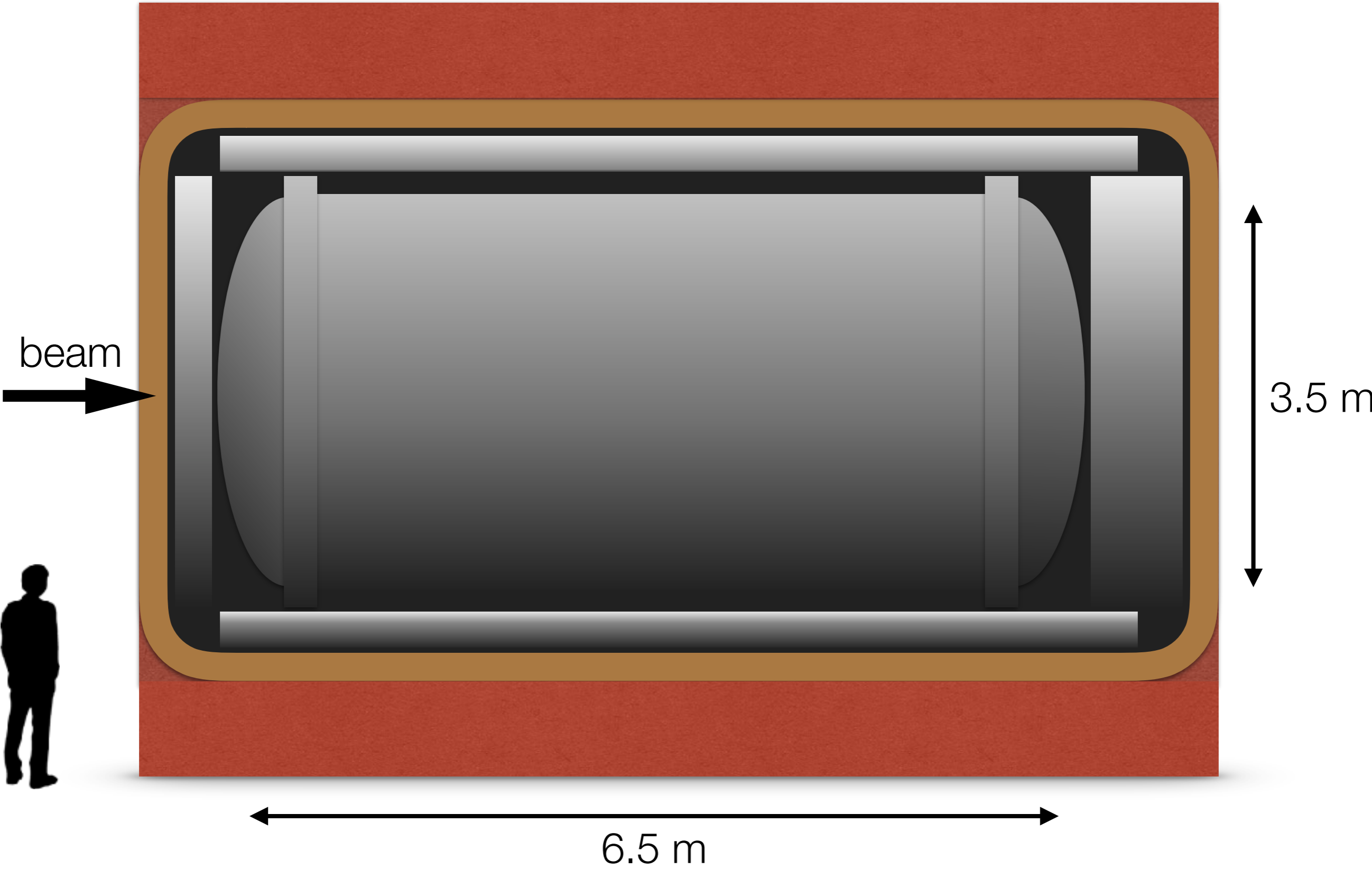


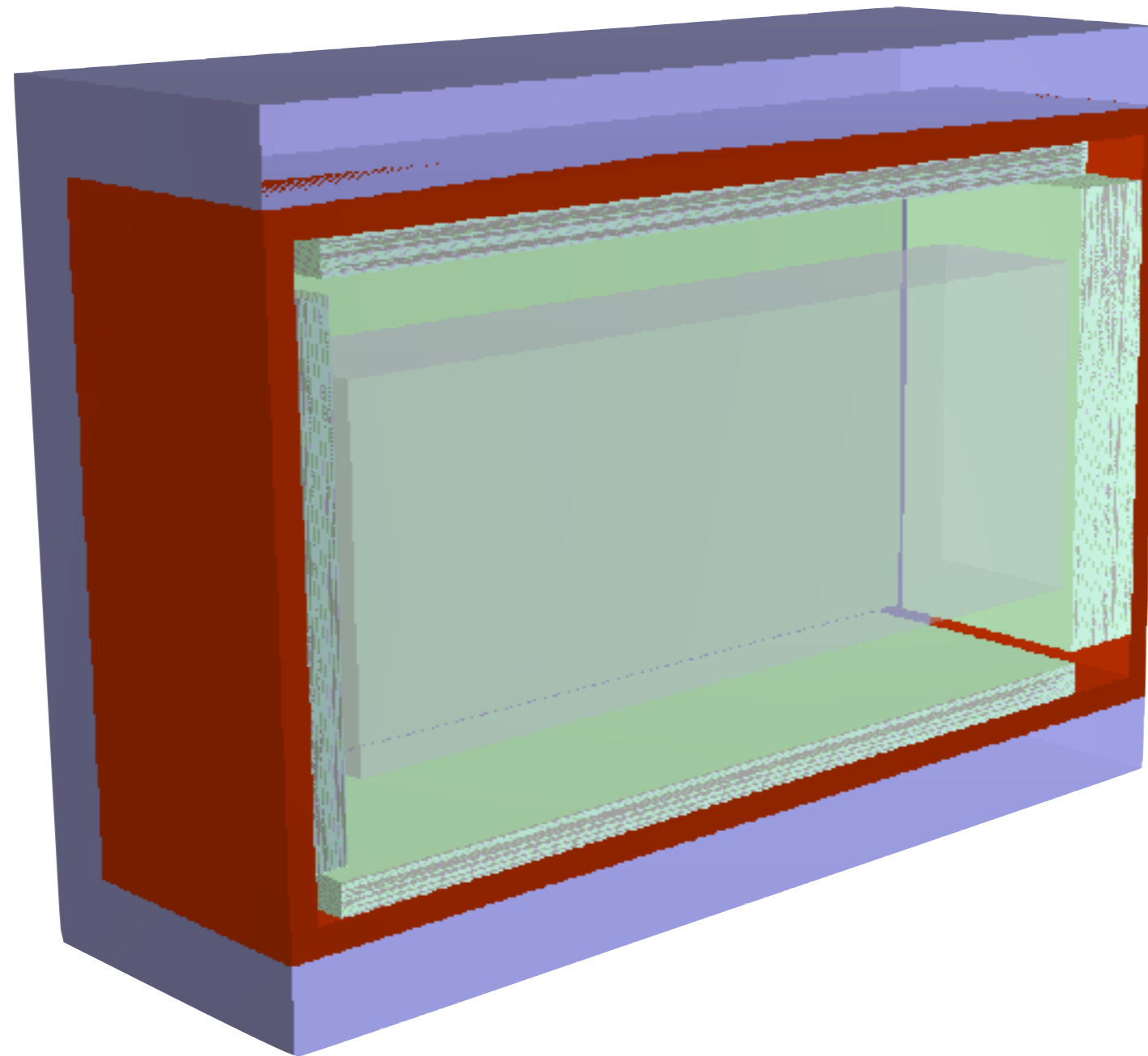
JUSTO MARTIN-ALBO (OXFORD U.)

