

CLAS Collaboration Meeting  
April 28-29, 2020

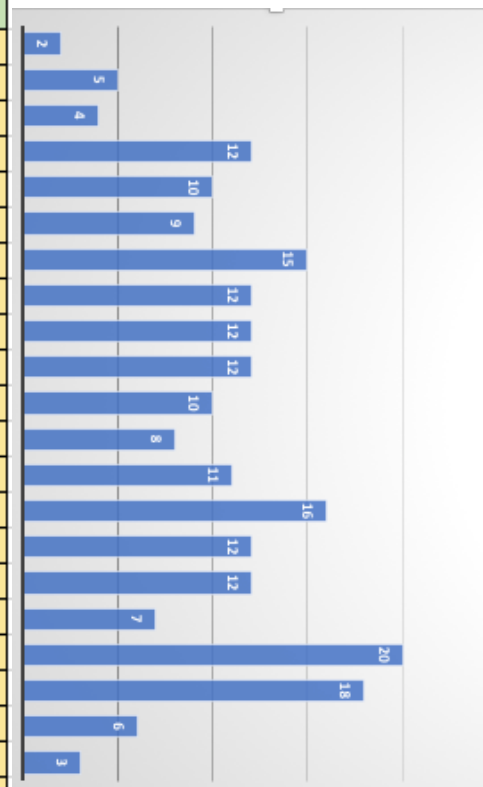
# Status of Hall B

Marco Battaglieri  
Jefferson Lab

# Refereed Physics Publications

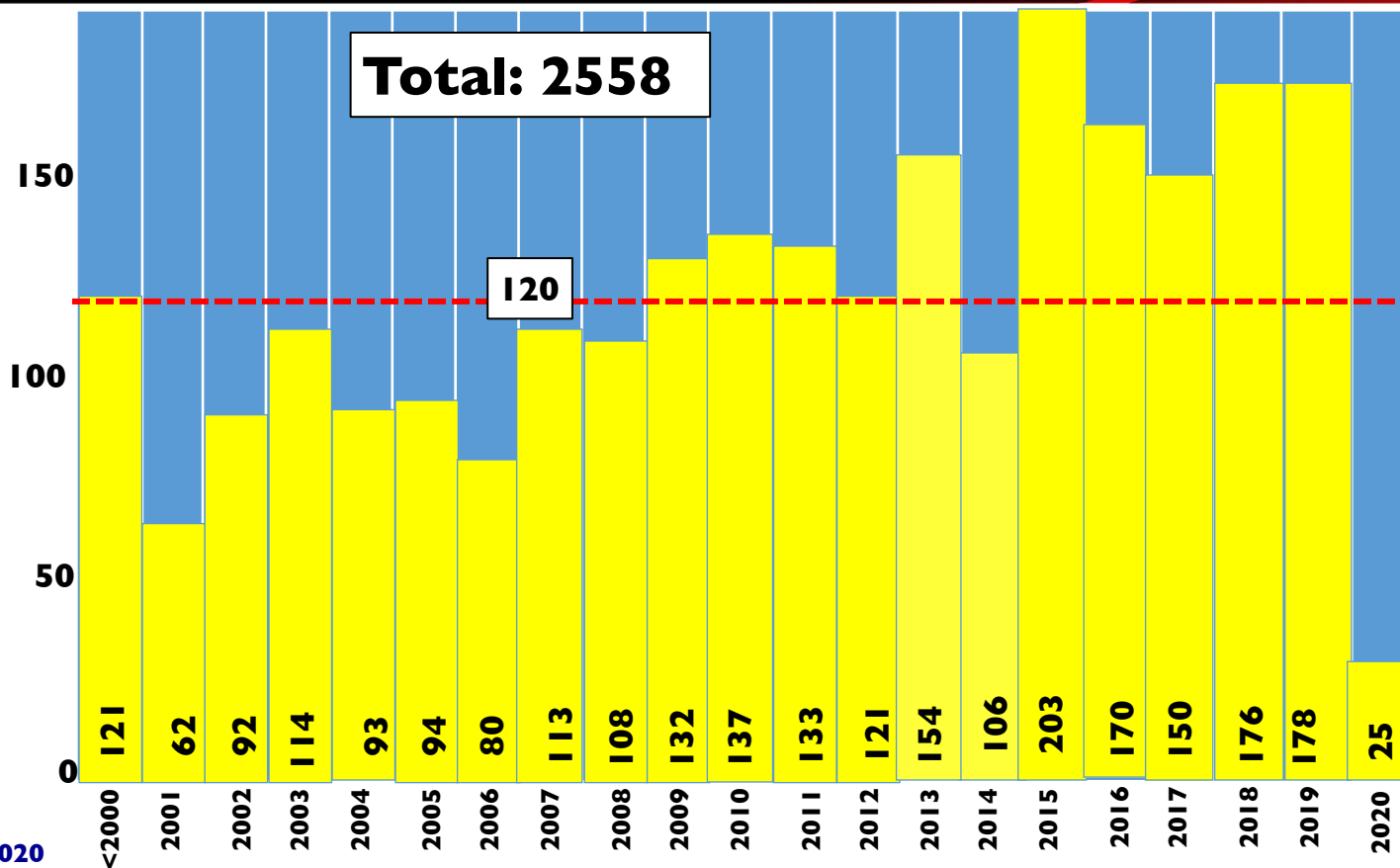
Hall B

|      | Spectroscopy | Hard Scattering | Nuclear | ALL   |
|------|--------------|-----------------|---------|-------|
| 2000 |              | 1               | 1       | 2     |
| 2001 | 2            | 3               |         | 5     |
| 2002 | 3            |                 | 1       | 4     |
| 2003 | 7            | 4               | 1       | 12    |
| 2004 | 3            | 3               | 4       | 10    |
| 2005 | 7            | 3               | 2       | 9     |
| 2006 | 8            | 4               | 3       | 15    |
| 2007 | 7            | 2               | 3       | 12    |
| 2008 | 4            | 6               | 2       | 12    |
| 2009 | 8            | 7               | 4       | 12    |
| 2010 | 4            | 2               | 4       | 10    |
| 2011 | 3            | 1               | 4       | 8     |
| 2012 | 6            | 3               | 2       | 11    |
| 2013 | 8            | 6               | 2       | 16    |
| 2014 | 5            | 6               | 1       | 12    |
| 2015 | 4            | 5               | 3       | 12    |
| 2016 | 7            |                 |         | 7     |
| 2017 | 12           | 7               | 1       | 20    |
| 2018 | 10           | 6               | 2       | 18    |
| 2019 | 1            | 2               | 3       | 6     |
| 2020 | 1+2          | 1               | 2+1     | 3+4   |
| SUM  | 110          | 61              | 43      | 216+4 |



updated 04/27/2020

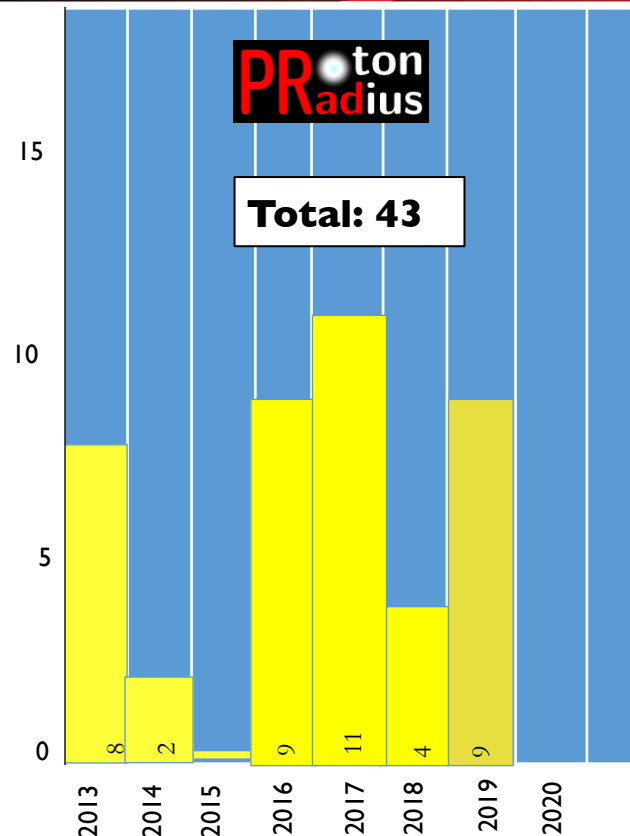
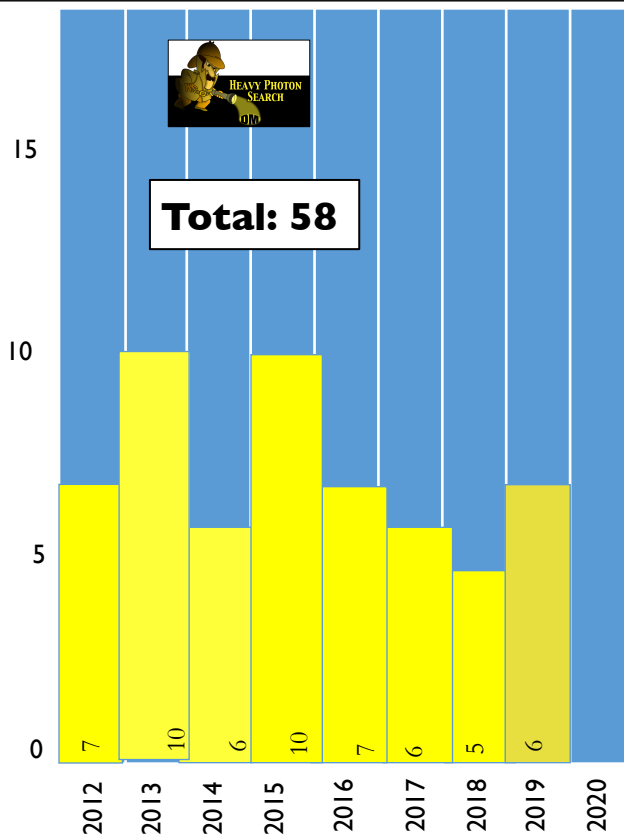
# Conference Presentations



