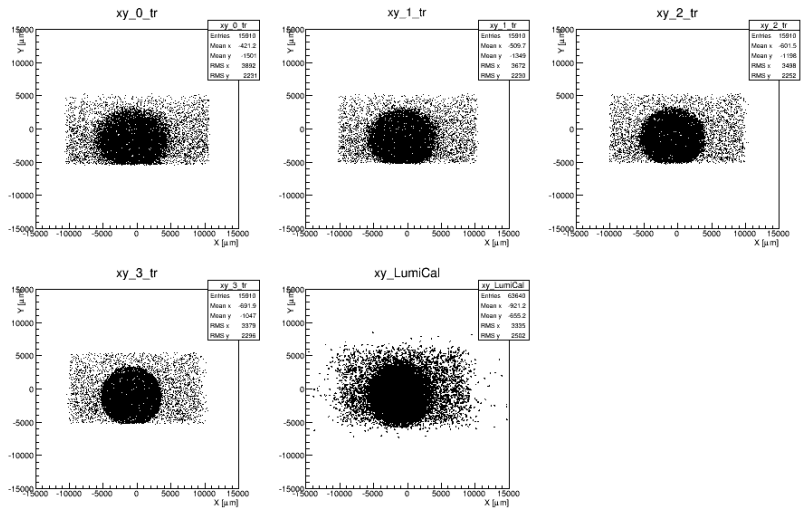
- 4 hits are required to make a track
- Track seed is always 2 hits from the first two planes (same as alignment...)
- For the case of multiple track events, there is no way to distinguish between the track that triggered and the other tracks

Tracking results

Hitmaps of all hits associated with tracks:



(a) Electron runs

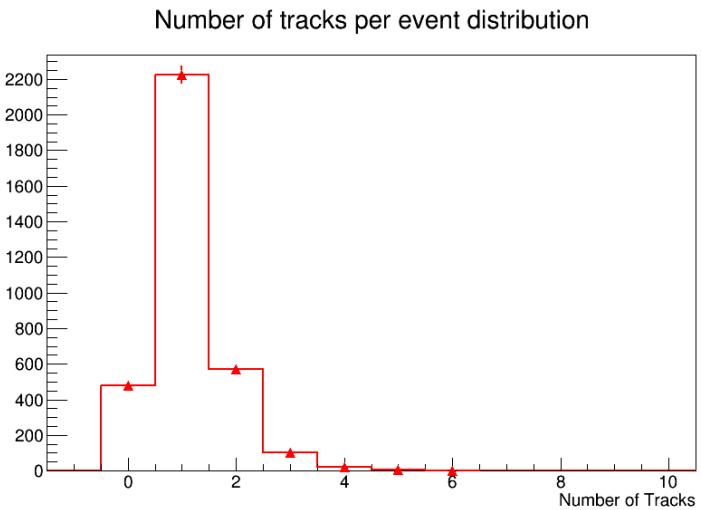


(b) Hadron runs

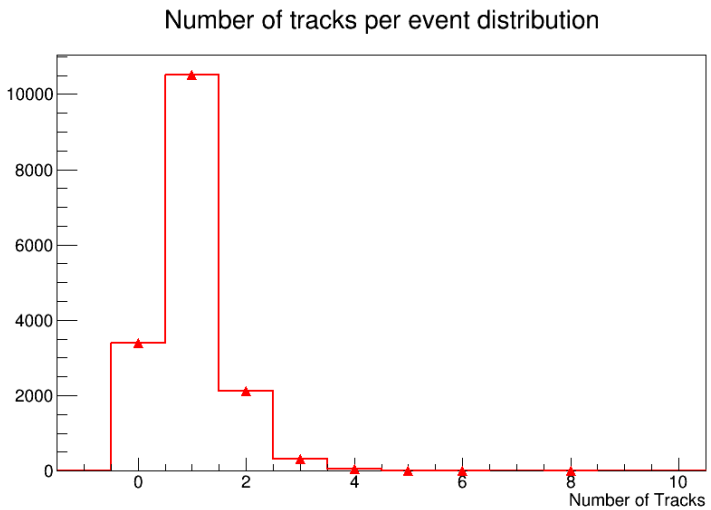
Many tracks that go outside of the trigger area!

