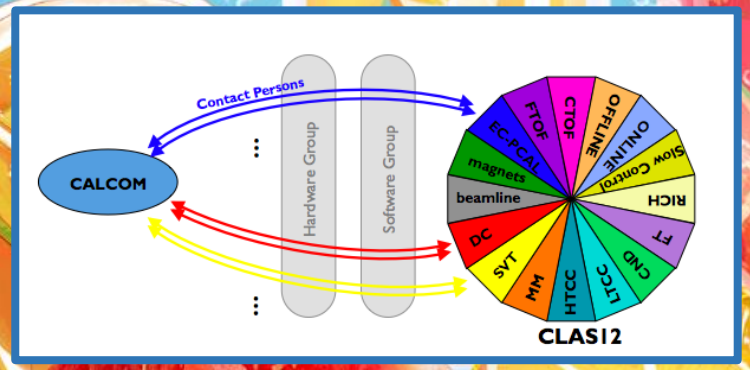
CALCOM Status and Plans

Topics:

- Calibration status - RG-L
- Pass-3 preparations
- DC performance study
- Summary



Daniel S. Carman

CLAS Collaboration Meeting

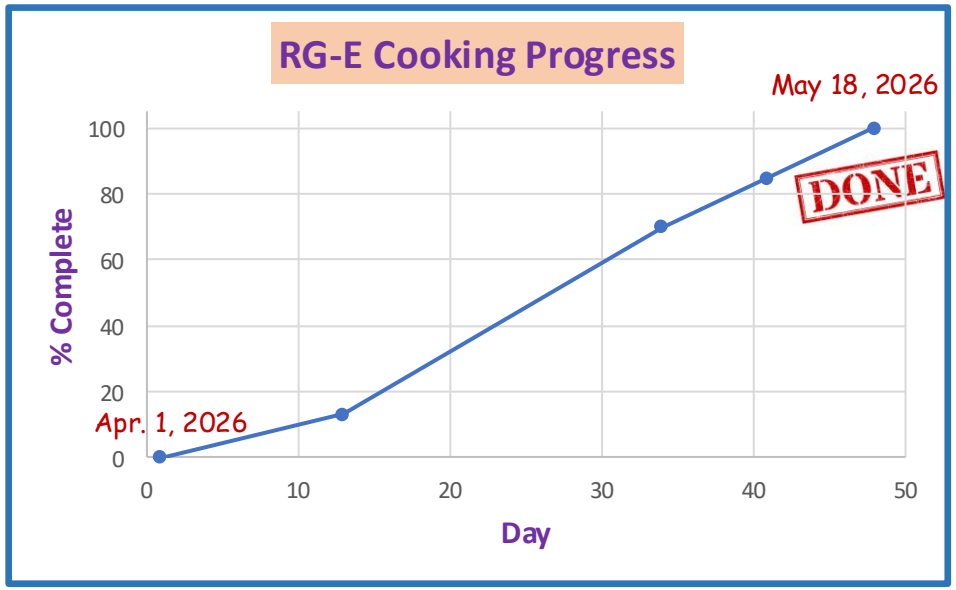
June 29-July 2, 2026

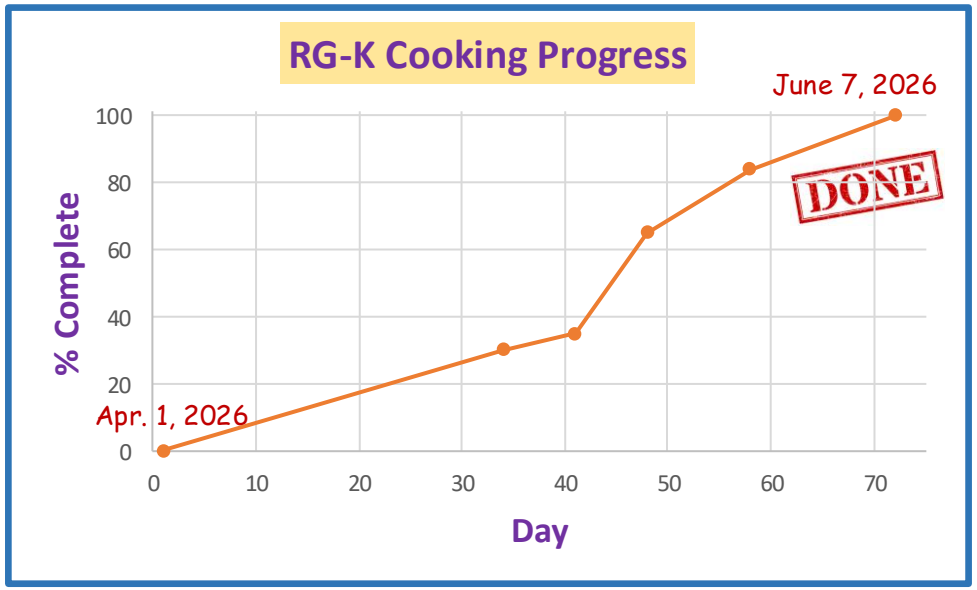
Active Run Groups in Calibration Mode – June 2026

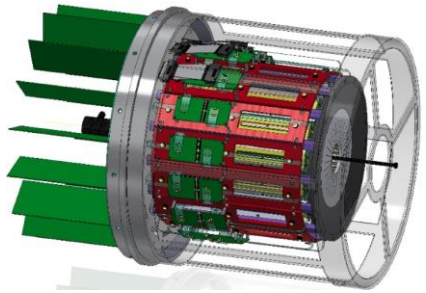
#	Run Group	Dataset	Conditions	Run Range	Stage
1	RG-L	Spr25	D2, 4He 2.2 GeV, 10.7 GeV	21310 - 23065	Calibrating

A single dataset now being calibrated

	Analysis Coordinator	Chef
RG-L	Mohammad Hattawy	Mathieu Ouillon, Noémie Pilleux

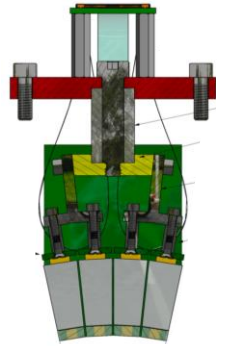






RG-L Spr/Sum25 - Status

[5] RG-L – Pass-1 Calibration Review Nov. 14, 2025



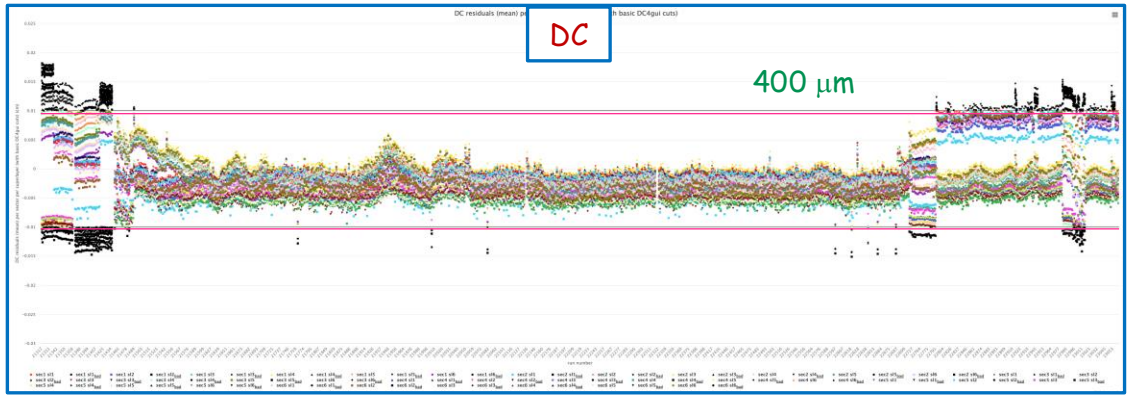
FD calibrations -- where do things stand?

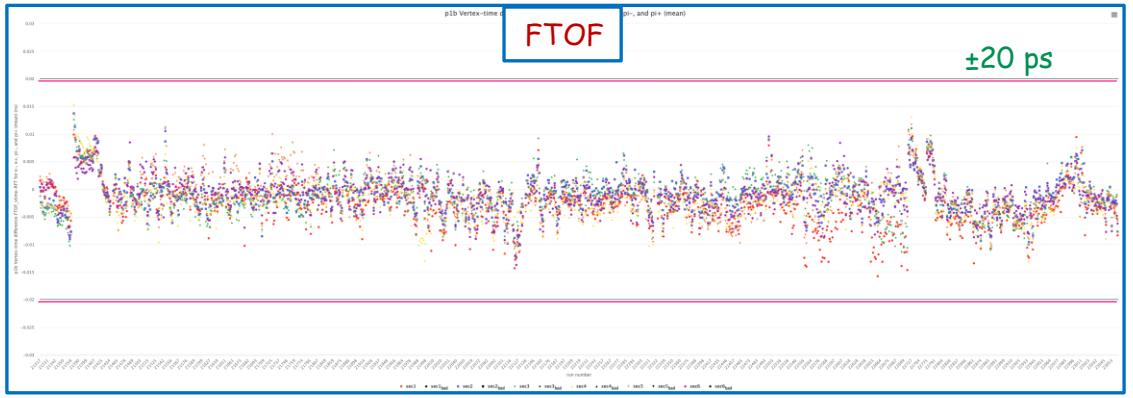
- DC alignment finished
  - 2nd iteration required after finding S4 shift
- Beam offset calibrations done
- Calibrations are done for:
  - RF, FTOF, ECAL
- Calibrations in progress for:
  - HTCC, RICH, LTCC, FT-Hodo, FT-Cal
- DC calibrations in progress:
  - Initial t_0 calibrations done
  - TDC window cuts complete
  - Time-over-threshold cuts considered
  - Time-to-distance calibrations underway

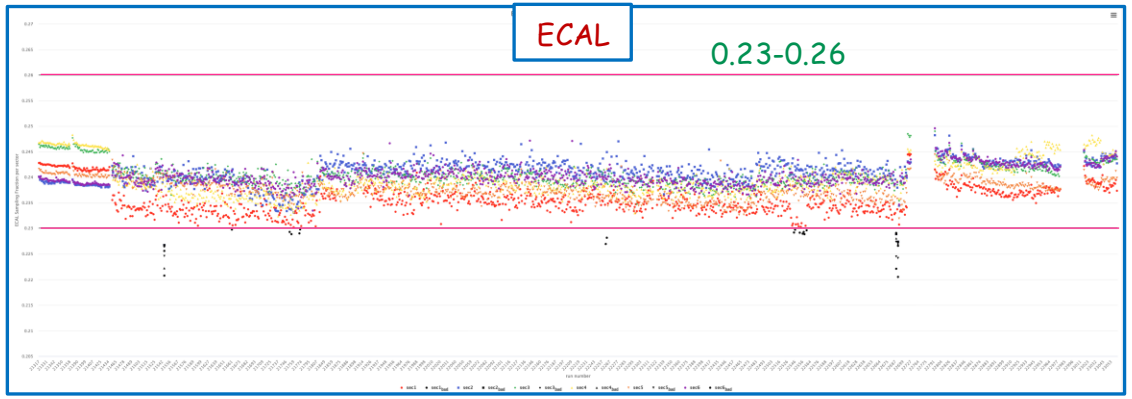
CD calibrations – where do things stand?