Source: CSC  
updated April 27 2020

# Conference Presentations

## Hall B



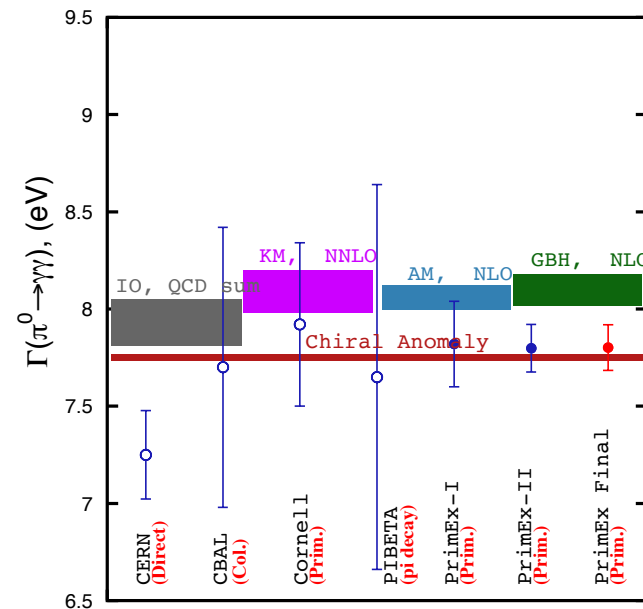
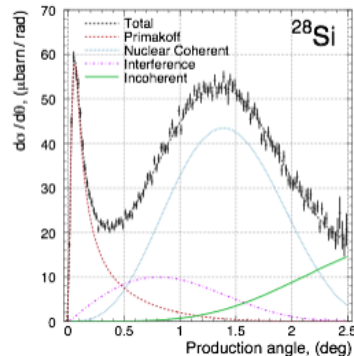
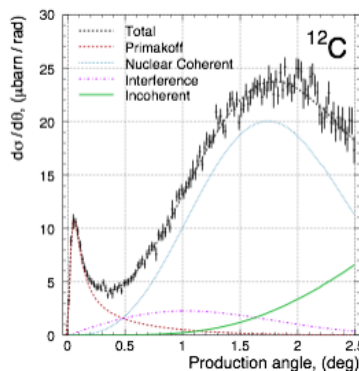
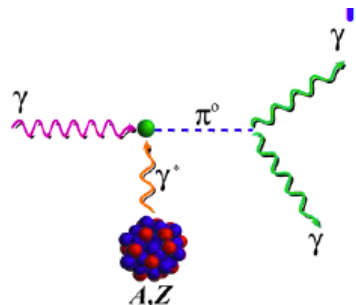
Source: HPS & PRAD wiki

updated Nov 11 2019

# Hall B Overview

- **CLAS12 first physics runs:** RG-A (13 proposals, 139 PAC days), RG-K (3 proposals, 100 PAC days), RG-B (7 proposals, 90 PAC days), RG-C (BONUS, 185 PAC days)
- **Continued flow of results from Hall B (CLAS+PRAD+HPS+PRIMEX..)**
  - > 220 physics papers in peer reviewed journals (> 10,000 citations)
  - 5 papers in Nature, 1 paper in Science
  - ~2,600 conference talks (~1,650 invited)
- **Specialized Hall B experiments**
  - PRAD experiment – results published in Nature
  - PRIMEX - results published in Science
  - Heavy Photon Search - Analysis of 2016 data ongoing

## A Precision Measurement of the $\pi^0$ Radiative Decay Width via the Primakoff Effect

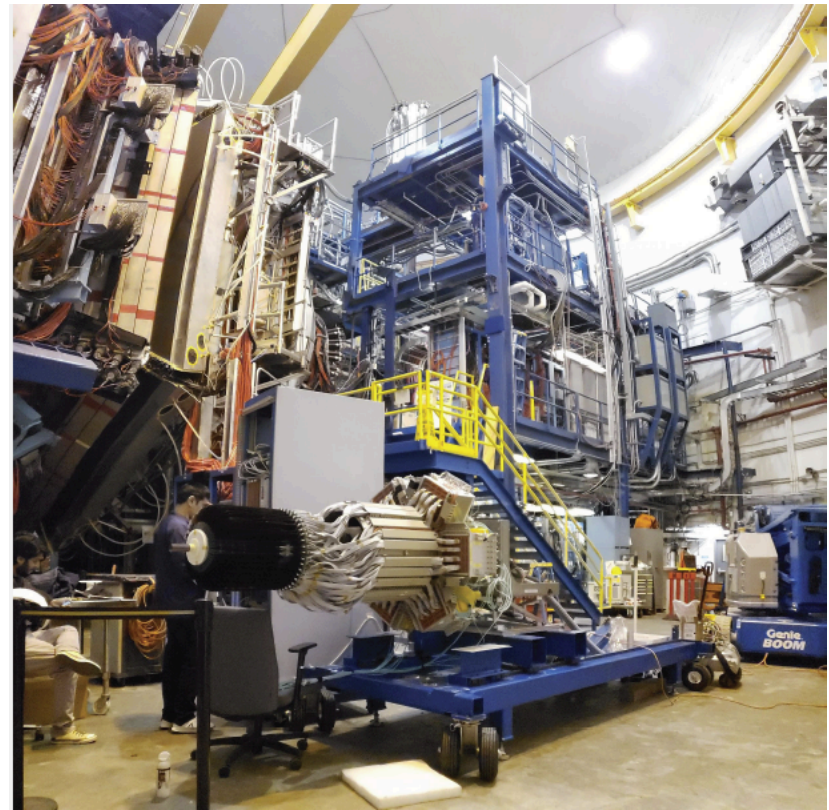
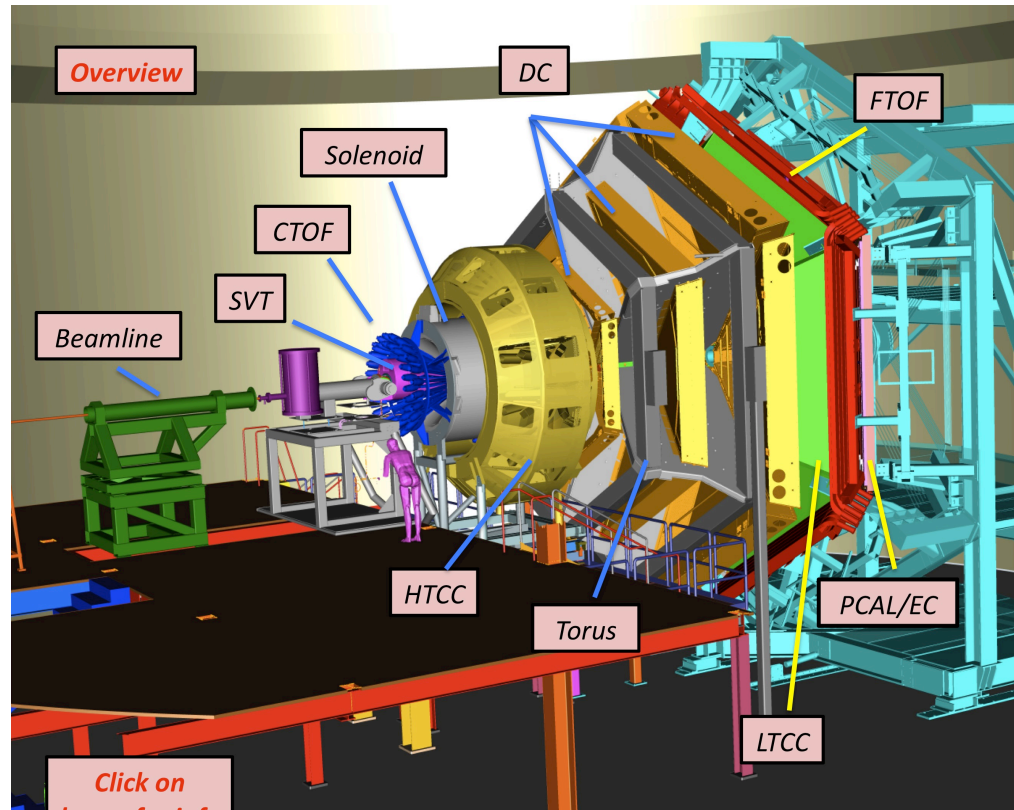


