Hall B:User Experience and Utilization

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University of Richmond

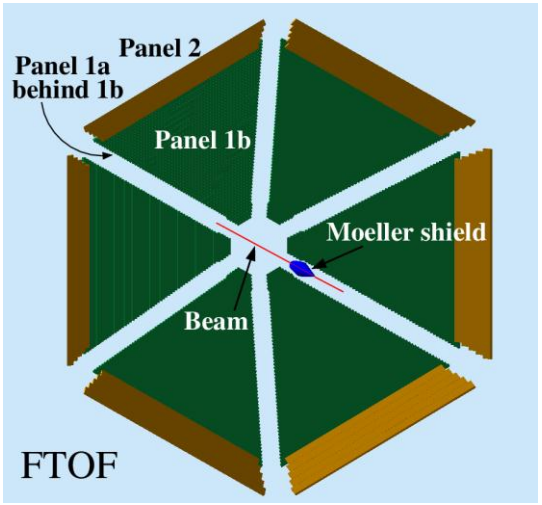
12 GeV Software and Computing Review
Jefferson Lab
February 10-11, 2015

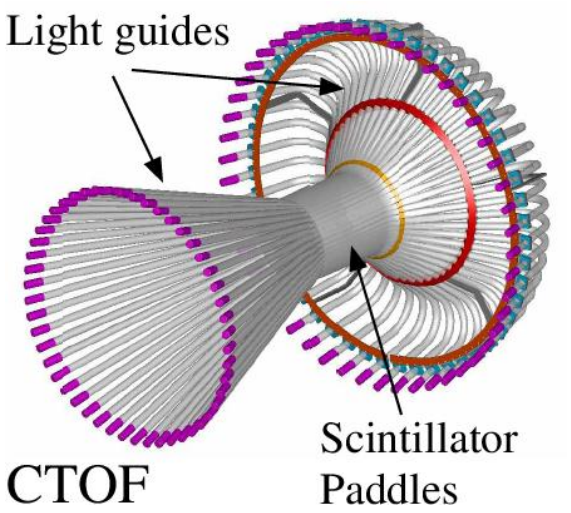
Goals and Outline

- Committee Charge - 1.c
  - Are the halls getting users engaged at an appropriate level to demonstrate usability and readiness from a user's perspective?
  - Has the collaborations identified effective and appropriate mechanisms to support utilization of the software by the entire collaboration?
  - Is the level of user documentation appropriate for this point in time?
- Outline of talk
  - Example of user software work: TOF reconstruction
  - User experience: developers, projects, workflow.
  - Connection with committee charge.

TOF Reconstruction

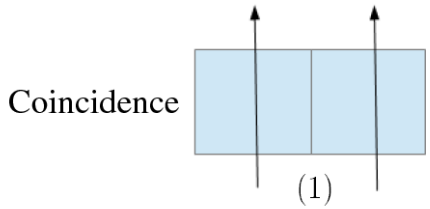
- Forward Time-of-Flight (FTOF)
  - 6 sectors, double-sided PMT readout.
  - Paddles: Panel 1a - 23, Panel 1b - 62, Panel 2 – 5.
- Central Time-of-Flight (CTOF)
  - 48 paddles, double-sided PMT readout.
  - form hermetic barrel around target.
- Outputs
  - Times (T_L, T_R from TDCs)
  - Positions (y_{hit} from $T_L - T_R$)
  - Hit times (T_{hit} from $(T_L + T_R)/2$)
  - Deposited energy (E_{dep} from ADCs)

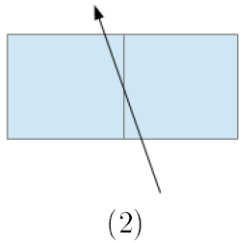


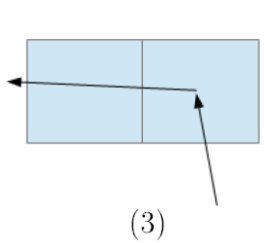


TOF Reconstruction Methods

- 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 $E_{dep} = \sqrt{E_L \cdot E_R} \cdot e^{y}$
  - 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.