Tracking results

Track multiplicity:



(a) Electron runs



(b) Hadron runs

Far too many zero-track events...

Conclusion

The good news:

- We are able to read and process the telescope data
- Alignment procedure produces good residuals plots
- The tracking process is able to find most of the tracks, trigger area is well seen in hitmaps
- Propagation to LumiCal seems good (see next talk by Itamar)

The bad news:

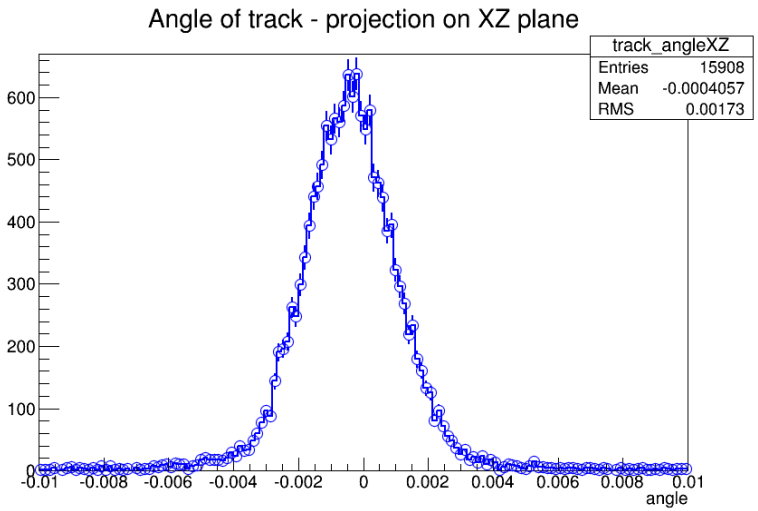
- Only two planes are aligned (optimally - three)
- Tracking is incomplete: many zero track events, many occasions of missing tracks in multi-track events
- There is no way to know which track is the trigger track

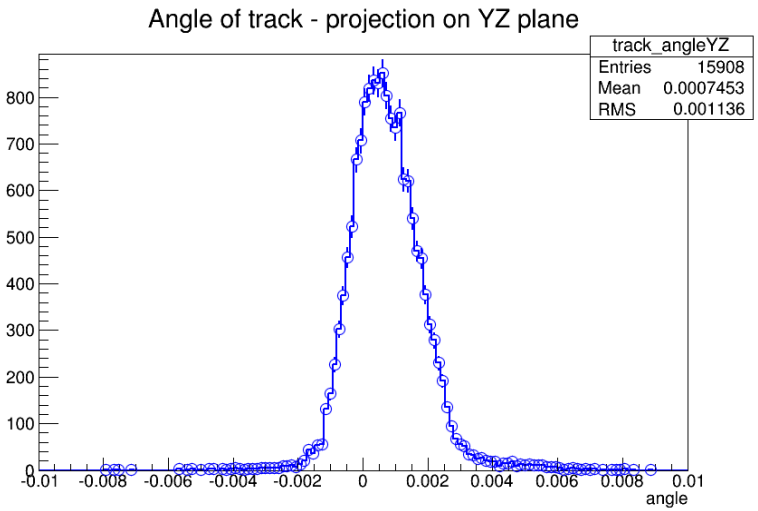
Conclusion

Outlook:
Move on to using the alignment and tracking procedures available in TAF framework. The desire is to have full reconstruction of all tracks resulting in (almost) no zero track events, and the availability of the trigger track in all events.

Extra Slides

Track angles for hadrons:





Track angles for electrons: