CLAS Collaboration Meeting, March 2025

CLAS12 Calibration Task Force

Raffaella De Vita (Jefferson Lab) and the Calibration Task Force

March 4, 2025



CLAS12 Calibrations Task Force

- Task Force appointed with the **objective** of making calibrations more efficient:
 - "calibrations": all the steps in between data taking and data processing for physics
 - "more efficient": (more) automatic, faster, using less resources, ...

Charge:

- Perform a survey of the calibration process, i.e. procedure, execution time, tools, resources, most frequent issues/errors
- Identify key items to reach the objectives
- Define a work plan to address them
- Execute the highest priority item(s)
- Verify the impact

Members:

– N. Baltzell, D. Carman, R. De Vita (chair), C. Dilks, F. Hauenstein



Task Force Activity

Meetings:

- Kick-off meeting on November 1st, 2024
- Meeting every other week since then

• Focus:

– Data Collection:

- Survey of the calibration process
- Collected information on the most frequent issues/errors
- Compiled list of potential upgrades for existing tools

- Identification of key areas and priorities:

- Procedural
- Resource related
- Tools related

- Implementation of first action items

- Calibration checklist
- Reduction of data volumes
- Unified calibration code repository

Documentation

- Collected material, presentations, meeting minutes in O365 shared drive



Survey of the calibration process

- Collect data on
 - Number of iterations
 - Number of processed runs and events
 - Expected/actual processing time on the JLab batch farm (full Hall-B production fairshare/actual fairshare at the given time
 - Total time including human time
 - Disk space usage

for every calibration phase/step

 Focus on data sets with ongoing calibration for better accuracy via real-time data collection

		name	RG	X				CPU fairshare (M/da	y)		600
Example of		number of triggers (B)	4	10			computing resources	startup overhead (da	ys)		1
схатрь о		number of settings		6			resources	disk quota (/volatile)			400
Example of collected data		data volume (TB)	115	0							
collected data		number of runs	63	0							
	data set general information	raw event size (kB)	2	19							
		decoded event size (kB)		6							
		calib event size (kB)		7	values in italics are preliminary *includes data processing						
		mon event size (kB)	4	0							
		events in calibration runs (M)	1(0							
		pass0 files/run	2	20							
			Iterations	N. runs	5 N	I. of Events (B)	Time (days)*	Wall time (days)	Fairshare (days)	Disk (TB/iter.)	
	calibration step	FD alignment		3			15				
		CD alignment		0							
		beam offset		1		0	25	6	6 C)	0
		RF		2		0	7	() ()	0
		FTOF calibration		2	45	4.5	30	20	9.50)	52
		DC calibration		3	15	1.5			5.50)	52 12 17
		Other detectors		2	15	1.5			4.50)	17
		pass0s		5 6	630	4.38			12.30		40
		totals				11.9	77.0	26.0	31.8	1	120.8



Survey of the calibration process

Data across Run Groups are not always complete but lead to the same findings (not in order of relevance):

- Calibration protocols/algorithms keep being improved
 - Necessary to achieve the best quality or address new issues (for example, new DC alignment and calibration)
 - Significant overhead/delays during development
- Usage of computing resources is significant
 - Processed data amount up to 30% of total \rightarrow can be weeks of processing time
 - Data volumes produced can be hundreds of TB, even if transient
- Human resources involved in the process are large
 - Many people and time
 - Delays unavoidable without (more) automation
- Non-negligible impact of accidental mistakes
 - Variety of examples and causes
 - Usually requires repeating the affected calibration step



New calibration checklist

- Outlines all the tasks of the calibration process
- Provide information on preparatory steps and interdependencies
- Developed in collaboration with CalCom
- Being tested with ongoing calibration

