

Pass2 tasks status

- Pass2 tasks status information available in O365 spreadsheet

– See

https://jeffersonlab-my.sharepoint.com/:x:/g/personal/devita_jlab.org/EWEMPTgyNrpGizPqPvuJFNoB1M2eBG7RyEk9MIOvqsqJzQ?e=RznWhx

- Software tasks also tracked via GitHub issues and milestones

– See

<https://github.com/JeffersonLab/clas12-offline-software/milestone/3>

Category	Task	Description	Priority (1-4)	Manpower	Status	
			1=high, 4=low	Core	Support	
			* needs further information		<i>italic: not identified yet</i>	
Software	Add new e/pi separation cuts in EB	Implement additional ECAL cuts to improve e/pi separation (iss605)	1	0.01(NB)	Complete	
Software	Use event vertex in direction calculation for FT	Define angles of particles in FT based on vertex of FD particle. Requires discussion on moving FT particle building to EB and swimming to vertex (iss604)	1	0.01(NB)+0.02(RDV)	Complete	
Software	Resolve DC intrasector z-vertex dependence	Investigate and resolve the observed phi dependence of the vertex z coordinate (a "smile") in MC (iss603)	1	?(VZ)+?(RDV)	Complete. To be addressed in GEMC	
Software	Resolve DC covariance matrix issues	Validate the FD tracking covariance matrix in the TSC frame, transform it to the lab frame and tune it using MC (iss607)	1	?(VZ)	In progress	
		- Implement new generic KF - Implement straight track reconstruction for beam data and cosmic - Remove/understand biases in reconstructed 3-momentum, vertex and residuals - Implement shifts and rotations for BMT to support alignment - Implement eloss and multiple scattering in KF - Optimize seeding and rejection of out of time hits - Implement Lorentz angle correction for SVT		done 0.05(VZ) 0.025(RDV)+0.025(VG) 0.02(VZ)+0.05(YG) 0.02(VZ)+0.05(YG) 0.02(VZ)		
Software	Complete restructuring of CVT	- Port the covariance matrix to the lab; validate and tune the matrix elements Finalize reconstruction for both direct and indirect light, assess resolution and efficiency	1	0.02(VZ)	0.2	In progress
Software	Complete RICH reconstruction	Depends on the previous row (Complete RICH reconstruction)	1	?	?	Waiting on alignment
Software	Incorporate RICH into EB	Update of clustering and veto algorithm based on ongoing studies	1	?(NB)	?	Postponed
Software	CND clustering and neutral veto refinement	Relevant for RG-F	1	0.01(NB)	0.025	In progress
Software	Complete RTPC reconstruction	Relevant for RG-F	1	?	?	In progress
Software	Complete FMT tracking	Relevant for RG-F	1	?	?	In progress
Software	Incorporate AI-assisted tracking for DC	Integrate and validate AI-assisted tracking (iss608)	1*	0.05(GG)+0.05(RDV)+0.025(VZ)	0.1+0.1+...	Complete
Software	Save TB tracks with no beta	Assume a beta (pion?) for those that don't have non-DC timing information (iss621). May require some optimization on beta cuts	1*	0.02(SS)		Complete
Software	FTT reconstruction	Complete FTT reconstruction	2	0.05(RDV)	0.05	In progress
Software	Implement ECAL clustering sharing	Algorithm is known, pending implementation (iss601)	2*	0.02(NB)+0.02(LCS)	0.05	In progress
Software	Revisit geometric track-hit matching criteria in EB	Optimize cut values for non-LTCC based on geometrical residuals	2	0.05	0.05	In progress
Software	Revisit geometric track-hit matching criteria in EB	Optimize cut values for LTCC Use CCDB status tables in reconstruction to knock out dead/malfunction detector components. Particularly relevant for MC, but unclear how relevant it is for real data's pass2.	2	0.025(NB)	0.05	In progress
Software	Status tables	Implement combined use of 1A and 1B time in PID. Pending improvement estimate and definition of implementation strategy	2	0.02(RDV)+0.01(LCS)		In progress
Software	Use combined FTOF 1A and 1B timing in EB		2*	0.025(NB)	0.1	Study in progress