Theory and Experiments

- Precise measurement of  $\pi^0$  two-photons decay width
- Precise test of chiral symmetry and anomalies
- PrimEx (PrimEx-II) data **analysis is completed**. Paper submitted to Science past summer (2019).
- The paper with the PrimEx final results **accepted for publication by Science**



- HPS Collaboration is preparing for PAC48 jeopardy to defend the remaining 135 days of beam time (used 45/180 PAC days)
- After repairs of the detector, HPS will be ready for the next physics run in 2021
- Work on the update document for PAC has started. The document will include the final results from the engineering run and the performance of the 2019 detector during the first physics run
- The review process of resonance and displaced vertex searches started, we expect unblinding of 2016 data in a week to 10 days. The final results of both searches will be available within a week after that
- HPS (remote) collaboration meeting: May 13 to 15. We expect the release of the final results from the engineering run data at the meeting and prepare publication afterward
- In the meantime, work is lead by the analysis group via dedicated meetings and two mini-workshops (all remote)
- Calibration of 2019 data is ongoing. Detector groups are making a good progress on Ecal, hodoscope and SVT. After the first round of SVT alignment, the vertex resolution in the data got within 30% of the expected MC values.
- We expect to start the physics analysis of 2019 unblinded data sample in fall 2020. The analysis will proceed at a much faster pace, as our analysis procedures and software framework are better prepared.



## – Run Group A:

- 13 experiments
- 10.2-10.6 GeV polarized electrons
- Liquid-hydrogen target
- ~300 mC, ~50% of approved beam time

## – Run Group K:

- 3 experiments
- 6.5, 7.5 GeV polarized electrons
- Liquid-hydrogen target
- ~45 mC, ~12% of approved beam time

## – Run Group B:

- 7 experiments
- 10.2-10.5 GeV polarized electrons
- Liquid-deuterium target
- ~155 mC, ~43% of approved beam time

## – Run Group F (BONUS):

- 7 experiments
- 10.2 GeV polarized electrons (+2.2 GeV for calibration)
- Gas-deuterium target +RTPC
- ~49% of approved beam time

## CLAS12 data taking

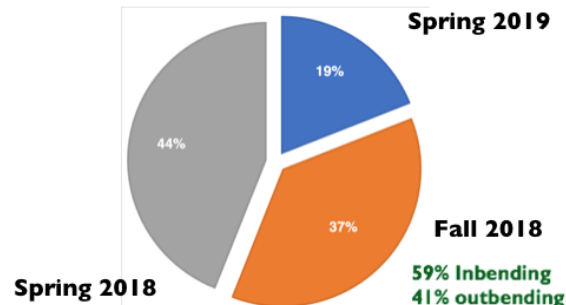
- from Feb 2017 (KPP) to Spring 2020 (physics runs)