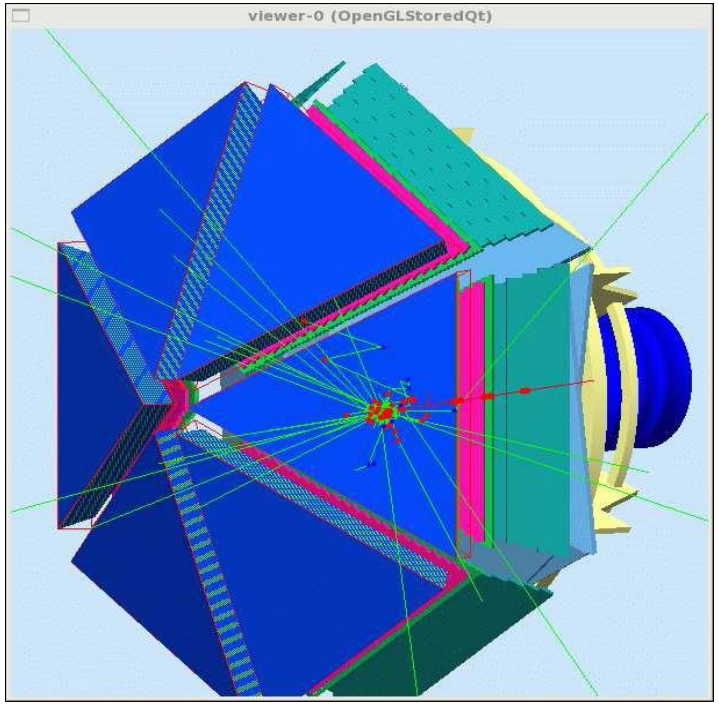






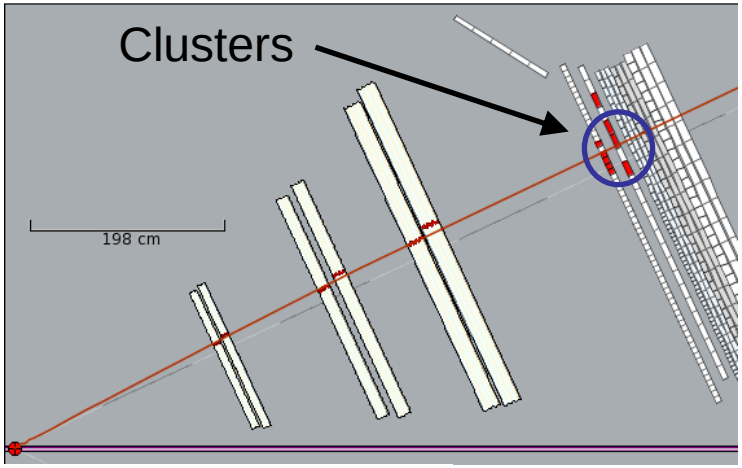
Code Validation

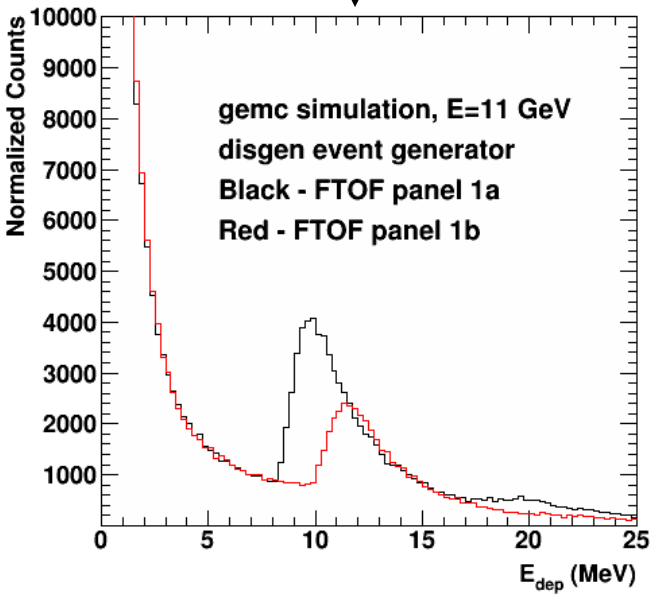
- Simulation is primary testing tool of TOF reconstruction code.
- CLAS12 Simulation – *gemc*
- Simulations done on Richmond cluster and copied to JLab.
  - Accessible, well-documented, bug reporting, website.
  - JLab staff member (M. Ungaro).
- Event generation
  - disgen – proton DIS
    - Range of final states and momenta.
    - Local
  - QUEEG – quasielastic scattering
    - Local, under svn.
    - CLAS-NOTE 2014-008.
  - Pythia (more in V.Ziegler talk)
    - Pythia6 - now in use.
    - Pythia8 - no electroproduction