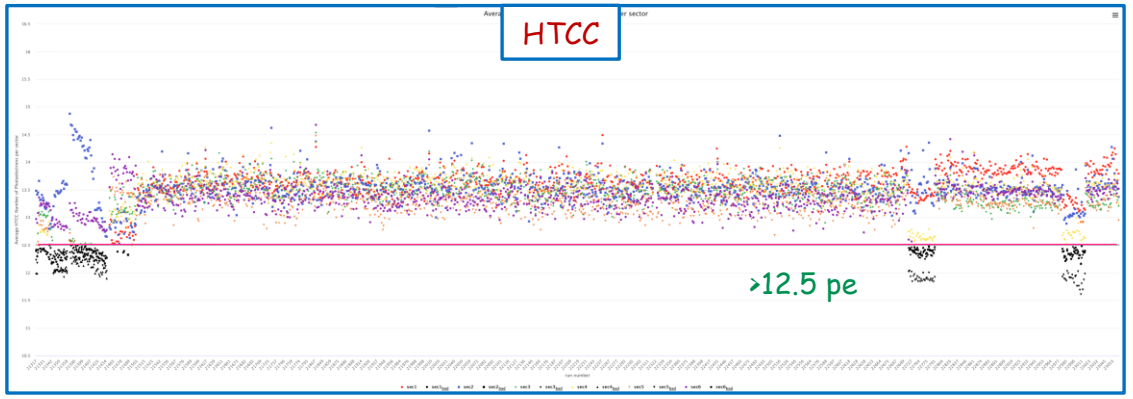
- Development/validation of ATOF and AHDC algorithms & suites in progress using data and MC
- ATOF calibrations in progress:
  - Global time offsets advanced
  - Energy loss calibrations ongoing
- AHDC calibrations in progress:
  - Initial t_0 calibrations done
  - Initial time-to-distance calibrations in progress with layer dependence
- ALERT alignment (layer, wire-to-wire, Δz) in progress
- Calibration of CTOF and CND (procedure TBD)
- Difficult to predict when cooking of dataset will begin – aiming for 2026 completion

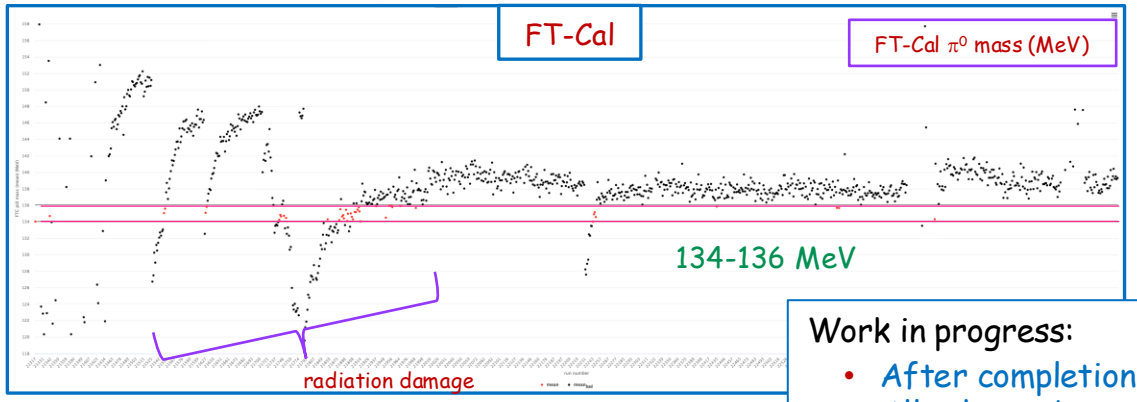
RG-L Sum25 – Calibration Timelines

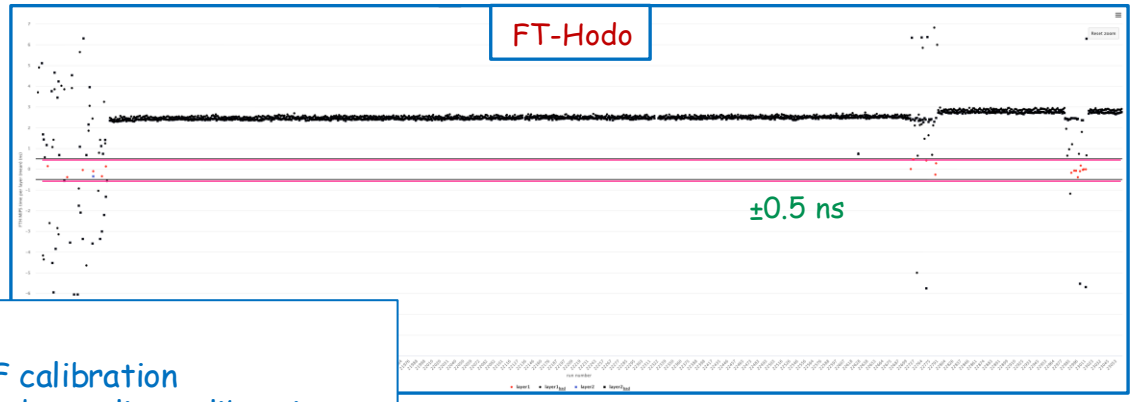












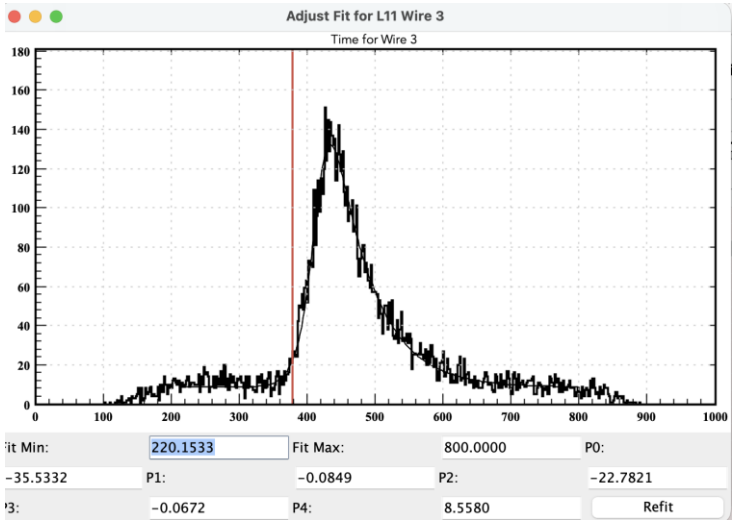
Work in progress:

- After completion of FTOF calibration
- All other subsystems based on online calibrations

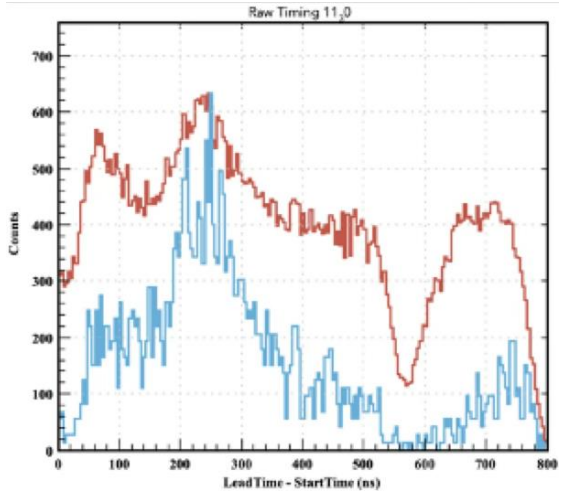
RG-L ALERT AHDC Calibration Status

Michael Paolone

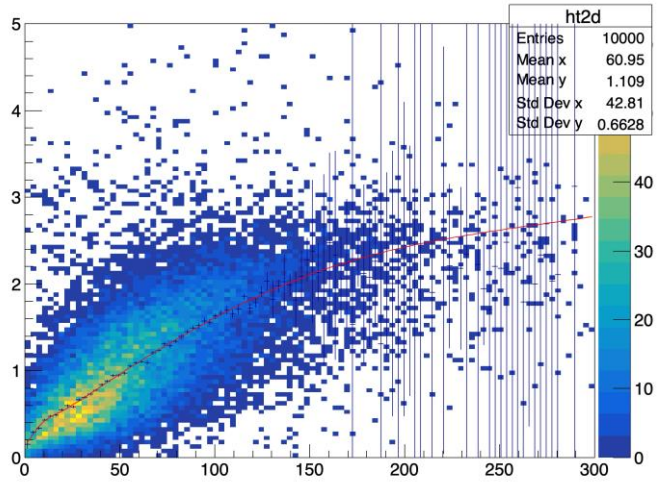
- Timing:
  - T_0 calibrations on early calibration runs: completed
  - T_0 calibration-timelines on production: in progress
    - Challenges: Clean timing signal; PID will help once implemented
- Time-to-Distance:
  - Initial T2D on early calibration runs: completed
  - T2D timelines on production: just starting
    - Challenges: iterative with T_0 calibration
- ADC gains:
  - Initial gains calibration on early calibration runs: completed
  - Gains timelines on production: in progress
    - Challenges: identifying clean signals above background



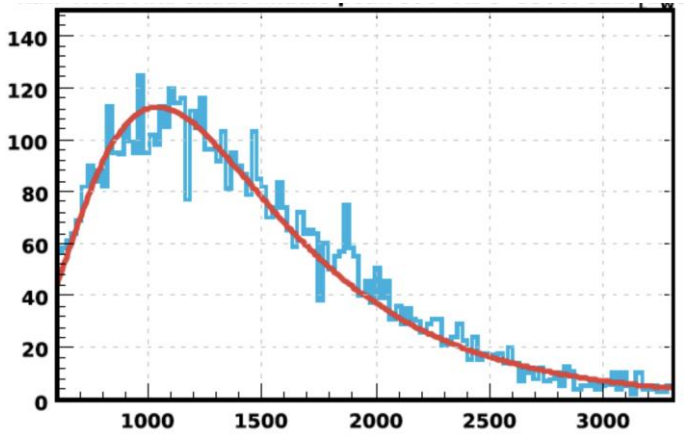
Calibration timing spectra for a single wire, with T_0 fit



Production run timing spectra for single wire (red) with clustering to reject noise (blue)



Time vs. distance distribution (all wires) from calibration run (with T2D fit function)