## – Nuclear targets test (special run):

- 10.2 GeV electrons
- LD2, LHe and Pb targets
- 100% of scheduled time

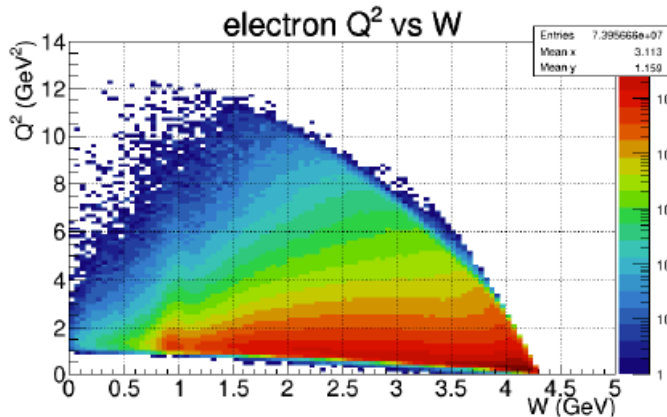
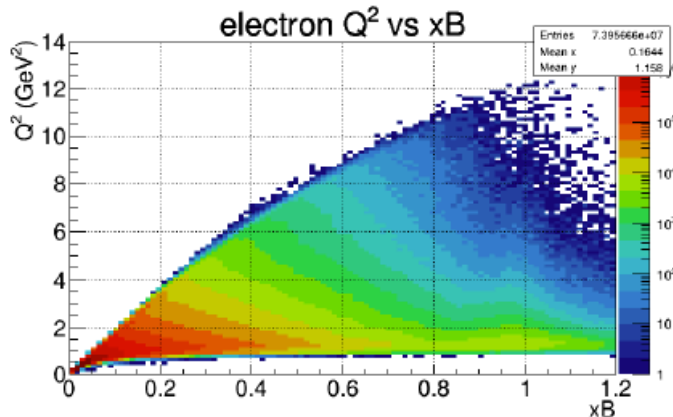
## RG-A

- Currently processing a fraction of the data set
- Focus on: TMD science program via single and di-hadron SIDIS for the first CLAS12 publication
- Fall '18 Inbending Pass I completed
- Fall '18 Outbending Pass I started on April 27 (Pass I Readiness Review on April 23)



## RG-A Fall 2018 Outbending

- 13.5 B events;
- 40 TB of dst files on cache/mss
- 120 TB of decoded file from mss
- 25 TB of trains on cache/mss
- 28 days of data processing



## Report

Readiness Review for the pass1 processing of the HallB/CLAS12 RG-A data (Fall2018/outbending)

Thursday, April 23, 2020

Review committee:  
Nathan Baltzell  
Marco Minzella  
Cole Smith  
Sergey Stepanyan (chair)  
Larry Weissman

The review took place on April 22, 2020, in remote setting over the bluejeans. For the agenda and presentation please refer to the review page:  
<https://clas12-docdb.jlab.org/cgi-bin/docDB/private/DisplayMeeting?conferenceid=2>

The Hall-B/CLAS12 RG-A successfully processed the first part of the fall 2018 data set acquired with the so-called 'inbending' polarity of the CLAS12 torus magnet. This review was organized to assess the readiness of the second part of fall 2018 run with the 'outbending' setting of the CLAS12 torus magnet polarity. As in the case of the first part, the processing of this data set is to provide enough statistics for the first publication(s) of physics results from CLAS12 in FY20. Note that this is not the final processing of the presented data set, as certain aspects of the software, alignment and calibrations are not yet final, e.g. CVT alignment and the tracking algorithm for the central tracker.

The review committee wants to thank RG-A for preparing the presentations, providing ancillary information, and for patiently answering our questions during the review meeting. Below are our answers to the Review Charge questions and some comments. It must be noted that there are no recommendations. RG is ready for Pass1 of the 'outbending' data from the fall 2018 run period. While no recommendations, we think it is RG's interest to look carefully at our comments and fix what is possible before starting the data processing.

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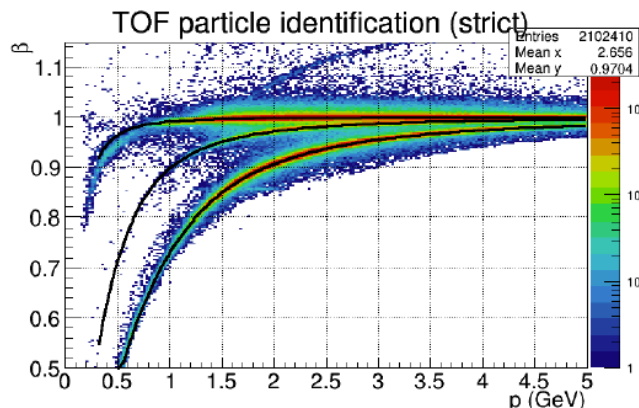
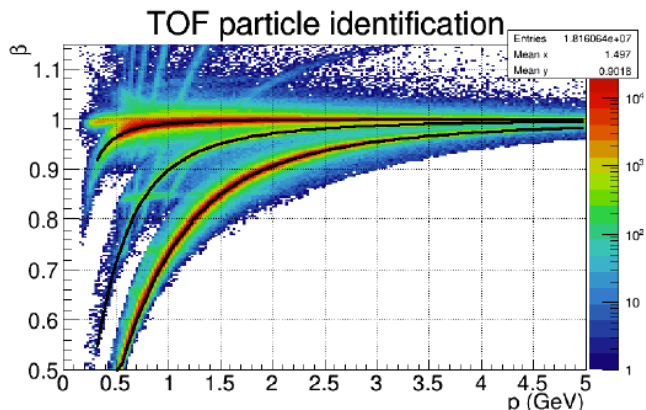
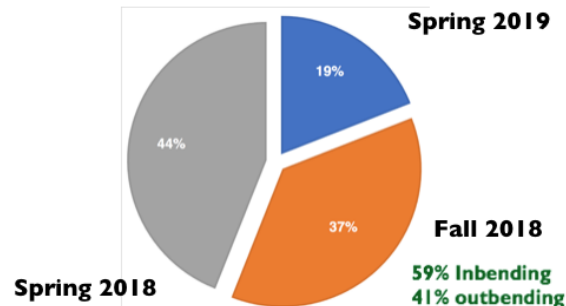
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Yes - The current algorithms and methods used for calibration, alignment, and the reconstruction of data are adequate to achieve performance specifications foreseen for CLAS12 as has been demonstrated with Pass0 processed data.