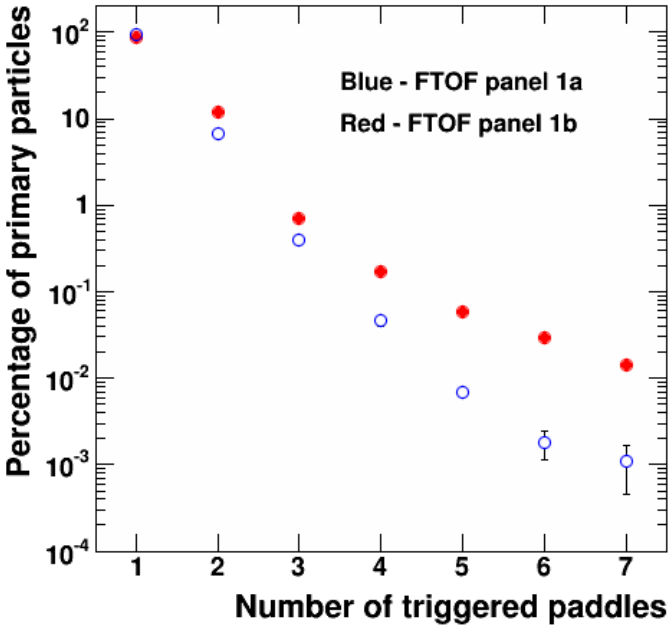


FTOF Standalone Reconstruction Results

- Validated in stress tests.
- Time difference with gemc.
- Measured N_{adj} dependence.
- Optimized clustering parameters.
- E_{dep}.
- CLAS12-NOTE 2014-003.





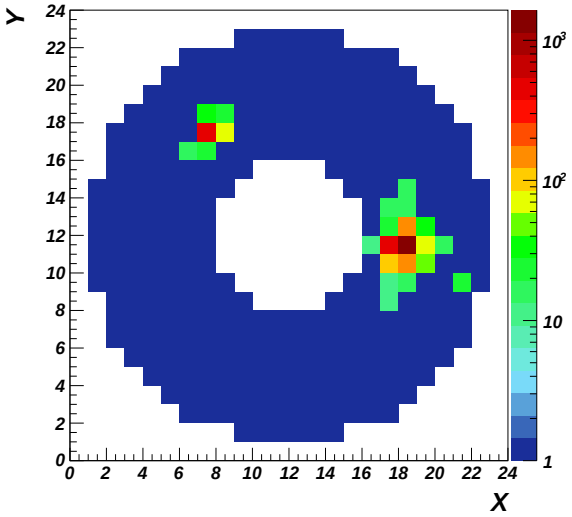


TOF Status

- CLAS12 generation 1 TOF reconstruction completed
  - Standalone versions for FTOF and CTOF.
  - Working as a service in analysis chain.
  - Validated in stress test.
  - Documentation: CLAS12-NOTE 2014-003.
- Updated to new clas-io libraries, bank definitions.
- New test version for event builder development.
- First version of code to match drift chamber track from hit-based tracking with FTOF hit.
- Geometry package in use.
- Streamlined code.