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# PROGRESS ON GAR-TPC SIMULATION



- 
- Pressurised argon gas TPC inside a  $\sim 65 \text{ m}^3$  titanium vessel.
    - Holds  $\sim 1$  tonne of argon at 10 bar.
    - Momentum measurement with magnetic field.
    - Particle identification using  $dE/dx$ .
  - Sampling calorimeters (plastic scintillator and Pb) surrounding vessel.
    - Detection of neutrals leaving TPC.
    - Time-stamping of TPC tracks.
    - Barrel and upstream calorimeters:  $10 X_0$ . Downstream:  $20 X_0$ .
  - Dipole magnet (0.4 T) surrounding detectors.
    - Heavy copper coils and iron return yoke.



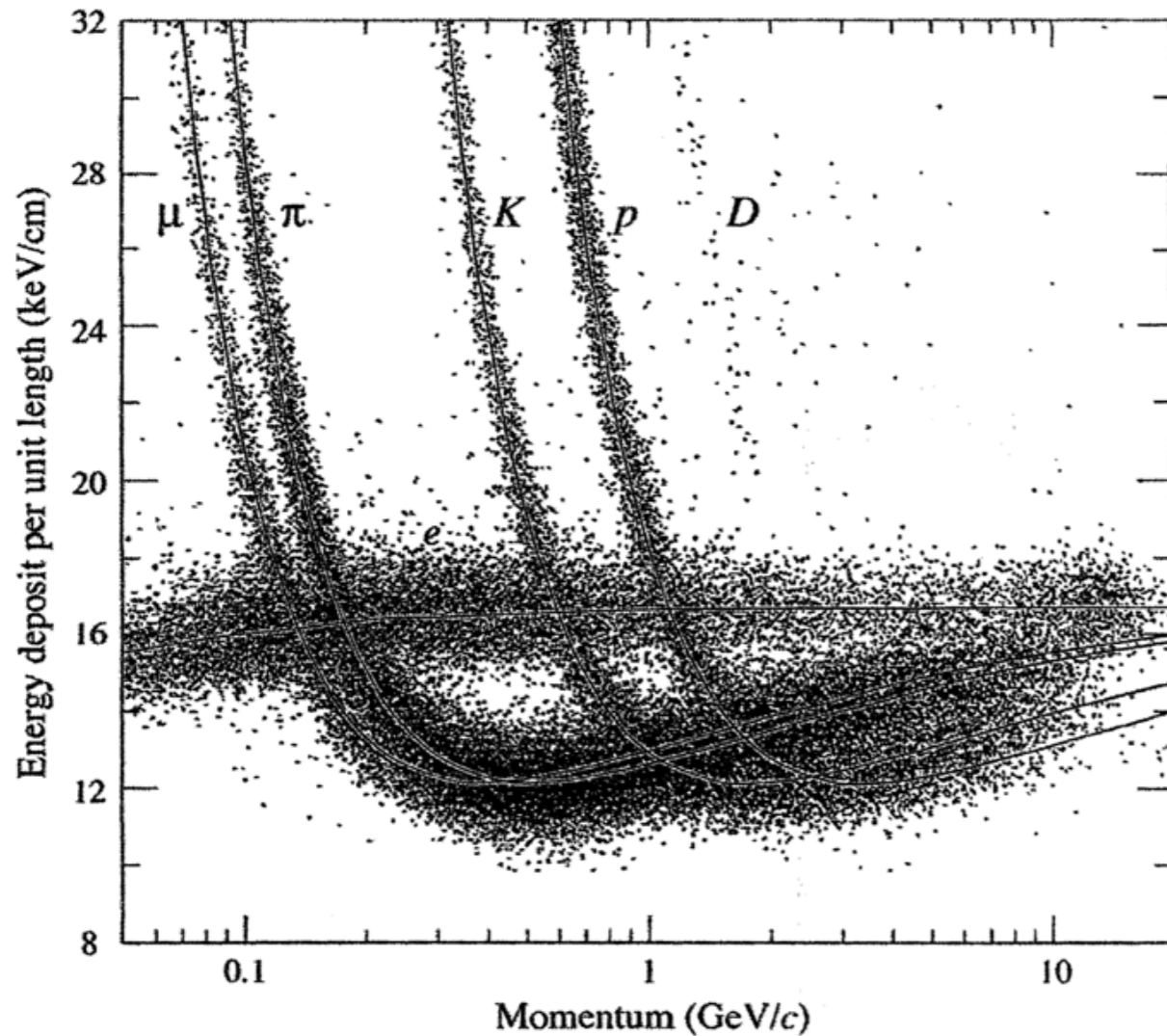
- Main objective: improve the realism of the simulation data with respect to previous productions.
  - Simulation of backgrounds (cosmics, beam events in passive detector materials and cavern).
  - MC truth smearing and reconstruction.
  - Event selection based on reconstructed data.

$$\frac{\sigma(p_T)}{p_T} = \frac{\sigma_T p_T}{0.3 B L^2} \sqrt{\frac{720}{N+4}} + \frac{0.05}{B L} \sqrt{\frac{1.43 L}{X_0}}$$

$$\sigma_\theta = \frac{\sigma_L}{L} \sqrt{\frac{12(N-1)}{N(N+1)}} + \frac{0.015}{\sqrt{3} p} \sqrt{\frac{L}{X_0}}$$

$$(p_T = p \sin \theta)$$

For tracks of length  $L$  and with  $N$  measurements.  
Resolution better than 5% for long 1-GeV tracks.



