

Event Reconstruction Monitoring

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Outline

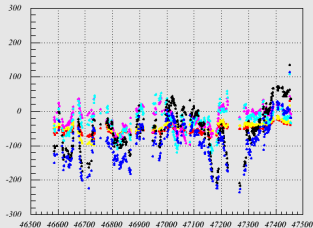
- 1 Monitoring Stability vs Run Number
- 2 Monitoring Full Run Statistics
- 3 Data Processing with CLARA Diagnostics



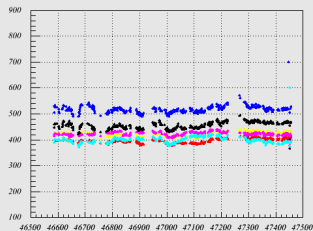
Monitoring Stability vs Run Number

DC Residuals per sector

DC Mean for different superlayers - sector 1



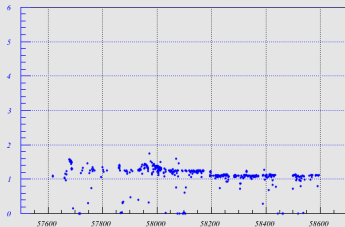
DC Sigma for different superlayers - sector 1



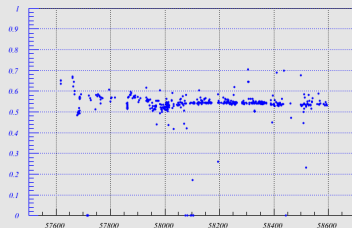
- Should be centered at zero with optimized width
- Sensitive to all calibration ingredients: drift velocity / DOCA hit time (including global RF offsets) alignment

DC Tracks per Event

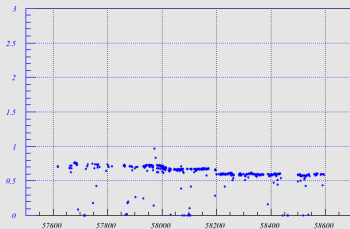
Hit based tracks / Events



Time based tracks / Hit based tracks



Time based tracks / Events



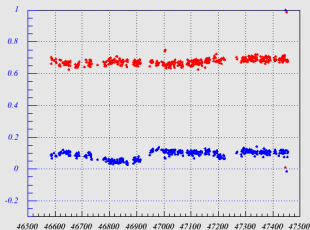
- Number of tracks per Events at 5.9 GeV e1-dvcs2 @ $2.4 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$
- Ratio of HB to TB linked to background/efficiencies

Tracking vertex

Reconstructed X vertex

Mean

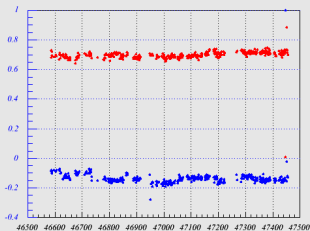
Sigma



Reconstructed Y vertex

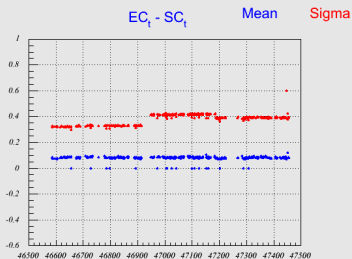
Mean

Sigma

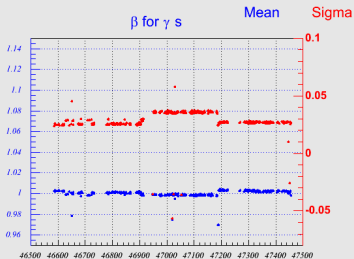


- Intersection of track with plane perpendicular to the mid-sector
- Sector dependence gives beam position
- Extrapolation to a fixed transverse plane through beam position
- Closest Approach of multiple track; elastic events?
- Minimization can optimize :
Relative position of Forward and Central Trackers
Constraints on the solenoid field axis