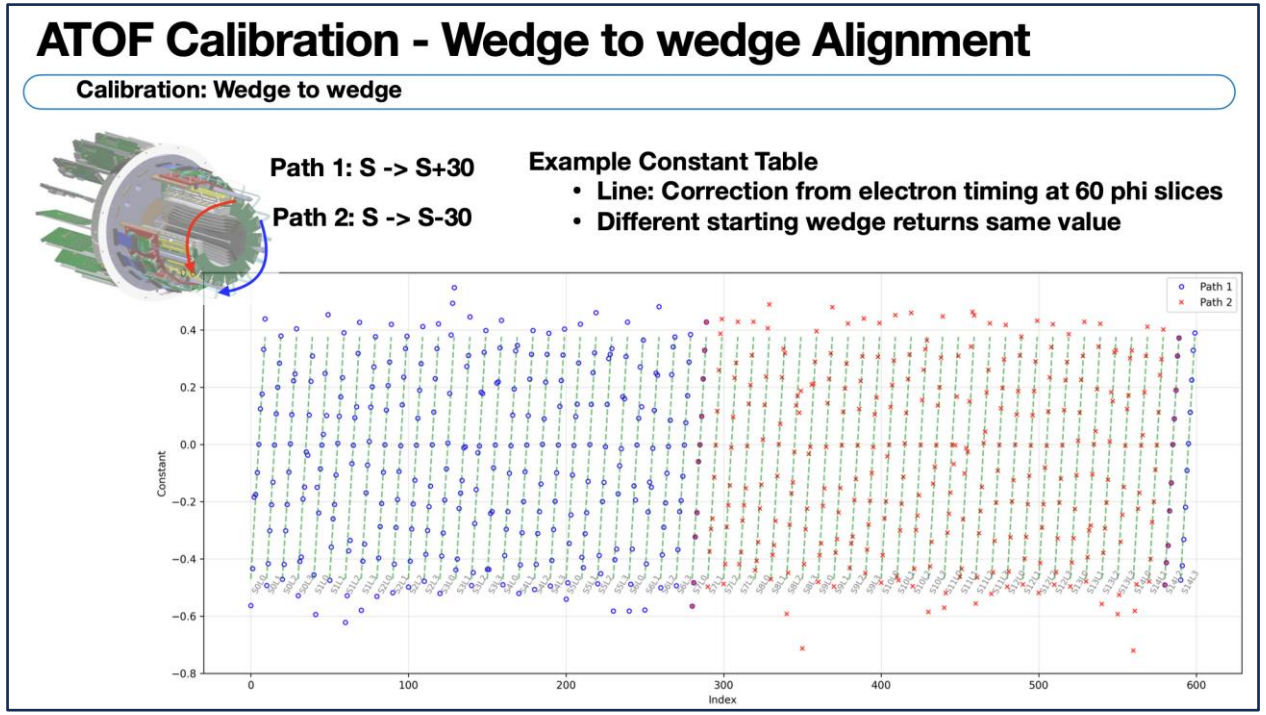


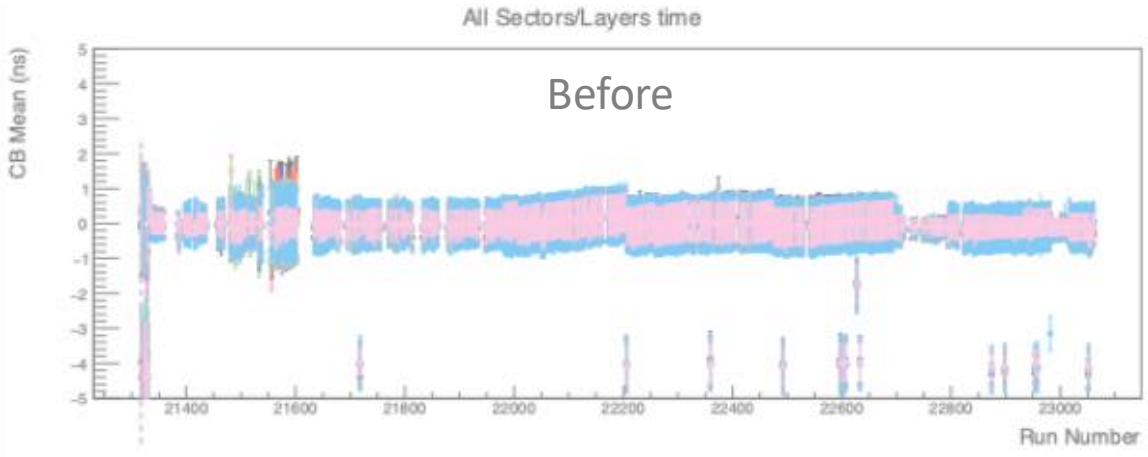
Fit to single wire ADC gain spectra for low momentum proton tracks

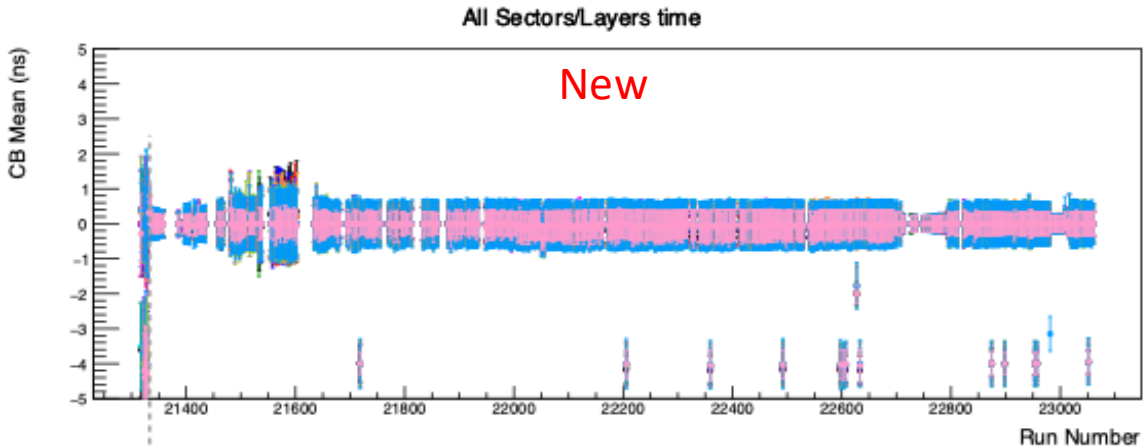
RG-L ALERT ATOF Calibration Status

Zhiwan Xu

- Work on ATOF timing has advanced:
  - Wedge-to-wedge alignment procedure developed and used for calibration
  - Global timing studied vs. run # within the different RG-L run periods (2, 6, 11 GeV) and functionals development to remove drifts
- Effective velocity calibration calibrated
- CCDB tables updated
- CalCode: https://code.jlab.org/hallb/alert/atof/atof-timeline
- ATOF calibration still needs matching with AHDC
- Energy loss calibrations upcoming

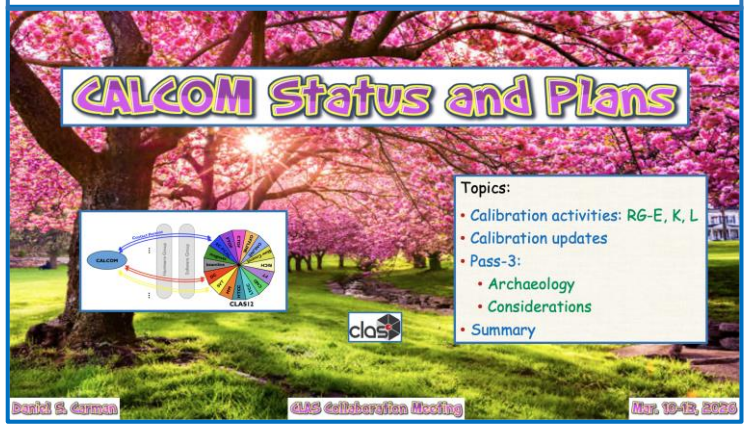






Pass-3 Considerations

Summary: CALCOM update Mar. 2026



1. DC realignment efforts to account for the thermal contraction of the cryotarget
   - Includes improved zero-field DC calibration protocols and improved alignment software since pass-2 work
   - Includes updates to DC geometry after extensive review
2. Application of new protocols for DC time offsets and time-to-distance calibration
   - New TDC jitter corrections, time window cuts
3. Updated calibration protocols for subsystems
4. Improved tracking algorithms – DC and CVT
5. Investigations of tracking anomalies
   - Attempt to explain angle and charge dependence of forward track reconstruction
6. Run-by-run hardware status tables
7. New RICH alignment and calibration procedures
8. Matching Monte Carlo to data

Pass-3 Development Status

1. Suite development:
   - ✅ Implementation of subsystem calibration banks (smaller disk size, faster processing) (Raffaella)
   - WORK IN PROGRESS DC benchmarking and validation (Florian)
   - ✅ Suite batch compatibility – includes save histogram feature (Nathan/Chris)
   - ✅ Calibration suite updates/streamlining (Developers)
2. Workflow improvements:
   - ✅ Simplification to YAML configuration files (Nathan/Raffaella)
   - ✅ Code speed-ups (decoding and reconstruction) (Nathan)
   - ✅ Workflow simplification (decoding and denoising in CLARA) (Nathan/Raffaella)
   - WORK IN PROGRESS Single chef model (Nathan)
3. Reconstruction development:
   - ✅ New DC denoising algorithm and implementation of AI methods into HBT (Tongtong)
   - 🚧 WORK IN PROGRESS Improvements to conventional CVT tracking (Veronique/Tongtong)
   - 🚧 WORK IN PROGRESS Development/exploration of AI tracking finding/denoising for CVT (Pierre/Richard/Tongtong)
4. Calibration procedure tracking:
   - ✅ Calibration dashboard checklist (Chris/Daniel)
5. Miscellaneous studies:
   - 🚧 TO BE DONE Study torus field map systematics (Mathieu/Raffaella)
   - 🚧 TO BE DONE Revisit implementation of DC endplate bowing (Mathieu/Raffaella)
   - 🚧 TO BE DONE Study CVT global alignment (i.e. tilts/rotations) (TBD)

