

## **Updates:**

- **Projection Matchin Algorithm**
- **Shower reconstruction**

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## Projection Matchin Algorithm: updates on LArSoft module and algorithm classes

- **Added methods to create single-segment track – needed to reconstruct direction and  $dQ/dx$  of EM cascade using a few hits selected in the initial part** (these were used for CDR plots).

### For general track reconstruction:

- Track is accepted if it has a low value of the *objective function* and (if available) the track *projection to 3<sup>rd</sup> plane* is matching hits. Next the track is extended iteratively.
  - After tuning only a fraction of small ( $< \sim 5$  hits) clusters is not used by the reconstruction.
  - The logic of using clusters is still deveoped, we should commint next steps today.
  - Bug fixed in the gradient formula, trajectory is now much more detailed.
- Method for (optional) flipping the stopping track by  $dQ/dx$  is corrected, added use of induction planes if the collection projection is short (see next slide).
- Plane-to-plane time offsets tuned, again „no offset” gives best reconstruction (strange).

### Next steps:

- Line clustering (now used in tests) is processing also EM showers, and they are used then by 3D reco – it works well only for really simple showers. **Work is needed to separate tracks and showers** (now it is only possible to stop making tracks from small clusters).
- Merging of tracks, with reoptimization – code partially done, internal algorithm structures are ready for this extension, needed also for track/shower separation.

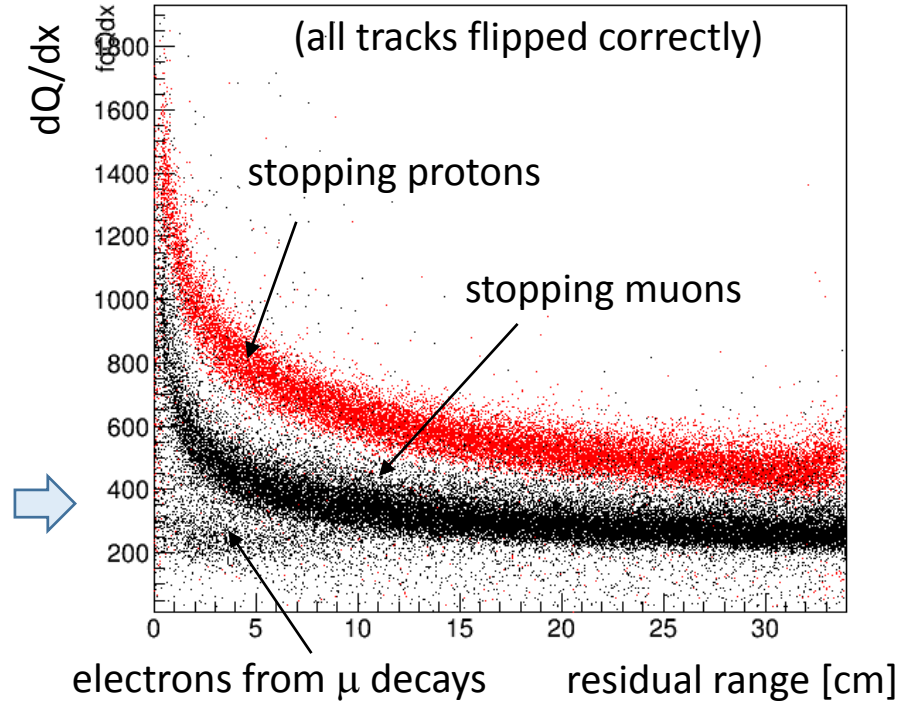
# Projection Matchin Algorithm: updates on LArSoft module and algorithm classes

**Next step**, merging of tracks, reoptimization:

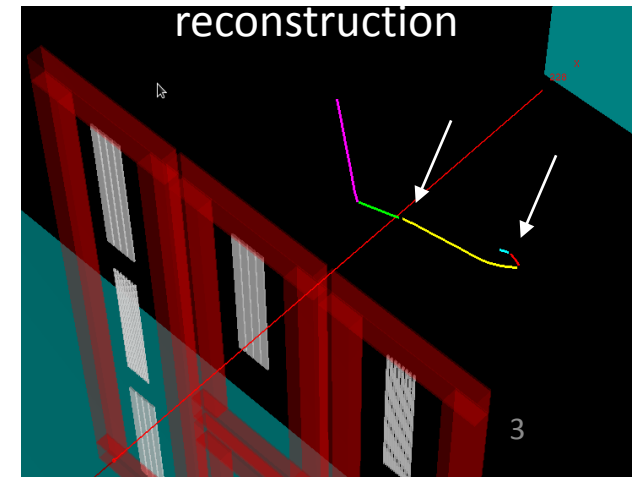
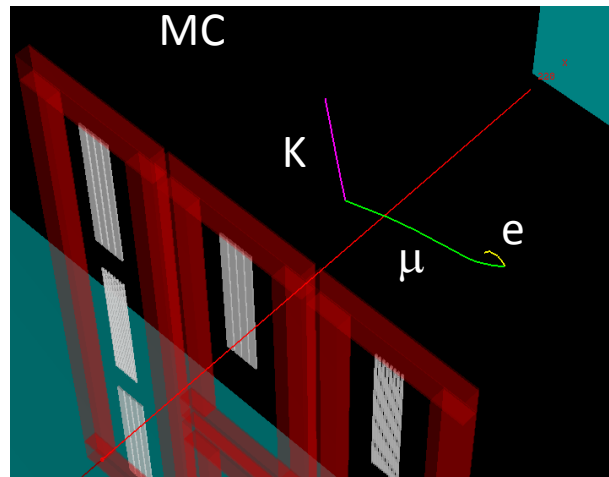
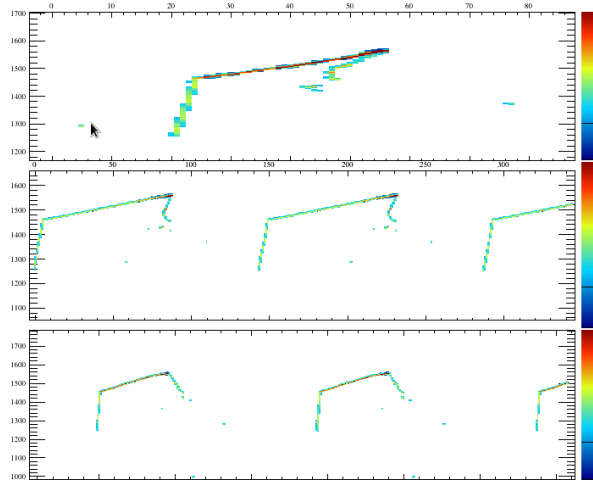
- merge co-linear tracks
- join tracks in vertices