Credit: Latifa E., F.X. Girod

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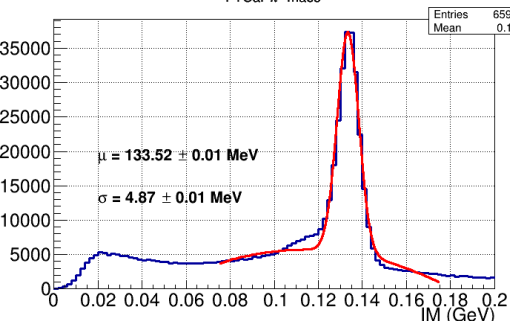
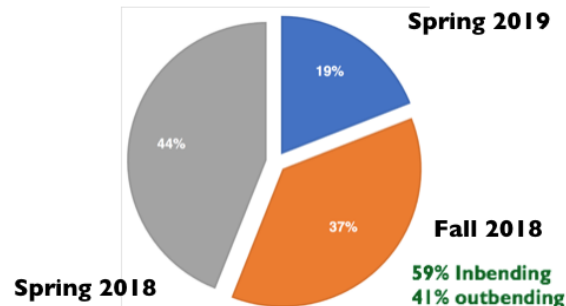
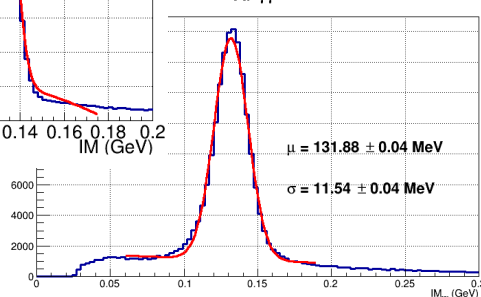
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FTCal  $\pi^0$  massECal  $\gamma\gamma$  IM

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 $\pi^+\pi^-\pi^0$  IM

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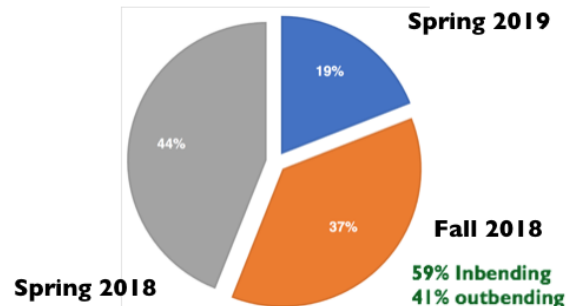
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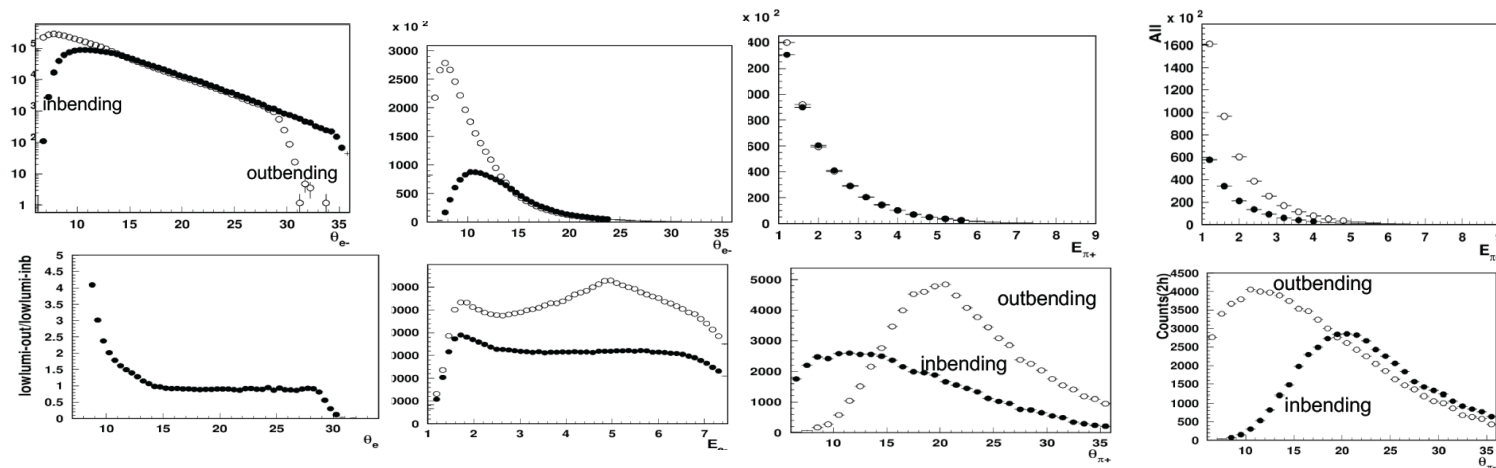
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Credit: H.Avgyan