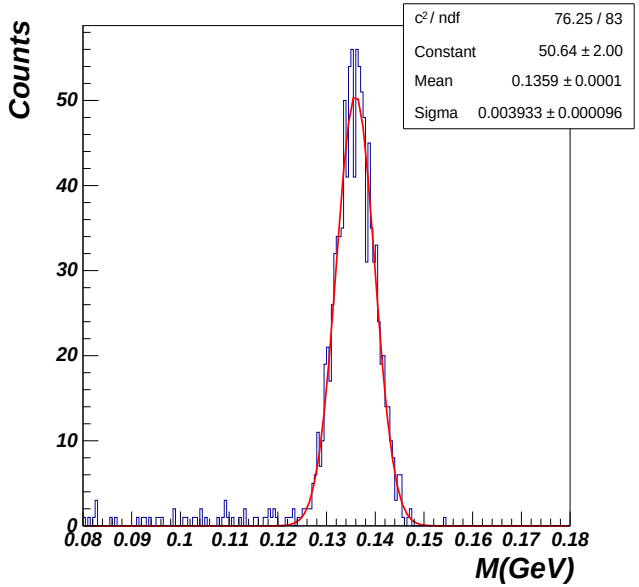
More Projects and People

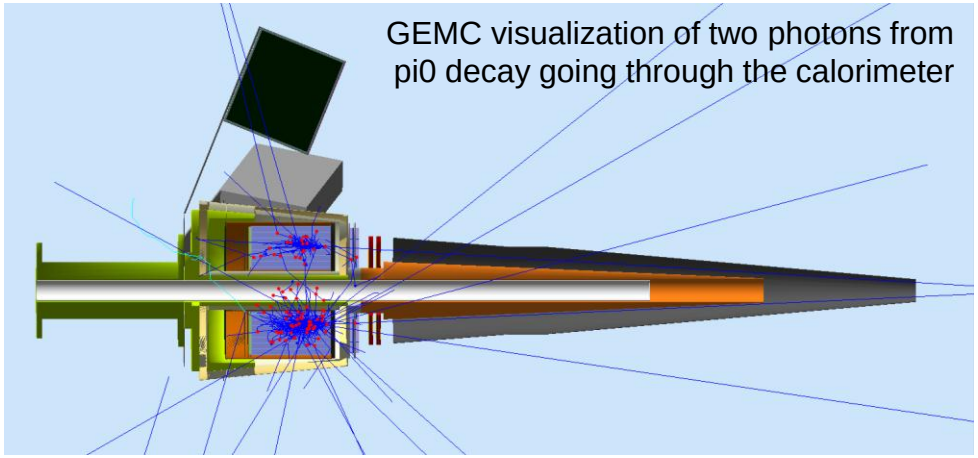
- Forward Tagger (FT)
  - Simulation and validation (gemc)
  - Reconstruction (coatjava, evio-Root)
  - Raffaella De Vita (Genova)



Example:

- Simulation of $\pi^0 \rightarrow \gamma\gamma$ events with full FT geometry
- $\gamma\gamma$ invariant mass spectrum show clear π^0 peak

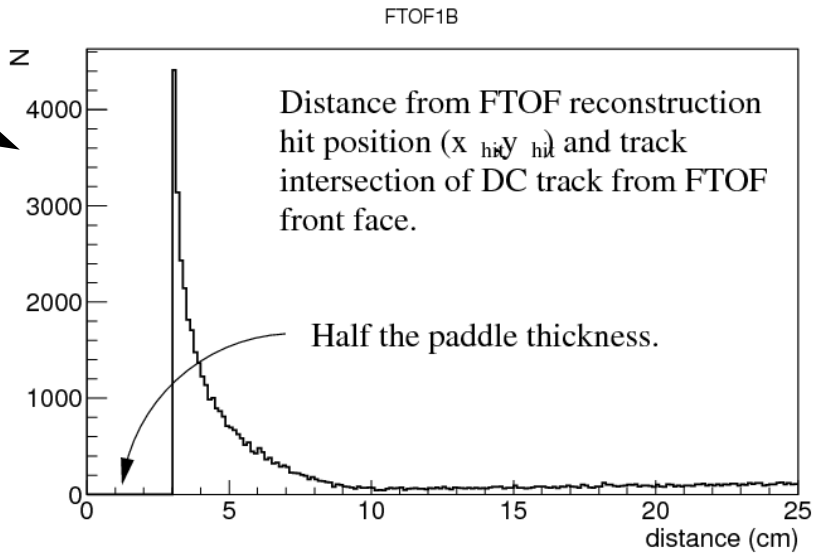




L. Lanza (Universita di Roma Tor Vergata and INFN-Roma2)

People and Projects

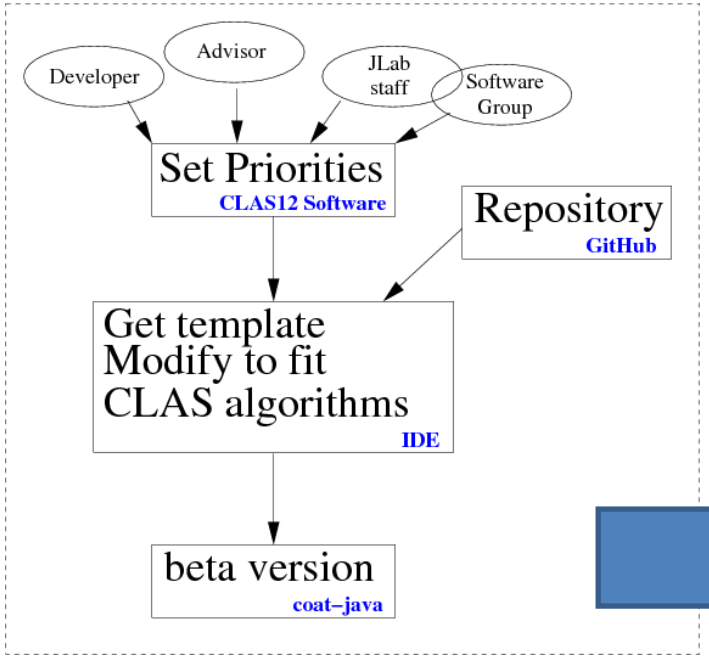
- Use of gemc is widespread.
- Time-of-flight reconstruction
  - E.Golovach (Moscow State)
  - G.P.Gilfoyle (Richmond),
- FT Reconstruction
  - Raffaella De Vita (Genova)
- ced12 development
  - Dave Heddle (CNU)
- Central Neutron Detector reconstruction
  - Daria Sokhan (Glasgow)
- DC geometry
  - Jeremiah Hankins (CSUDH)
- Validation suite and BST calibration
  - Justin Ruger (CNU)
- RICH simulation and validation
  - Silvia Pisano (INFN)
- Barrel Silicon Tracker reconstruction
  - Yuri Gotra (JLab)



