Hall B:User Software Contributions

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12 GeV Upgrade Software Review

Jefferson Lab
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Thomas Jefferson National Accelerator Facility

Goals and Outline

❑ Committee Charge - 1.c
- o Are users engaged at a sufficient level to demonstrate usability and readiness from a user's perspective?
- o Has the CLAS Collaboration identified appropriate mechanisms to support utilization of the software by the entire collaboration?
- o Is the level of user documentation appropriate for this point in time?

❑ Outline of talk
- o TOF reconstruction software: detectors, methods, results, and status.
- o User experience: developers, workflow.
- o Connection with committee charge.

TOF Reconstruction

❑Forward Time-of-Flight (FTOF)
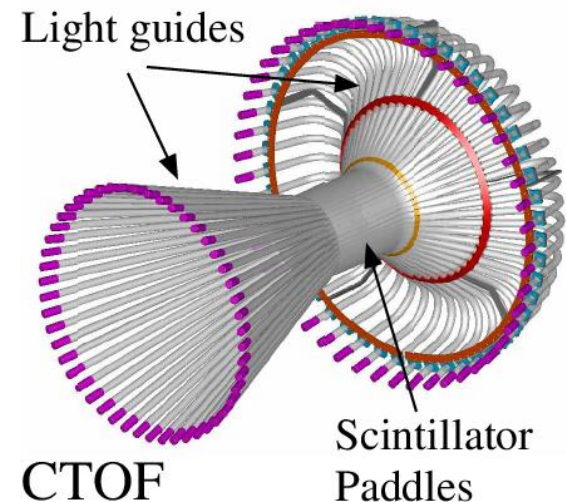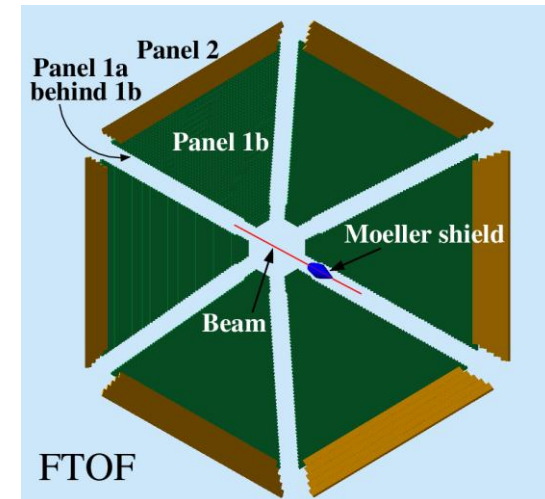 o 6 sectors, double-sided PMT readout.
  o Paddles: Panel 1a - 23, Panel 1b - 62, Panel 2 – 5.

❑Central Time-of-Flight (CTOF)
  o 48 paddles, double-sided PMT readout.
  o form hermetic barrel around target.

❑Outputs
 o Times
  o Positions
  o Hit times
  o Deposited energy

FTOF

CTOF

TOF Reconstruction Methods

- ❑ Single TOF paddles and clusters
  - ○ adjacent hits grouped based on cuts on Δy_{hit} and Δt_{hit}.
- ❑ TDC Time (T_L, T_R)
  - ○ Apply time walk corrections and calibration
  - ○ Clusters - energy-weighted average.
- ❑ Deposited Energy (E_{dep})
  - ○ Apply ADC calibration and $E_{dep} = \sqrt{E_L \cdot E_R}$
  - ○ Clusters – sum E_{dep}'s
- ❑ Position (y_{hit})
  - ○ Use T_L-T_R to get y_{hit} relative to paddle center.
  - ○ Clusters - energy-weighted average.
- ❑ Hit time (T_{hit})
  - ○ Average T_L, T_R
 - ○ Clusters - energy-weighted average vs. earliest hit.

Code Validation

❑ Simulation is primary testing tool of TOF reconstruction code.

❑ CLAS12 Simulation – *gemc*

❑ Simulations done on Richmond cluster and copied to JLab.

- o Accessible, well-documented, bug reporting, website.
- o JLab staff member (M. Ungaro).

