

CLAS Collaboration Meeting Mar 2-5, 2021

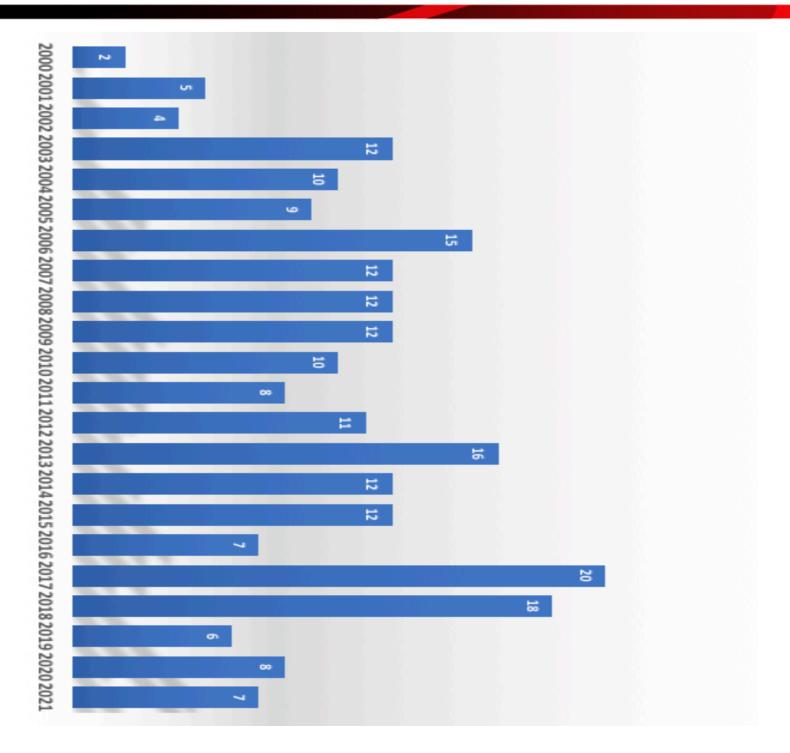
Status of Hall B

Marco Battaglieri Jefferson Lab



Refereed Physics Publications

	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	5	1	2	8
2021	2	4	1	7
SUM	116	66	46	228



• +I CLAS paper submitted to Nature

• 2 CLASI2 papers submitted to PRL



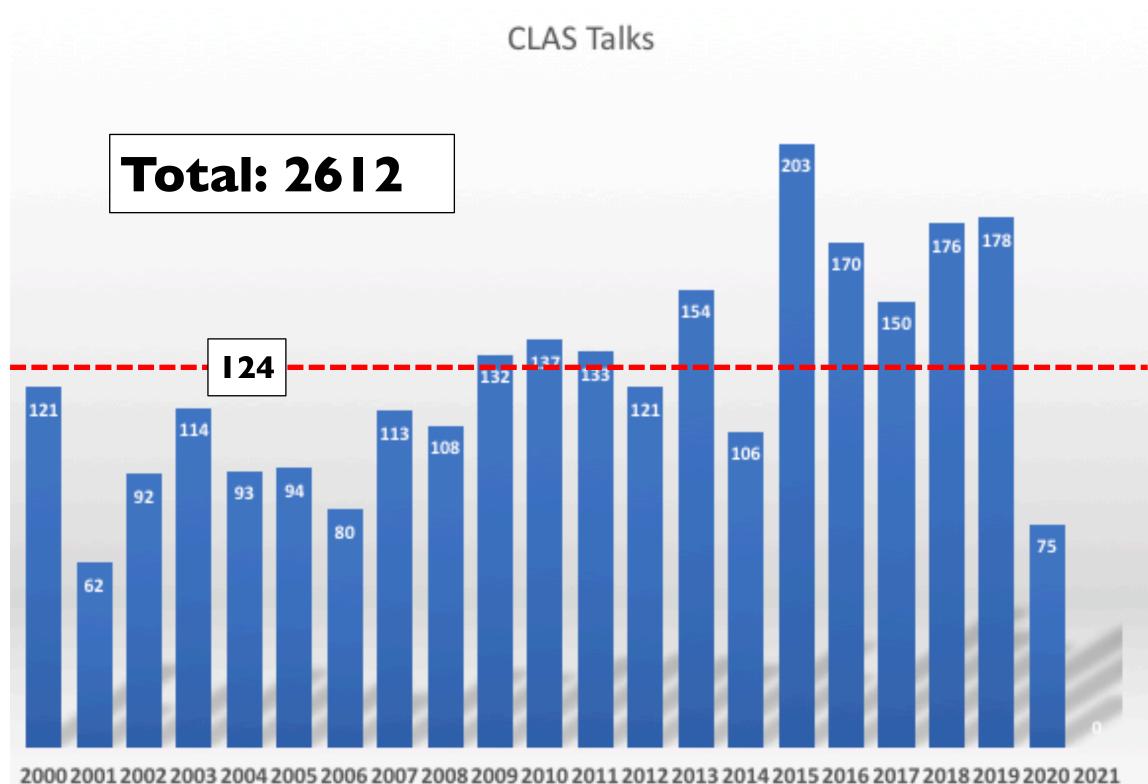




updated 03/01/2021



Conference Presentations



Source: CSC updated March | 2021

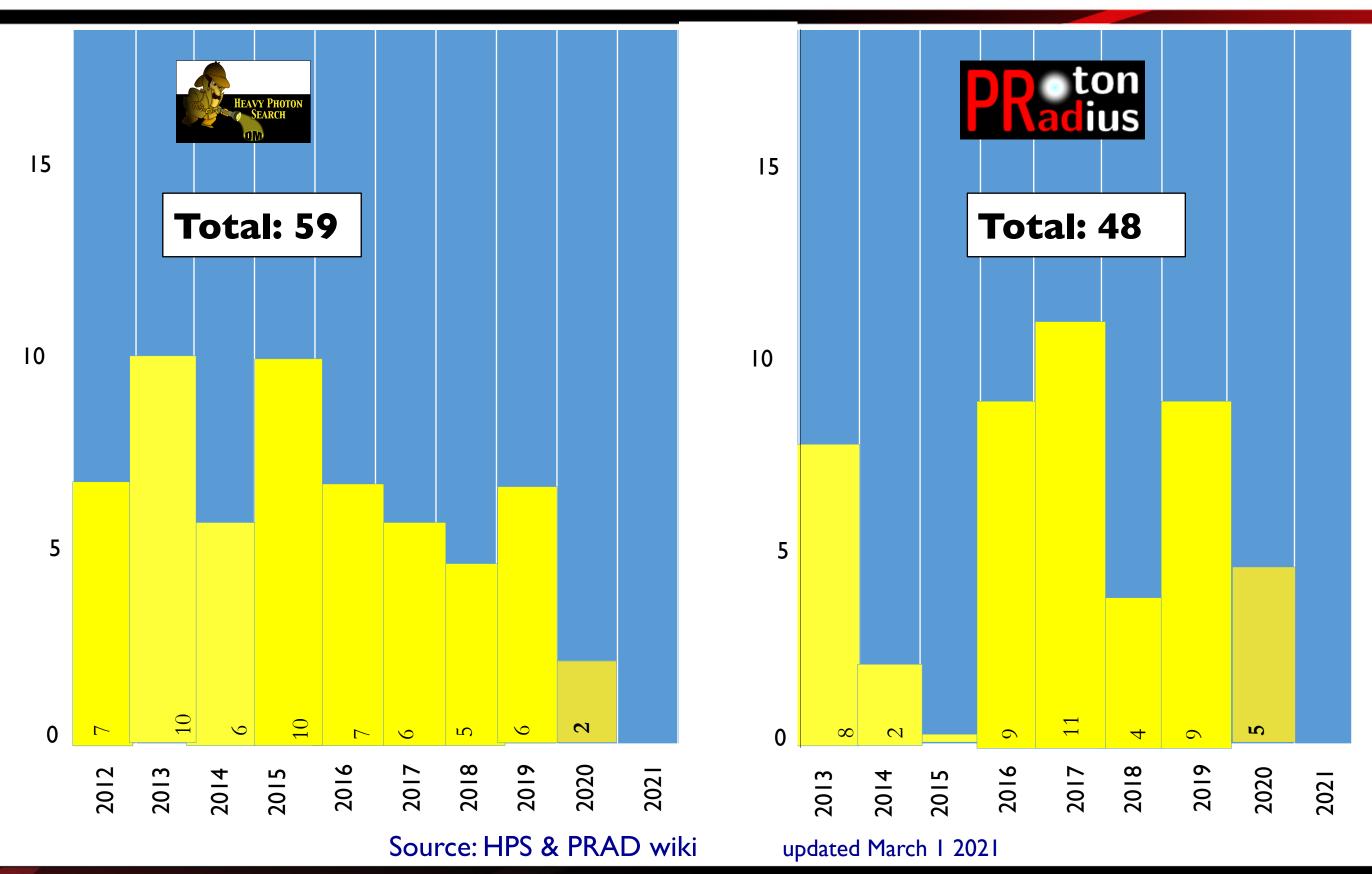








Conference Presentations



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Hall B highlights

CLASI2 physics runs:

- RG-A (13 proposals, 139 PAC days) partial -
- RG-K (3 proposals, 100 PAC days) partial -
- RG-B (7 proposals, 90 PAC days) partial -
- RG-F (BONUS, 42 PAC days) concluded -

Continued flow of results from Hall B (CLAS+PRAD+HPS+PRIMEX..)