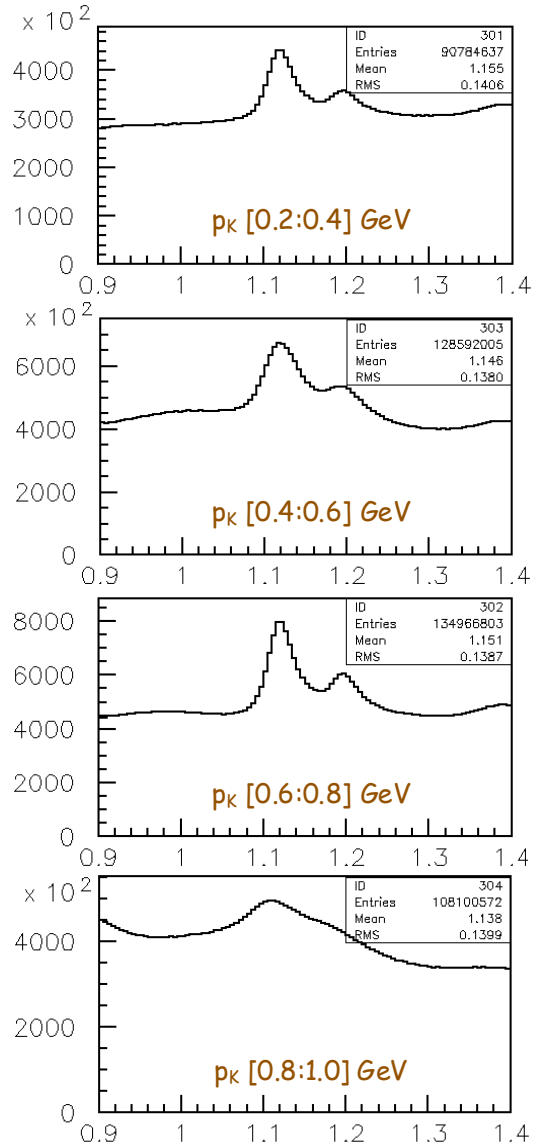
Pass-3 Development Status – CVT Tracking

3. Reconstruction development:
   - ✅ New DC denoising algorithm and implementation of AI methods into HBT (Tongtong)
   - 🚧 Improvements to conventional CVT tracking (Veronique/Tongtong)
   - 🚧 Development/exploration of AI tracking finding/denoising for CVT (Pierre/Richard/Tongtong)

Synthesis of email from Richard Tyson – June 25, 2026

1. We have been investigating denoising in the CD – two main problems:
   - "fake" tracks formed by noise
   - noise hits distorting "true" clusters & tracks
2. Most of our work so far has been optimizing the various parameters of the denoising, such as which variables are used by the network and the network internal parameters. We now have a fairly good idea of how these parameters affect the network performance.
   - I'm hopeful that in the next 6 months we can have the denoising fully integrated in the reconstruction, with a view towards doing larger collaboration wide testing.
3. We are now studying signal hit efficiencies and background hit rejection in simulation.
   - Our first next step is to get a feeling for the impact of the network on the full reconstruction efficiencies and resolutions.
   - Tongtong has written code to integrate the network in COATJAVA so that we can hopefully begin testing effects on reconstruction.
4. Tongtong is now taking over lead on CD tracking
   - Continuing work started by Veronique on a number of projects - including improvements to conventional algorithms on tracking seeding using the CTOF integrating the denoising.
   - There's also scope to look at track finding, although this will depend somewhat on the outcome of the denoising.

RG-K 6.4 GeV data



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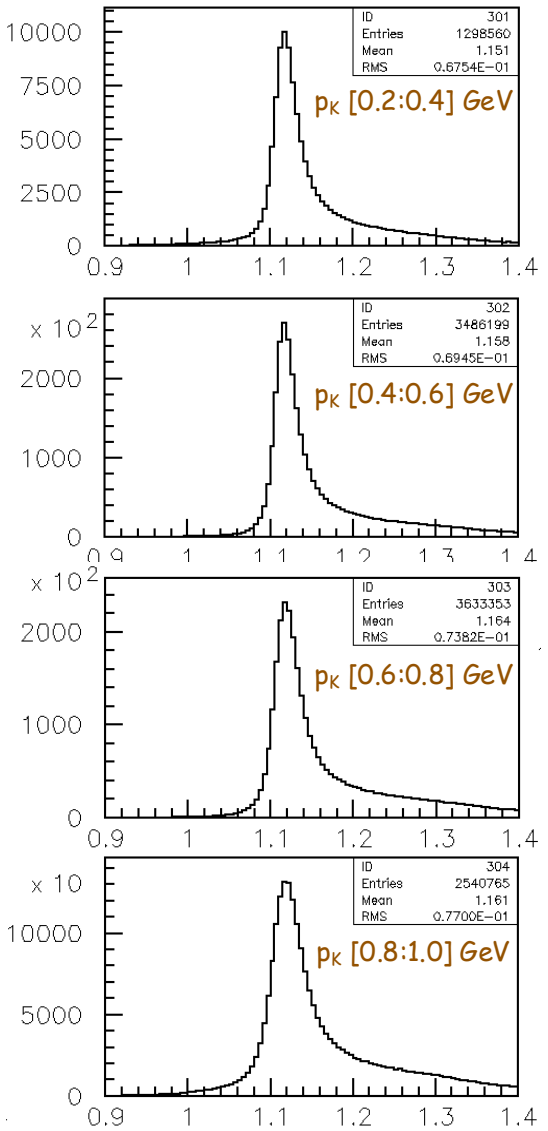
RG-K 6.4 GeV MC



Calibration Dashboard

Christopher Dilks

All Dashboards | Run Group L | Template | Test

Run Group L Calibration Dashboard

Dashboard View | Table View

Start Point

Index	Status	Task	Contact Person	Validation	Prerequisites
0	done	Online calibration	Analysis Coordinator + Subsystems		

Preparatory Steps

Index	Status	Task	Contact Person	Validation	Prerequisites
1	ongoing	Cable swaps	Analysis Coordinator + Subsystems		0
2	ongoing	FTCAL leakage and angular correction tables	Raffaella De Vita		0
3	ongoing	RICH reco tables	Marco Mirazita		0
4	ongoing	DC TDC cuts	Florian Hauenstein		0
5	ready	Update geometry in CCDB	Analysis Coordinator		0
6	ready	Update target materials in CCDB	Analysis Coordinator		0
7	ready	TDC jitter	Analysis Coordinator + Subsystems		0
8	done	Dataset archaeology	Daniel Carman		0
9	done	Pressure	Florian Hauenstein		0
10	done	Ready for Calibration review	Daniel Carman		0
11	done	RF config in CCDB	Raffaella De Vita		0
12	blocked	Sign Off Preparatory Steps			1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

Ancillary Information

Index	Status	Task	Contact Person	Validation	Prerequisites
13	done	Run Initial Physics Timelines	Chef + Christopher Dilks	physics timelines	
14	done	Helicity and Initial HWP	Nathan Baltzell	physics timelines	
15	done	FCup, Beam Blocker, and SLM	Rafayel Paremuzyan + Nathan Baltzell	physics timelines	
16	done	Sign Off Ancillary Information			13, 14, 15

Detector Alignment

Index	Status	Task	Contact Person	Validation	Prerequisites
17	done	Sign Off Detector Alignment			18, 19, 20
18	done	DC alignment	Raffaella De Vita		
19	done	Beam offset		beam spot analysis on new pass0	20
20	done	FD alignment	Cole Smith		18

Calibration Phase 1

Index	Status	Task	Contact Person	Validation	Prerequisites
21	done	RF calibration - remove global offsets	Raffaella De Vita	calibration timelines	19
22	done	FTOF calibration and HW status assessment	Daniel Carman		21
23	done	Second FTOF calibration (if necessary)	Daniel Carman	calibration timelines	24
24	done	RF calibration	Raffaella De Vita		22
25	done	DC time offset calibration	Florian Hauenstein	calibration timelines	22
26	done	Sign Off Calibration Phase 1			21, 22, 23, 24, 25

Calibration Phase 2

Index	Status	Task	Contact Person	Validation	Prerequisites
27	ongoing	ALERT alignment			26
28	ongoing	DC calibration and HW status	Florian Hauenstein	calibration timelines	26
29	ongoing	CND calibration and HW status	Silvia Niccolai	calibration timelines	26
30	ongoing	CTOF calibration and HW status	Daniel Carman	calibration timelines	26
31	ongoing	FT-Cal calibration and HW status	Raffaella De Vita	calibration timelines	26
32	ongoing	FT-Hodo calibration and HW status	Nick Zachariou	calibration timelines	26
33	ongoing	HTCC calibration and HW status	Izzy Illari	calibration timelines	26
34	ongoing	LTCC calibration and HW status	Valerio Mascagna	calibration timelines	26
35	ongoing	RICH timing calibration	Marco Mirazita	calibration timelines	26, 39
36	ready	BAND calibration and HW status	Florian Hauenstein	calibration timelines	26
37	ongoing	ATOF calibration and HW status			27
38	ongoing	AHDC calibration and HW status			27
39	done	RICH alignment	Marco Mirazita		18
40	done	ECAL calibration and HW status	Cole Smith	calibration timelines	26
41	blocked	Sign Off Calibration Phase 2			27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Calibration Phase 3

Index	Status	Task	Contact Person	Validation	Prerequisites
42	ready	BAND time walk calibration	Florian Hauenstein	?	10
43	ready	Additional subsystem calibrations	Subsystems	calibration timelines	26
44	ready	ECAL sampling fraction tables	Cole Smith	calibration timelines	40
45	ongoing	RICH Cherenkov angle calibration and HW status	Marco Mirazita	calibration timelines	35
46	blocked	Sign Off Calibration Phase 3			42, 43, 44, 45

AI Networks

Index	Status	Task	Contact Person	Validation	Prerequisites
47	blocked	Train DC AI track-finding networks	Analysis Coordinator	AI vs conventional studies with/without denoising and luminosity scan analysis	46
48	blocked	Test DC denoising network	Analysis Coordinator	AI vs conventional studies with/without denoising and luminosity scan analysis	46
49	blocked	Sign Off AI Networks			47, 48

Final Check

Index	Status	Task	Contact Person	Validation	Prerequisites
50	blocked	Final calibration checks	Analysis Coordinator	calibration and physics timelines (with new software release if necessary)	51
51	blocked	Run Physics Timelines	Chef + Christopher Dilks		49
52	blocked	Final HWP			51

Cooking Readiness

Index	Status	Task	Contact Person	Validation	Prerequisites
53	blocked	Physics trains definition	Analysis Coordinator		50
54	blocked	Data vs. MC efficiency study	Analysis Coordinator		50
55	blocked	Physics analyses - final validation	Run Group		53

