



Event Builder Status








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CLAS Collaboration Meeting

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Overview

- “Event Builder” is the last CLAS12 service run, after all detectors
- Geometrically associates detector responses into particles
- Defines event start time, and does a basic particle identification
- Retrieves/analyzes various event-based quantities, e.g. helicity state
- Writes all info for physics analysis into DSTs (REC* banks)
- Documentation: https://clasweb.jlab.org/wiki/index.php/CLAS12_EventBuilder

 EBAnalyzer.java	switch default, unassigned pid quality to 99	5 days ago
 EBEngine.java	Merge pull request #255 from JeffersonLab/vg-optimize	4 days ago
 EBHBEEngine.java	Merge pull request #255 from JeffersonLab/vg-optimize	4 days ago
 EBMatching.java	cherenkov matching fixes	8 days ago
 EBTBEEngine.java	Merge pull request #255 from JeffersonLab/vg-optimize	4 days ago
 EBio.java	disable scaler readout	5 days ago
 EventBuilder.java	particle-htcc combos for looser matching requirements	5 days ago

 EBCCDBConstants.java	Merge branch 'development' into ebdev-mrg	4 months ago
 EBCCDBEnum.java	Merge branch 'development' into ebdev-mrg	4 months ago
 EBConstants.java	EBConstants: cleanup	3 months ago
 EBRadioFrequency.java	eb cleanup: move rf to rec instead of service	3 months ago
 EBScalers.java	eb: cleanup unused imports	8 days ago
 EBUtil.java	eb: cleanup unused imports	8 days ago
 SamplingFractions.java	eb: move sampling fractions to dedicated class, add pid- and sector-d...	5 months ago

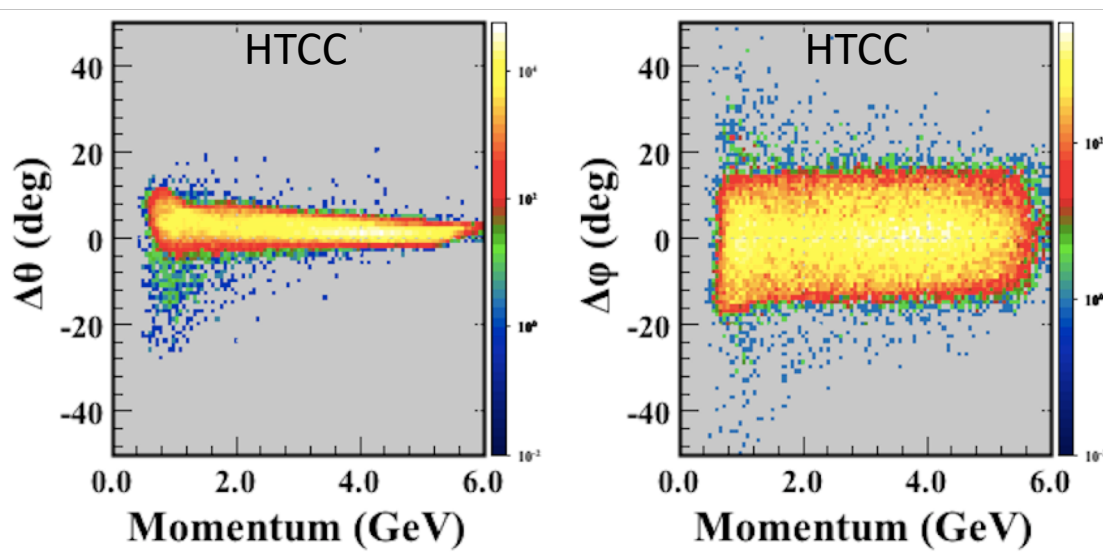
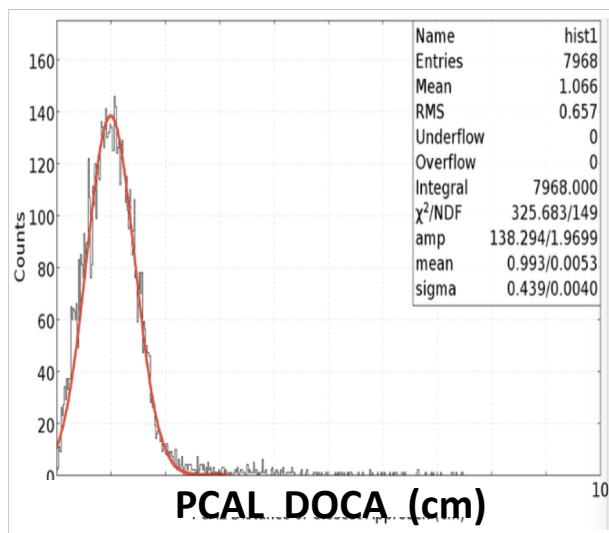
Creating Particles