- ~ 230 physics papers in peer reviewed journals (> 14,000 citations)
- 4 papers in **Nature** (+1 Nature Phys.), I paper in **Science**
- >2,600 conference talks (~1,660 invited)

Specialized Hall B experiments

- PRAD experiment results published in Nature
- PRIMEX results published in Science
- Heavy Photon Search

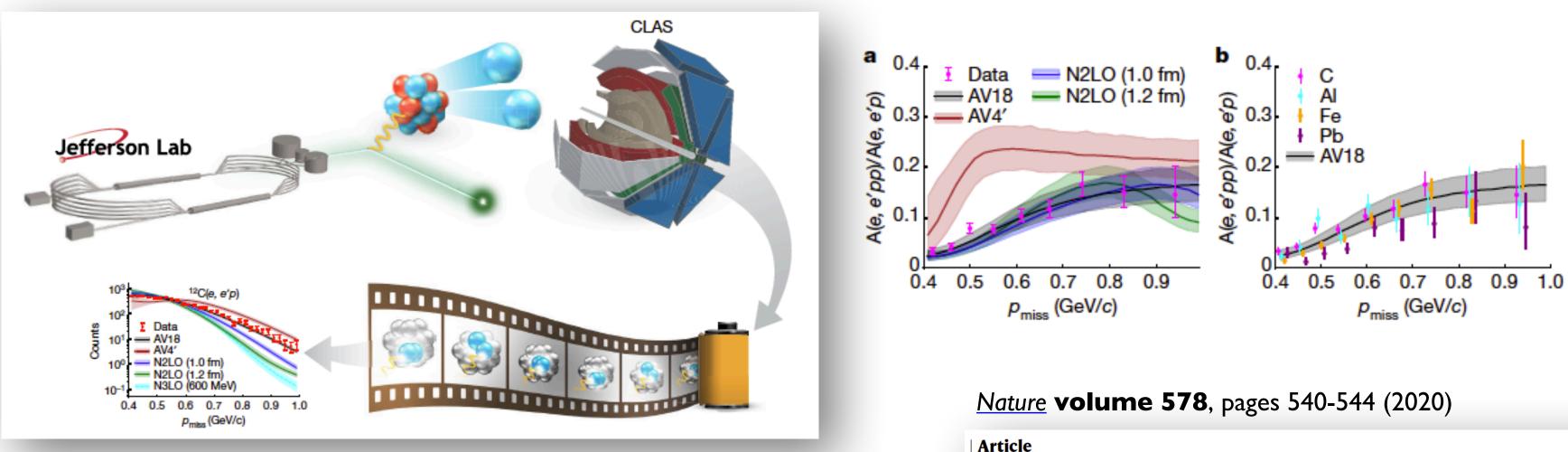


PRAD+HPS+PRIMEX..) 0 citations)

Jefferson Lab



Nuclear interaction via e-scattering



CLAS6 data mining activity

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- Electron-nucleus scattering to test nuclear interaction
- Short range correlations up to 400 MeV/c (relative p)
- Transition from spin-dependent tensor force to spinindependent scalar force

-JSA

Access to nuclear force in extreme conditions (neutron stars)

6



Probing the core of the strong nuclear interaction

https://doi.org/10.1038/s41586-020-2021-6 Received: 21 August 2019	A. Schmidt ^{1,2} , J. R. Pybus ¹ , R. Weiss ³ , E. P. Segarra ¹ , A. Hrnjic ¹ , A. Denniston ¹ , O. Hen ^{1⊠} , E. Piasetzky ⁴ , L. B. Weinstein ⁵ , N. Barnea ³ , M. Strikman ⁶ , A. Larionov ⁷ , D. Higinbotham ⁸ & The CLAS Collaboration*						
Accepted: 10 January 2020							
Published online: 26 February 2020 Check for updates	The strong nuclear interaction between nucleons (protons and neutrons) is the effective force that holds the atomic nucleus together. This force stems from fundamental interactions between quarks and gluons (the constituents of nucleons)						

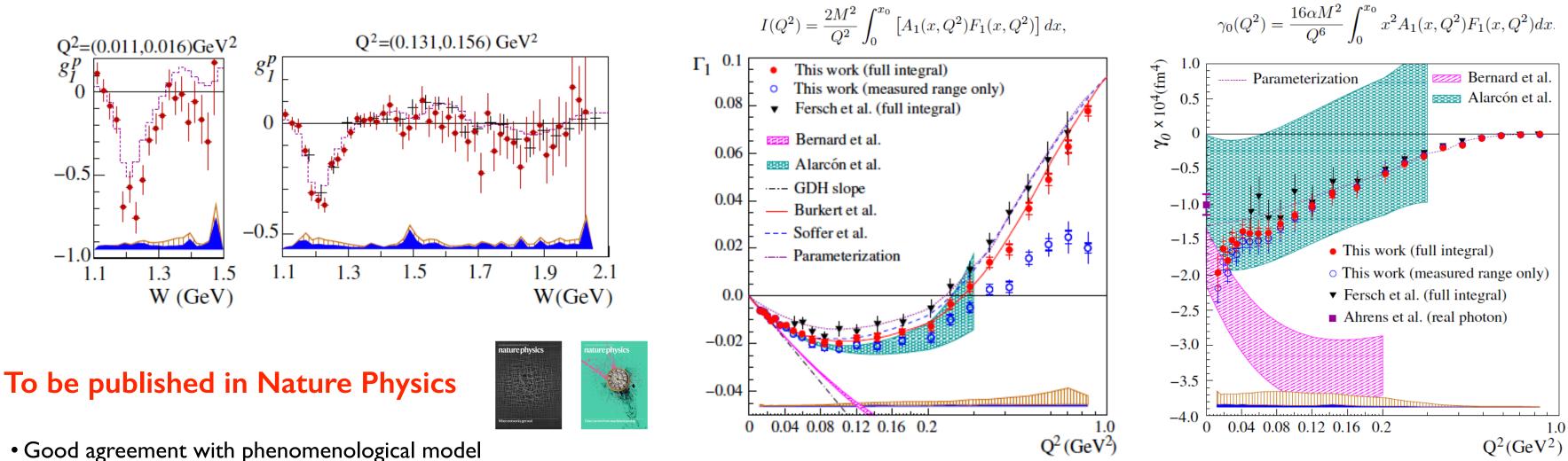


EG4 results



Measurement of the proton spin structure at long distances

• Lattice or EFT to describe QCD at long distances (non-perturbative). Spin observables can challenge XEFT, widely used to describe other observables • Spin-dependent xsection in nucleon resonance region at very low Q2: E=1.1GeV - 3.0 GeV, NH3 DNP (longitudinal) target PT~75%-90% + P_{Beam}~85% + e' in CLAS



- Good agreement with phenomenological model
- XEFT are reasonably in agreement but room to improve the theory with new CLAS data
- Theory fails to reproduce the generalised longitudinal spin polarisability $\gamma_0(Q2)$ (interpreted as nucleon spin-dependent response to virtual photon)
- In XPT the main contributions are: p- π cloud and Δ excitation (opposite sign). Data indicate Δ dominance at low Q2 while the π cloud gets suppressed by Q2









Heavy Photon Search

Physics Analyses

- Finishing the analysis of 2016 data:
 - \circ the resonance search analyses are reviewed and approved
 - $\circ\,$ the review of the vertexing analysis will be concluded soon
- Most of the calibrations and alignment work for 2019 data are done
- Getting ready for a "pass-0" production
- While no publications, in 2020 three theses completed

2020 Summer run preparation

- Scheduled for 54 days (27 PAC days), starting in mid August •
- Mostly the previous detector with few changes: \bullet
 - new FEBs
 - \circ new L0 and L1 sensors
 - \circ replacing the collimator

and repairs (SVT, ECal and hodoscope) and upgrades (DAQ and DQM)

- SVT to be moved to the clean room for repairs, the schedule depends on the travel restrictions due to the pandemic
- Similarly, shifts scheduling will depend on the allowed travels (a large number of oversees collaborators), looking into remotes shift taking (have some experience from the past run for running SVT)