	Category	Rem	Contact Person	Prerequisites	Calibration Checklist	v2 Outcomes	Validation	Documentation Source
Step #	Gategory	Dataset archaeology	Daniel Carman	Frerequisites	liput Data	list of runs and known issues	valuation	RCDB, logbook,
2	-	Ready for Calibration review	Daniel Carman			usc of runs and known issues		ALCOM wikings
	1	inclugior delabellation chew				/geometry/shifts/* /geometry/*/alignment		
3		Update geometry in CCDB	Analysis Coordinator			/geometry/rich/config		
4	1	Update target materials in CCDB	Analysis Coordinator			/geometry/materials/target		
	-		Analysis Coordinator +					
5		Cable swaps	Subsystems			updated TTs and/or swap configuration		
	Preparatory		Analysis Coordinator +					
6	steps	TDC jitter	Subsystems			updated jitter tables		
7	- otops	DE antério CODB	Raffaella De Vita			updated /calibration/eb/rf/config		
	-	RF config in CCDB	Ranaetta De vita			updated /calibration/ft/ftcal/ecorr.		
8		FTCAL leakage and angular correction tables	Raffaella De Vita			/calibration/ft/ftcal/thetacorr,		
0		FTCAL teakage and angular contection tables	Haliaetta De vita			/calibration/ft/ftcal/obicorr		
	-					/calibration/rich/reco_flags		
9		RICH reco tables	Marco Mirazita			/calibration/rich/reco_parameters		
10	-	Pressure	Florian Hauenstein			updated /hall/weather/pressure		
11		hwp	Analysis Coordinator			updated /runcontrol/hwp		
12	Ancillary							
12	information	helicity	Analysis Coordinator			updated /runcontrol/helicity	physics timelines	
13	mormation	fcup and slm	Analysis Coordinator Christopher Dilks	-		updated /runcontrol/fcup and /runcontrol/slm Data-set specific settings		
		Setup physics timelines	Christopher Dilks			Data-set specific settings		
15	-	Raster calibration						
16	1	DC alignment	Raffaella De Vita	reasonable DC calibration, DC swaps,		updated /geometry/dc/alignment table in CCDB		https://github.com/JeffersonLab/clas12alignment/tree/master/dc
	-			zeroed beam spot (raster+beam position)				
17	1	CVT alignment	Yuri Gotra	BMT timing cuts in CCDB		updated /geometry/cvt/svt/layeralignment		the://dithub.com/miguelignacio/alignment/tree/master/clas12
	-			-		/geometry/cvt/mvt/alignment		
	Detector					updated /geometry/ftof/alignment		
18	alignment	FD alignment	Cole Smith	#16		/geometry/ec/alignment /geometry/pcal/alignment		
	-							
19	-	FMT alignment (if necessary)	Yuri Gotra	DC alignment		updated /geometry/fmt/alignment		tine://ditbub.com/lefforconl.bb/clas12alignmont/tree/master/lm
						updated CVT and beam position tables		
20		Beam offset		full pass0 with DC and CVT alignments	Pass0 recon files	/geometry/beam/position /geometry/cvt/svt/position	hearn enot analysis on new nasef	in grangestion
2.0		beamonace		tai passo min bo ana orrangimenta	1 4330 1000111103	/geometry/cvt/mvt/position	beam sport anarysis on new passo	in preparation
						rgeometry cvomvoposition		
21		RF calibration - remove global offsets	Raffaella De Vita	full pass0 after #19 and reasonable FTOF	Pass0 RF train	updated /calibration/eb/rf/on/eb/rf/offset	calibration timelines	ttps://dithub.com/lefterceni.ch/clas12calibration.d
21		RF calibration=remove global onsets	Hallaetta De vita	panel 1B calibration (sigma<100 ps)	Passo RF train	opuated /calibration/eb/n/on/eb/n/onset	caubration timetines	
22		FTOF calibration and HW status assessment	Daniel Carman	#21	Calibration train	updated FTOF calibration tables		New // New page 1 of the set of the set for the set of
22	2 Subsystem	FTOF caubration and Hw status assessment	Daniet Carman	#21	Caubration train	updated FTOF cationation tables		
23	calibration -	DC time offset calibration and HW status	Florian Hauenstein	#22		updated	calibration timelines	
23		DC time offset caubration and HW status	Florian Hauenstein	#22		/calibration/dc/time_corrections/T0Corrections	caubration timelines	
	phase 1					updated /calibration/band/time_walk_amp_left		
24		BAND time walk calibration	Florian Hauenstein		Laser data	/calibration/band/time_walk_amp_right	?	
25	1	RF calibration	Raffaella De Vita	#22	Pass0 RF train	updated /calibration/eb/rf/on/eb/rf/offset		tips://dithub.com/lefferconl.ab/clas12calibration.d
26		Second FTOF calibration (if necessary)	Daniel Carman	#25	Calibration train	updated FTOF calibration tables	calibration timelines	time://dithub.com/lefferconl.sh/clas13calibration.to
						updated		
27		DC time-to-distance calibration and TDC	Florian Hauenstein			/calibration/dc/time_to_distance/T2Dpressure		
		cuts						
	-			-		/calibration/dc/time_corrections/TDCtimingcuts		
28		BAND calibration and HW status	Florian Hauenstein	-		/calibration/dc/time_corrections/TDCtimingcuts updated /calibration/band/*		
28	-	BAND calibration and HW status	Florian Hauenstein	-				
	-			-	Calibration train	updated /calibration/band/*		See tutorial and algorithm documentation at
28 29	-	BAND calibration and HW status CND calibration and HW status	Florian Hauenstein Silvia Niccolai		Calibration train			See tutorial and algorithm documentation at https://gilhub.com/leffersoni.ab/clas12calibration-cnd