Timing and CTOF/ECAL Coincidence



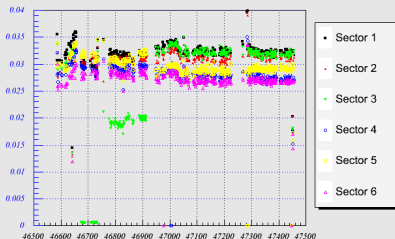
- Mean value corresponds to SC/EC distance
- Mostly independent of tracking calibration



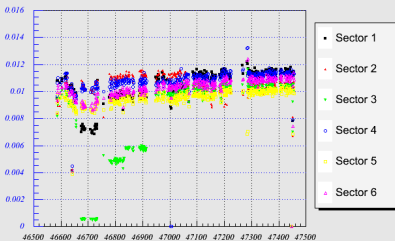
- From ECAL only
- Separation from neutrons

Electrons/Pions Yields per sector

Number of electrons / TRIGGERS (different sectors)



Number of pions / TRIGGERS (different sectors)



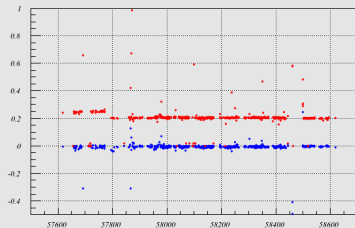
- Sensitive to all components
- Stability / sector dependence systematics in high level analysis

RF Times

Electrons RF

Mean

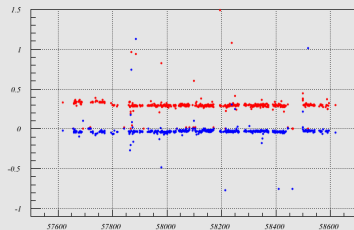
Sigma



π RF

Mean

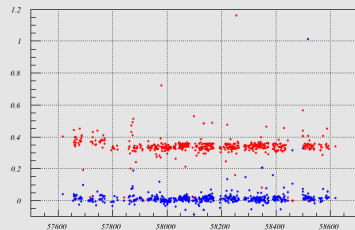
Sigma



Protons RF

Mean

Sigma



- Electron RF basis for others / TBT / EB
- Consistency proton and pion resolutions

Other Detectors Reconstruction

Forward Tagger **has its own trigger** (monitoring not included in previous plots)

- electron Energy spectrum
- electron θ distribution
- π^0 invariant mass peak mean and width
- cluster multiplicity
- Coincidence $T_{\text{Cal}} - T_{\text{Hodo}}$
- Coincidence $XY_{\text{Cal}} - XY_{\text{Hodo}}$
- Coincidence $XY_{\text{Cal}} - XY_{\text{Trck}}$

Central Tracking, CTOF

- Track residuals
- Positives / Proton rates vs angles
- Vertex coincidence multitrack events (Forward)

Central Neutron Detector

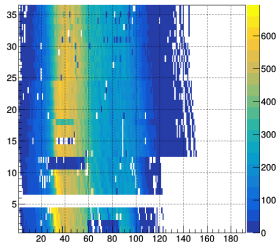
- CND self coincidence between 3 layers vs run number
- Timing, Geometrical coincidence CTOF & CND, mean and sigma vs run number
- Geometrical coincidence between Tracker & CND vs run number
- Triple coincidence Tracker, CTOF, & CND vs run number