Credit: S.Stepanyan



Proton Charge Radius

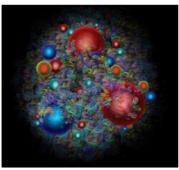
PRad-II: a new and upgraded version of PRad-I. Awarded by PAC48 with A scientific rating (40 PAC days) with C-I condition to remeasure the Proton Radius with a factor of 4 times better than PRad

STR[®]NG-<mark>2</mark>20

Shrinking the proton (a featured article)

Jan C. Bernauer (Stony Brook University), Ashot Gasparian (North Carolina A&I University), Dominique Marchand (IJCLab Orsay), Randolf Pohl (J-G Mainz University) Introduction

Quantum Chromo Dynamics (QCD) in the non-perturbative (strongly interacting) regime describes the physics inside nucleons and nuclei, and with that, of almost all visible matter in the Universe. An accurate description has implications for other fields, from astrophysics (e.g. neutron stars, baryogenesis, solar physics) to atomic physics (e.g. finite size effect in spectroscopy). The proton is the simplest stable QCD system, and it is paramount to understand how the nucleon properties emerge from the underlying physics. The proton elastic electric and magnetic form factors, which describe the distribution of charge and magnetisation inside the proton, offer direct access to the proton's internal structure. Their accurate knowledge is a touchstone for QCD theory and lattice calculations.



However, even basic quantities like the charge rootmean-square radius, given by the slope of the electric form factor at zero four-momentum transfer $(Q^2 \rightarrow 0)$, are not settled. In 2010, a 4% difference between an analysis of a muonic hydrogen spectroscopy experiment [1] (rp = 0.84184(67) fm), and both the results of the Mainz high precision form factor experiment [2] (rp = 0.879 (5)stat (6)syst fm) and the CODATA value [3] ($r_p = 0.8768(69)$ fm), based on a series of normal hydrogen spectroscopy measurements and radius extractions from earlier scattering data, was found. Without any readily available explanation, this discrepancy became quickly known as the proton radius puzzle [4].

Now, ten years later, the puzzle is still not fully resolved, see [5] for a recent review. Beside numerous theoretical explanations - none have found widespread acceptance - new data is sparse and somewhat inconclusive. On the spectroscopy side, most measurements using normal hydrogen [6],[7] have found values compatible with the small muonic value, but some new measurements still align with the larger radius seen before [8]. On the scattering side, the discussion focused on the extraction of the slope of the proton electric form factor at Q2 = 0 from the cross sections via fits, and remaining questions can only be addressed with new, precise data especially at low Q². A new measurement demonstrated the use of initial state radiation, an alternative to the standard technique with fundamentally different systematics, extending the Q² range down to 0.001 (GeV/c)² and obtaining a large radius [9], albeit with large uncertainties. The PRad experiment [10], discussed below, pushed the Q2 boundary even lower by another factor of 10 and found a small radius. On the overlap region with previous data, the PRad result shows a clearly different Q2 behaviour. This new discrepancy, larger than any systematic effects so far envisioned to explain the proton radius puzzle, calls into question not only the extraction of the proton radius, but our knowledge of the proton form factors over the whole range of Q2. It is clear that new data is desperately needed. Luckily, a series of

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PRad-II

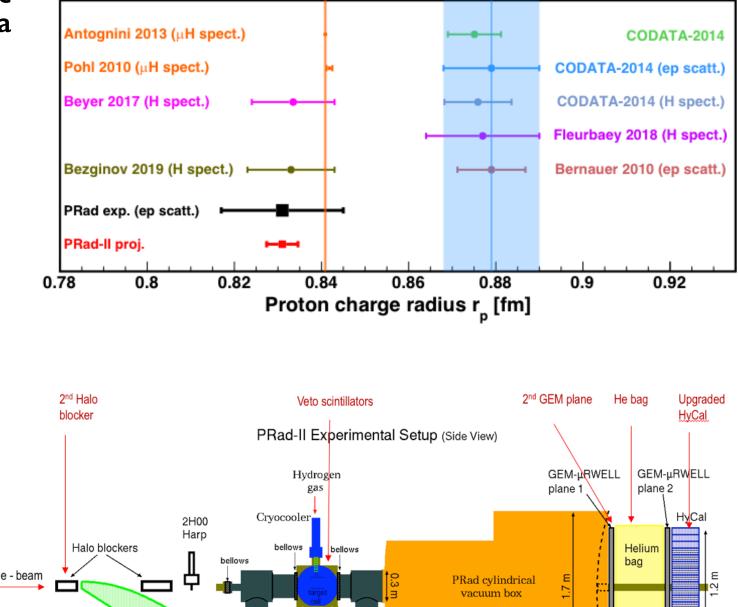
- A factor of 16 times more statistics:
- additional beam halo blocker before the Tagger magnet;
- small-size veto scintillators to reject the Moller events at very small scattering angles;
- 2 GEM planes for better tracking capabilities;
- upgrade HyCal to all PbWO₄ crystal based calorimeter for better subtraction of ep-inelastic contribution

Status

- PhysDiv C-I Review is scheduled for March 12
- PRad Collaboration submitted NSF RI-I preproposal to support the experimental setup upgrade
- Appointed a Hall-B Task Force (PI: S.Stepanyan) to support the C-I Review preparation



Tagge





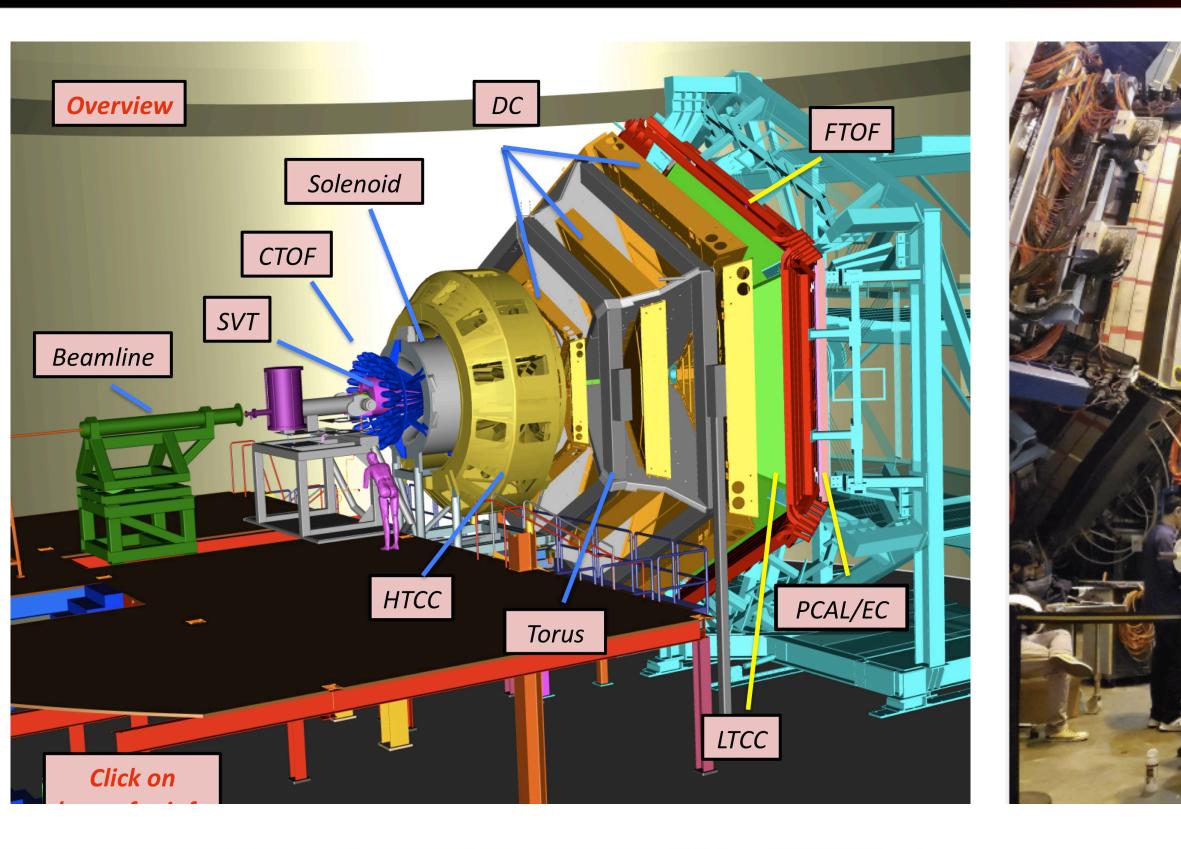
Credit: A.Gasparyan

0.4 m





















- Run Group A:

- 13 experiments
- 10.2-10.6 GeV polarized electrons
- Liquid-hydrogen target
- $\sim 300 \text{ mC}$, $\sim 50\%$ of approved beam time

