MARCH 4, 2025

ATOF RECONSTRUCTION

NOÉMIE PILLEUX

U.S. DEPARTMENT OF ENERGY
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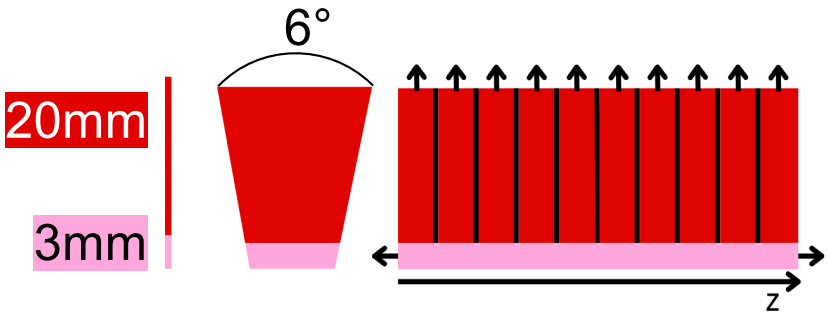
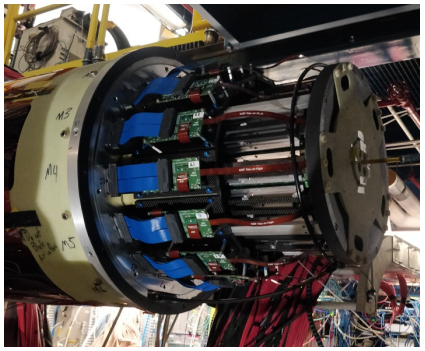
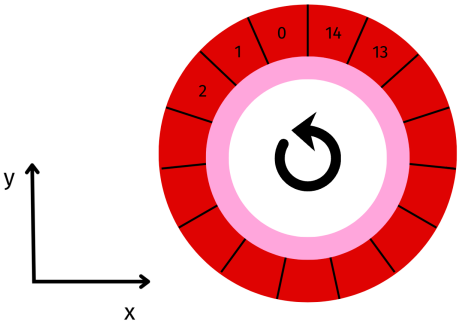
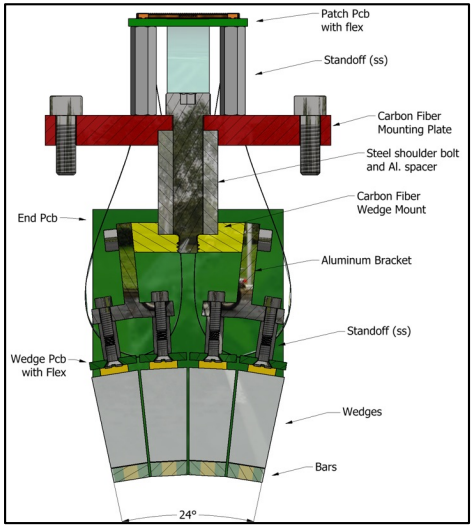
THE ALERT TOF

- Identifying light ions: H, ^{2}H, ^{3}H, ^{3}He, ^{4}He at low momenta.
- Scintillation detector with SiPM readout.
- Surrounds the AHDC, nested in the CD, radius between ~8 cm and ~10 cm, 30 cm long.
- Composed by 60 modules, each composed by a long bar readout at both ends and ten wedges readout individually.