## RG-A

## Calibration Suite Development Team

Chef and Analysis Coordinator : Nick Markov

| Subsystem | Group Leader             | Developer(s)  |
|-----------|--------------------------|---|
| CND       | Silvia Nicolai (Orsay)   | Pierre Chatagnon (Orsay)  |
| CTOF      | Daniel S. Carman (JLab)  | Louise Clark (Glasgow)  |
| DC        | Mac Mestayer (JLab)      | Dilini Bulumulla (ODU), Latif Kabir (Miss St.)                    |
| ECAL      | Cole Smith (JLab)        | Cole Smith, Joshua Artem Tan (KNU)                                |
| FT        | Raffaella De Vita (INFN) | Raffaella De Vita, Nick Zachariou (Edinburgh)                     |
| FTOF      | Daniel S. Carman (JLab)  | Louise Clark (Glasgow)  |
| HTCC      | Youri Sharabian (JLab)   | Nick Markov (UConn), Will Phelps (GWU)                            |
| LTCC      | Maurizio Ungaro (JLab)   | Maurizio Ungaro, Burcu Duran (Temple), Sylvester Joosten (Temple) |
| MVT       | Maxime Defurne (Saclay)  | Maxime Defurne, Guillaume Christiaens (Saclay)                    |
| RICH      | Marco Contalbrigo (INFN) | Marco Contalbrigo, Marco Mirazita, Andrey Kim                     |
| SVT       | Yuri Gotra (JLab)        | Yuri Gotra  |

## • TCS and J/psi

- Rafavel Paremuzyan (Post Doc, UNH)
- Nathan Baltzell (Post.doc, JLab)
- Joseph Newton (PhD, ODU)
- Pierre Chatagnon (PhD, Orsay)
- Pawel Nedeł-Turonski (Staff, Stony Brook)
- Valery Kubarovski (Staff, JLab)
- Stepan Stepanyan (Staff, JLab)

## • Monitoring

- Andrey Kim (UConn)
- Christopher Dilks (Duke)
- Brandon Clary (UConn)
- Sangbaek Lee (MIT)
- CLAS12 sub-system experts

## • Data Validation

- F.X Girod
- Harut Avakian
- Derek Glazier
- RGA – Analysis team

## • Deep Exclusive phi

- Brandon Clary (PhD, UConn)
- Khyngseon Joo (UConn)

## • Deep Exclusive rho

- Dilini Bulumulla (ODU, PhD)
- Charles Hyde (ODU, Professor)

## • Deeply Virtual Compton Scattering

- Joshua Artem Tan (PhD, KNU / JLab)
- Latifa Elouadrhiri (Staff, JLab)
- Guillaume Christiaens (Ph.D., CEA Saclay / Glasgow)
- Noëlie Cherrier (Ph.D., CEA Saclay)
- Maxime Defurne (Staff, CEA Saclay, also  $\pi^0$ )
- Francesco Bossu (Staff, CEA Saclay)
- Sangbaek Lee (MIT)

• Deep Exclusive  $\pi^0$  and  $\eta$ 

- Valery Kubarovski (Staff, JLab)
- Ivan Bedlinskiy (Staff, ITEP)
- Andrey Kim (Post-Doc, UConn / JLab)
- Elizabeth Gibney (GWU) (starts this June)
- Latifa Elouadrhiri (JLab)

## • Inclusive and Pion SIDIS

- Tim Hayward (Ph.D., W&M)
- Keith Griffioen (Professor W&M)
- Stefan Diehl (Post-Doc, UConn)
- Christopher Dilks (Duke)

## • Target Fragmentation Lambdas

- Marco Mirazita (Staff, INFN/Frascati)

## • Di-hadron production

- Anselm Vossen (Professor, Duke)

## • MesonEx program with the focus on p p

- D. Glazier (staff, Glasgow)
- A. Thornton (Staff, Edinburgh)
- N. Zachariou (Post Doc, Glasgow)
- A. Filippi (Staff, INFN Torino)
- L. Guo (Professor, FIU)
- S. Adhikari (PhD, FIU)
- A. Khanal (PhD, FIU)
- M. Dugger (Professor, ASU)
- E. Pasyuk (Staff, JLab)
- Will Phelps (CNU)
- Genova Group

Moscow State:  
Evgeny Golovach (staff)  
Evgeny Isupov (staff)  
Two graduate students

South Carolina:  
Ralf Gothe (Prof.)  
Nick Tyler (grad. student)

JLab:  
Daniel Carman (staff)  
Victor Moiseev (staff)

UConn:  
Khyngseon Joo (Prof.)  
Nick Markov (Post doc)  
One graduate student

Juelich:  
Michael Kunkel (staff)  
One graduate student

Ohio University:  
Ken Hicks (Prof.)  
Gleb Fedotov (Postdoc)  
One graduate student

Rome:  
Annalisa D'Angelo (Prof.)  
Lucilla Lanza (Postdoc)  
One graduate student

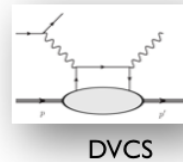
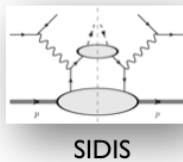
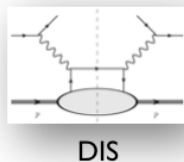
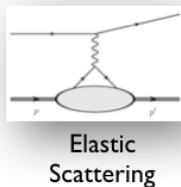
## Nuclear targets test

### GOALS:

- **Validate simulations** by measuring radiation dose at various locations around the target
- Measure **occupancies and the leakage currents** in the silicon sensors