- Run Group K:

- 3 experiments
- 6.5, 7.5 GeV polarized electrons
- Liquid-hydrogen target
- $\sim 45 \text{ mC}$, $\sim 12\%$ of approved beam time

- Run Group B:

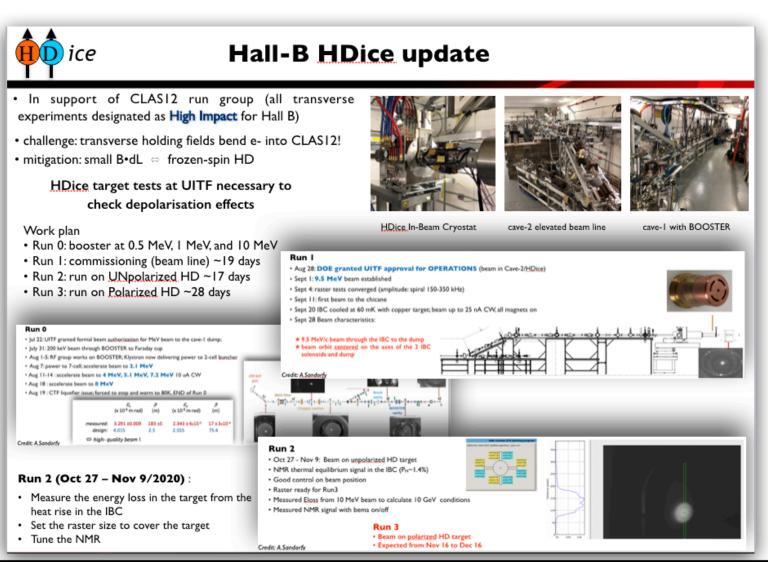
- 7 experiments
- 10.2-10.5 GeV polarized electrons
- Liquid-deuterium target
- ~155 mC, ~43% of approved beam time

- Run Group F (BONUS):

- I experiment
- 10.2 GeV polarized electrons (+2.2 GeV for calibration)
- Gas-deuterium target +RTPC
- ~92% of approved beam time (Run concluded!)

CLASI2 data taking from Feb 2017 (KPP) to Summer 2020 (physics runs)

-Nuclear targets test (special run):







 I0.2 GeV electrons • LD2, LHe and Pb targets 100% of scheduled time





Data processing

-Run Group A:

- 13 experiments
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- Liquid-hydrogen target
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Data processing

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- Run Group F (BONUS):

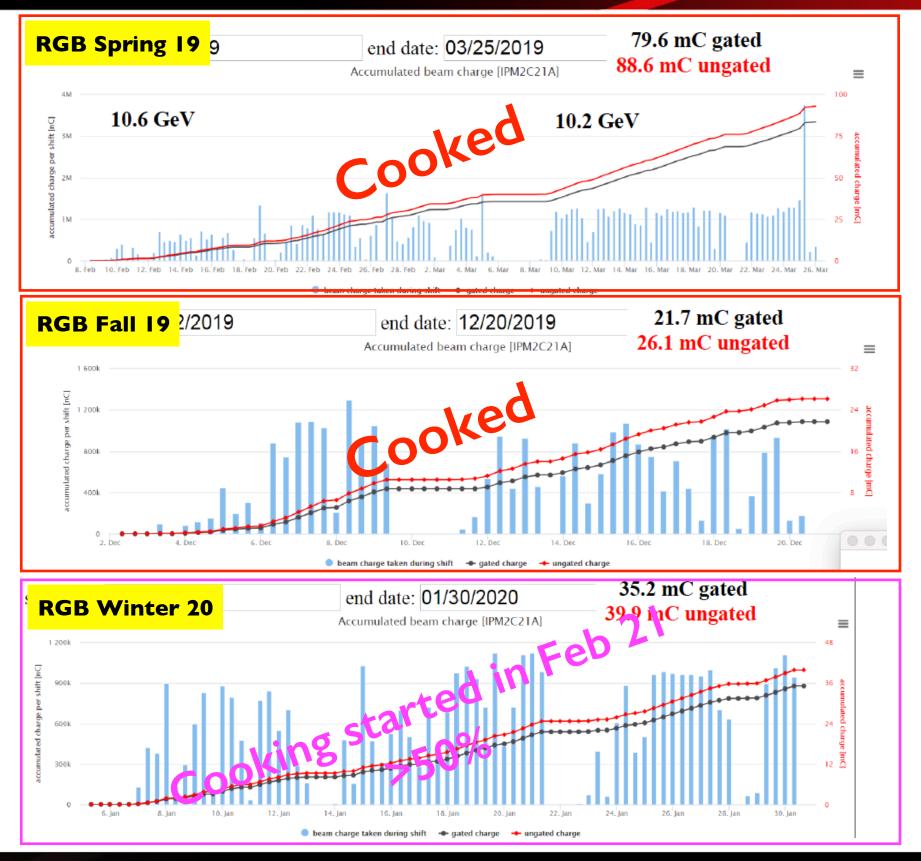
• I experiment

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• 10.2 GeV polarized electrons (+2.2 GeV for calibration)

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- Gas-deuterium target +RTPC
- ~92% of approved beam time



13

Hall B

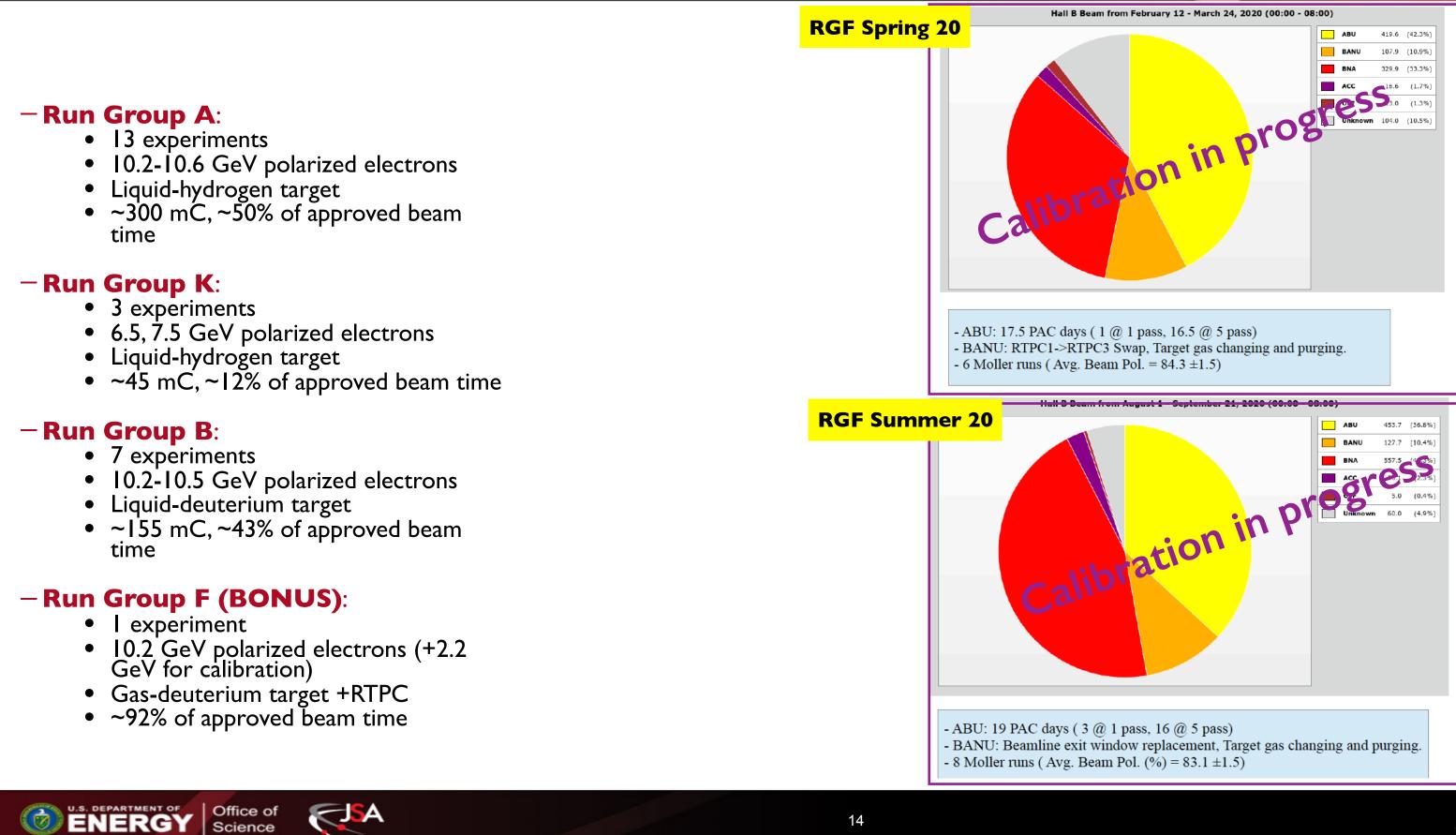




-JSA

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Data processing









Data processing

	Calibration status	Cooking status	Tim
 – Run Group A: 13 experiments 10.2-10.6 GeV polarized electrons Liquid-hydrogen target ~300 mC, ~50% of approved beam time 	In progress	60% done	
 Run Group K: 3 experiments 6.5, 7.5 GeV polarized electrons Liquid-hydrogen target ~45 mC, ~12% of approved beam time 	Completed	Fully cooked	
 – Run Group B: 7 experiments 10.2-10.5 GeV polarized electrons Liquid-deuterium target ~155 mC, ~43% of approved beam time 	Almost completed	90% cooked	
 Run Group F (BONUS): I experiment I0.2 GeV polarized electrons (+2.2 GeV for calibration) Gas-deuterium target +RTPC ~92% of approved beam time 	In progress	_	St as