❑ Event generation

- o disgen – proton DIS
  - ▪ Range of final states and momenta.
  - ▪ Local
- o QUEEG – quasielastic scattering from deuterium
  - ▪ Local, under svn,
  - ▪ CLAS-NOTE 2014-008.

viewer-0 (OpenGLStoredQt)
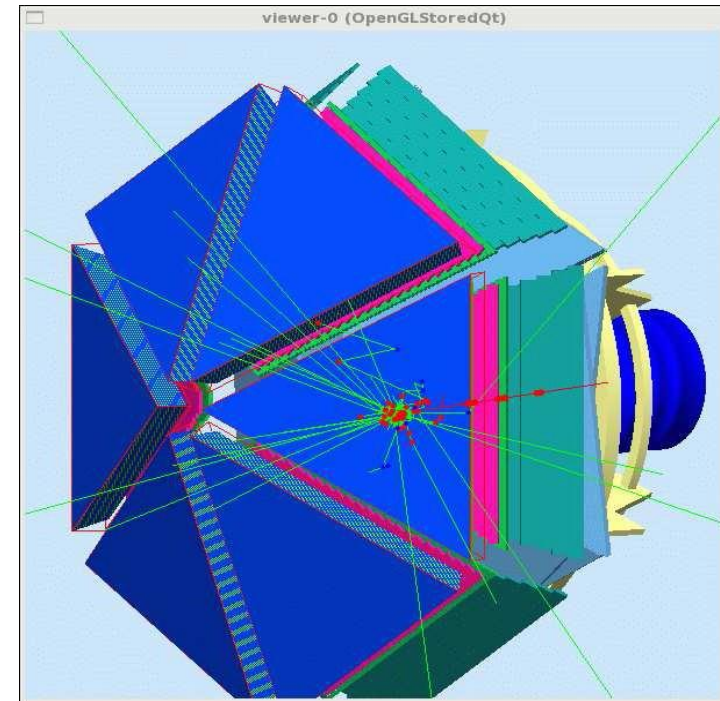
FTOF Standalone Reconstruction Results

□ Time difference with gemc.

□ Measured N_{adj} dependence.

□ Optimized clustering parameters.

□ Cluster efficiency.

□ E_{dep}.

□ CLAS12-NOTE 2014-003.
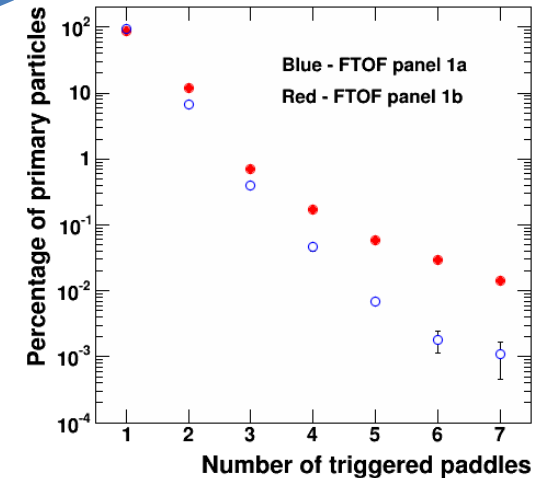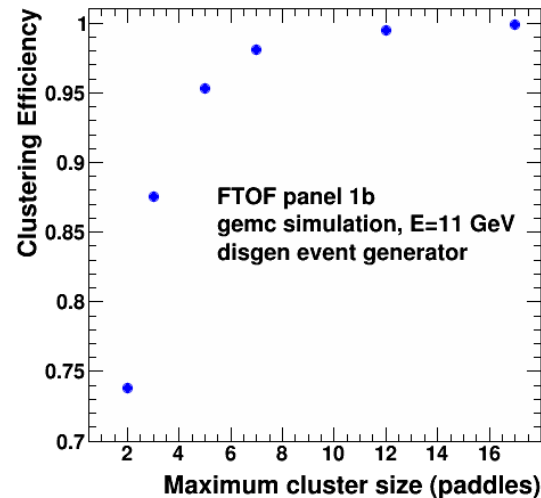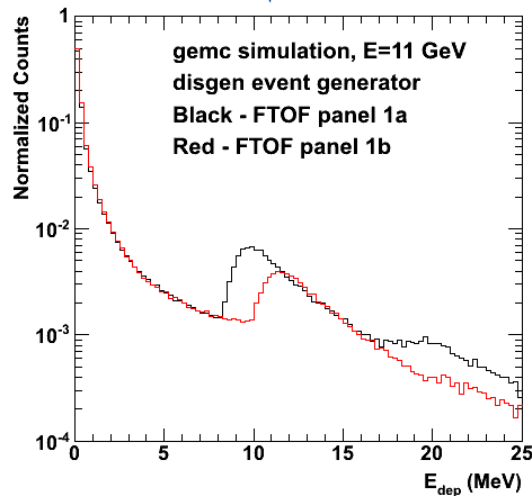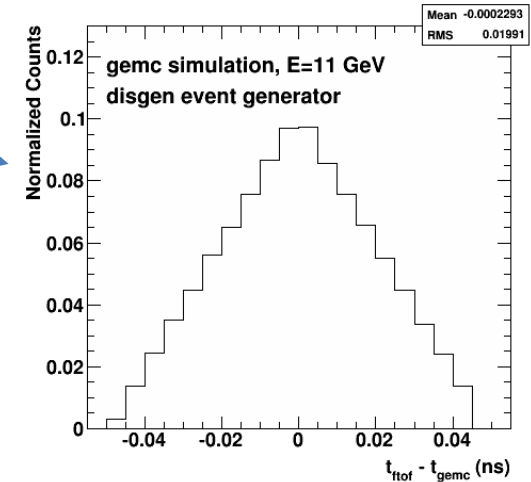
Current Status