- WG meeting on May 22nd
- Report expected for the end of May

## RG-B



+ J/psi photo-production & SRC

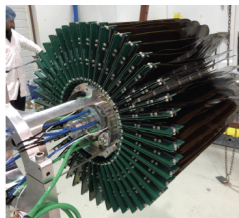
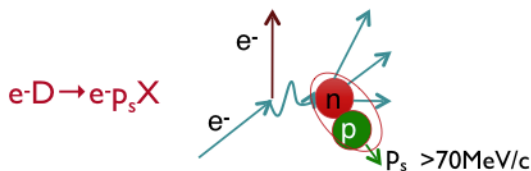
- Detector calibration ongoing
- Ready for Pass I data reconstruction
- Pass I Readiness Review on May 8th

## RG-K

- 6-7 GeV electron and low- $Q^2$  electron scattering on hydrogen

- Detector calibration ongoing
- Ready for Pass I data reconstruction
- Pass I Readiness Review on May 15th

## RG-F



- Detector calibration ongoing

## Task Forces

- Forward tracking
  - Central tracking
  - New polarised targets
  - Future CLAS12 Hi-Lumi
  - Future CLAS12 PID
  - Future CLAS12 Trigger/DAQ
  - CLAS12 software development
  - AI support to CLAS12 sw
  - CLAS12 data preservation
  - Physics analysis framework
  - GEMC for streaming RO
  - Novel tracking technologies
  - BG merging
  - RG-L (ALERT) integration
  - Regular report on Friday meeting (6/14)
  - Documentation available on wiki pages
- \* These TFs have been recognised of interest for a lab-wide effort  
\* New Task Force since last Collaboration meeting

## Integration in Hall-B of new RGs activities

- New Task Forces will be appointed to support RG integration in Hall-B/CLAS12
- Hardware (new equipment) and Software (dedicated reconstruction)
- Composition: Staff experts (according to the new equipment) + B. Miller (integration) + SW Group representative
- Regular meeting with the TF + general meeting with Hall-B staff
- Preparation for the ERR
- Procedure tested with ALERT TF

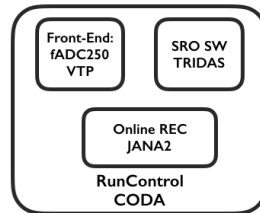
## Preparation for future runs

- Solid target holder design almost finalised
- Moeller cone for NH<sub>3</sub> polarized target design
- Plans to use Time-Over-Threshold techniques to reduce non-track-correlated hits
- Explored synergies with world expert for future CLAS12 at Hi-Lumi
- Based on the RGA PassI cooking experience, needs of strengthen the CALCOM role
- Software Group activity for better calibration suites (in particular DC) and support to the PassI cooking
- Strong support to Task Force activity
- New strategies to involve Users in sw activities (e.g. tutorials, sw containers, service work, ...)
- MC simulation deployment in oversee grids (UK and Italy)

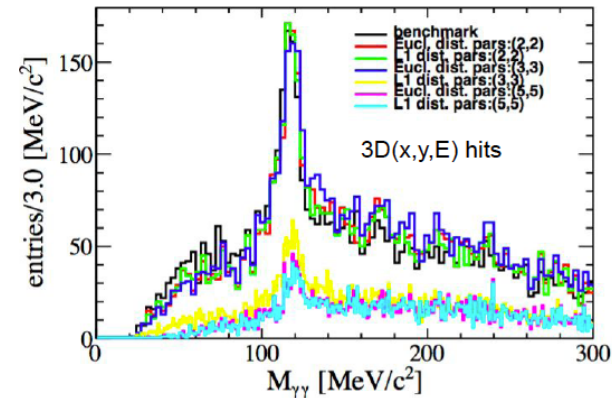
## Streaming readout

- Optimization of each component
- Improved stability for extensive performance benchmarking
- Test of AI-supported algorithm for clustering
- Some ideas to use Quantum Computing for Streaming RO

### Streaming readout



Double cluster  $\pi^0$  mass as obtained by an unsupervised hierarchical clustering algorithm implemented in JANA framework by C.Fanelli



Credit: S.Boiarinov, A.Celentano, B.Raydo, D.Lawrence, C.Fanelli, M.Bondi, G.Gavalian, G.Heyes, T.Chiarusi, F.Ameli, C.Pellegrino, P.Musico, V.Berdnikov, S.Vallarino, M.Ungaro

- As per today, April 27, we are still in lockdown (MEDCON6)
- Only few people has granted the access on-site
- Regular monitoring of Hall-B equipment and instrumentation
- Remote working demonstrated to be effective (a lot of activities and work done!)
- No issues with the computer farm (data cooking worked well so far)

**Proposed schedule**

- Acc ops expected to resume in Jan-21 after a long shutdown for the ColdBox replacement
- Assume 30 weeks operations split between Spring/Fall runs
- Assume to restart at 5 passes (10.6 GeV)
  - ~50 PAC days RG-D (~50% PAC days allocated) - nuclear targets - Color transparency + hadronization
  - ~20 PAC days RG-K (6.4 GeV on hydrogen)
  - ~35 PAC days RG-M - neutrino's and SRC in nuclei (2, 4.3, 6 GeV)
  - ~25 PAC days HPS (4.7 GeV)
- Summer/Fall 2021: NH3/ND3 installation (~2 months)
- Ready to resume in 2022 to run RG-C for the whole year
- Schedule agreed among the Halls
- Waiting for green light (budget)

- The JLab leadership, in coordination with the Commonwealth of Virginia, is working on operation resuming
- Most likely we'll be back in MEDCON5 status (limited on-site personnel and strict social distance rule)
- Plans for restarting and accelerator schedule are taking into account these difficulties
- The priority is to accomplish the FY20 physics program (complete RG-F) if possible
- As soon as the situation will be defined we'll discuss the possible options depending on the beam energy available