meline for completion

Spring 18 calibration in progress

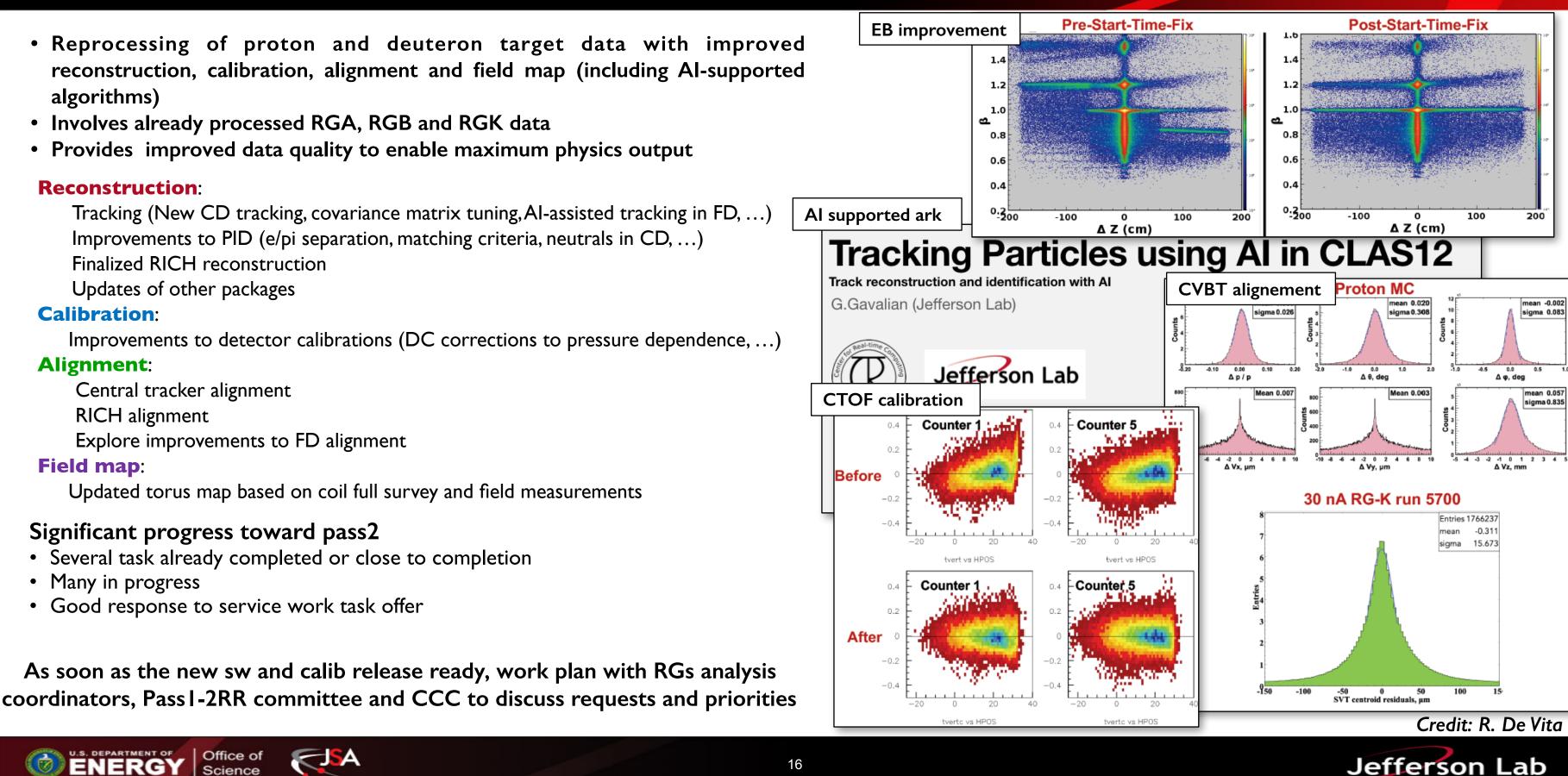
> **Goal:** complete the Pass I reconstruction of the whole RGA/B(/F) data sets in the next couple of months to analyse the entire statistics available

Start cooking in as soon s calibrations are ready





Pass2 data rec preparation



Hall B



CLAS12

Data analysis

First multidimensional, high precision measurements of semi-inclusive π^+ beam single spin asymmetries from the proton over a wide range of kinematics

- So far, good mapping of ID PDF (longitudinal momentum dependence)
- Are the q carrying an orbital angular momentum? how is it connected to the spin of the nucleon? q correlations?
- 3-D structure accessed trough Transverse Momentum dep. Distributions (TMDs)
- Semi Inclusive DIS (SIDIS) to study the transverse structure of the nucleon
- Single Spin Asymmetries (SSA) sensitive to TMDs and Fragmentation Functions (FF)
- Beam SSA: twist-3, subleading, O(M/Q), accessible in fixed target, medium energy (~10 GeV) experiments

 \star First multi-D measurement over a wide kinematic range

 \star Extraction of Collins and TMD functions

First Observation of Beam Spin Asymmetries in the Process e $p \rightarrow e' \pi^+ \pi^- X$ with CLAS₁₂

- SIDIS ingredients: q in the nucleon (PDF), hadronization (Fragmentation Functions)
- Fragmentation in 2h is sensitive to several TMDs and Dihadron Fragmentation Functions (DiFFs)
- Spin-momentum correlations in hadronization
- Access to PDF e(x) (transv polarized q in a unp nucleon, tw-3) and Dihadron FF GI-perp (helicity of fragmenting q)
- Complement single-hadron SIDIS, with the advantage of another degree of freedom
 - \star First measurement of BSA in di-h production
 - \star Sub-leading PDF e(x) different from 0
 - **\star** First helicity-deg FF G₁^{\perp} observation



Ha

First multidimensional, high precision measurements of semi-inclusive π^+ be spin asymmetries from the proton over a wide range of kinematics