Pass2

No due date 48% complete

- 14 Open ✓ 13 Closed
- Implement ECAL cluster sharing
#601 opened on Oct 6, 2020 by baltzell
- Use HTCC timing in EB matching
#602 opened on Oct 6, 2020 by baltzell
- Add new e/pi separation cuts in EB
#605 opened on Oct 6, 2020 by baltzell
- Use FTOF clustering
#606 opened on Oct 6, 2020 by baltzell
- Resolve DC covariance matrix issues
#607 opened on Oct 6, 2020 by baltzell
- Incorporate AI-assisted tracking for DC
#608 opened on Oct 6, 2020 by baltzell
- optimize ECinner and EOuter reporting planes to zero timing residuals
#506 opened on Mar 18, 2020 by raffaelladevita
- Move scalers configurations to CCDB
#393 opened on Aug 16, 2019 by baltzell
- CND clustering and neutral veto refinement
#641 opened on Jan 7 by raffaelladevita

AI-assisted tracking

▪ Status (see Gagik's presentation):

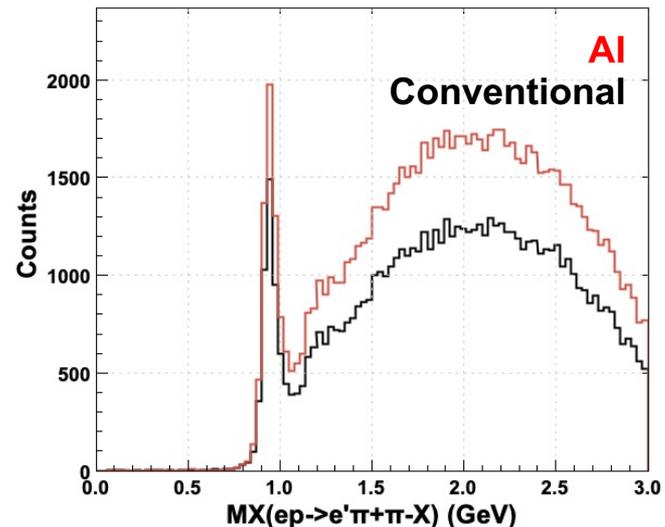
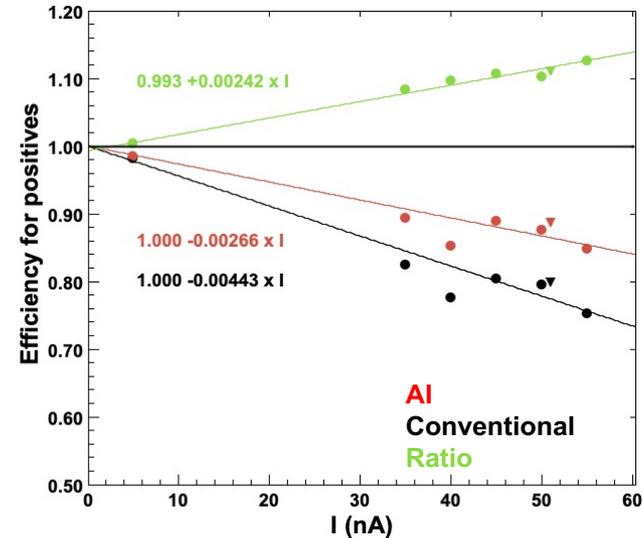
- Integration in reconstruction completed
- Validation of both 6SL and 5SL tracking
- Luminosity scan analysis completed
- First tests on MC
- Workflow for neural-net training, deployment and handling, supporting multiple data sets, exercised

▪ In progress/To do:

- Extend validation to other detector configurations (outbending) and other data sets
- Process data to assess impact on physics with the help of the Collaboration

▪ Resources:

- 0.025 FTE by Gagik
- 0.025 FTE by Raffaella for validation



CVT reconstruction and alignment

▪ Status (see Sebouh's talk):

– Reconstruction:

- Most distortions observed with old code understood and resolved
- Algorithm improvements impacting efficiency and resolution
- New geometry package and layer removal functionality to support alignment

– Alignment:

- “Pre-alignment” (manual adjustments to shifts and tilts) completed for both SVT and BMT(Yuri)
- Full alignment, using KF-based approach, implemented and currently being debugged (Sebouh and Miguel)
- Parallel effort by Maxime on Millipede

▪ In progress/To do:

– Reconstruction:

- Complete validation of new BMT clustering and Lorentz Angle Corrections
- Check chi2 and covariance matrix
- Complete Eloss
- Switch to jnp matrix library to improve speed
- Assess efficiency in high background and identify possible improvements