29	Subsystem	CND calibration and HW status	Silvia Niccolai			updated /calibration/band/* updated /calibration/cnd/*		
	Subsystem				Calibration train Calibration train	updated /calibration/band/*	calibration timelines	
29 30 31	calibration -	CND calibration and HW status CTOF calibration and HW status ECAL calibration and HW status	Silvia Niccolai Daniel Carman Cole Smith	¥26	Calibration train	updated /calibration/band/* updated /calibration/cnd/* updated /calibration/ctof/* updated /calibration/ccal/*	calibration timelines	
29 30 31 32		CND calibration and HW status CTOF calibration and HW status ECAL calibration and HW status FT-Cal calibration and HW status	Silvia Niccolai Daniel Carman Cole Smith Raffaella De Vita	¥26	Calibration train	updated /calibration/band/* updated /calibration/cnd/* updated /calibration/cod/* updated /calibration/ccd/* updated /calibration/t/ttcd/*	calibration timelines	
29 30 31 32 33	calibration -	CND calibration and HW status CTOF calibration and HW status ECAL calibration and HW status FT-CaL calibration and HW status FT-Hodo calibration and HW status	Silvia Niccolai Daniel Carman Cole Smith Raffaella De Vita Nick Zachariou	¥26	Calibration train Calibration train Calibration train	updated /calibration/band * updated /calibration/cnd/* updated /calibration/cnd/* updated /calibration/ctd/* updated /calibration/ftcd/* updated /calibration/ftcd/*	calibration timelines	
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29 30 31 32 33 34	calibration -	CND calibration and HW status CTOF calibration and HW status ECAL calibration and HW status FF-Eda calibration and HW status FF-Hodo calibration and HW status HTCC calibration and HW status	Silvia Niccolai Daniel Carman Cale Smith Raffaella De Vita Nick Zachariou Izzy Illari	#26	Calibration train Calibration train Calibration train Calibration train	updated /calibration/band* updated /calibration/cnd/* updated /calibration/cnd/* updated /calibration/cnd/* updated /calibration/thcd/* updated /calibration/htcc/*	collbration timelines	
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29 30 31 32 33 34 35	calibration -	CND calibration and HW status COTE calibration and HW status IECAL calibration and HW status FT-Focia calibration and HW status FT-Fodo calibration and HW status HTCC calibration and HW status LTCC calibration and HW status	Silvia Niccolai Daniel Carman Cole Smith Raffaella De Vita Nick Zachariou Izzy Illari Valerio Mascagna	¥26	Calibration train Calibration train Calibration train Calibration train Raw data	updated /calibration/band/* updated /calibration/cnd/* updated /calibration/cnd/* updated /calibration/treal/* updated /ca	collocation timelines	
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29 30 31 32 33 34 35 36 36 37 38 39 40	calibration phase 2 Subsystem calibration phase 3	CND calibration and HW status ECICE calibration and HW status ECL calibration and HW status ECL calibration and HW status HF-Cat calibration and HW status HTCC calibration and HW status LTCC calibration and HW status RICH timing calibration Additional subsystem calibrations ECAL sampling fraction tables RICH Chernekov angle calibration and HW status	Silvia Niccolai Daniel Carman Cole Smith Rofinatela De Vita Nick Zacharirou Izzy Illari Valerio Mascagna Marco Mirazita Subsystems Cole Smith Marco Mirazita	#26 #31 #36	Calibration train Calibration train Calibration train Calibration train Raw data Calibration train	updated /calibration/band* updated /calibration/cnd* updated /calibration/cnd* updated /calibration/cnd* updated /calibration/thcd* updated /calibration/thcd* updated /calibration/thcc* updated /calibration/tcc* updated /calibrat	calibration Emelines Al vs conventional studies with withbout denoising and	
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29 30 31 32 33 34 35 36 36 37 38 39 40	calibration- phase 2 Subsystem calibration- phase 3 Al networks	CND calibration and HW status ICOE calibration and HW status IECAL calibration and HW status IFC-Lac calibration and HW status IFC-Lac calibration and HW status IFC-Cac calibration and HW status IFCC calibration and HW status IFCC calibration and HW status RICH timing calibration RICH timing calibrations ECAL sampling fraction tables RICH Chernkov angle calibration and HW status	Silvia Niccolai Daniel Carman Cole Smith Raffeello De Vita Niek Zachariou Ezy Itari Valeria Mascagna Marco Mirazita Subsystema Cole Smith Marco Mirazita Analysis Coordinator	#26 #31 #36	Calibration train Calibration train Calibration train Calibration train Raw data Calibration train	updated /calibration/cand* updated /calibration/cand* updated /calibration/cad* updated /calibration/cad* updated /calibration/tad* updated /calibration/tad* /calibration/tad* updated /calibration/tad* /calibration/tad* updated /calibration/tad* /calibration/tad* updated /calibration/tad* updated /calibration/tad* updated /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad* /calibration/tad*	calibration Emelines Al vs conventional studies with withbout denoising and	
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Reduction of data volumes