. Dichl.^{34, 6} A. Kim.⁶ G. Argelini,¹³ K. Joo,⁶ S. Adhikari,¹¹ M. Amaryan,²⁰ M. Arratia,⁵ H. Atac,⁴³ H. Avakian, . Ayerbe Gayoso,³¹ N.A. Baltzell,⁴⁴ L. Barion,¹⁵ S. Bastami,⁶ M. Baltaglieri,^{44, 17} I. Bedlinskiy,²⁸ F. Benmokhta (ab), "N.A. Barken," L. Barken, "I. Bosei," S. Boisrinov, ⁴⁴ K.-T. Brinkman, ni,^{47,20} A.S. Biselli,⁵ M. Bondi,¹⁷ F. Bosei,³ S. Boisrinov,⁴⁴ K.-T. Brinkman, D. Buhamula,²⁰ V.D. Barkert,⁴⁴ D.S. Carmar,⁴⁴ J.C. Carvajal,¹¹ A. S. Darkert,⁴⁴ D.S. Carmar,⁴⁴ D.S. Carvajal,⁴⁵ D. S. Carvajal,⁴⁵ D. S. Carvajal,⁴⁵ D. S. Carvaja,⁴⁵ D. S. Carv betry 2: 2: G. Cullo, 1: 1: L. Clack ⁴ B.A. Clary ⁶ P.L. Cole, ⁵ M. Cull, ⁵ A. C. Costantini, ⁶, ²⁰ ede, ¹² A. D'Angelo, ¹⁸, ³⁷ N. Dashyan, ⁵² R. De Vita, ¹⁷ M. Defurne, ² A. Deur, ¹⁴ C. Dilles, ⁷ C. Djalali, ²⁰ V. Greste, ¹⁴ A. D'Angelo, ^{18,17} N. Dashyan,⁵² R. De Vita,¹⁷ M. Defarre,³ A. Dear,⁴⁴ C. Dillas,⁷ C. Djalali,³²
 M. Dagger,² R. Dupre,⁵² M. Eirhart,^{1,12} A. El Alsoui,⁶ L. El Foraj, ¹¹ El Eostofritti,⁴⁴ S. Fegan,⁶⁵ A. Filippi
 T. Forest,¹⁴ G. Gavalian,⁴⁴ G.P. Gilfoyle,³⁵ F.X. Girod,⁴⁴ D.I. Contr,⁴⁵ A.A. Golubenko,⁴¹ R.W. Gote,⁴²
 Y. Gotra,⁴⁴ K.A. Grifforen,³⁴ M. Goidal,⁴¹ K. Haft,¹⁴ [I. Skoloyan,⁴⁵, 20] M. Hattawy,³⁰ T.B. Hayene,⁵¹
 D. Heidle,^{4,44} K. Hicko,³² A. Hobart,⁵² M. Heiney, ¹⁰ S.F. Hyde,³⁵ D.G. Ireland,⁴⁵ E.L. Isupov,⁴¹ H.S. Jo,²
 R. Johrston,³⁵ S. Joosten,¹ D. Koloya, M. Hattawy,³⁰ A. Kripko,³⁴
 V. Kubarovsky,⁴⁴ S.E. Kuhn,³³ L. Koloya, M. Leali,^{47, 20} S. Lee,³² P. Lenias,^{11,10} K. Livingston,⁴⁵ Z. La,³⁰
 L.D. MacGregor,⁴⁵ D. Jone,⁴⁴ D. N. Markov,^{44,4} L. Mariorand,¹⁷ V. Mascagna,^{46,20} B. McKinon,⁴⁵
 Z.E. Meziani,^{1,41} D. G. Luba,⁴⁵ T. Miraceva,⁴⁶ M. Miracita,¹⁶ V. Mokeev,⁴⁴ P. Moran,²⁶ A. Movsisovan,¹⁸ T. Minecvs, ⁴⁵ M. Mirazita, ¹⁶ V. Mokeev, ⁴⁴ P. Moran, ²⁶ A. Movsi Z.E. Meziani,^{1,1} Z.G. Moran,² T. Minseres,⁶ M. Mirazita,¹⁶ V. Mokeev,⁴⁴ P. Moran,²⁶ A. Movsiyyar, C. Munoz Casarad, P. Nadel-Turonski,⁴⁴ P. Naidoo,⁶⁸ K. Neupare,⁴⁷ S. Niccolai,¹¹ G. Niculaecu,² T.R. O'Connell,⁶ M. Osipenko,¹⁷ M. Paolone,^{30,43} L.L. Pappalardo,^{13,10} R. Paremuzyan,^{44,29} E. Pasyu W. Phelps,⁴ O. Pogorelko,²⁸ Y. Prok,³⁰ A. Prokudin,⁶ B.A. Rase,^{11,44} M. Ripani,¹⁷ J. Ritman,²² A. Rizzo C.D. Roberts,³⁹ P. Rossi,^{44,16} J. Rowley,³² F. Sabatić,³ C. Salgado,³¹ A. Schmidt,¹³ E.P. Segarra,² Y.G. Sharahian, 44 U. Shrestha, 22 O. Soto, ¹⁶, 45 N. Sparveris, 43 S. Stepanyan, 44 P. Stoler, 36 LI. Strakovsky, Strauch,⁴² K. Tengin,⁶ A. Thernton,⁴⁵ N. Tyler,⁴² R. Tysen,⁴⁵ M. Unguro,⁴⁴ L. Venturelli,^{47,20} H. Voskaryan, A. Vossen,⁷ E. Voutisr,¹² D.P. Watts,⁵⁰ K. Wei,⁶ X. Wei,⁴⁴ S.-S. Xu,⁴⁰ B. Yale,³¹ N. Zacharira,⁴³ and J. Zhang² (The CLAS Collaboration)

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Observation of Beam Spin Asymmetries in the Process $ep \rightarrow e'\pi^+\pi^- X$ with CLAS12

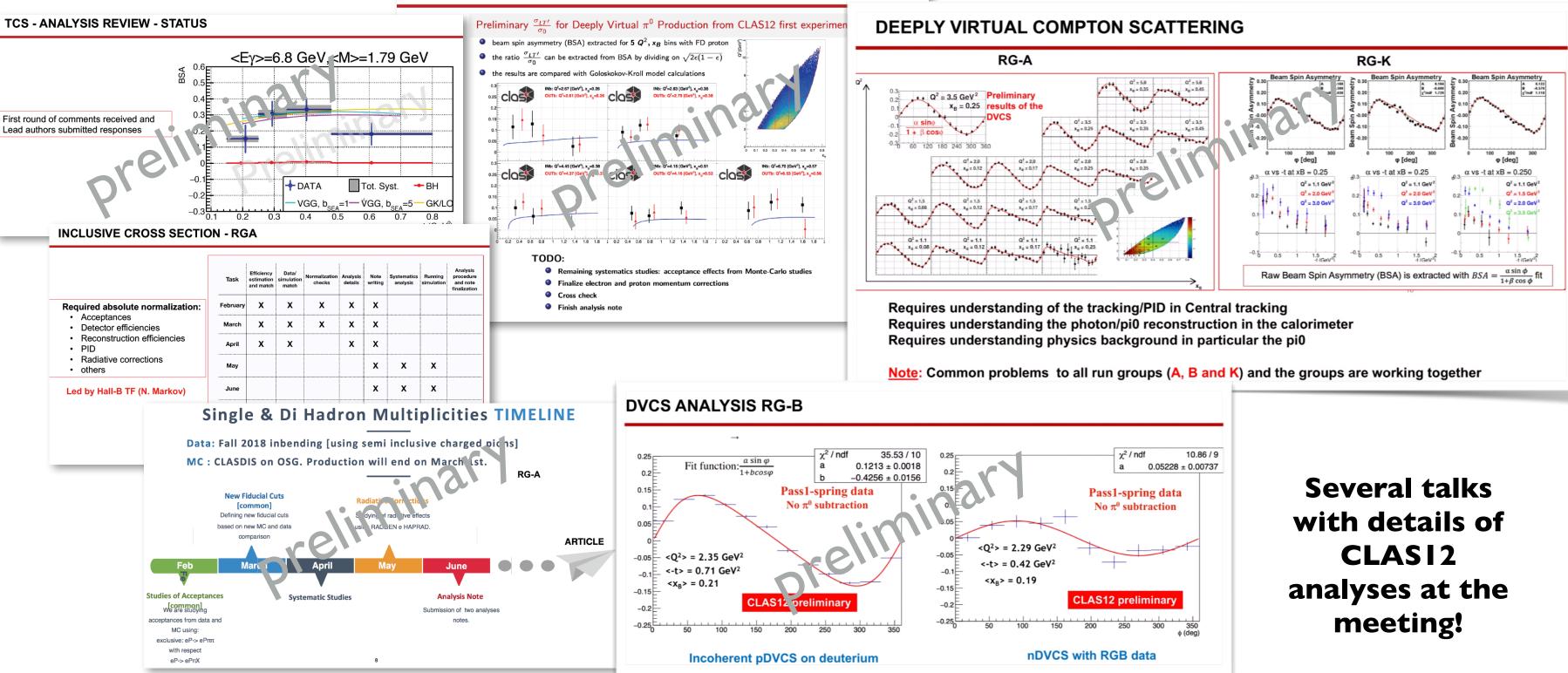
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L.L. Pappalardo,^{8,21} R. H. W. Dyan,^{4,33} E. Pasyuk,³ W. Dhelps,⁴⁶ O. Pogorelko,¹⁰ Y. Prok,¹⁷ B.A. Raue,⁴³,⁴ M. Ripani,⁹ J. R. Guzo,^{35, 26} P. Osoya,³⁵ A. Brosley,³⁰ F. Sabatoi,¹⁵ S. Stepanyan,³ L. K. Kuzovsky,⁸ E.P. Segarra,⁴¹ Y.C. sharabian,³ U. Shrestha,²⁰ O. Soto,^{43,16} N. Sparveris,⁷ S. Stepanyan,³ I.I. Strakovsky,⁸ S. Strauch,³⁷ A. Thornton,³⁸ N. Tyler,³⁷ R. Tyson,³⁸ M. Ungaro,³ L. Venturelli,^{12,13} H. Voskanyan,²⁷ E. Voutier,¹⁸ D.P. Watts,³¹ K. Wei,²² X. Wei,³ M.H. Wood,⁴⁹ B. Yale,¹ N. Zachariou,³¹ and J. Zhang⁴⁰ (The CLAS Collaboration

Credit: S.Diehl, T.Hayward, Latifa E.