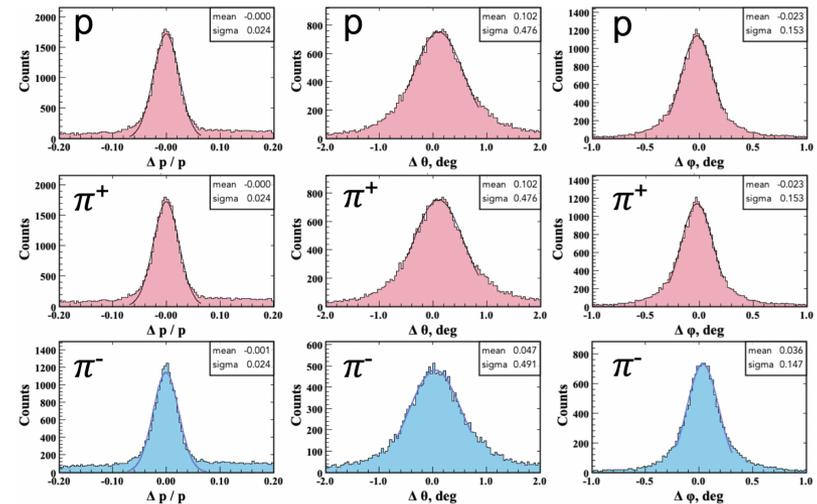
– Alignment:

- Upon completion of BMT clustering and Lorentz-angle validation, process data with pre-alignments constants to assess impact on physics
- Complete alignment with KF-based approach

▪ Resources:

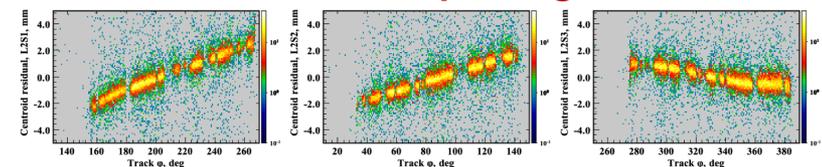
- 0.1 FTE of Veronique for reconstruction
- 0.1 FTE of Yuri and/or CVT team for reconstruction validation
- 0.1 FTE of Yuri for alignment support
- 0.2 FTE of Sebouh and Miguel for alignment

SIDIS MC sample

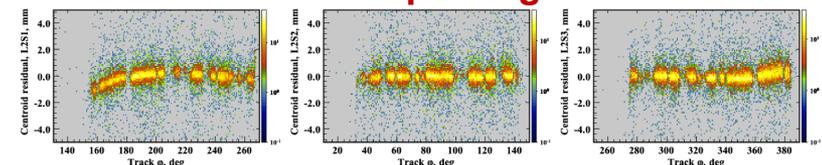


Multi-track DIS sample (Harur)