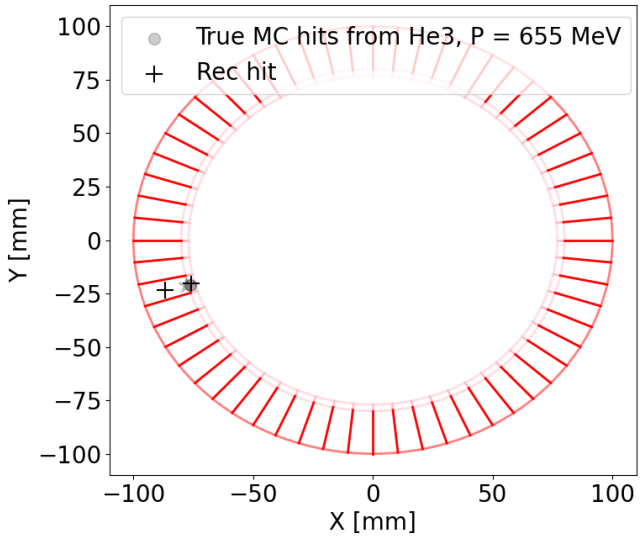


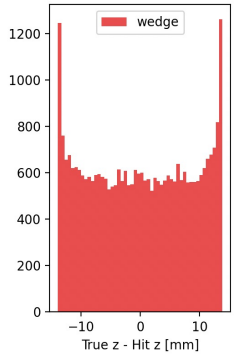
Drawing by T. O'Connor

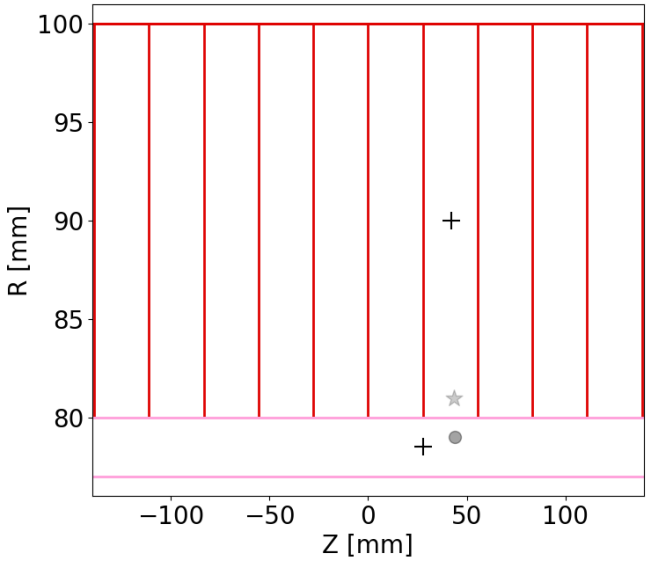
- Modules are grouped in 15 sectors, each composed by 4 modules readout by the same frontend board.
- Readout based on PETIROC board, recording TDC and TOT information for charge measurement.
- Reconstruction algorithm?
  - Clustering of the TDC/TOT hits.
  - Timing and energy measurement.
  - PID with tracking information.

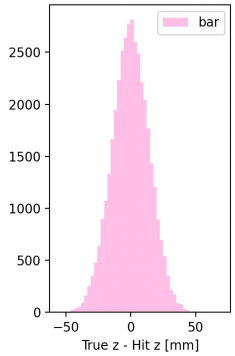
ATOF HITS

- ATOF hits are recorded in the ATOF::tdc bank for each channel, saving their **TDC** and **TOT** information.
- Hits in the bar are formed by associating responses from up/down stream ends of the ATOF.
- The geometry service makes the sector/layer/component to x/y/z translation.
  - All x/y and the z position for the wedges are taken as coordinates of the center of each scintillator.
  - The time difference for bar hits gives the z position.
- TOT/TDC to energy/time correcting for light propagation and time offsets.