Jefferson Lab

CLASI2 preliminary results

EXCLUSIVE PIO ANALYSIS - RGA



Credit: Latifa E., G.Angelini, N.Markov, P.Chatagnon, A.Kim, F.Bossu, M.Defurne, F.X. Girod, S.Niccolai



CLAS12







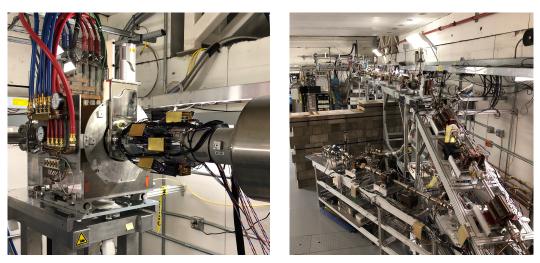
CLAS12



- In support of CLASI2 run group (all transverse experiments designated as High Impact for Hall B)
- challenge: trans. holding fields bend electrons into the detector !
- mitigation: small B•dL \Leftrightarrow frozen-spin HD

Work plan

- Run 0: booster at 0.5 MeV, I MeV, and 10 MeV
- Run 1: commissioning (beam line) ~19 days
- Run 2: run on UNpolarized HD ~17 days
- Run 3: run on Polarized HD ~28 days
- [Run 2b: calibration purpose currently running]



HDice In-Beam Cryostat

Run 3 (Nov 23 - Dec 17/2020):

- 2 frozen-spin HD targets, eHD60 & eHD66, both starting with P(H) ~ 30 %
- H-spins flipped with AFP to eliminate hyperfine dilution

HDice target tests at

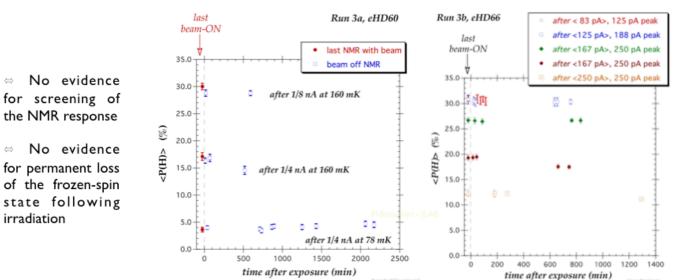
UITF necessary to

check depolarisation

effects

Expectations going into Run 3 (from brief 2012 tests):

- Moller electrons would create a partial screening of the NMR response - Run 2 reduction in NMR is either due to screening, or to higher HD temperatures
- chemical changes following ionization might break the frozen-spin state
- provided the beam was rastered at > 10 KHz, heat should not be the dominant issue



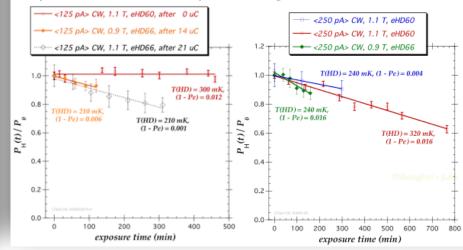
 reduced NMR signals in run 2 must reflect higher HD temperatures using Thermal equilibrium NMR signals to deduce HD temperatures

T(IBC) < 80 mK, but T(HD) > 200 mK heat is certainly an issue

consequence of higher temperatures:

 dP/dt under different holding fields: different atomic el pol same current 👄 same temperature

• High HD temperatures (> 200 mK) result in only partial atomic electron polarization 👳 flipping electron spins have Fourier components at the H-Larmor frequencies a significant dP/dt



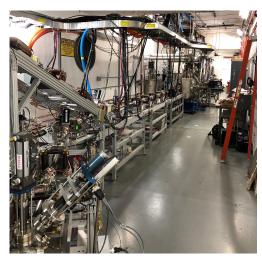
Credit: A.Sandorfy, X.Wei, C.Hanretty, T.Kageya, M.Lawry



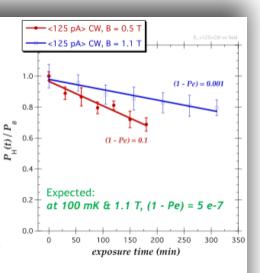




cave-2 elevated beam line



cave-1 with BOOSTER



- initial dP/dt slope is flat. but develops with dose
- but, there is no long-term effect on the frozen-spin state (P_H is steady with no beam) \Leftrightarrow charge build-up ?

HDice UITF tests summary

- the present state of HDice is not able to support the required RG-H luminosity. If there is another viable target technology that can provide most of the Physics reach, it should be pursue
- if alternative options are limited, there are avenues worth investigating that may extend the viability of HDice targets, although these are R&D projects

HDice report at summer **CLAS Coll meeting**



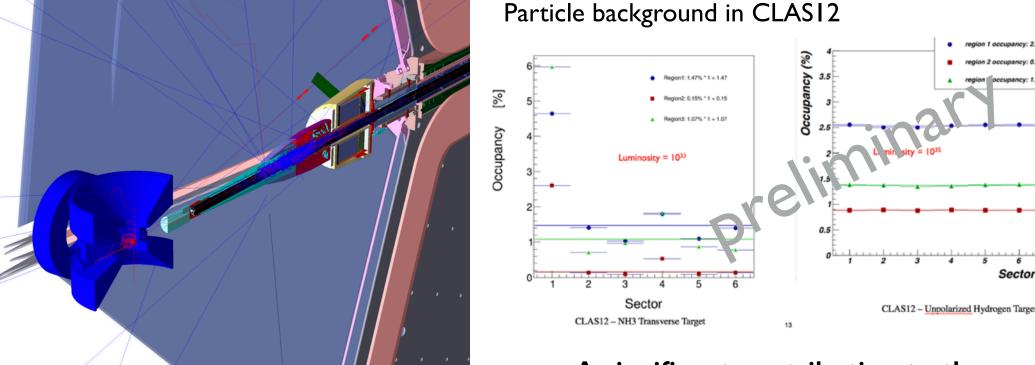
CLAS12 Transverse Polarized target alternatives

Transvere Polarized target alternatives

- Hall-B Task Force appointed (E.Pasyuk)
- Identified NH3/ND3 DNP target as an alternative
- currently studying the impact on CLASI2, impact on approved physics program

Physics impact

- A Reduction in luminosity from 5×10^{33} cm⁻²s⁻¹ to 1×10^{33} cm⁻²s⁻¹;
- Increase in polarization from 60% to 80%;
- Change in the dilution factor from 1/3 to 3/17;
- Operating 5 sectors (instead of 6) of CLASI2 Forward Detector due to electromagnetic background;
- Removing the Forward Tagger covering small angle photons (this only affects the DVCS program);
- Removing the CLASI2 Central Detector (this only affects the DVCS program).

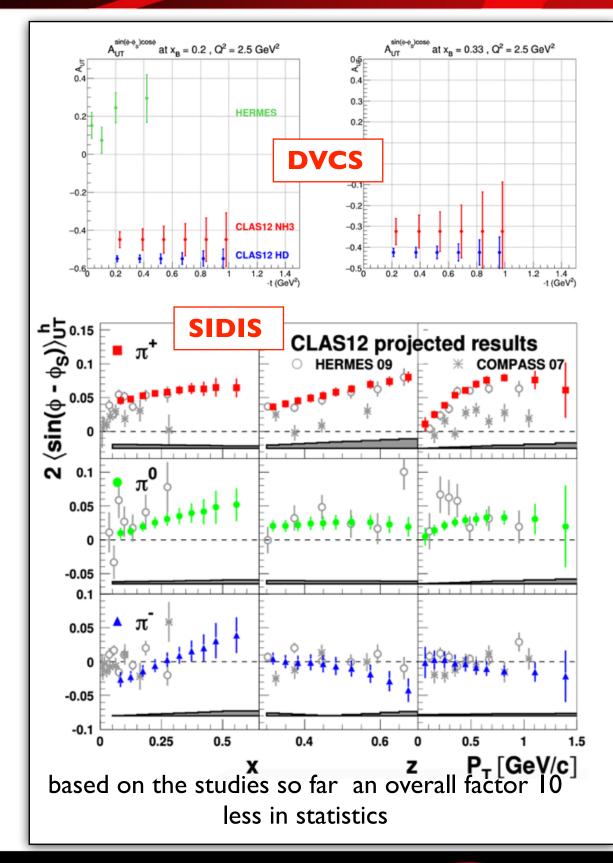


A significant contribution to these studies is expected from RG-H

C.Keith, E.Pasyuk, S.Stepanyan, Latifa E., F.X.Girod, M.Ungaro, H.Avagyan







Hall B

Jefferson Lab

CLAS12

Science & Technology Review

TJNAF biennial Science and Technology (S&T) Review, July 7-9, 2020

CLASI2

- demonstrated to exceed the expected performance
- · Room for improvement for alignment, calibrations and efficiency

Data reconstruction

- Started massive cooking of 2y of data
- So far:
- I 3.5B triggers
- 0.3PB raw \rightarrow 40TB DST \rightarrow 25TB skimmed
- 4M core/hrs processing time
- 600k jobs processed by JLab farm (SWIF) with 6 corrupted files ...