❑CLAS12 generation 1 TOF reconstruction completed
  o December, 2013.
  o Standalone versions for FTOF and CTOF.
  o Working as a service in analysis chain.
  o Validated in stress test.
  o Optimized parameters for forming cluster from multiple-paddle hits.
  o CLAS12 NOTE 2014-003.
❑Updated to new clasio libraries, bankefs, summer 2014.
❑New test version for event builder development.
❑First version of code to match drift chamber track from hit-based tracking with FTOF hit.
❑Geometry parameters read from service.
❑Streamlined code.

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People

❑Developer categories: A – environment programmers, B – service developers, C – physics-only users

❑Time-of-flight reconstruction software developers
- o Alex Colvill, master's student, University of Surrey, 2013
  - ▪ Created full set of reconstruction software
  - ▪ optimized algorithms for forming clusters
- o G.P.Gilfoyle, spring 2014
  - ▪ work done at University of Richmond
  - ▪ updated FTOF to new clasio, bankdefs (with JLab help)
- o E.Golovach, summer-fall 2014
  - ▪ periodic visitor to JLab from Moscow State
  - ▪ Working on FTOF reconstruction now (track matching).

❑JLab support – V.Ziegler, G.Gavalian

User Workflow
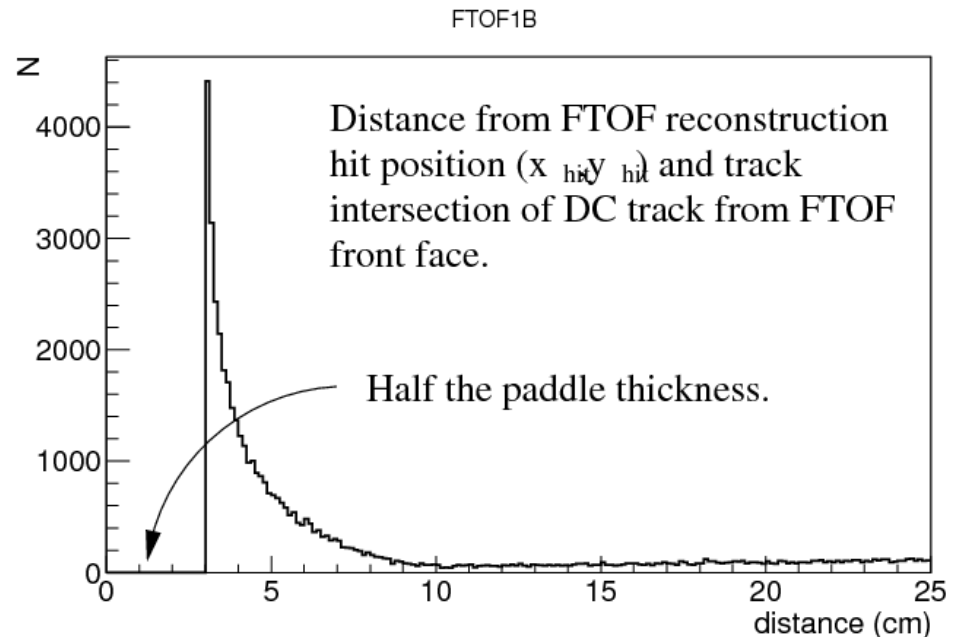

Getting Started
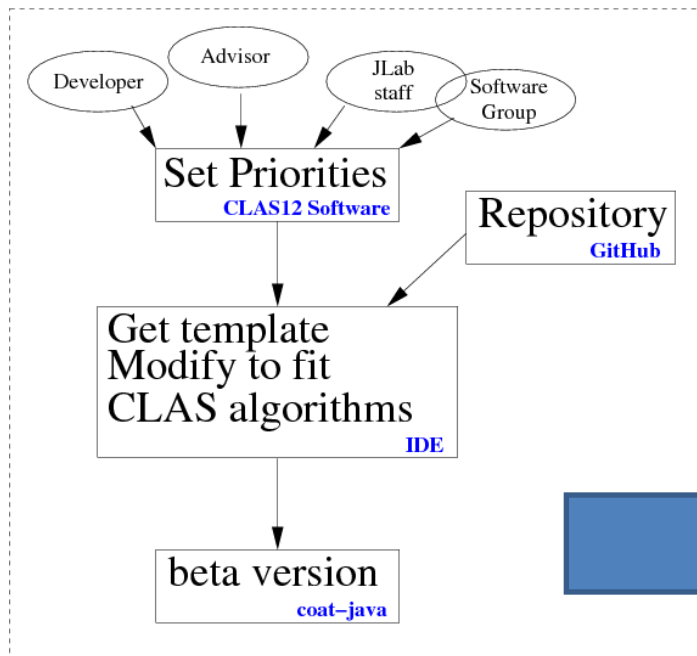
Development Cycle
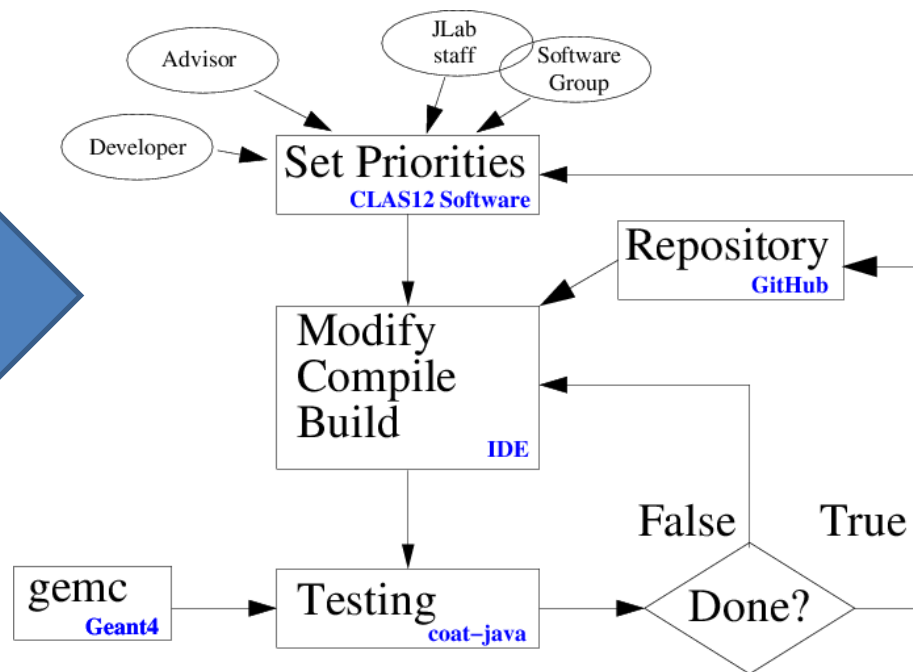
Connection to Charge

- Are users engaged at a sufficient level to demonstrate usability and readiness from a user's perspective?
    - Gilfoyle (Richmond), Golovach (Moscow State) and their students have been able to make significant contributions to the time-of-flight reconstruction package.