Drift Chamber Studies

CLAS12-Note 2026-004

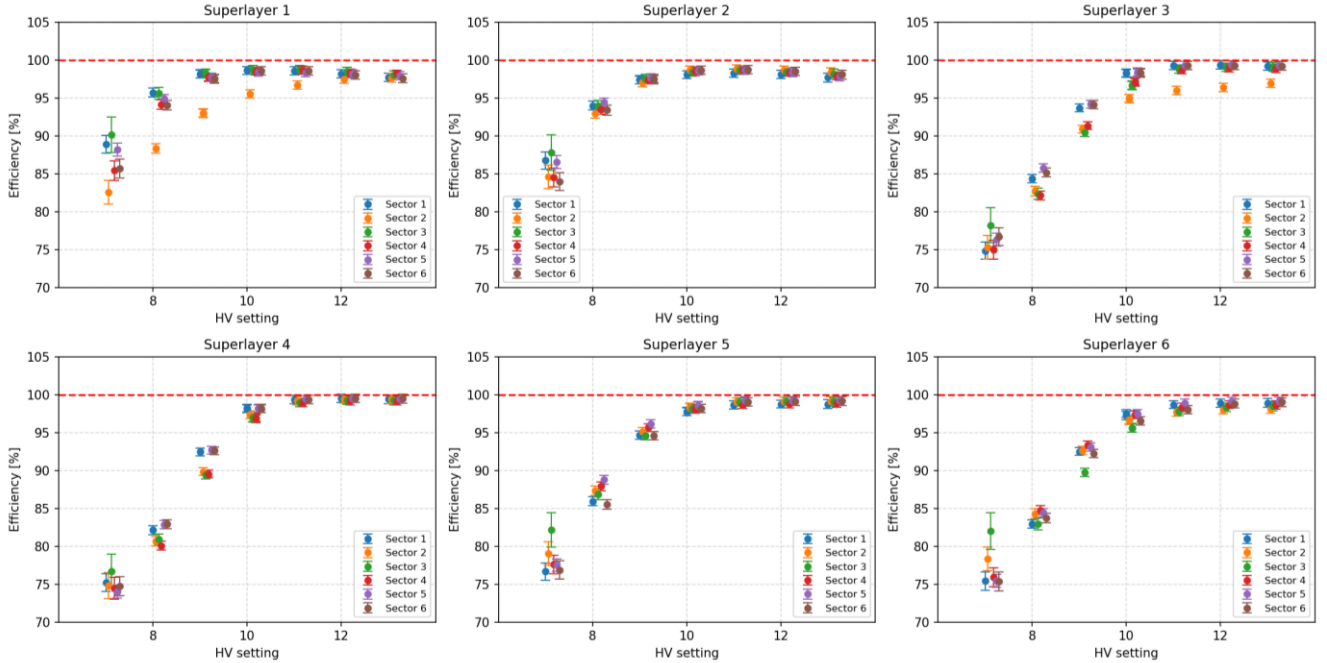
Exploration of CLAS12 Drift Chamber Resolution and Efficiency

Daniel S. Carman, Florian Hauenstein, Veronique Ziegler
Jefferson Laboratory

(Dated: May 18, 2026)

Explorations of the CLAS12 drift chamber performance in terms of resolution and hit efficiency have been completed based mainly on data taken during the RG-K 2023 commissioning run and the 2024 production beam time. The resolutions were explored as a function of the high voltage configuration settings for each drift chamber region in terms of missing mass and invariant mass reconstructions for different final states spanning a broad kinematic range. The resolution was also explored as a function of the beam-target luminosity. The single-layer hit efficiency was explored as a function of the high voltage settings for each drift chamber region and as a function of the discriminator threshold setting. Finally, the drift chamber calibration protocols have undergone a new implementation since 2024 and the impact of these substantive updates is quantified.

Efficiency



Resolution

1) The CLAS12 resolution function for missing mass is driven primarily by the HV setting of DC R2
2) The CLAS12 resolution function for missing mass has a very weak dependence on the R1 and R3 HV settings
3) The resolution studies from different final state channels show a reasonable correspondence when scaling from channel-to-channel

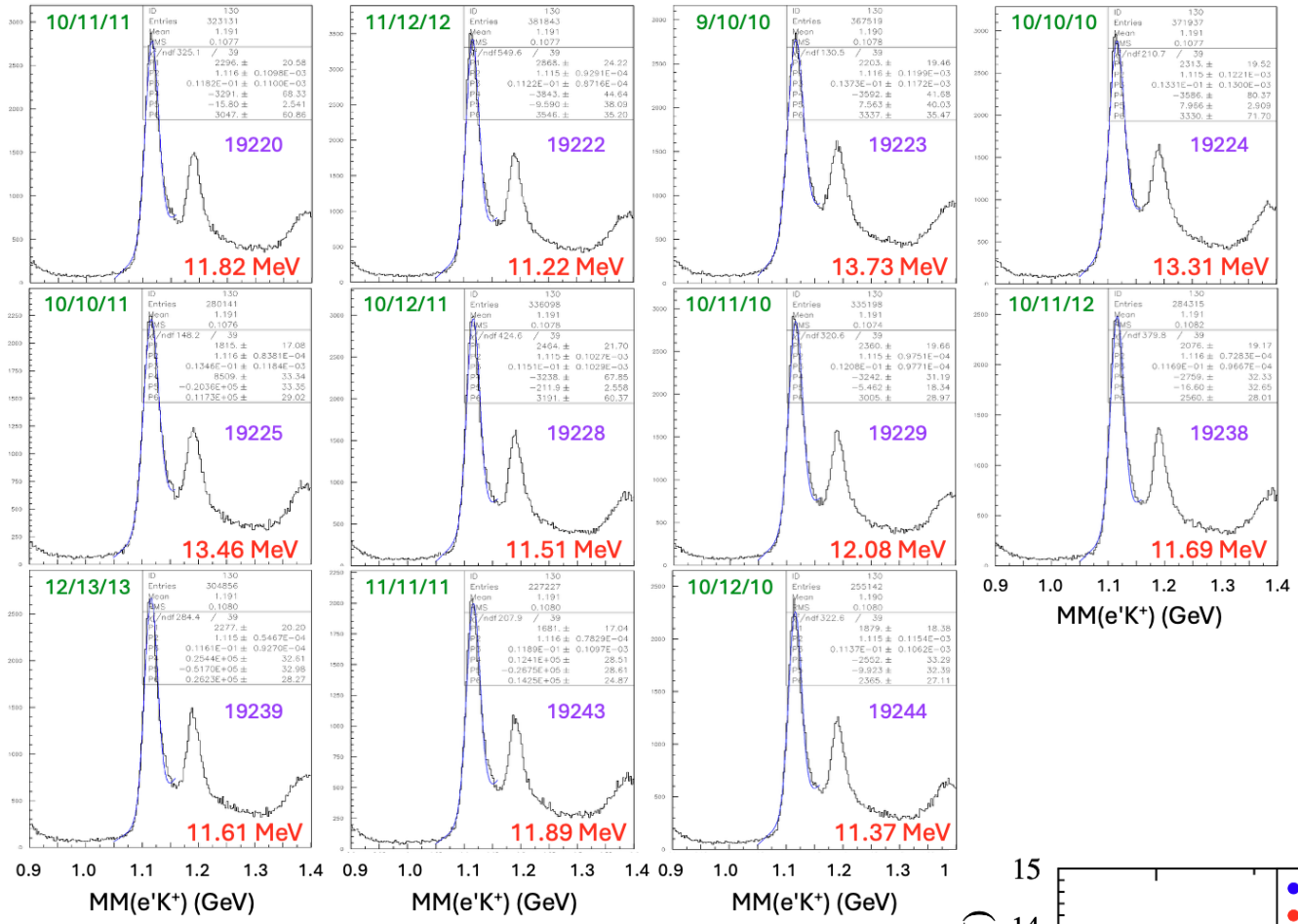
CLAS12 DC HV Setting History

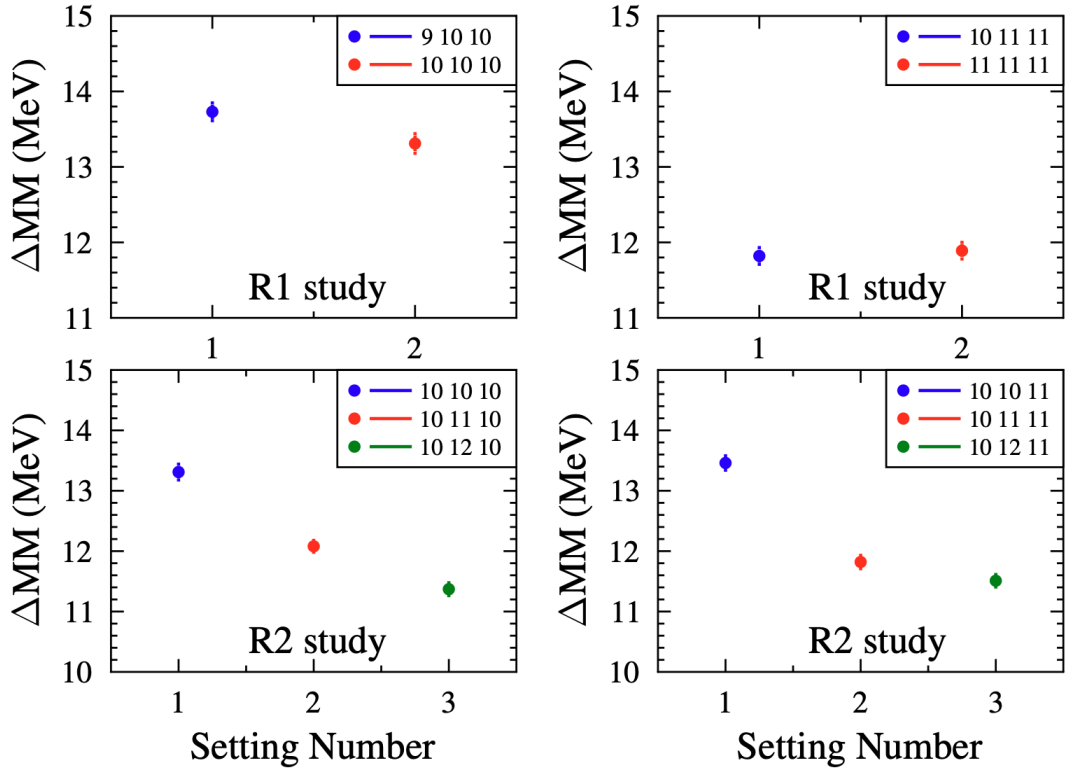
Run Number	R1 DC HV Setting	R2 DC HV Setting	R3 DC HV Setting
19220	10	11	11
3 19222	11	12	12
19223	9	10	10
19224	10	10	10
19225	10	10	11
19226	10	10	11
4 19228	10	12	11
19229	10	11	10
19238	10	11	12
19239	12	13	13
19243	11	11	11
19244	10	12	10