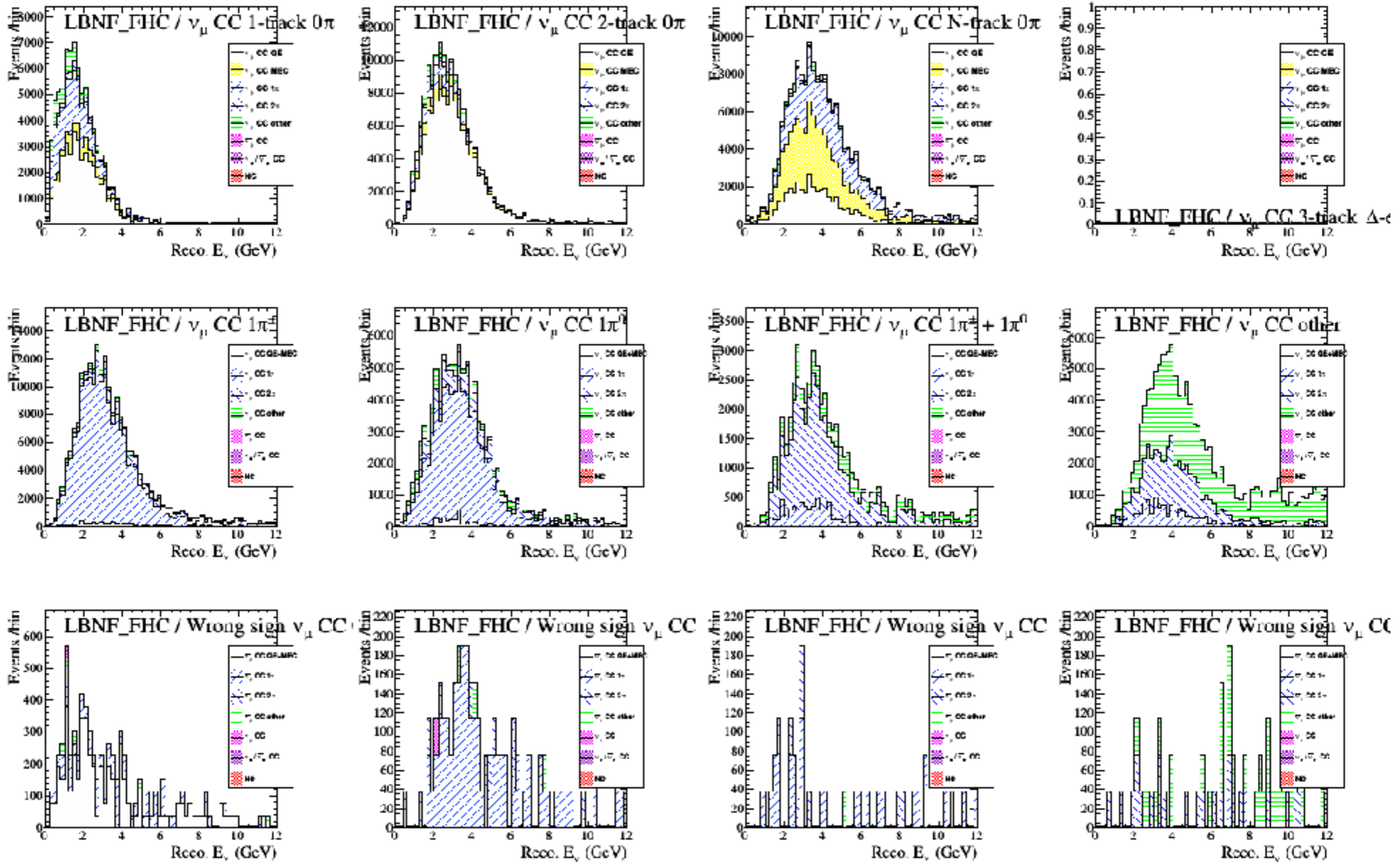
PEP-4 TPC  
 (~3%)