- Data volumes produced for calibration and monitoring of a data set can amount to hundreds of TB
 - Transient data usually written to /volatile (400 TB CLAS12 quota)
 - Large volume due to reconstructed files with all necessary banks for calibration (~5xDSTs)
 - Can lead to early deletion when calibrating multiple data sets
 - Partial mitigation in the final detector specific calibration skims with event and bank filtering, but still 10s, up to 100s GB per typical calibration run (100 M events)
- Analysis of banks list and sizes in reconstructed files for calibration indicates:
 - Data required for a specific detector calibration is often spread in many banks that need to be included in the output
 - Often, only a fraction of those bank entries (e.g. hits, clusters, ...) is used
 - Few detectors dominate the overall volume
- Large reduction can be achieved by building calibration-specific banks with:
 - All the information needed
 - Only for the hits/clusters/... that are relevant
 - Only for the events of interest
- Quantitative study based on first implementation:
 - New calibration banks designed with the help of detector experts
 - Tested on "major" contributors (DC, FTOF, RICH)
 - Reduction of corresponding volumes ranging from 5x (DC) to 30x (FTOF)
 - Overall reduction of reconstruction output of 3x
 - Benefit for calibration skims too

Calibration tools

- Currently, most detector calibrations are run interactively and/or require results inspection by the calibrator to assess convergence
- First list of upgrades necessary to minimize human intervention and move towards automation:
 - extend software functionalities
 - improve robustness of analysis algorithms
 - implement clear metrics for evaluating the results quality
- First step by collecting all calibration software in a single gitlab repository
 - facilitate implementation of new software functionalities
 - simplify code management and maintenance

Just at the beginning, more to come in the next months



Summary

- First phase focused on collection of data completed:
 - Several factors impact the calibration process efficiency, i.e. not a single culprit
 - Combined effort is needed to strengthen procedures, reduce usage of computing resources, and improve automation of calibration tools
- First action items identified and addressed
- Now moving the focus to calibration tools