applications:

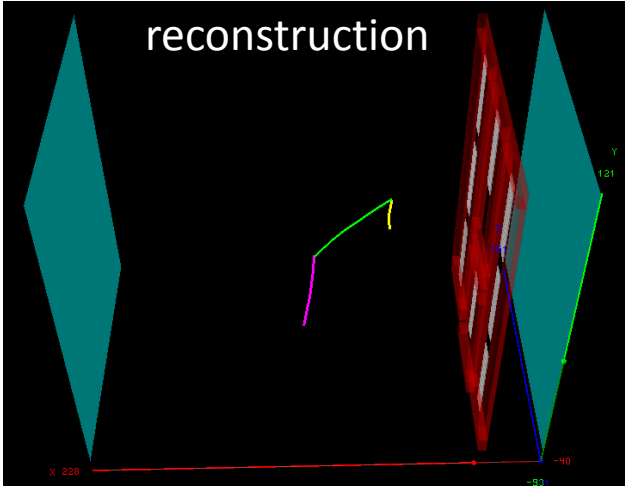
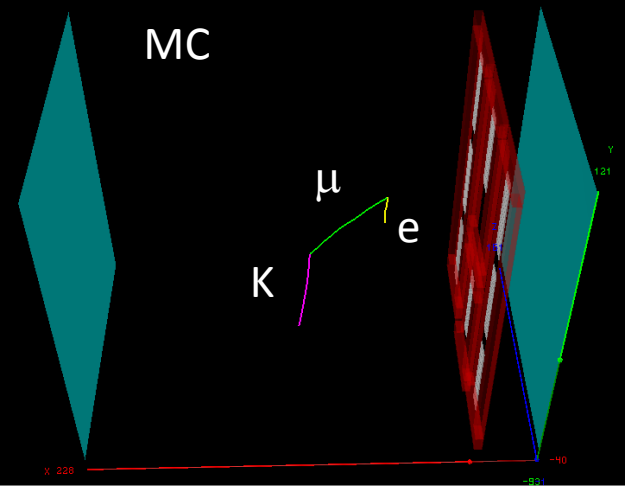
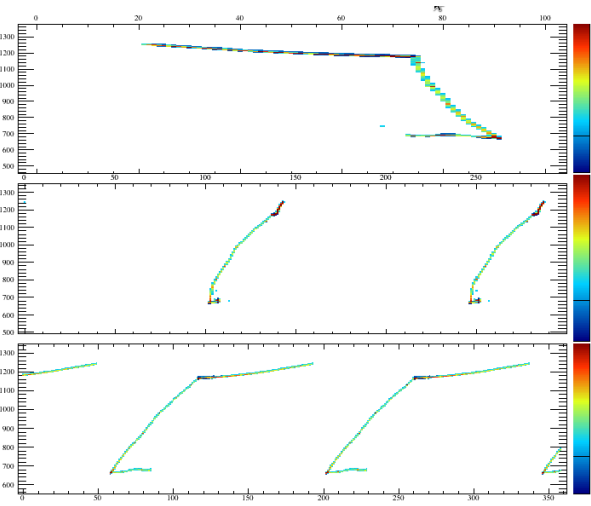
- **efficient track selection in track/shower separation**
- particles in decay chains (first to try, since we are interested in  $dQ/dx$  and PID); now the module is efficient in simple cases:  $\mu$ ,  $\rho$
- neutrino interaction vertices



tracks in the example optimized separately,  $\mu$  and e are broken in parts



tracks in the example optimized separately, here the tracks are correct



## Update on showers

- Shower start point in a single 2D view settled:
  - algorithm tested for single photon cascades
  - results for Collection view, 1000 events: 84% events with distance between MC vtx and reco vtx  $< 0.5$  cm (inefficiency reasons as previously shown: frontal projection, or very track-like topologies).
- $\pi^0$  reconstruction developed now:
  - reconstruction of the 2D start point of each cascade and in each view.
  - matching views to find the shower pairs with the lowest drift time difference between 2D start points in views.
  - 3D reconstruction of the primary vertex and initial direction with  $dQ/dx$  from recent additions to PMA code.
  - then finally: reconstruction of the angle between two showers.