$$\sigma_E(25 \text{ keV}) \simeq 10\%$$

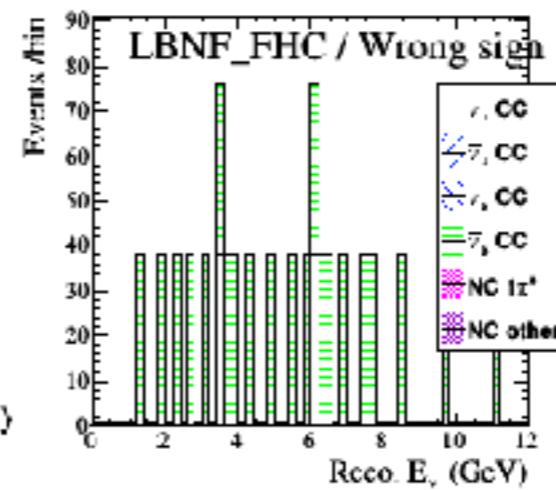
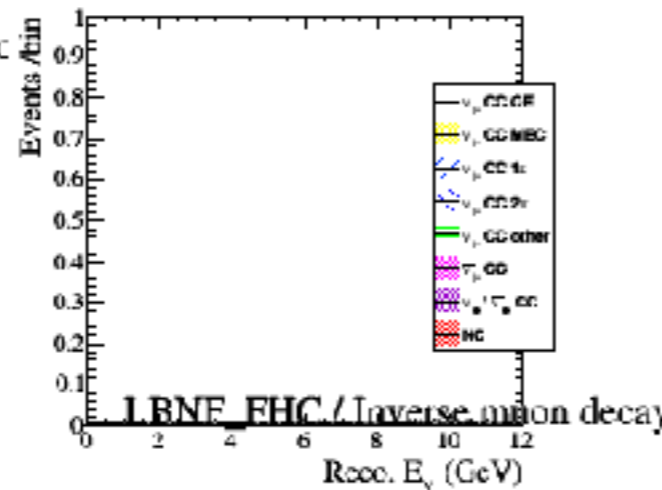
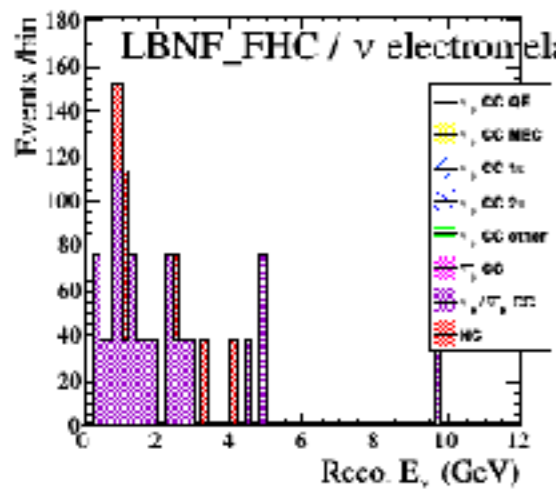
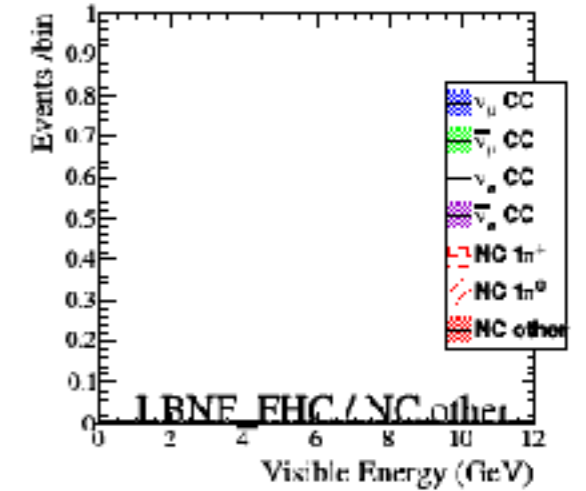
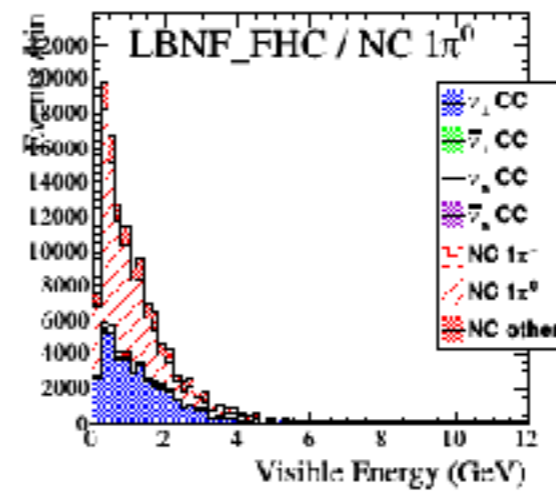
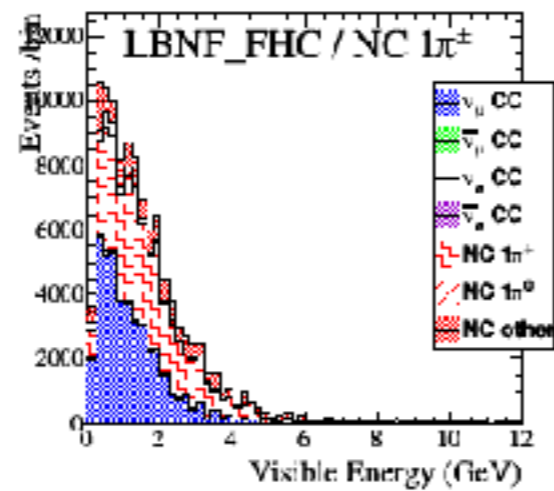
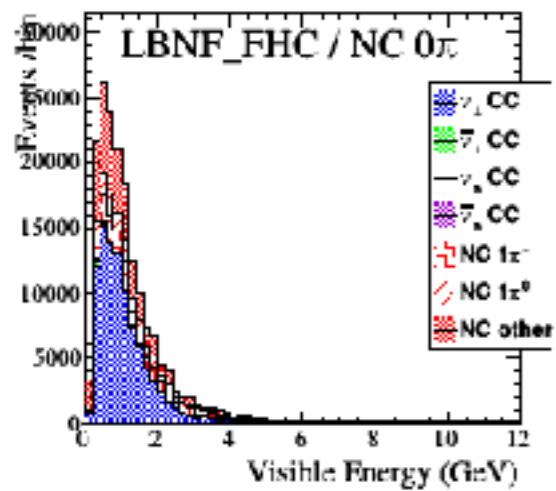
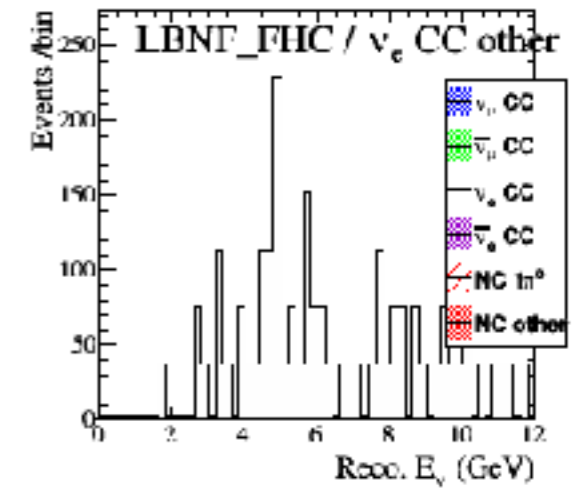
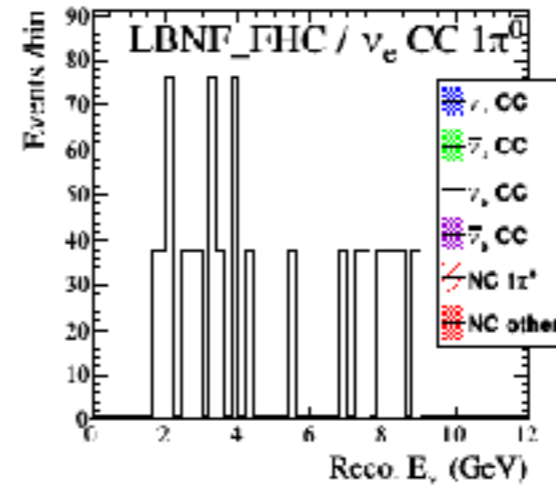
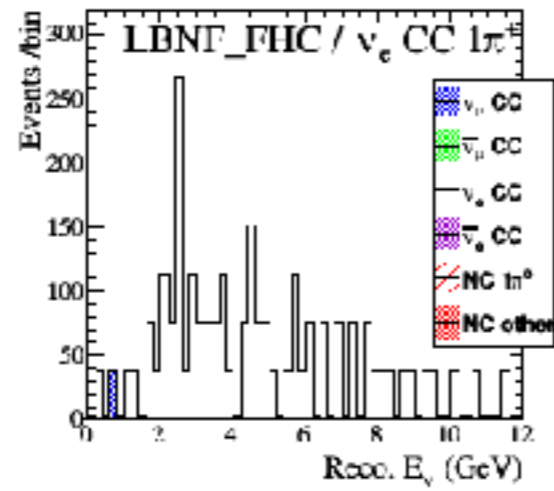
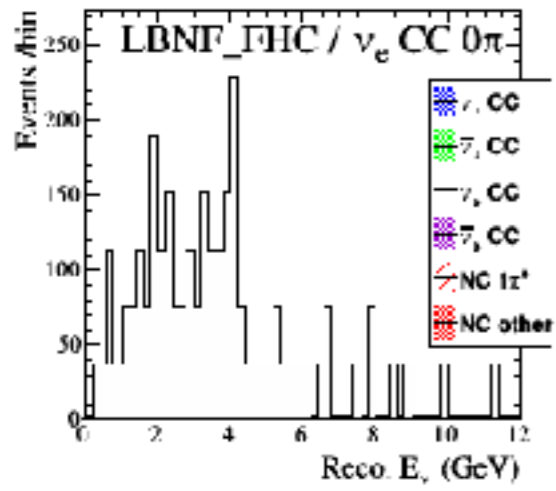
(Energy of short, contained tracks  
 can be measured by range.)