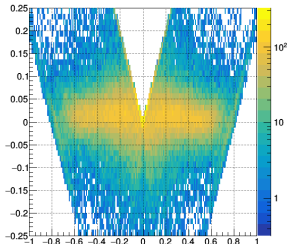
Monitoring Full Run Statistics

A few examples of detector details

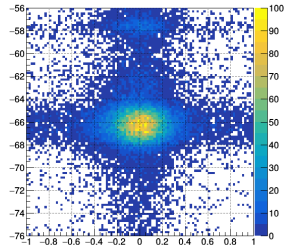
TBT layer vs wire Sec1



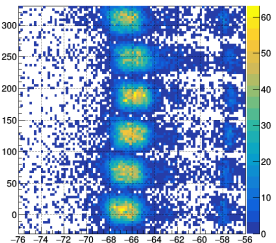
residuals Vs fitDOCA SL1S1



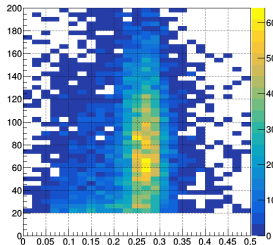
RF offsets vs Z?vl



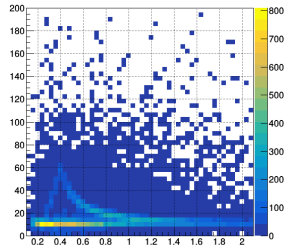
Electron Z vertex



S1 CC ph.e. vs [D]E/p



dE/dX vs P pos



Full Cooking Monitoring Physics

- $ep \rightarrow eX W$ per sector
- $ep \rightarrow eX W$ vs θ per sector
- $ep \rightarrow ep$ elastic (E', θ) correlation per sector
- $ep \rightarrow ep$ elastic beam energy per sector
- $ep \rightarrow ep$ elastic beam energy vs θ per sector
- $ep \rightarrow e\pi^+ X$ Missing mass
- $ep \rightarrow e\pi^+ X$ $\sin\phi$ helicity signal vs Missing mass
- $ep \rightarrow ep\gamma$ $\sin\phi$ helicity signal vs W



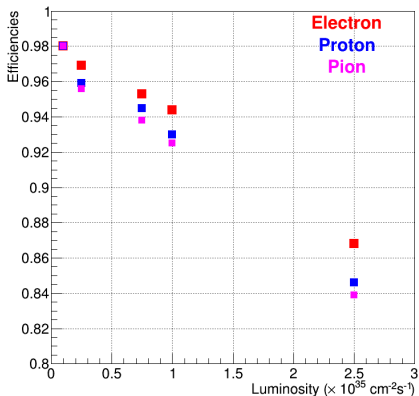
More Physics Coincidence Quantities

- $ep \rightarrow ep$ elastic (e Forward Carriage and p Central Tracker)
 - ▶ Coplanarity
 - ▶ Beam Energy
 - ▶ Vertex Closest Approach
- Coincidence with Forward Tagger
 - ▶ Elastic $ep \rightarrow ep$
 - ▶ Primakoff π^0, η



Efficiencies vs Luminosity

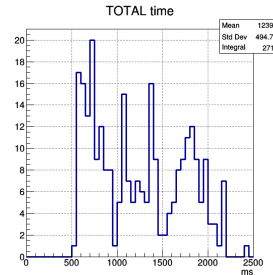
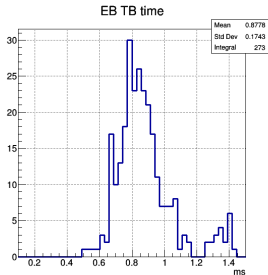
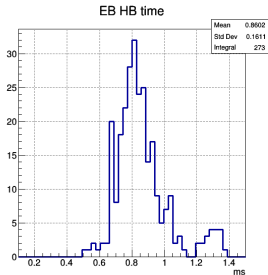
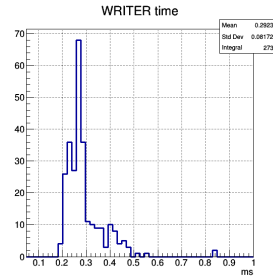
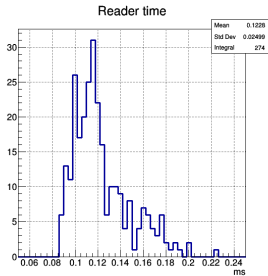
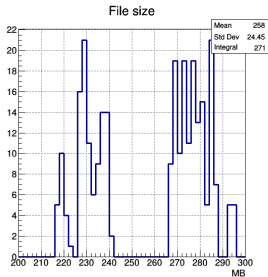
Result for efficiencies vs luminosity



