Ideas, plans, and considerations on 3D reconstruction

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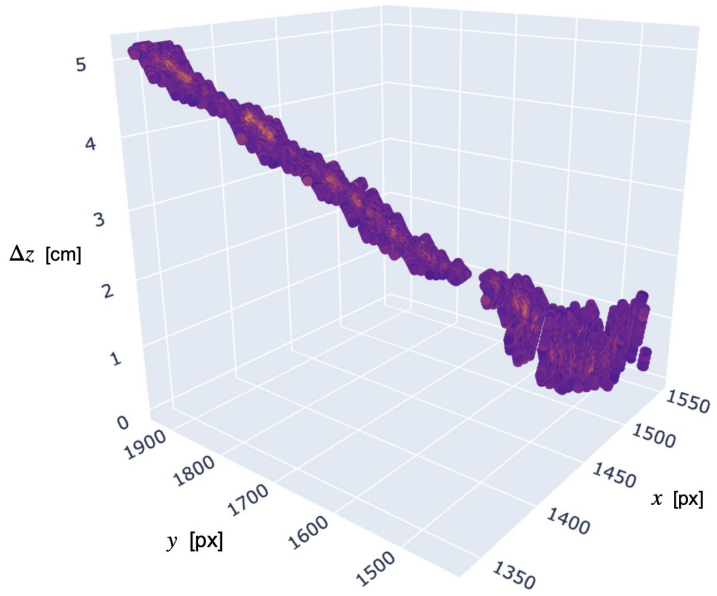
Coimbra Analysis Meeting - 8.6.2023

Requirements

1. Event definition
2. Event reconstruction in space and time
3. Matching between camera and PMTs

- For physics: reconstruct 3d tracklets of order 1 mm to few cm (v ~ 5cm/us) -> 20ns to few us

- For calibration: reconstruct longer tracks both NR and ER (MeV e, and cosmics)



Cherry picked event!

Event definition

- Fast ADC => tracks of about 3 cm (all we need for physics)
- Slow ADC => all the others
- Hit definition: largest ionization energy deposit compatible with the detector resolution
    - **Few 100 um in (x,y) and about 50 ns in time; ^{55}Fe spots represents good candidates for a spotlike deposit**
- Because light (energy) does not scale linearly with the distance, we need to reconstruct **extended objects as the combination of their point-like constituents** (assess the size of the error as a function of the deposit size, I suspect it is lage as a big power of the distance is involved)
- For **horizontal tracks** the position reconstruction is **broken** (to what extent?)

Time over threshold (TOT)

- Can we assume that the TOT is independent of the energy (amplitude) calibration? Probably not, but to what extent?
- The FWHM should be fairly insensitive to the overall normalization, at the most some uncalibrated events below a minimum threshold.
- How do we define whether 2 or more picks belong to the same deposits? Can we use the electron interaction length to get an order of magnitude (@ what E?)? 1 ns => 50 um in space, probably peaks with a separation of O(10ns) refer to the same deposit.
- **A possible algorithm: calculate the FWHM for WF above a th >~ mV ignoring deeps below th of 10ns**

Fast algorithm (short tracks <= cm)

- Get the total charge of a WF above th
- Get the FWHM
- Run PMT reco for E, x, y
- Run matching algo with clusters keeping in mind that the PMT spatial resolution is of the order few mm (FWHM ~50ns) to few cm (FWHM~1us)

We should try it out and assess its performance: matching eff., position resolution, energy resolution, z reconstruction

Refined algorithm

- Slice the WF in hits ~50ns long either:
  - around the peak, probably with variable time width
  - or starting from the first rising edge at a constant length
- Run PMT reco for each hit for E, x, y
- Run matching algo with clusters
- Once the cluster is identified, get subclusters and refine results using also the camera x, y of subclusters

We can get dE/dx with PMT. We need subclusters, both for comparison and to be feed to PMT reco for better performance.

We should try this out and assess performance.

Calibration measurements

Alpha angle: quantify to what extent PMT reco is sensible to alpha in range 3-5

1. Measure @ LNF (to do):
    a. Study effect of angle (done) and distance separately
    b. Study effect of source spectrum, UV vs visible
    c. Study effect of material: plexiglass, gas, and interfaces between them
2. Use data golden sample (ongoing)
3. Calibrate PMT response with Xray sources @ LNF:
    a. Energy response: linearity and resolution
    b. Can we produce incline tracks? Shoot Xrays perpendicular to the GEM plane? Energetic Xray and a collimator?
4. Use high energy electrons, is it possible to redo this testbeam?
5. Use the neutron run foreseen soon at the BTF