    - Time spent on-site is crucial for start-up.
- Has the CLAS Collaboration identified appropriate mechanisms to support utilization of the software by the entire collaborations?
    - For TOF project the common tools are far enough along for off-site users to make contributions.
    - Simulations with gemc and analysis in the Clara framework are ongoing at Richmond and MSU.
- Is the level of user documentation appropriate for this point in time?
    - Lots of material for FTOF, but should be localized (CLAS12 wiki?).
    - Bug reporting, access to JLab staff for support can be crucial to get software working offsite.

Additional Slides

Track Matching with Drift Chambers

- Match drift chamber track with FTOF hit.
- Hit-based tracking results are used now.
- DC track is propagated from last DC plane to front face of FTOF panel (**B**=0) using geometry service tools.
- FTOF returns (z_{hit},y_{hit}) where z_{hit} is in the center of the paddle.
- Consider only single paddle clusters.
- First results:

FTOF1B

Distance from FTOF reconstruction hit position (x $_{hit}$,y $_{hit}$) and track intersection of DC track from FTOF front face.

Half the paddle thickness.

distance (cm)

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Energy-weighted T$_{hit}$ vs. Earliest T$_{hit}$

❑ Cluster hit times have been calculated as the energy-weighted sum of the paddle hit times.

❑ We also considered taking the earliest T$_{hit}$ among the paddles of each cluster.

All panels, N$_{adj}$ ≥ 2
gemc simulation, E=11 GeV
disgen event generator