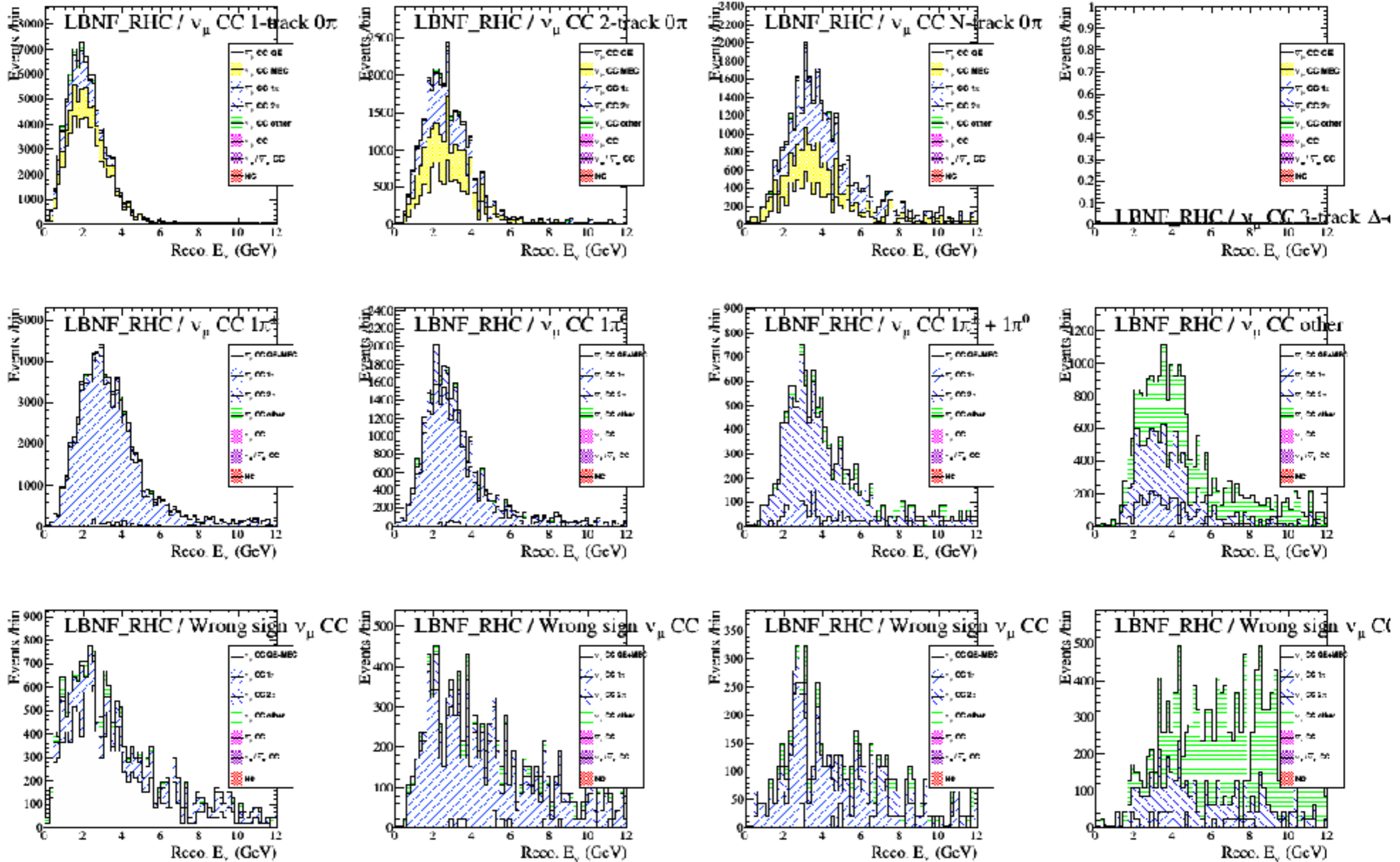
$$\sigma(dE/dx) = 0.41 N^{-0.43} (N P)^{-0.32}$$