Charged Particles

- associate detector responses with tracks, geometrically, based on DOCA

Neutral Particles

- identify remaining trackless ECAL/CND hits as neutrals, assume straight trajectory, and associate with other detectors' unmatched, geometrically, based on DOCA



Currently loose, flat detector-dependent cuts, with minimum-DOCA hit chosen and only one (*) response allowed per detector layer per particle.

Timing information is currently ignored at this stage.

** Being expanded ...*

Event Start Time

Choose “Trigger Particle”

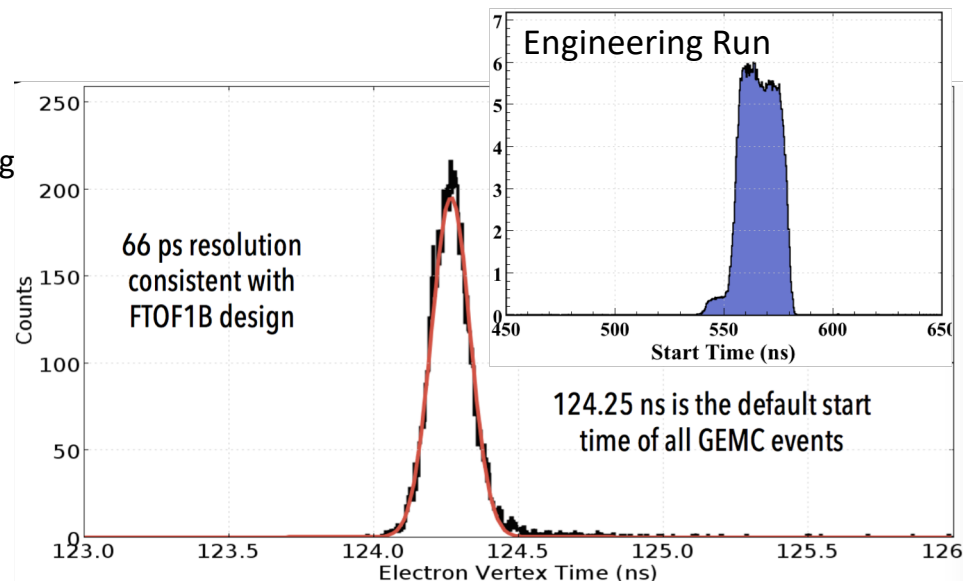
- highest energy e^- else e^+ , if one exists
- else highest momentum track with an FTOF hit, assumed a π
- Forward Tagger
 - *** in progress ***
 - Uses a [“shadow” bank](#), i.e. not adulterating existing data, just appending, when appropriate (i.e. no electron in FD), with new RECFT::Particle based on start time from FT, based on algorithm from FT analyzers