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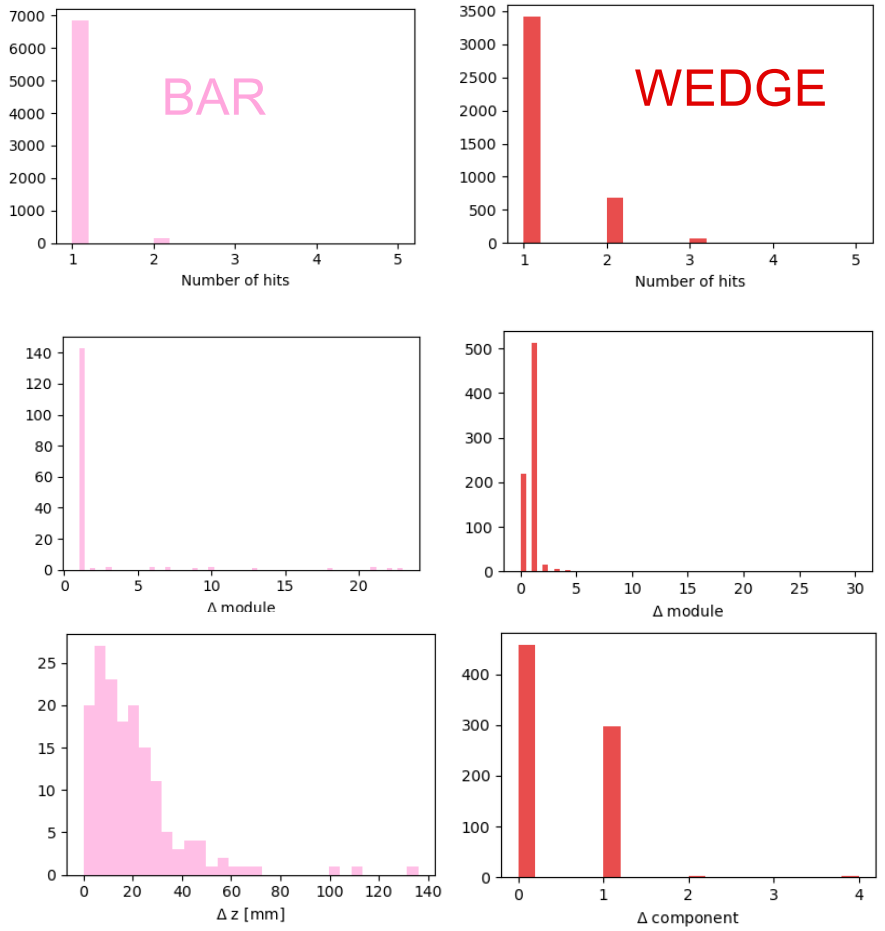
ATOF CLUSTERS

- Reading ATOF hits, associating them in clusters.
- Simulations show energy deposit within ±1 module of max energy hit and
  - Within ±1 “z slices” for the wedges.
  - Some z limit to be defined for the bars.
  - A timing window to be defined.
- Starting from the most energetic hit, clusters are built within these limits, summing their energies and taking the time/position from the most energetic hit.