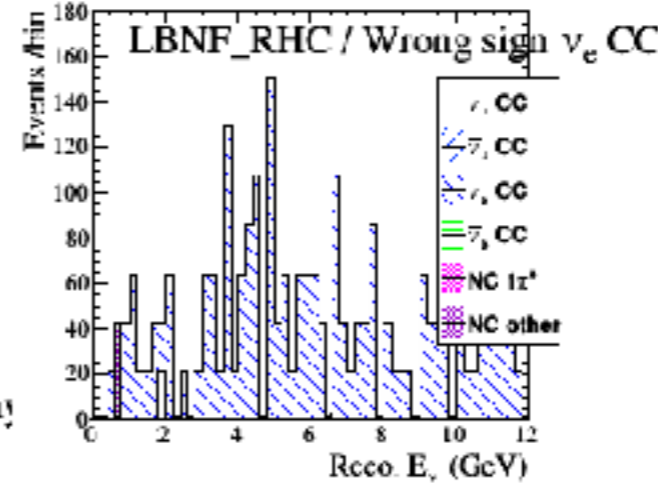
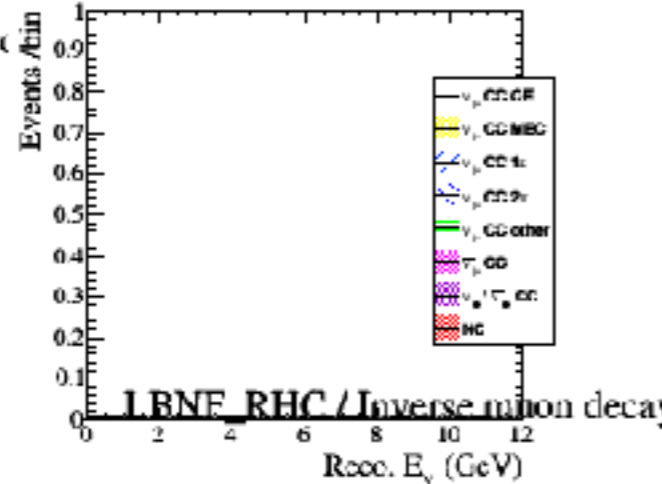
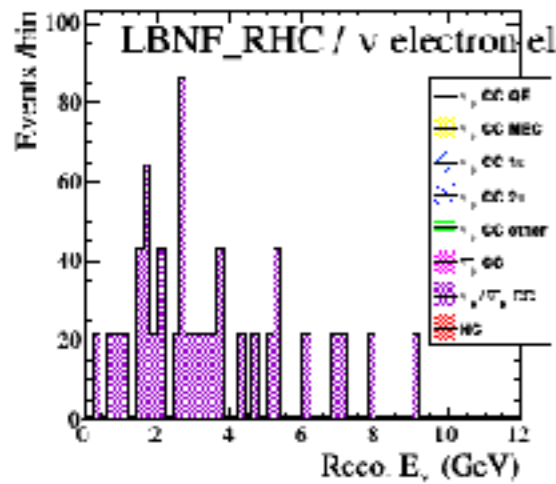
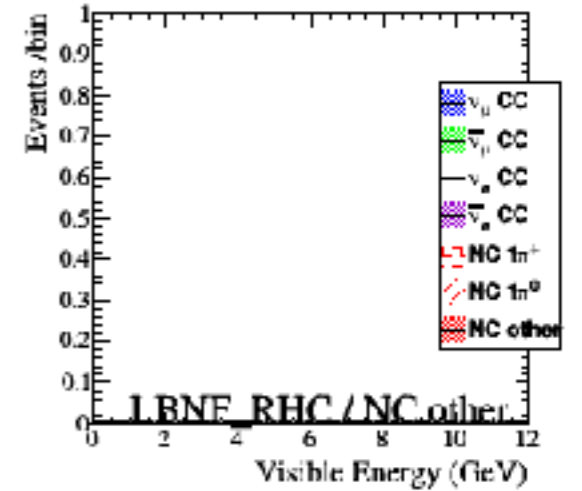
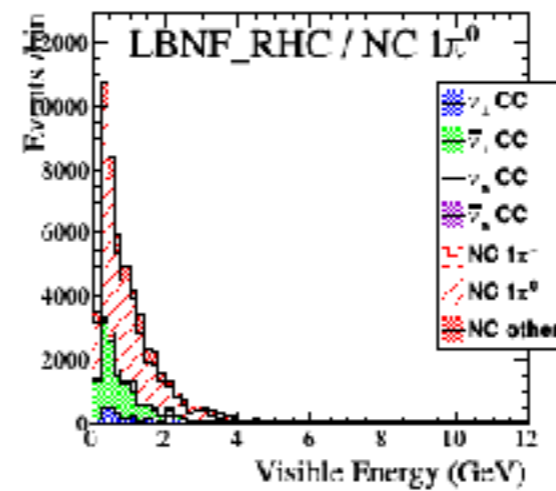
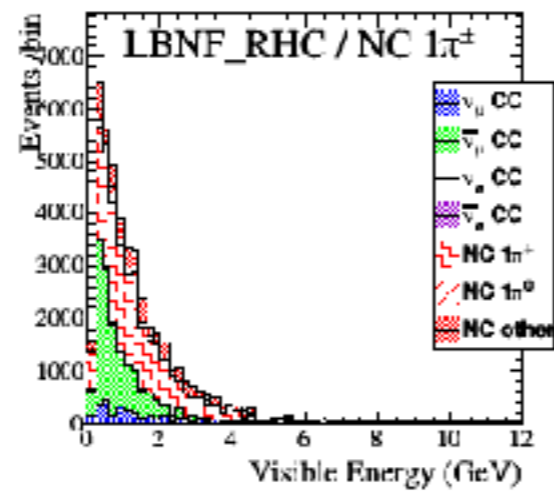
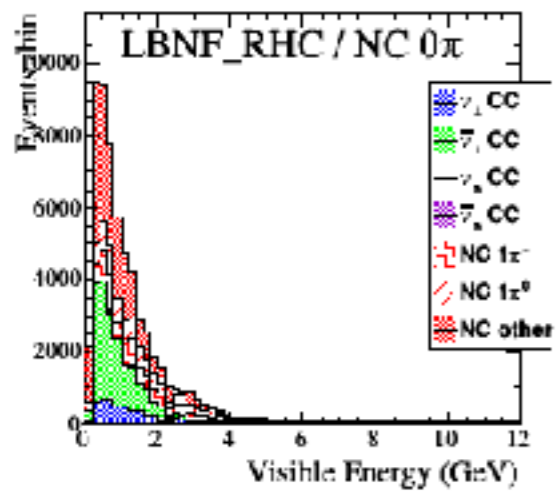