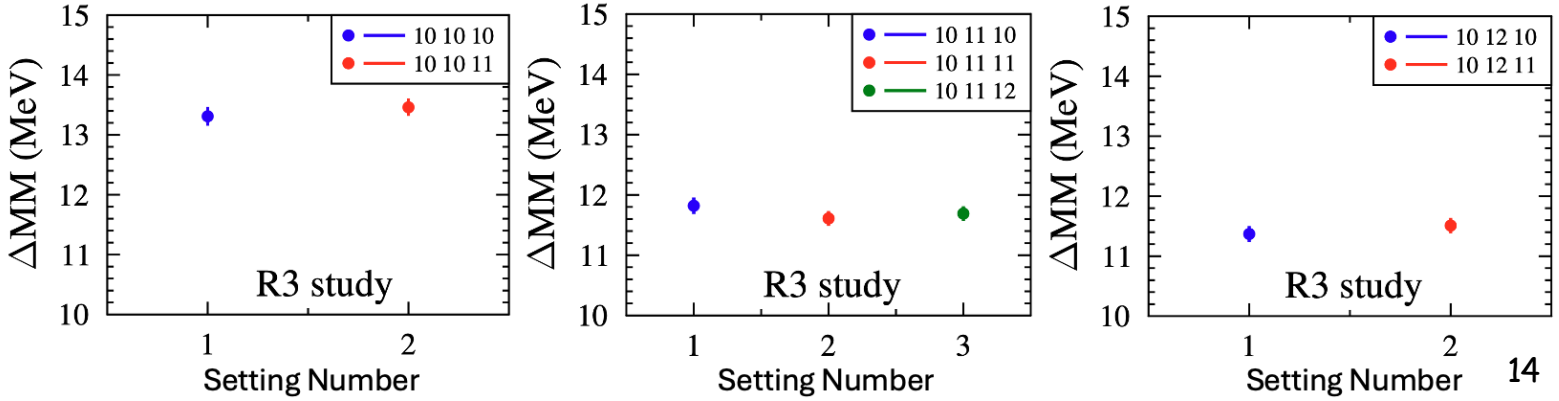
Run Group	Date Range	R1	R2	R3
RG-A Spr18	2/2018 - 5/2018	8	10	9
RG-A F18 (early)	10/2018	8	9	9
RG-A F18	10/2018 - 11/2018	9	10	10
RG-K Win18	11/2018 - 12/2018			
RG-A Spr19	3/2019 - 4/2019			
RG-B Spr19	2/2019 - 3/2019			
RG-B F19/W20	12/2019 - 1/2020			
RG-F	2/2020 - 9/2020			
RG-M	10/2021 - 2/2022	10	10	10
RG-C	6/2022 - 3/2023			
RG-D	10/2023 - 12/2023	10	11	11
RG-E	3/2025 - 5/2025			
RG-K Spr24 (3rd pass)	1/2024 - 2/2024	11	12	12
RG-K Spr24 (4th pass)	2/2024 - 3/2024	10	12	11
RG-L (5th pass)	4/2025 - 7/2025	9	11	11
RG-L (3rd pass)	8/2025 - 9/2025	10	11	11

DC HV Scan - KY

E_b = 6.395 GeV
Torus = 100% outbending
Solenoid = 100%
FT-Off







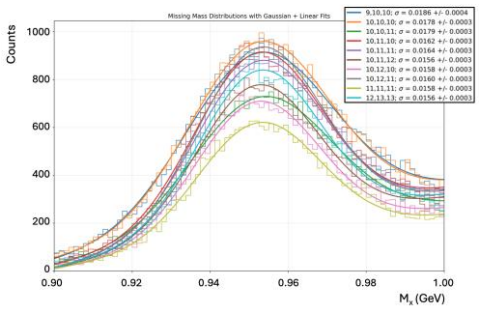
- Elastic scattering: ep → e'X Yijie Wang (MIT)
- $K^+\Lambda$ exclusive: ep → e'$K^+\Lambda$ Daniel Carman (JLab)
- π^+n exclusive: ep → e'π^+n Timothy Hawyard (MIT/JLab)
- $\pi^+\pi^-p$ exclusive: ep → e'$\pi^+\pi^-$p Krishna Neupane (JLab/CNF)
- Λ semi-inclusive: ep → e'ΛX, Λ → pπ^- Veronique Ziegler (JLab)

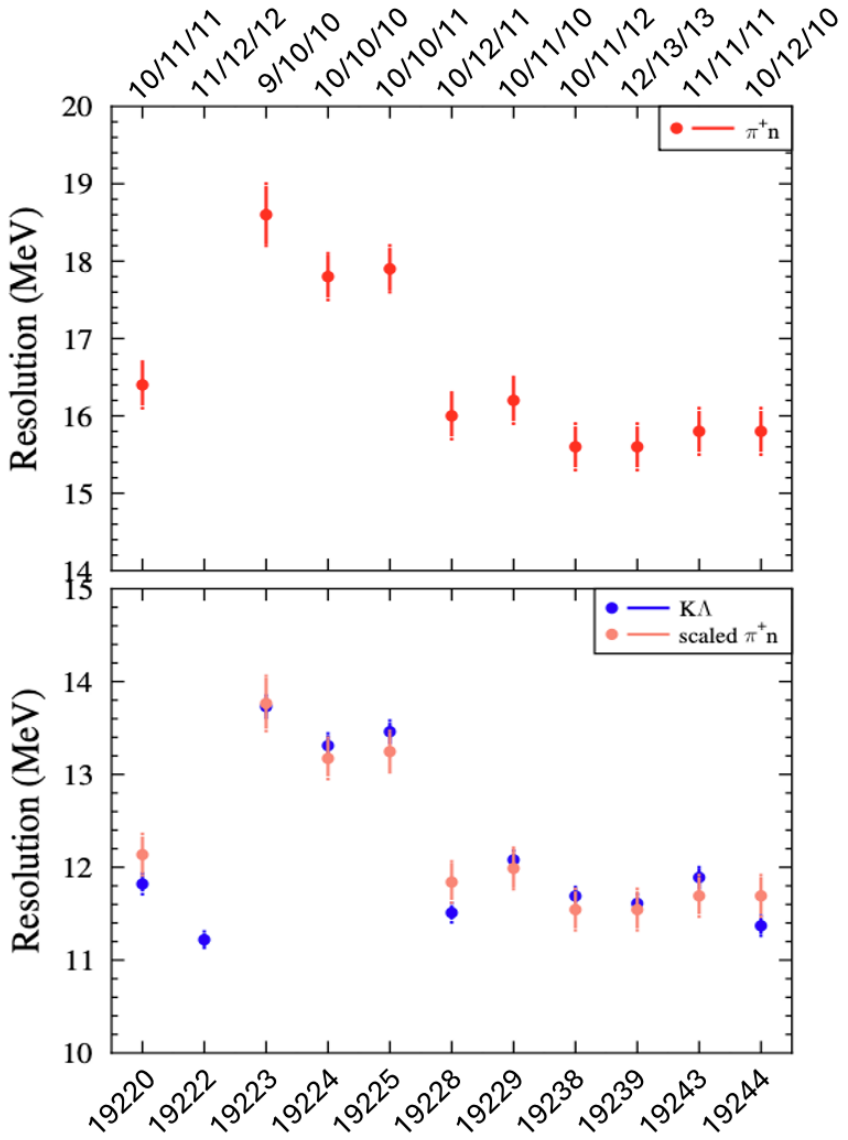
DC HV Scan – Other Channels

Timothy Hayward

Krishna Neupane

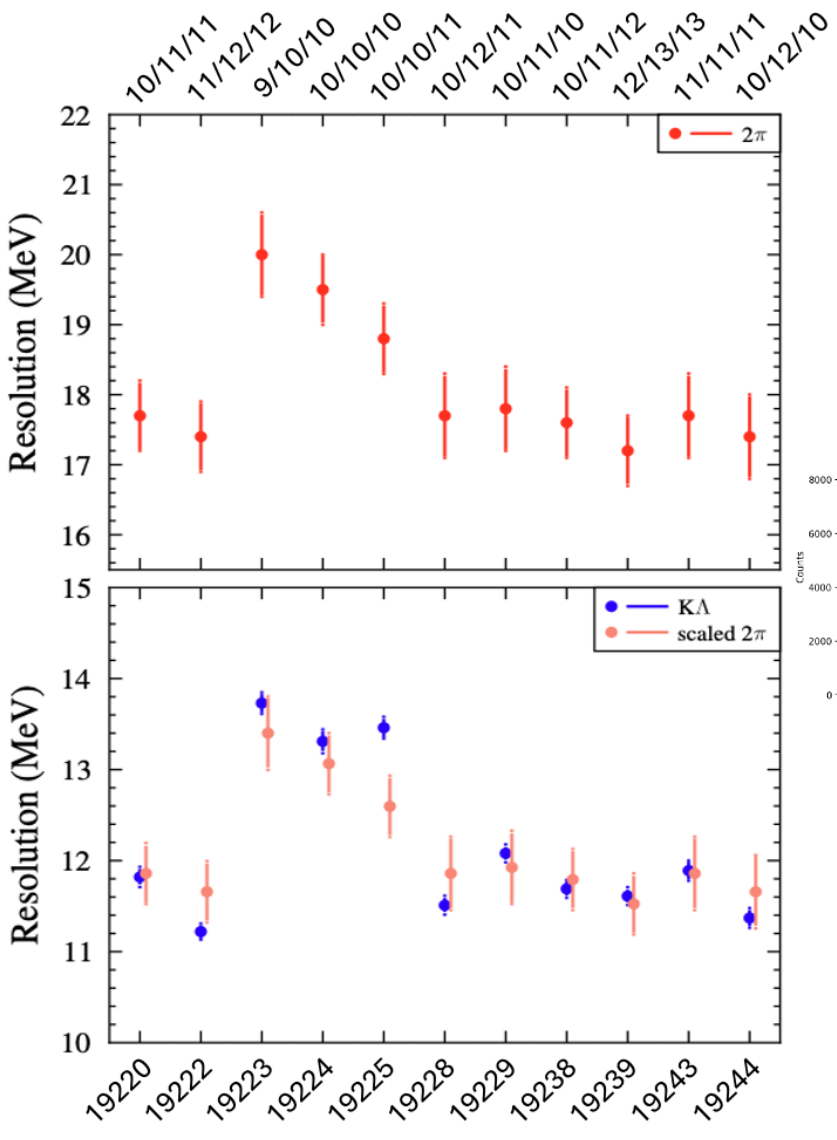
π^+n

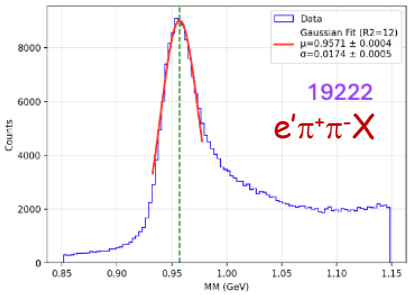




*Combine all sectors without momentum corrections

2π





Summary

- CALCOM has been overseeing the detector calibrations of the different CLAS12 datasets:
  - Completed: RG-E and RG-K cooking
  - Current focus: RG-L - finishing calibrations for FD; advancing ALERT calibration suites/protocols
- Laying the groundwork for "pass-3" recalibrations/recooking:
  - Updated code suites for improved speed and automation
  - New DC tracking software development (DC denoising/hit selection)
  - Improved/streamlined calibration protocols (including for DC alignment)
  - Implemented calibration dashboard for tracking

    👉 Must improve DC calibration "turn-around"