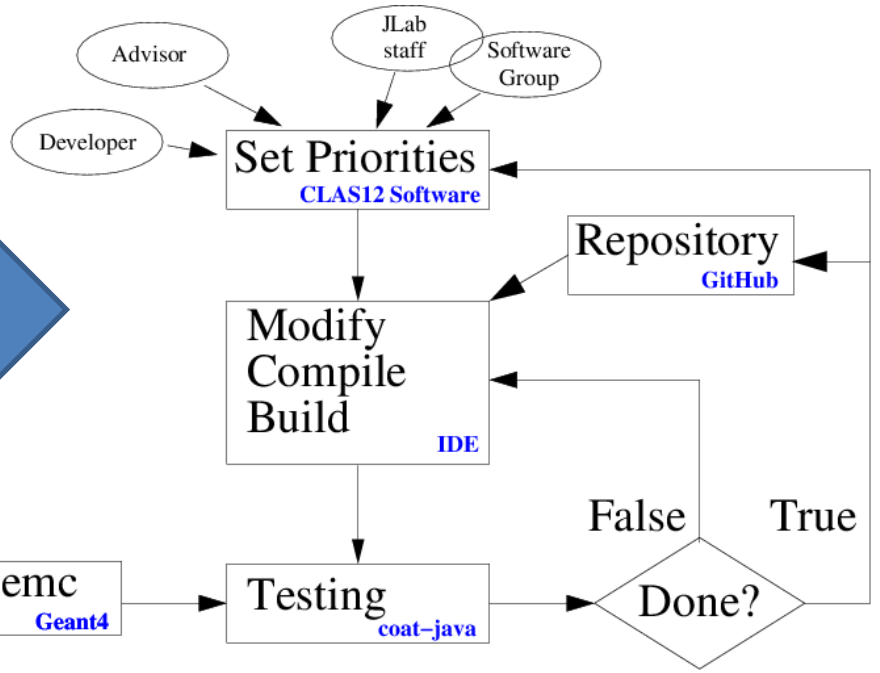
Projects listed use gemc and the CLAS12 common tools: ClaRA, coatjava, gemc, ced12,…

User Workflow

Getting Started



Development Cycle



Connection to Charge

- Are the halls getting users engaged at an appropriate level to demonstrate usability and readiness from a user's perspective?
  - Gilfoyle (Richmond), Golovach (Moscow State) and their students have made significant contributions to the TOF reconstruction package.
  - Use of common tools is ramping up.
  - Time spent on-site is crucial for start-up.
- Have the collaborations identified effective and appropriate mechanisms to support utilization of the software by the entire collaboration?
  - 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, MSU, Genova, Saclay, and INFN and spreading to other CLAS Collaboration groups.
- Is the level of user documentation appropriate for this point in time?
  - Well developed for gemc.
  - Material for TOF and EC/PCAL, but need better user interface.
  - Starting to centralize documentation, tutorials, etc.
  - Bug reporting, access to JLab staff for support, crucial for offsite users.

Summary and Conclusions

- CLAS12 simulation (gemc), framework (Clara), data formats (evio), event display (ced12) are mature packages and readily accessible to collaboration members.
- Reconstruction tools (coatjava) are now being used for testing, validation, and development by an increasing number of users.
- Documentation status is diverse – some needs updating, better organization.

During an internal CLAS12 software review one of the reviewers, Jeremy McCormick (SLAC) asked about using the CLAS12 event display. He was able to download the package from gitHub, reconstruct events, and view them in ced12 in a matter of minutes.

Hi, Jerry.

It works! Thanks.

I was also able to easily run your reconstruction and produce an EVIO output file.

—Jeremy

Additional Slides

A RICH for the CLAS12 Detector

A RICH has been proposed to optimize kaon/pion/proton PID in the momentum range 3−8 GeV. It has to fit into the constraints of the pre-existing CLAS12 geometry.

Simulations based on gemc run to optimize the RICH setup, to understand PID capability and to study the impact of the RICH material budget on the downstream EC&FTOF detectors.