Construct its vertex time

- based on path length, mass, momentum

Use nearest RF bunch to assign start time

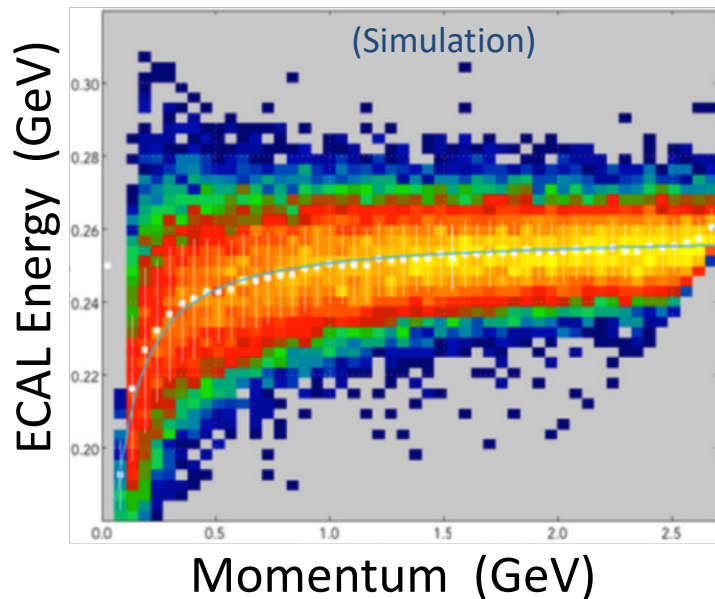
- Correction for non-zero z-vertex is still disabled
 - especially important for CTOF
 - ideally requires DC-CVT to be aligned w.r.t. each other, else using one’s z-vertex degrades the other’s TOF timing resolution



Lepton and Neutral Identification

e^-e^+ in Forward Detectors

- Charged Track ECAL, HTCC, and FTOF hits
 - PCAL > 60 MeV
 - HTCC #phe > 2
- ECAL sampling fraction
 - $\pm 5\sigma$ sampling fraction parameterized in momentum
 - REC::Particle.chi2pid is N_σ from nominal, so tightening the criteria can be done with simple cut on chi2pid
 - ***Sampling fraction in CCDB needs to be updated based on final calibration***



Neutrals

– Forward Detector

- ECAL clusters unassociated with a track
 - seeds with PCAL first and matches to EC Inner/Outer
 - then seeds with EC Inner, and finally EC Outer
- Also associates them with unmatched FTOF (currently unused)
- γ
 - ECAL $\beta > 0.9$
 - Energy calculated from ECAL and sampling fraction parameterized in momentum
 - ***Sampling fraction in CCDB needs to be updated based on final calibration***
- neutron
 - $\beta < 0.9$
 - Energy calculated from β assuming neutron mass

– Central Detector

- CND clusters unassociated with a track assigned as neutrals
- Also associates them with unmatched CTOF (currently unused)
- neutron
 - $\beta < 0.9$
 - Energy calculated from β assuming neutron mass

Forward Tagger

- e^-
 - Matched calorimeter and hodoscope clusters
 - No charge separation, assumed negative
- γ
 - Calorimeter cluster unmatched to hodoscope
- Energies based on calorimeter