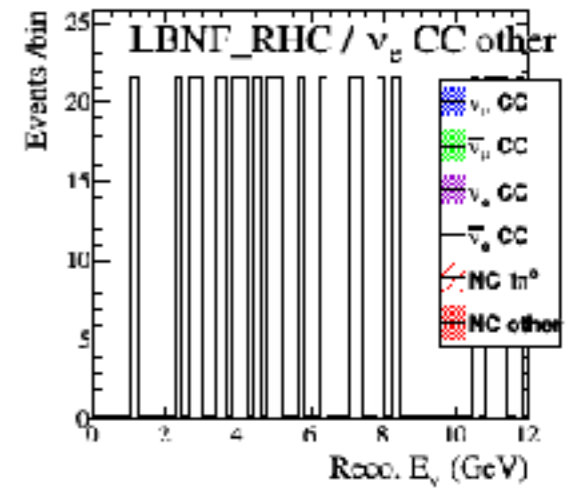
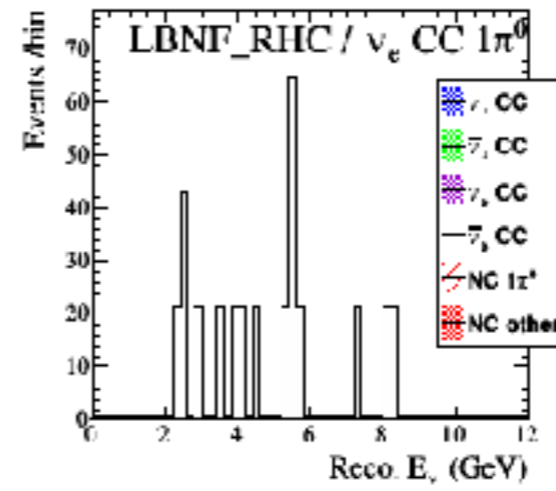
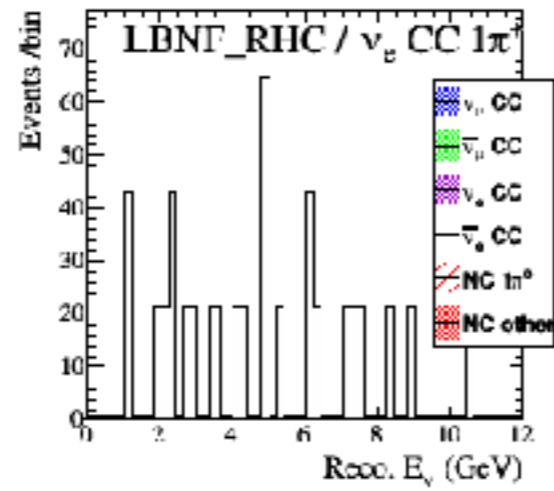
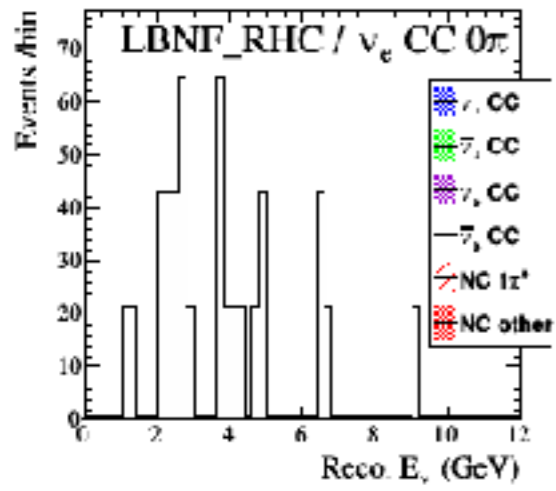
Empirical formula for Ar.  
 Resolution better than 5% for  
 our conditions.