BMT-Z before pre-alignment



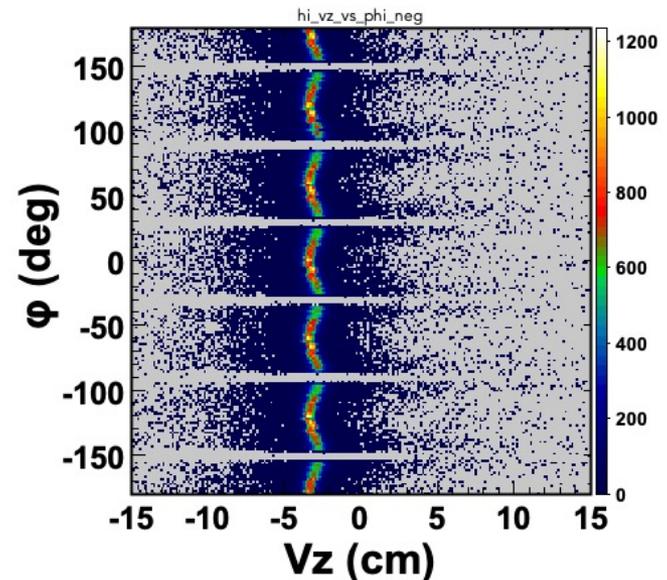
BMT-Z after pre-alignment



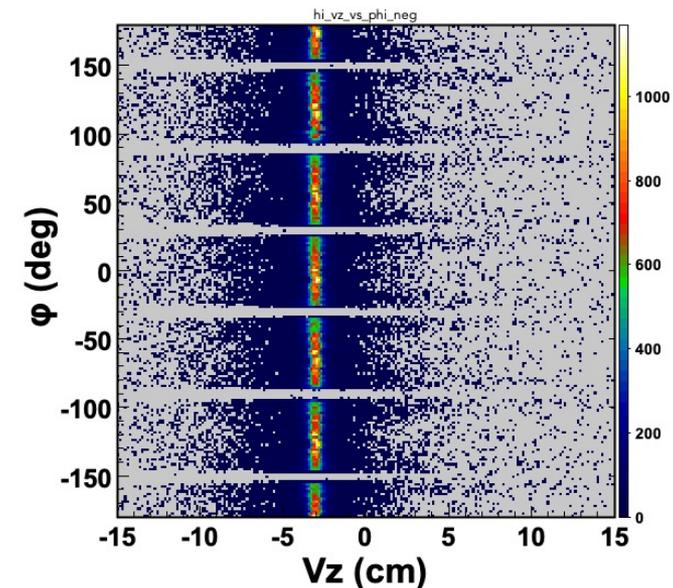
RG-B run 6342, empty target, 0 T, 5 nA, RG-B

Other FD tracking tasks

- **Intra-sector phi dependence of z vertex resolved:**
 - Caused by truncation of the Torus map in GEMC in the upstream region.
 - No impact on real data
 - Will be addressed by switching to D. Heddle's library to generate the composite field from binary maps
- **Covariance matrix:**
 - Transformation from local to global frame implemented
 - Comparison of matrix diagonal element versus MC resolution indicates (pulls) further tuning is necessary
 - Debugging of matrix transport and filtering in KF
- **Detached vertex package:**
 - Currently under validation
- **DC alignment improvements and geometry systematics:**
 - Test of systematic shifts of stereo angle
 - Alignment procedure is being repeated and possible improvements will be investigated
- **Resources:**
 - >0.05 FTE Veronique
 - 0.05 FTE Raffaella
 - 0.15 FTE Collaborators



π^- at
 $p=4\text{ GeV}$,
 $\theta=20^\circ$,
 $z=-3\text{ cm}$,
outbending
torus at
200%, no
solenoid



Torus field map

■ Status

- Test of new torus field maps:
 - 2020 map based on modified coil geometry in the upstream corner
 - 2021 map based on full survey of individual coils
- Comparison with 2018 map (identical coil shapes based on “average” survey) shows significant improvement of elastic peak position for both 2020 and 2021 maps, with 2021 being slightly better
 - See https://clasweb.jlab.org/wiki/index.php/Clas12_software_meetings_2021_February_18.2C_2021