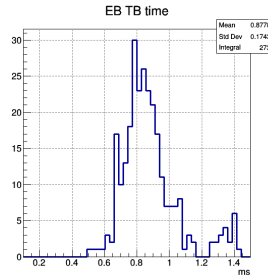
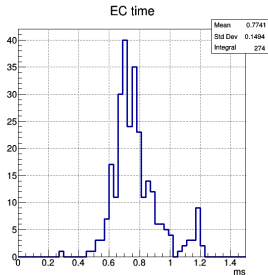
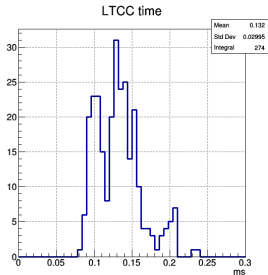
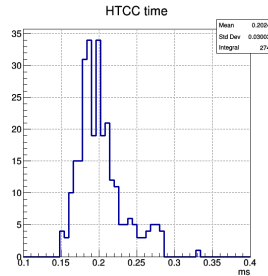
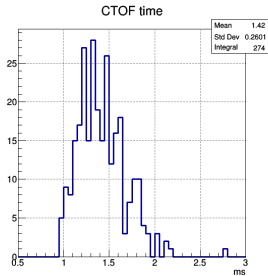
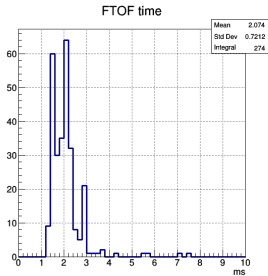
- CLAS12 Design Operating Luminosity $10 \times 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$
- High efficiency, small variation around design luminosity
- Preliminary Results, Efficiencies may be Optimized

Data Processing with CLARA Diagnostics

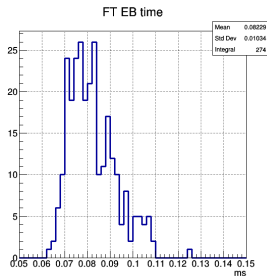
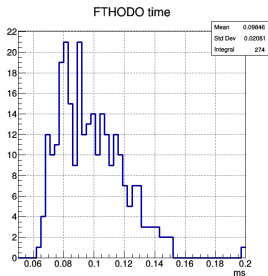
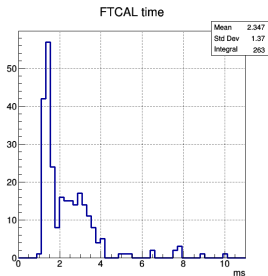
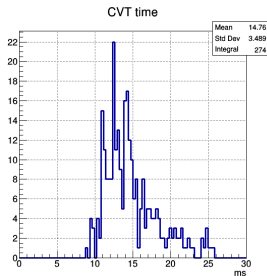
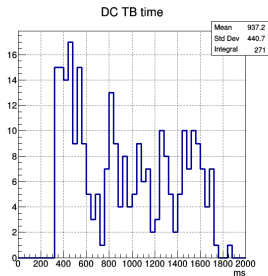
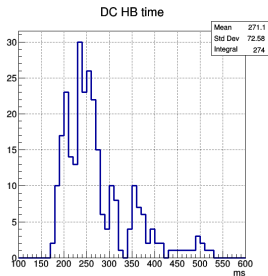
Various Diagnostics from CLARA



Detector Reconstruction Times (From CLARA)



Forward Tagger, Tracking Times (From CLARA)



Conclusion

- Many ideas to produce many histograms
- See Vardan's talk for service integration into CLARA (online)
- Will include visualisation service
- High level summary for on/off-line shift takers and logbooks
- Low level detail plots for experts / calibration
- Basis for list of (golden) runs for luminosity normalization