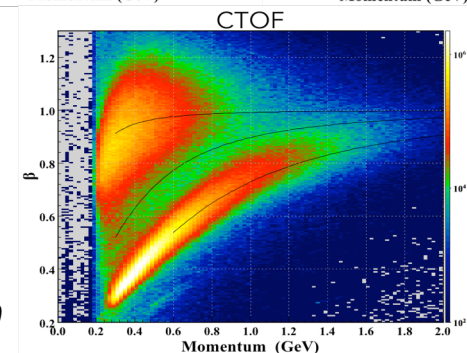
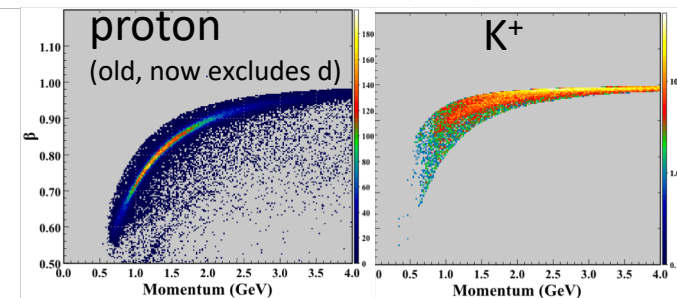
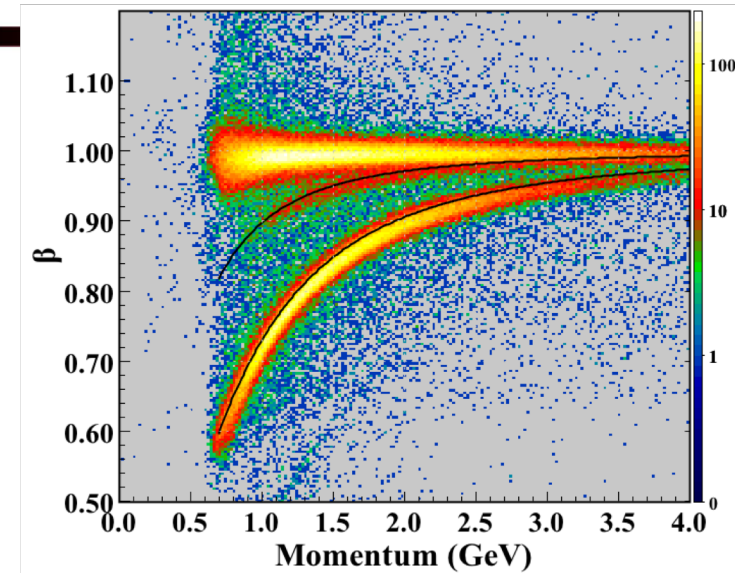
Charged Hadron Identification

If a track fails e^-/e^+ identification, assume it's a charged hadron and assign its identity based on minimizing the time difference between event start time t_0 and vertex time.

$$\Delta t_i = t_0 - \left[t_{FTOF} - \frac{L}{\beta_i(p)} \right], \quad i = \pi/K/p/d/\dots$$

- If no TOF info, pid=0
- Vetoes from Cerenkov
 - #photoelectrons greater than 2 and below kaon threshold
→ reassign to π
- REC::Particle.chi2pid is a signed N_σ from nominal timing, based on σ per FTOF-paddle, so tightening the requirements can be done with a simple cut on chi2pid
- Can be extended to more sophisticated scheme, e.g. multi-dimensional likelihood, ML ...
- ***Will need updating from RICH, and now BAND***

Plots are 10.6 GeV @ 5nA, require e^- for start time, and black curves are $\Delta\beta/\Delta t=0$



DSTs

High level HIPO banks for physics analyses

- Names are prefixed by “REC”, in EVENT.json
 - <https://github.com/JeffersonLab/clas12-offline-software/blob/master/etc/bankdefs/hipo/EVENT.json>
- REC::* is based on time-based tracking, RECHB::* on hit-based
- We keep only REC banks in standard physics analysis workflow, and drop all lower level info
 - Also keep RUN::* and RAW::scaler banks

The main examples:

- REC::Event
 - run/event #, event time, trigger bits, helicity, etc
- REC::Particle
 - pid, charge, momentum, etc
- REC::“ResponseType”
 - e.g. Calorimeter, Scintillator, Cherenkov, Track
 - hit/cluster energies, positions, times, shapes
 - contains pindex link to its particle
 - *Note, this only contains responses associated with particles*
 - with pointer to REC::Particle and corresponding clusters/hits in lower-level detector banks

Documentation:

https://clasweb.jlab.org/wiki/index.php/CLAS12_DSTs

Note, there appears to still be some misconception on the required cpu overhead of reverse indexing during analysis, which should be independent of the analysis details and a once-per-event operation.