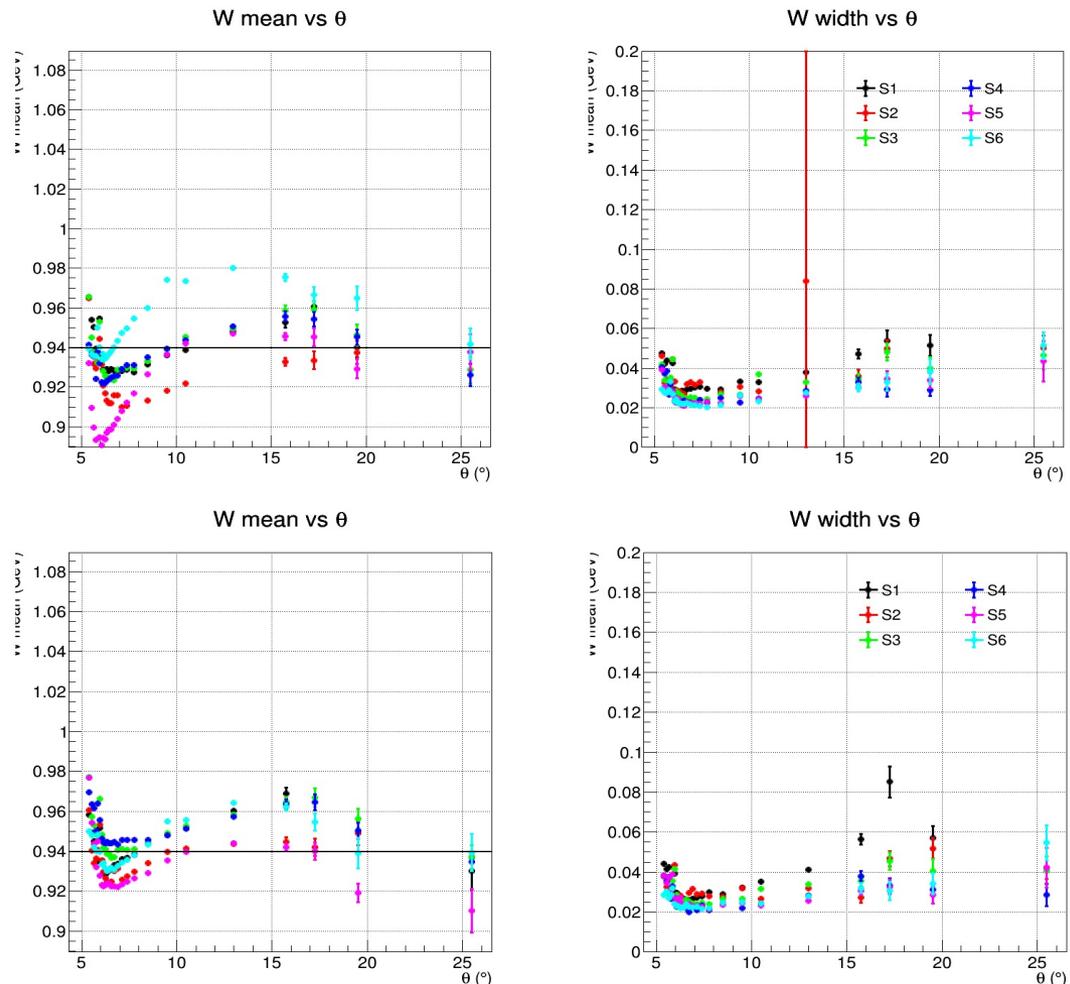
- Test with finer grid maps completed, finding no significant difference

■ Plans:

- Currently testing effects of torus shift
- Test of ad-hoc corrections to the field to be formalized
- Repeat field map measurement analysis

(*) for all maps, coil positions are fit to the field map measurements

Elastic peak studies from RG-K 6.5 GeV data



ECAL updates

Cluster sharing and split clusters:

- Particularly relevant for π^0 reconstruction given small angle between decay photons. Significant impact on DVCS analyses
- Found potential issue with artificial clusters arising from multiple peaks (fluctuations?)
- Refinement of peak finding algorithm necessary
- More work than expected, in progress
- See <https://clasweb.jlab.org/wiki/images/5/5b/SW-ClusterMerging-1.14.21.pdf>

Alignment:

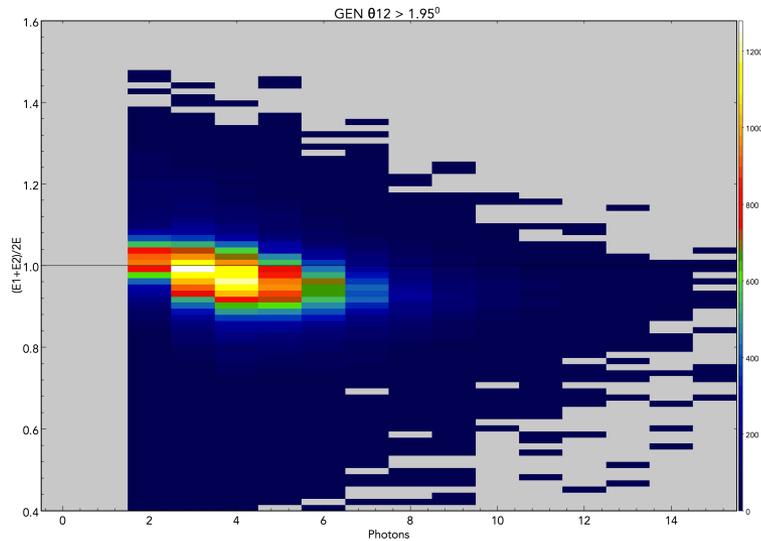
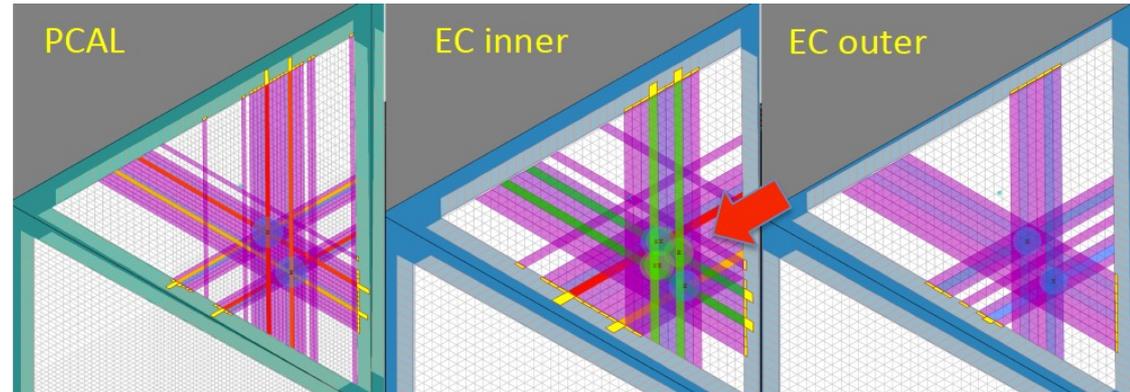
- Potential issue with alignment and geometry found and being investigated