Simulated alpha cluster shape

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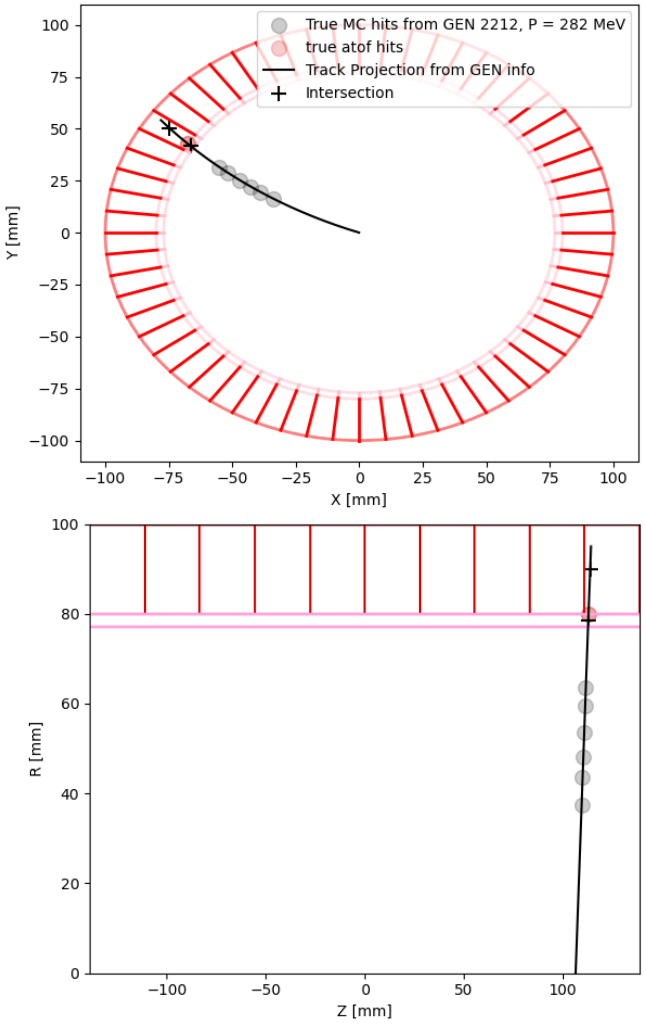
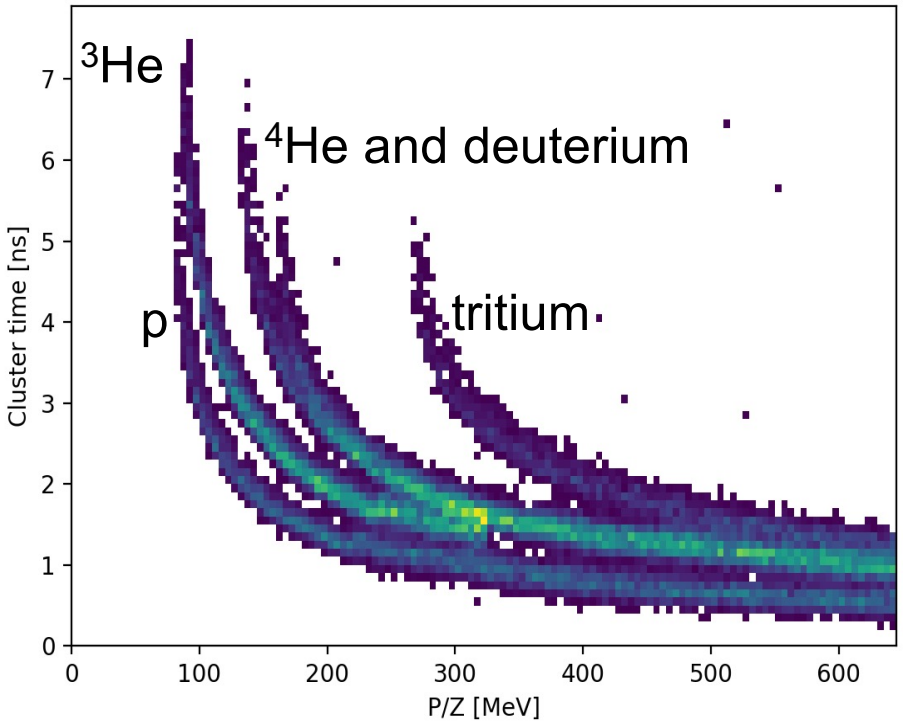
AHDC-ATOF MATCHING

AHDC Track Projection

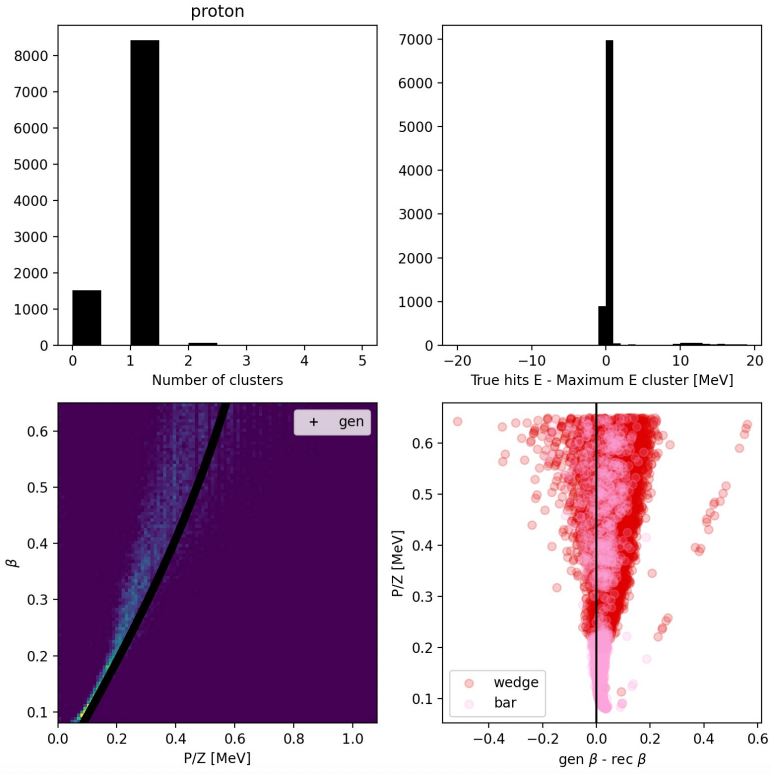
- AHDC tracks and ATOF clusters should be matched for calibrations and PID.
- AHDC tracks are projected onto surfaces of the ATOF using a helix model.
- ALERT::Projections bank created.
  - x,y,z positions at different radii.
  - Path length to surfaces.
  - Path length inside the scintillators.
- Geometrical match between clusters and track projections, ϕ,z limits to be defined.
- For now, **projecting perfect tracks** using the MC::Particle bank info.