Validation Tests

To check software progress, MC-based

- `clas12-offline-software/validation`
- test gemc files automatically downloaded from webserver
 - kept in sync with latest gemc version
- decoded, reconstructed, analyzed to perform
 - data sanity checks
 - yields, efficiency / misidentification
- A few are included in automatic Travis build tests
 - *this has proven extremely useful, despite the occasional maintenance overhead*

Index of /clas12offline/distribution/coatjava/validation_files/eb

Name	Last modified	Size	Description
Parent Directory		-	
4a.2.2-fid-r10-10K/	16-Apr-2018 07:31	-	
4a.2.2-fid-r10/	10-Mar-2018 16:08	-	
4a.2.2-fid-r11/	10-Mar-2018 15:59	-	
4a.2.3-fid-r10-100/	10-Jun-2018 12:11	-	
4a.2.3-fid-r10/	20-Apr-2018 16:27	-	
4a.2.3-fid-r11/	20-Apr-2018 15:54	-	
4a.2.4-fid-r10-100/	28-Aug-2018 13:52	-	
4a.2.4-fid-r10/	28-Aug-2018 10:10	-	
4a.2.5-fid-r11-100/	06-Nov-2018 21:03	-	
4a.2.5-fid-r11/	06-Nov-2018 19:38	-	

	electronFTgamma.evio.gz	20-Apr-2018 16:27	2.9M
	electronFTpion.evio.gz	20-Apr-2018 16:27	4.4M
	electrongamma.evio.gz	20-Apr-2018 16:27	3.7M
	electrongammaC.evio.gz	20-Apr-2018 16:27	3.0M
	electrongammaFT.evio.gz	20-Apr-2018 16:27	4.5M
	electronkaon.evio.gz	20-Apr-2018 16:27	4.9M
	electronkaonC.evio.gz	20-Apr-2018 16:27	3.7M
	electronneutron.evio.gz	20-Apr-2018 16:27	3.4M
	electronneutronC.evio.gz	20-Apr-2018 16:27	3.0M
	electronpion.evio.gz	20-Apr-2018 16:27	5.1M
	electronpionC.evio.gz	20-Apr-2018 16:27	3.8M
	electronproton.evio.gz	20-Apr-2018 16:27	4.7M
	electronprotonC.evio.gz	20-Apr-2018 16:27	3.5M

2-particle test events

- electron plus another, in different sectors
 - e^- : **1-9 GeV**
 - other (hadron/photon): **1-4.5 GeV**
- Clas12FastMC at generator level to ensure expected trajectories intersect all relevant detectors
 - i.e. account for B-fields, acceptance
 - very useful tool, needs to be extended to CD/FT

Forward Detectors		MC Truth					
		e	π	K	p	γ	n
P I D (%)	e	98					
	π		89	17	<1		
	K		5	72	<1		
	p		3	5	95		
	γ					93	30*
	n					3	65

A rough efficiency based on 1K events for each, averaged over given kinematics, used to help track software development. For e^- / hadrons, demoninator requires a track; any other detector/reconstruction inefficiencies, kaon decay, track-matching, etc, are absorbed. Empty cell means $\ll 1\%$. *Cut currently at $\beta=0.9$ (2 GeV).

Documentation

- https://clasweb.jlab.org/wiki/index.php/CLAS12_DSTs
- https://clasweb.jlab.org/wiki/index.php/CLAS12_EventBuilder

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5_Non-DST Detector Banks

Please check it out when you have questions/concerns about DST format and Event Builder, and give feedback! ***Almost all questions we've received about EB and DSTs were already answered there, else updated!***

Summary

Updates since November

- Beam charge moved to decoding stage
 - with hipo4 event tags, based on RCDB run start time for FCUP offset subtraction to avoid clock rollover
 - meanwhile, online clock reduced to 100 kHz in 2019 to avoid rollover
- EPICS banks decoded to JSON in HIPO4 byte-array bank
- First version of FT-based start time in development and validation
- Many-to-one track-to-hit relationship implemented for studying and optimizing time-based tracking efficiency
- HWP position incorporated in CCDB and helicity corrected during reconstruction (raw info still preserved)
- Bugfixes
 - Propagate some missing REC::Response.status
 - Missing sector in REC::Cherenkov

TODO

- Turn on (and adjust?) z-vertex correction to start time
 - Only after DC-CVT relative alignment
- Switch to trajectory banks for path lengths
 - Pending updated trajectory banks
- Move FT to standard REC::Cal/Sci banks
- Investigate
 - possible track-hit matching improvements
 - alternative/better identification schemes
- Incorporate RICH, and now BAND, pending input from detector groups