Cluster reporting planes:

- Update needed to zero MC timing residuals

Resources

- 0.15 FTE by Cole
- May involve significant changes to reconstruction, FTEs may change

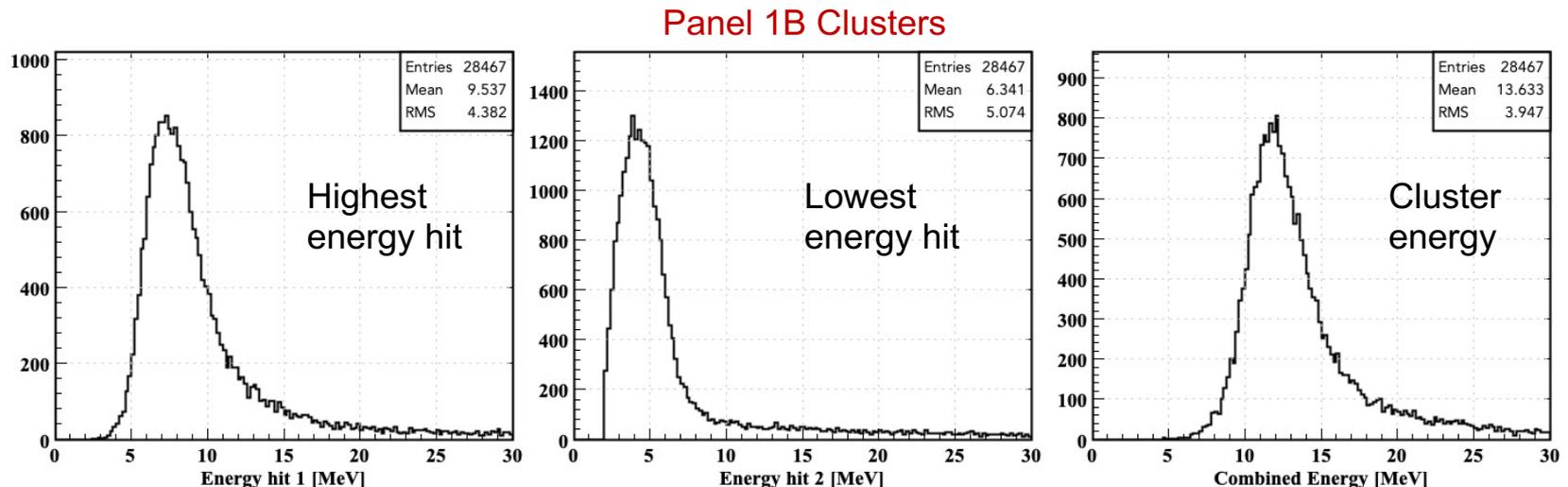


$\pi^0 \rightarrow \gamma\gamma$ simulation:
- Unphysical clusters (PC, ECi, ECo > 2) increase the photon yield and corrupt the energy reconstruction by 3-5%