- Ongoing technical work on simulation code.
  - Shrink output files by reducing the amount of stored information.
  - Pre-process ECAL showers for simpler use in analysis.
- Pick low-hanging fruits.
  - For example, a few selection samples are empty: must be an easy-to-fix bug.
  - Revisit neutrino energy reconstruction to understand resulting energy resolution.
  - ...

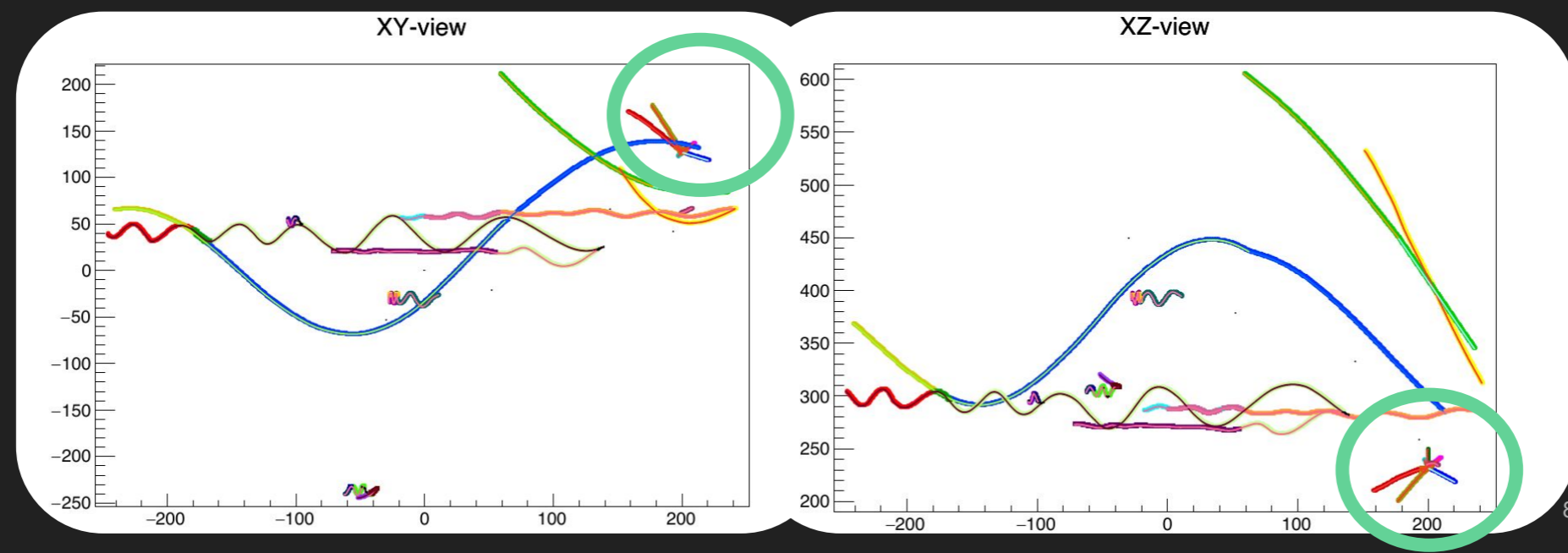
- Can we improve the realism of our pseudo-reconstruction?
  - Dedicated studies using existing tools (TREx, RecPack...) could be used to extract performance figures (e.g. spatial and angular resolutions).

## TREx at work



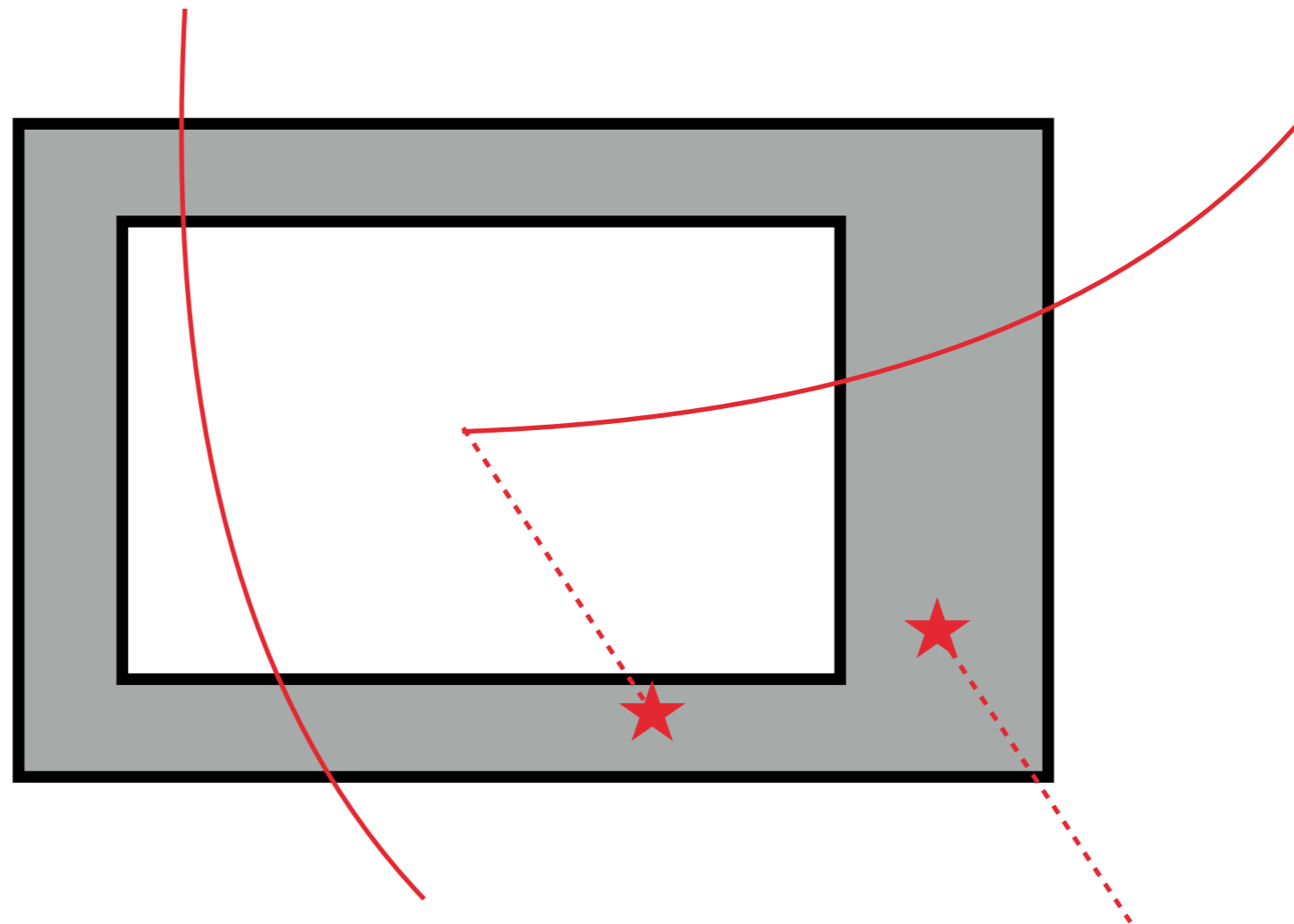
### Do we think TREx is up to the task?

Gas interaction with a cleanly reconstructed vertex and correctly associated tracks in a high background event: Input are G4-simulated Hits with voxelisation of 1x1x1cm





- Can we improve the realism of our pseudo-reconstruction?
  - The selection of ECAL showers has been cheated so far (picking only those coming from  $\pi^0$ 's). Overlapping showers will have an impact.



- 
- Recently-created GArTPC WG meeting now regularly (Tuesdays, every other week).
  - Brian Rebel working on art-ified software framework.
  - We're planning to study alternative detector configurations:
    - Light magnet proposed for LArTPC-ND.
    - Alternative ECAL designs.
    - ...