CLAS12 Offline Software Tools

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Overview

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Data Input/Output

- standard XML driven format for reading GEMC banks
- raw data decoder for raw pulse and fitted pulse modes
- unified interface for FPGA(FADC) database for pedestal subtraction
- standard interface for reading files and ET-ring

Calibration Framework

- standardized tables for calibration constants in CCDB
- unified interface for reading Calibration Constants
- GUI interface for detector plotting and data processing
- GUI for detector calibration software

Plotting Package

- improvements in plotting package introduction of LaTeX
- improvements in fitting algorithms (MINUIT)

Reconstruction

- modular reconstruction framework (CLARA based)
- initialization of run conditions and constants

CCDB Table Formats

• Calibration Constants tables are standardized.

SECTOR	LAYER	COMPONENT	СА	СВ
1	2	3	0.1	0.2
1	2	4	0.2	0.2
1	2	5	0.3	0.2
1	2	6	0.4	0.2

• FADC parameters table is standardized

CRATE	SLOT	CHANNEL	NSA	NSB
18	2	3	65	72
18	2	4	67	74
18	2	5	64	73
18	2	6	65	76

Data Input/Output

✓ Raw DAQ Data

- standard CCDB tables for pulse parameters (NSA,NSB, TET).
- standard tables for Translation Tables (CCDB).
- tools for reading FADC tables and Translation tables.
- visualization and constrain highlighting.
- simple interface to interact with data (independent of the source)

✓ Raw Detector Pulse viewer

- interface for pulse FADC visualization
- fitting for FADC pulse (integration)

✓ Event Decoder

- decoder for compact data structures
- pedestal subtraction/pulse fitter
- creating reconstruction detector banks

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А	A	A	pedestal	nsb	nsa	tet	
1	3	0	93.8	3	15	10	
1	3	1	137.5	3	15	10	
1	3	2	94.6	3	15	10	
1	3	3	125.4	3	15	10	
1	3	4	96.3	3	15	10	
1	3	5	110.5	3	15	10	
1	3	6	138.3	3	15	10	
1	3	7	112.0	3	15	10	
1	3	8	116.1	3	15	10	
1	3	9	101.2	3	15	10	
1	3	10	90.7	3	15	10	
1	3	11	106.5	3	15	10	
1	3	12	87.8	3	15	10	
1	3	13	134.6	3	15	10	
1	3	14	113.1	3	15	10	
1	3	15	109.3	3	15	10	
1	4	0	113.5	3	15	10	
1	4	1	114.7	3	15	10	
1	4	2	119.5	3	15	10	
1	4	3	125.4	3	15	10	
1	4	4	98.8	3	15	10	



Geometry & Calibration Tools

✓ Standard Detector Geometry Package Implements:

- Forward Time of Flight
- Electromagnetic Calorimeter
- Forward Tagger
- Drift Chambers
- Silicon Vertex Tracker
- Central Neutron Detector

✓ Geometry Tools and Utilities:

- Drawing package for 2D detector representation
- 3D shapes for CED-3D viewer
- Detector component tracker for Fast Monte-Carlo

✓ Calibration UI:

- new UI for developing Calibration code
- data stream implementation for EVIO files and ET-ring
- reasonable drawing and fitting package





Calibration Examples



✓ Calibration Framework

- detector drawing in 2D with clickable callback
- data stream panel with ability to run through files or et-ring events
- calibration constants table with detector identifiers and clickable callback

PCAL Monitoring



File Plugins



HTCC Calibration



Parameter	Description
μ	Mean number of P.E.
ω	Probability of type II bg
Q ₀	Pedestal position
Q ₁	Position of SPE peak
α	Exponential slope of type II
σ ₀	Width of pedestal
σ ₁	Width of PE distributions
scale	Normalization function
Height	~Total number of events





Data Visualization



Plotting Library:

- histogram and graph classes implemented
- plotting implemented matching ROOT API
- Fitting added using Minuet library
- Latex parsing added for titles and texts.
- I/O of histograms implemented, with browser.
- TNtuple class implemented for cut based plotting.
- NTuple I/O implementation in progress



```
14 TGCanvas c1 = new TGCanvas("c1","JROOT Demo",900,800,1,1);
15 //c1.setFontSize(14);
16
17 H1D h1 = new H1D("h1","ep #rarrow ep#gamma",200,0.0,14.0);
18 H1D h2 = new H1D("h2","ep #rarrow ep#gamma",200,0.0,14.0);
19
20 h1.setXTitle("M^2 [GeV^2]");
21 h1.setYTitle("Counts");
```

Reconstruction CLARA 4.3

✓ xMsg CLARA service bug

- general purpose public subscribe MPI
- utilizes zeroMQ socket libraries
- · Sockets that carry messages across various transports
 - In-process
 - Inter-process
 - TCP
 - Multicast
- Sockets can be connected N-to-N with patterns
 - Fan-out
 - Pub-sub
 - Task distribution
 - Request-reply
- Java, C++, Python bindings

✓ Reconstruction Framework

- reconstruction framework reads GEMC generation parameters.
- modular, runs as separate services.

✓ CLARA 4.3

- CLARA switched from using cMsg to xMsg (version 4)
- easy transfer from 2.2 interface to 4.3
- tests run on CLARADM machine show 250 Hz event reconstruction

Clas12 Reconstruction Application







Event rate (Hz)

Breaking News (11:38 AM)

S. Mancilla



Event rate (kHz)

Task List

Task	Details	Manpower
Calibration Database	API to read data into structures and submit data into database	0.25
I/O decoding	Implement decoders for all types of compact structures, tie them to translation tables.	0.25
Geometry	Improve geometry definitions, write API to port it to GEMC.	0.5
Detector Descriptors	Implement framework for describing detectors, used in geometry and calibration framework.	0.15
UI support	implement all necessary tools for displaying calibration process and detectors.	0.15
CLARA	constant development of offline software within CLARA	0.35
Monitoring Framework	Develop common structures to write monitoring software	0.25
Plotting	improve develop plotting package for online and offline visualization	0.25
Detector Visualization	Online offline detector Visualization	0.25

Summary

Developments:

- standardized calibration constants, FADC oparameterand Translation table structures
- developed tools for decoding compact formats and translate them into detector banks
- developed infrastructure for calibration software development:
 - detector drawing 2D package
 - threaded event processing interface
 - connecting to file or et-ring.
 - calibration constant table viewer/import/export/plotting
- reconstruction modules for PCAL/EC, Event Builder
- improvements in data visualization package, fitting improvements

To Do:

- develop UI for viewing translation tables and finding relations with FADC tables
- develop UI for calibration constants with detector 2D view
- improve plotting package to include more features
- data visualization persistence packages
- event builder visualization package