    👉 Understanding what can be done to improve CVT tracking … and on what timescale

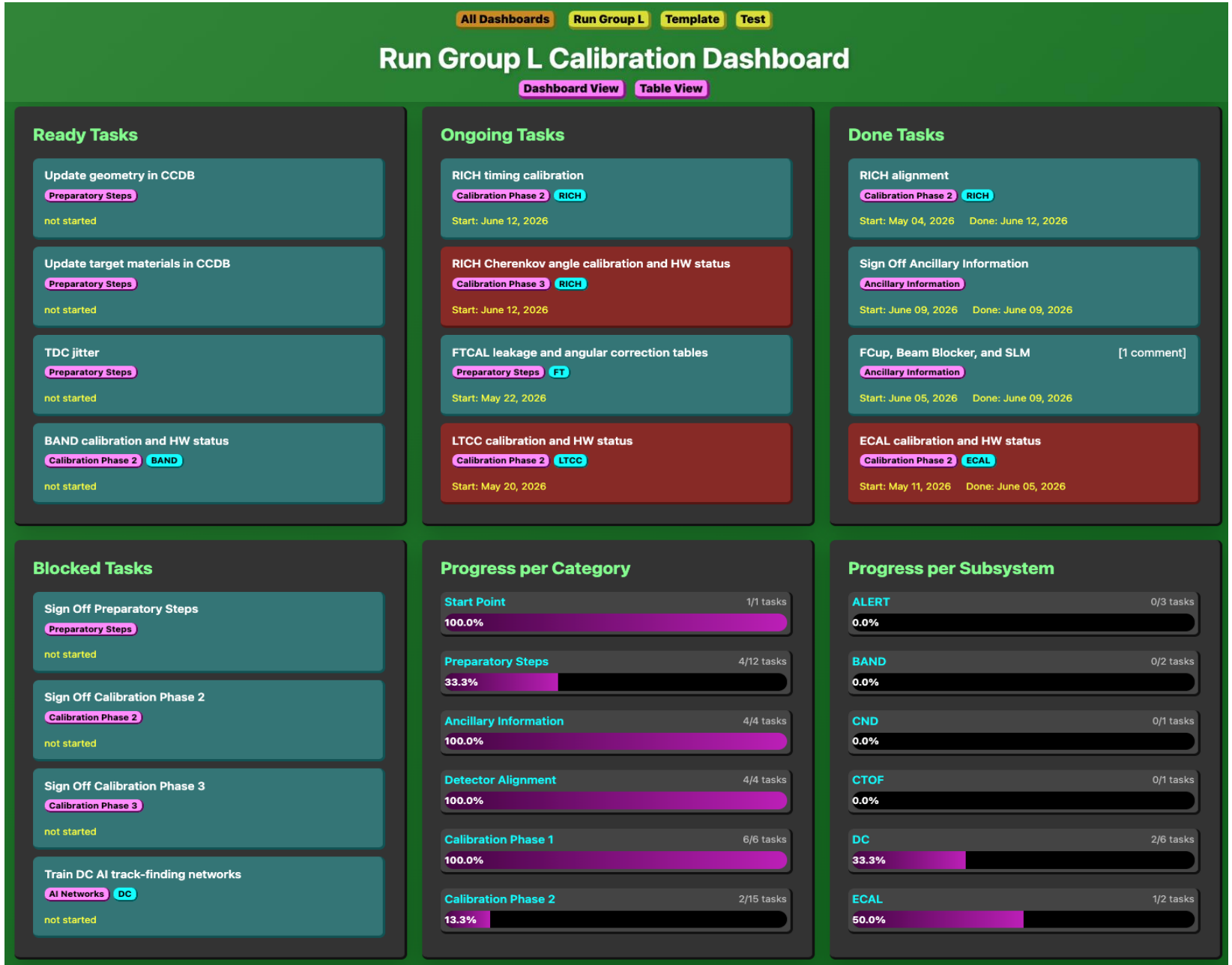
    👉 Run Groups still need to present a case of what they need – note that pass-2 cooking is already very good for the FD response in terms of efficiency and resolution
- As usual … CALCOM is a critical service-work committee for the CLAS Collaboration:
  - Lots of folks are part of this work: CALCOM, coordinators, chefs, timeline crew, subsystem leaders, calibrators, alignment team, Software Group, data validators, …

clas12_calcom@jlab.org

Backup Slides

Calibration Dashboard

Christopher Dilks



CLAS12 Calibration and Commissioning

Contents [hide]

CALCOM Committee

The role of the CALCOM (Calibration and Commissioning) Group is to be responsible for the development of the tools/algorithms to calibrate the CLAS12 detector and to help ensure that the design performance specifications are met. In addition the CALCOM group is responsible for developing the CLAS12 commissioning plan and overseeing its execution.

The committee is composed by:

- Daniel Carman (chair / hardware)
- Raffaella De Vita (software / hardware)
- Gagik Gavalian (common tools)
- Maurizio Ungaro (simulation)
- Veronique Ziegler (reconstruction)

CLAS12 Subsystem Contact Persons

System	Subsystem	Contact Person(s)	Software Contact Person
Calorimeters	ECAL	*C. Smith*	*C. Smith*
Central Tracker	SVT	*Y. Gotra*	*V. Ziegler*
	MM	*Y. Gotra*	*F. Bossu, M. Defurne*
	RTPC	*M. Hattawy*	*M. Hattawy*
Cerenkov Counters	HTCC	*Y. Sharabian*	*I. Illari, W. Phelps*
	LTCC	*M. Ungaro*	*V. Mascagna, M. Ungaro*
	RICH	*M. Contalbrigo*	*M. Mirazita*
Forward Tagger	FT-Cal	*R. De Vita*	*R. De Vita*
	FT-Hodo	*N. Zachariou*	*R. De Vita*
	FT-Trk	*R. De Vita*	*V. Ziegler*
Forward Tracker	DC	*F. Hauenstein*	*V. Ziegler*
	FMT	*Y. Gotra*	*V. Ziegler*
RF		*R. De Vita*	*R. De Vita*
Scintillation Counters	FTOF	*D.S. Carman*	*D.S. Carman*
	CTOF	*D.S. Carman*	*D.S. Carman*
	CND	*S. Niccolai*	*S. Niccolai*
	BAND	*F. Hauenstein*	*F. Hauenstein*

CLAS12 Calibration

Ready for Calibration Reviews:

- RG-A: Spr18, F18, Spr19
- RG-B: Spr19, F19/W20
- RG-C: Sum22, F22, W23
- RG-D: F23
- RG-E: Spr24
- RG-K: W18, Spr24
- RG-L: (TBD)
- RG-M: F20/W21

CLAS12 Dataset Information:

- CLAS12 Dataset Run ranges
- Run Group QADB information (Jan. 2025)

Information for Analysis Coordinators:

- Calibration sequence [1]
- Calibration overview [2]
- Calibration and Software Development Teams: [3]
- CCDB Tables and Usage Policies
- CLAS12 Hardware Status Word Definitions

Calibration Suite Documentation:

- Alignment: DC and FMT
- BAND: suite
- Beam Offset: suite
- Cherenkov:
  - HTCC: suite, tutorial
  - LTCC: suite
  - RICH: suite, Time calibration, Cherenkov angle calibration, Monitoring histograms and timelines, Scaler calibration runs
- CND: suite, tutorial, algorithms
- CTOF: suite, tutorial, algorithms, ccdb, geometry
- CVT:
  - MM:
  - SVT: suite
- DC: suite, tutorial, calibration wikipage
- ECAL: suite
- FT:
  - FT-CAL: suite, tutorial
  - FT-HODO: suite, tutorial
- FTOF: suite, tutorial, algorithms, ccdb, geometry
- RF: suite, tutorial
- RTPC: geom, ccdb

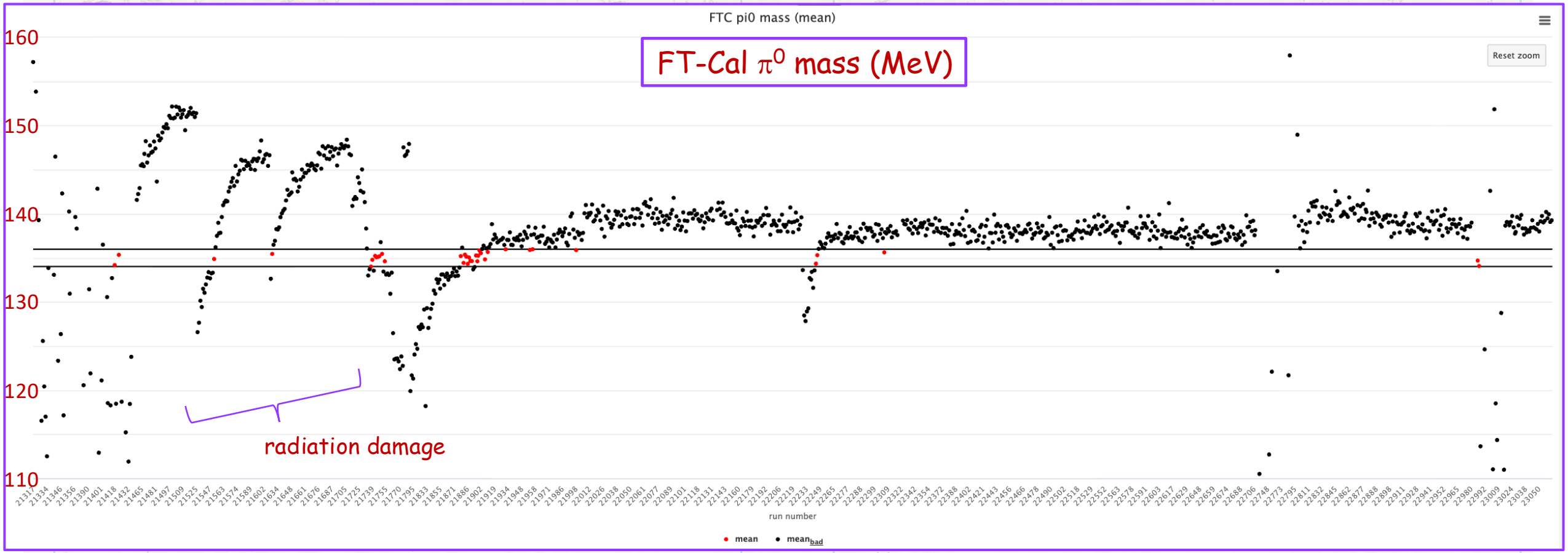
Meetings and Minutes

- Zoom meeting connection: [4]
- 2011 Meetings
- 2012 Meetings
- 2013 Meetings
- 2014 Meetings
- 2015 Meetings
- 2016 Meetings
- 2017 Meetings
- 2018 Meetings
- 2019 Meetings
- 2020 Meetings
- 2021 Meetings
- 2022 Meetings
- 2023 Meetings
- 2024 Meetings
- 2025 Meetings

clas12_calcom@jlab.org

https://clasweb.jlab.org/wiki/index.php/CLAS12_Calibration_and_Commissioning

RG-L Sum25 – Calibration Timelines



Work in progress:

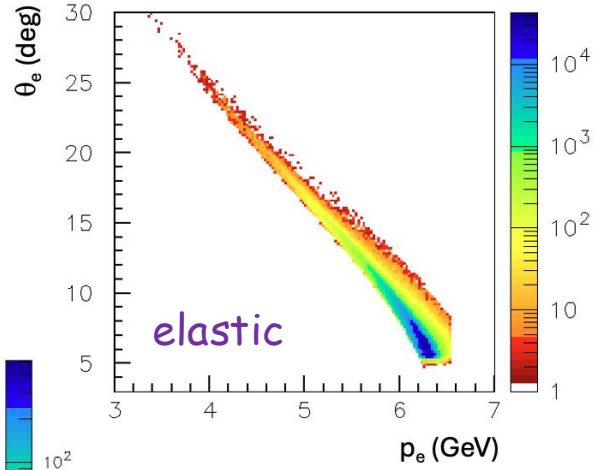
- After completion of FTOF calibration
- All other subsystems based on online calibrations

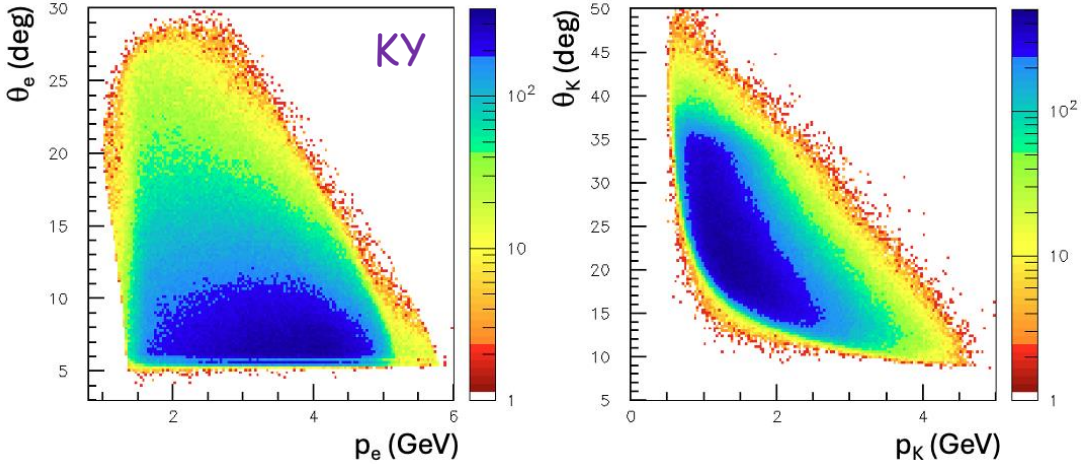
Overview of Final Resolution Studies

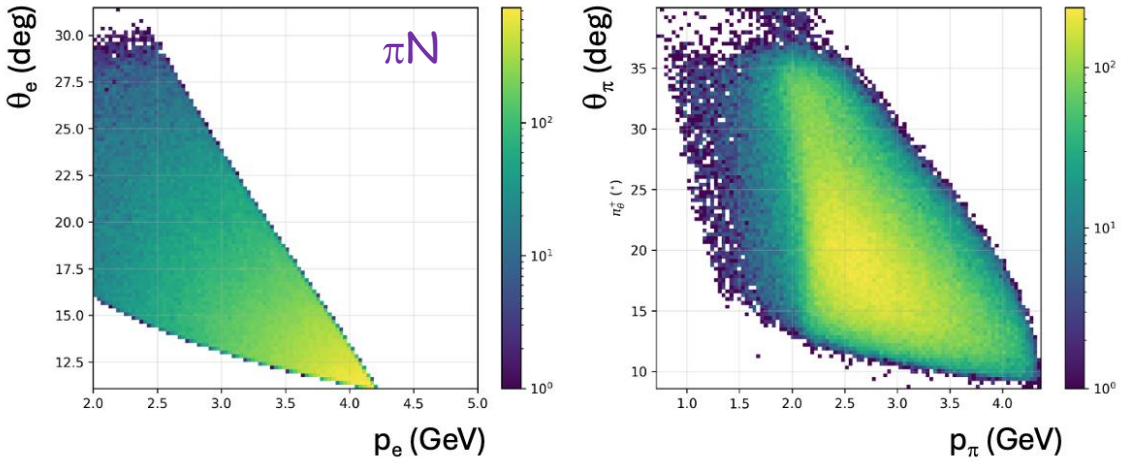
Explore CLAS12 resolution function:

- Focus on charged particle reconstruction in Forward Detector
- Final alignment/calibrations in place (RG-K ready for pass-1 cooking)
- Select multiple final states to span full CLAS12 acceptance

E_b = 6.395 GeV
Torus = 100% outbending
Solenoid = 100%
FT-Off





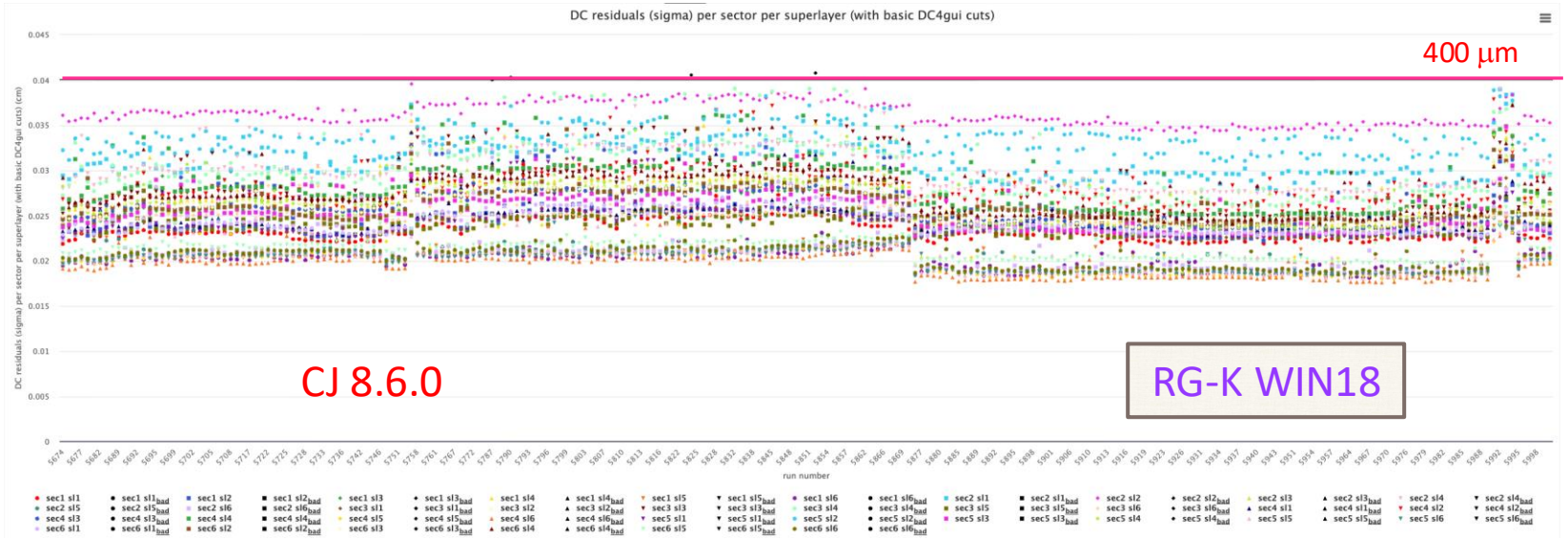


Reactions studied:

- Elastic scattering: $ep \rightarrow e'X$
  - Yijie Wang (MIT)
- $K^+\Lambda$ exclusive: $ep \rightarrow e'K^+\Lambda$
  - Daniel Carman (JLab)
- π^+n exclusive: $ep \rightarrow e'\pi^+n$
  - Timothy Hawyard (MIT/JLab)
- $\pi^+\pi^-p$ exclusive: $ep \rightarrow e'\pi^+\pi^-p$
  - Krishna Neupane (JLab/CNF)
- Λ semi-inclusive: $ep \rightarrow e'\Lambda X$, $\Lambda \rightarrow p\pi^-$
  - Veronique Ziegler (JLab)

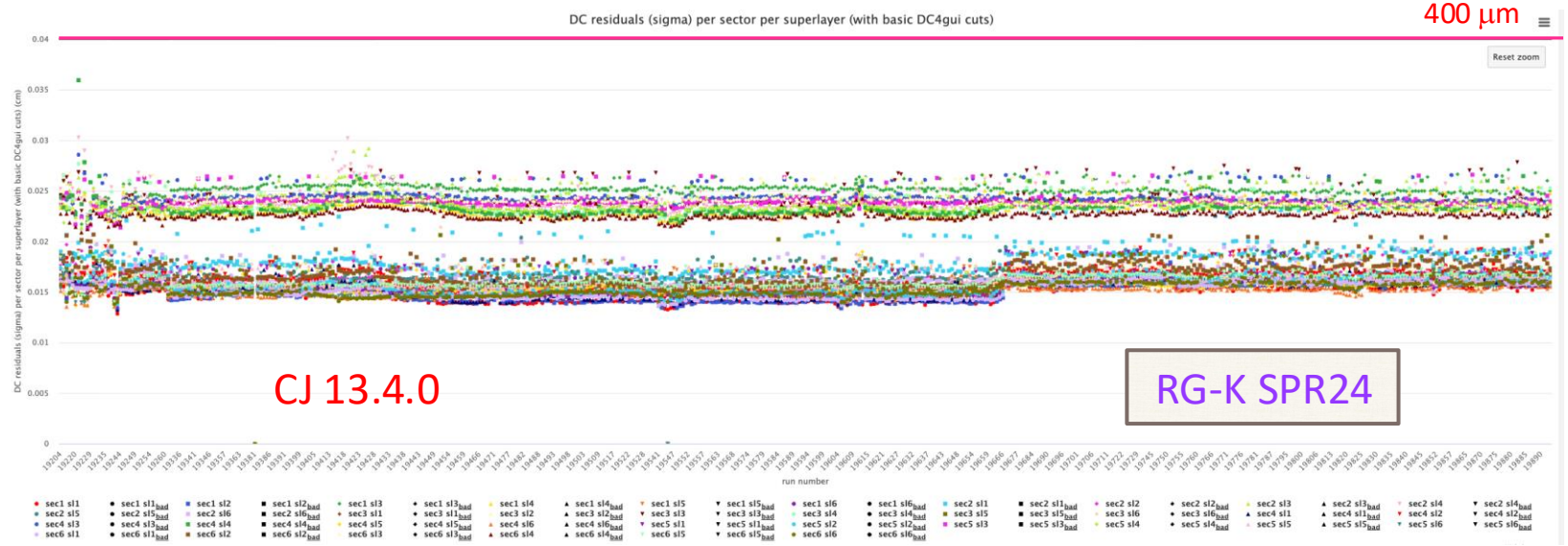
DC Timeline Resolution Comparison

9/10/10



OLD

11/12/12



Reconstruction
+
DC calibration
+
HV settings

NEW!