PID FROM SIMULATIONS



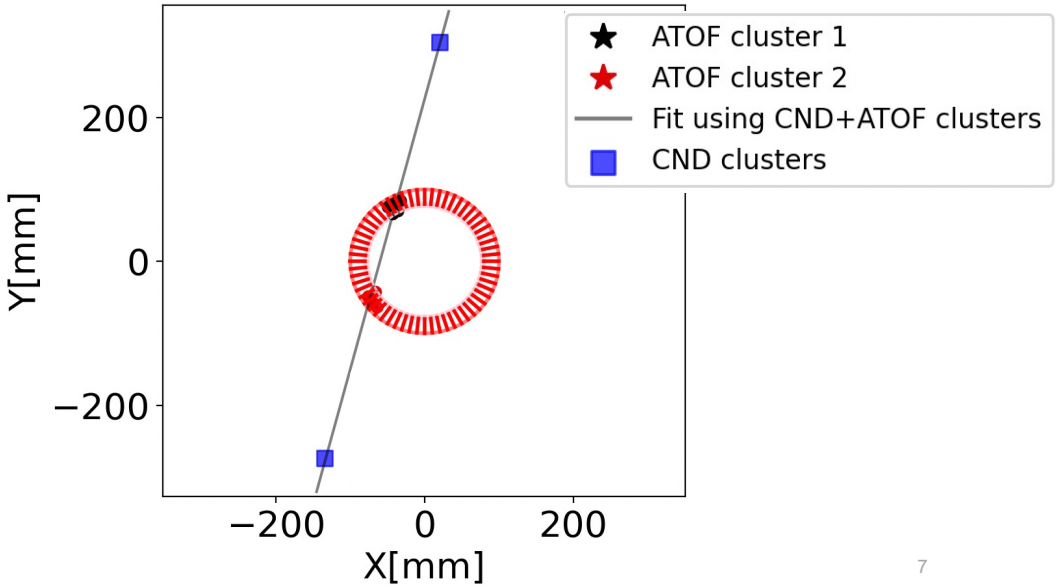
^{4}He and D will be further identified using dE/dx.

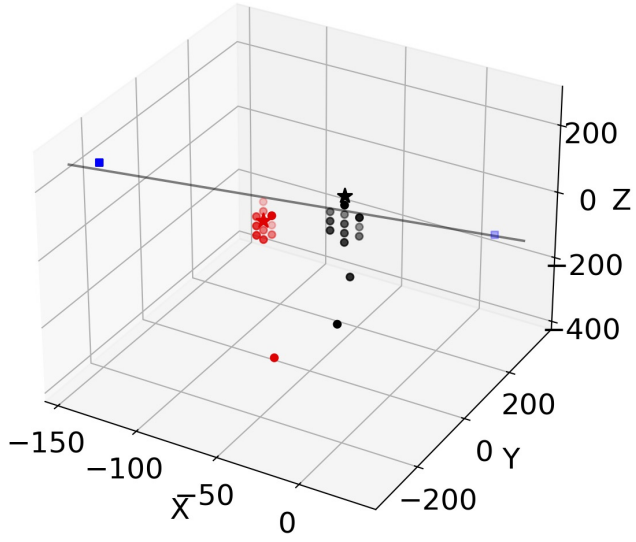


Only reflect the geometry resolution, using “perfect tracking” and perfect knowledge of the calibration constants/corrections.

COSMIC EVENTS TESTS

- ALERT has been taking cosmic runs for a couple of weeks.
- These runs are used to configure the AHDC and the ATOF, test the monitoring software, etc.
- First tests for the ATOF with the clustering algorithm.
- Ongoing efforts to configure the ATOF, study AHDC tracks, first calibrations, etc.





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