See <https://clasweb.jlab.org/wiki/images/5/5b/SW-ClusterMerging-1.14.21.pdf>

FTOF clustering

- **In-layer clustering:**
 - Cluster of neighboring paddle hits for corner-clippers tracks
 - Algorithm implemented in reconstruction and tested
 - Relevant improvement of energy reconstruction in 1B
 - Moderate (1-4%) improvement of timing in 1B
 - No benefit for 1A due to splash-back from PCAL, as well as for 2
 - Matching parameters optimized and loaded to CCDB
 - Code validation complete
- **Multi-layer clustering (1A+1B):**
 - Studies indicated limited benefit in real data
 - Combined usage of 1A and 1B information left to the analysis stage



FT updates

- Use event vertex or target position in definition of z vertex of FT particles:

- Study completed and reconstruction updated
 - Use target position as default in reconstruction
 - Leave further corrections based on events (topology dependent) to analysis
- See https://clasweb.jlab.org/wiki/images/3/36/20210128_ftvertex.pdf

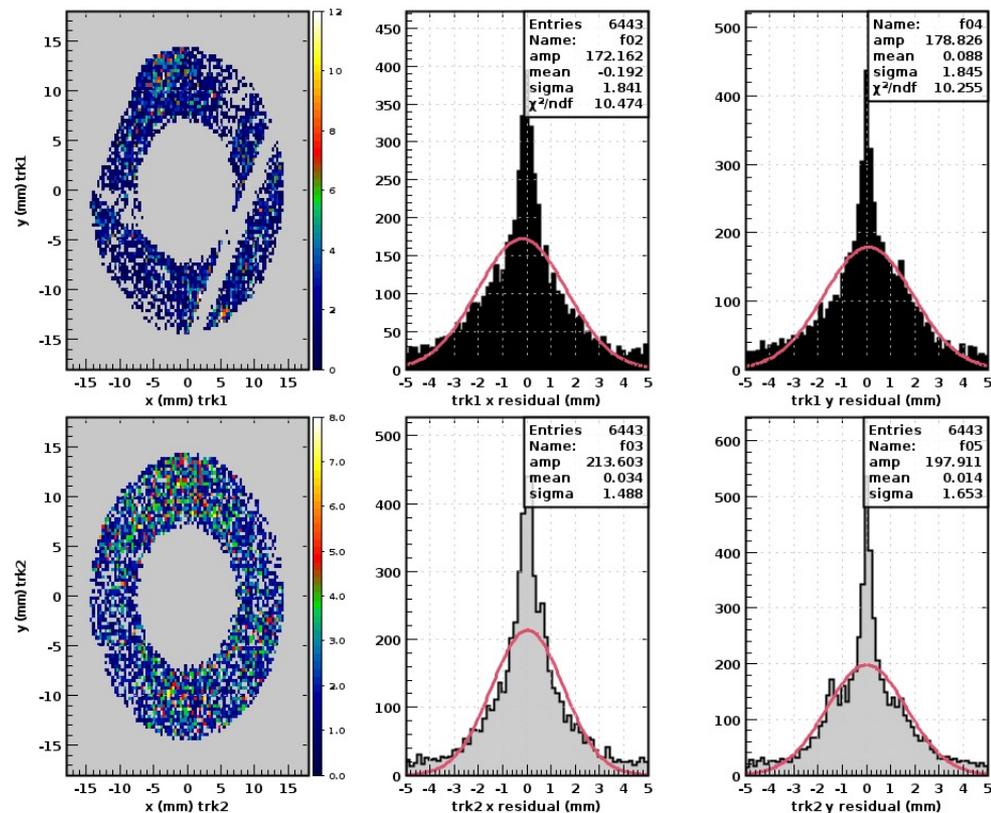
- Tracker reconstruction:

- First version completed and tested on simulations
- Test on data in progress
 - Issues with translation table found
 - Alignment and detector performance evaluation next
- See https://clasweb.jlab.org/wiki/images/1/1f/FTT_tracking_update_210128.pdf

- Resources:

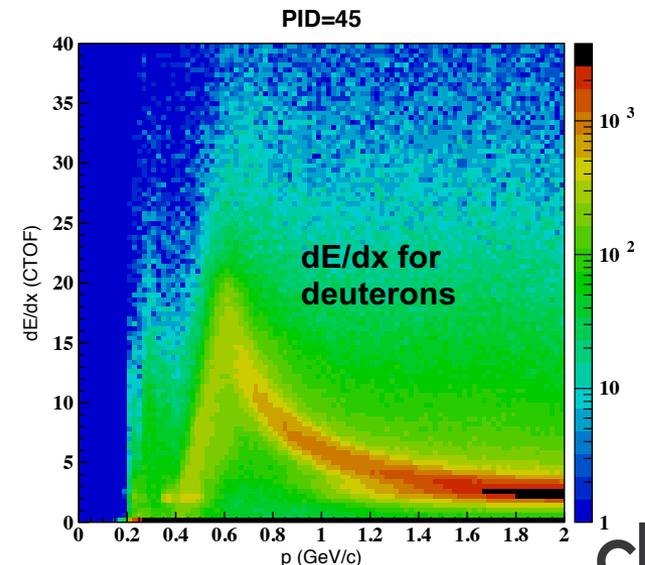
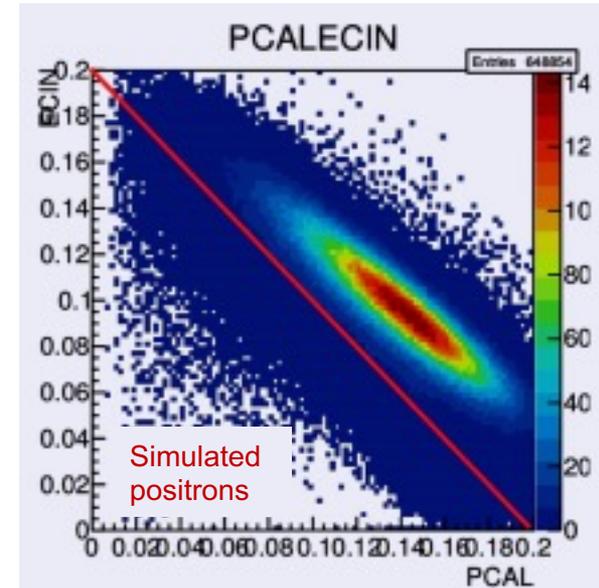
- >0.1 FTE by Alessandra
- 0.025 by Raffaella

Crosses in the two detectors RGA Fall18



EB updates

- **Updated RF correction in event start time:**
 - Unique choice of beam bucket for the event while maintaining particle-dependent v_z correction
 - Relevant for tracks originating far away from the target
 - Implementation complete (see <https://clasweb.jlab.org/wiki/images/6/6d/Baltzell-rf-20210204.pdf>)
- **New e/pi separation cuts:**
 - Use correlation between ECinner and PCAL energy deposition
 - Implementation complete
 - **Are more studies needed?**
- **Use of dE/dx in scintillators for hadron id:**
 - Study done as service work and by experts
 - **Should dE/dx be used in reconstruction or left to analysis?**
- **Tuning of track-hit matching cuts:**
 - Study done as service work
 - To be finalized upon tracking tasks completion
 - Use of timing in HTCC matching requires a change in HTCC calibrations
- **Address $dE/dx = 0$ for CTOF:**
 - Hypothesis is different track-hit/cluster matching criteria in upstream detector services and the event builder
- **Resources (track-hit matching):**
 - > 0.05 FTE by Nathan
 - 0.05 FTE for supporting validation



Other reconstruction tasks

- **BAND:**
 - Moving hardcoded geometry parameters to CCDB
- **CND:**
 - Improvements to clustering algorithm:
 - Energy sorting of hits; Use of independent matching cuts in x,y,z,t
 - Currently in final validation stage
 - New neutron identification algorithm based on AI, to be used in analysis
- **FMT:**
 - First alignment of RG-F 3-layer detector completed
 - Reconstruction now uses alignment constants. Still no improvement in vertex resolution for real data
 - Work resumed recently (?FTE)
- **LTCC:**
 - Implement cluster timing yet to be started (0.01 FTE)
- **RICH:**
 - Finalization of reconstruction algorithms for direct and indirect light still waiting for completion of mirror alignment (?FTE)
 - Integration in EB postponed
- **RTPC:**
 - Reconstruction available, refinements planned based on data analysis, yet to be integrated in the EB (?FTE)
- **Miscellaneous:**
 - Use status tables to reject hits in malfunctioning detector elements, in progress (0.01-0.02 FTE of work remaining)

Summary

- Significant progress toward pass2 but still much work to do
- Most demanding tasks:
 - Reconstruction: CVT, DC and ECAL
 - Alignment: CVT and RICH
- Other tasks still requires significant amount of work but either have more straightforward solutions or are less critical
- According to current assessment and understanding of the critical problems, at least 3-4 months are needed as a minimum for pass2 preparations