IT resources

- Docker containers for RecSW distribution
- Off-site resources: OSG + INFN + UK for CLAS12 simulations

Machine Learning for CLASI2

- Tracking: speed (6x)
- Clustering
- RecSW handles both conventional and Al algorithms (validation)
- Expected improvement in efficiency and resolution
- Future: on-line reconstruction

Review outcome

- Status of <u>HDice</u> tests (mid October 2020)
- Alternative options for a transverse pol target (Mid Jan 2021)

Credit: V.Ziegler



requires higher granularity tracker (GEM?)

the FT-Cal, application of AI algorithms

Streaming RO: first test in Feb performed using



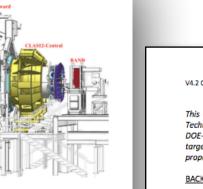
unsupervised hierarchical clustering algorithm mented in JANA framework by C.Fanelli

Two recommendations:

I. Carry out the UITF tests of the HDIce target as soon as possible. Report to DOE-NP no later than October 15, 2020

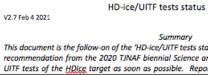
Future plans

2. Develop a definite plan for moving forward the transverse polarized 3D imaging measurements in parallel with HDIce testing. The plan should consider options for alternate targets with an analysis of the scientific impact and the timeline for carrying out the PAC approved experiments. Submit to DOE-NP by January 15, 2021



3D(x.y.E) hits M., [MeV/c2

cluster π0 mass as obtained by an



HD-ice/UITF tests status

V4.2 Oct 14 2020

Summary

This document is in response to a recommendation from the 2020 1 Technology Review to "Carry out the UITF tests of the HDIce target as s DOE-NP no later than October 15, 2020." The document describes the si target (HD-ice) tests at the new JLab Upgraded Injector Test Facility (UIT) proposed technology

BACKGROUND

The JLab physics program requiring a transverse polarized target H), proposed the HD-ice target as the leading technical option. Experin maximum scientific rating (A) by JLab PAC 38 and 39, and were designat for Hall-B, but were conditionally-approved (C1), subject to the 'success performance of an eHD test'.

The proposed HD-ice target makes use of an intense magn temperature (T ~ 10 mK) to polarize the proton and neutron in HD up to polarization; (subsequent RF manipulations can be used to adjust the s PH~20% and Pn~40%.). Other than the material of the containment cel target contains no unpolarized nucleons that would dilute the polarizati is brought to high polarization in a lab separate from the experimental technique is that once a frozen-spin state has been reached, to maint beam-on operations requires only a small B dL (of the order of ¼ Tm). The an electron beam run since the transverse holding field necessary to h electrons into the detector producing background and impacts the act experiment. When exposed to a charged particle beam, the HD depolarization related to beam particle energy loss as well as by m conventional targets. The polarization lifetime determines the applicabil an experiment and quantifies the overhead required for target replacer the external cryostat/field

An assessment of the HD-ice target lifetime with a multi-GeV pho during the last CLAS run in the 6 GeV era (the g14 run) in 2011-12, res compatible with operations with neutral particle beams. Some prelimin g14 exposing the target to a 6 GeV electron beam, were not conclusive tests to validate the use of the HD-ice target with an 11 GeV electron be

Due to the complication in running these tests in the experir installation of the HD-ice apparatus and the interference with the a Jefferson Lab decided to conduct the tests at the Upgraded Injector Test to a 10 MeV CW electron beam. While the energy lost by the beam in bremsstrahlung, which rises rapidly with incident energy, the resulting polarization. However, potential depolarization effects can result from deposition following Moeller scattering from the molecular ele deposited/electron in 5 cm of HD); but this is almost independent of th

> 2. Alternative options DOE by mid Janua with impact expect





s (PART-2)	
tatus' document provided in resp and Technology Review to "Carry	
ort to DOE-NP no later than Oct	
	his t.
	ne
INAF biennial Science and	
oon as possible. Report to	m
tatus of the frozen-spin HD F) and plans to validate the	bw
y and plans to validate the	as
	ter
(Hall-B Run Group H or RG-	ize
nents in RG-H received the	ter
ed as high scientific impact	ras
ful demonstration of viable	%.
	on
etic field (15 T) and low	Im
P _H ~60% and P _n ~20% vector	nal
pin populations to produce	HD
I and Al cooling wires, the	-
on asymmetry. The sample hall. The advantage of this	
ain the polarization during	
his is particularly useful for	
old the polarization, bends	eir
hievable luminosity of the	
-ice target can undergo	tial
echanisms different from ity of this technique to run	as
nent and re-polarization in	m
	to
oton beam was determined ulting in a value (~2 years)	m
ary tests performed during	ed.
and called for a new set of am.	
mental hall related to the	
pproved physics program,	
Facility, which provides up	_
the target is dominated by	
photons have no effect on	
the ionization and energy ctrons of HD (~2 MeV	
e incident beam energy in	
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for DC LL	ont t
for RG-H s	
n_{i} Λ n_{i}	ropor
ry. A new	repor
ed for June.	-
ed for june.	
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I. Results of Run0 and Run1 reported to DOE in October. Run2 and Run4 at the end of January

Transversely polarized target options for CLAS12 V2.9 Jan 15, 2021

Summary This document is in response to a recommendation from the 2020 TJNAF biennial Science and Technology Review to "Develop a definite plan for moving forward the transverse polarized 3D imaging measurements in parallel with HDIce testing. The plan should consider options for alternate targets with an analysis of the scientific impact and the timeline for carrying out the PAC approved experiments. Submit to DOE-NP by January 15, 2021". The document reports status and preliminary results of a study to assess possible transversely polarized target options for CLAS12, the envisaged timeline and the impact on the planned physics program. Three configurations of dynamically polarized solid ammonia, NH3, are considered. The third configuration is preferred based on risk, cost, and schedule. In this configuration the NH3 target figure-of-merit is similar as HDice, and the main limitation comes from the maximum operational luminosity due to the background generated in CLAS12 with a 5 T transverse field. More detailed studies will be available in approximately 6 months.

The Hall-B polarized transverse target physics program

The JLab, Hall-B physics program requiring a transverse polarized target (Hall-B Run Group H or RG-H), includes three sets of measurements

- Deeply Virtual Compton Scattering (DVCS): JLab experiment C12-12-010 'Studies of the spin azimuthal asymmetries in Deep Virtual Compton Scattering (DVCS) using the CEBAF 11 GeV polarized electron beam and transversely polarized target' providing access to different combinations of Generalized Parton Distributions (GPDs) and in particular, to the elusive GPD-E and the contributions of u and d quarks to the total orbital angular momentum of the nucleon.
- · Inclusive hadron production in Semi-Inclusive Deep Inelastic Scattering (SIDIS): JLab experiment C12-11-111 'Studies of azimuthal distributions of measured final state hadrons in coincidence with the scattered electron for the transversely polarized target' provide access to the Sivers function describing the unpolarized quarks, and "transversity" and "pretzelosity" distributions describing transversely polarized quarks in the transversely polarized nucleon
- · Di-hadron production in SIDIS: JLab experiment C12-12-009 'Studies of azimuthal distributions of measured final state hadron pairs' provide complementary access to quarks transversity distributions within the collinear theory, as well as enable studies of correlations of hadrons in hadronization process, crucial for interpretation of single-hadron measurements

All these experiments, grouped in Hall-B Run Group H or RG-H, received the maximum scientific rating (A) by the Jefferson Lab Program Advisory Committee PAC-38 and -39 and were designated as high scientific impact for Hall-B.

The experiments require to operate a transverse polarized target within the CLAS12 detector. The HDIce target was considered as the primary option, but preliminary results of recent tests performed at the JLab-UITF indicate that HDIce remains an R&D project that is not, at this time, ready to support RG-H.

Due to the challenges posed by the HDice target technology, these proposals are conditionally approved with specific conditions from the JLab PAC to be met for approval:



Hall B

Hall-B Agenda

Hall-B Task Forces

Lab-wide

100% Future CLAS12 Trigger/DAQ (S.Boiarinov, G.Heyes) 100% AI support to CLAS12 <u>sw. (G.Gayalyan</u>, D.Lawrence) 100% Future CLAS12 Hi-Lumi (S.Stepanyan)

100% Forward tracking (D.Carman)
100% Central tracking (Y.Gotra)
100% CLAS I 2 software development (N.Baltzell,
100% BG merging (S.Stepanyan)
100% GEMC for streaming RO (M.Ungaro)
100% New polarised targets (E.Pasyuk)
100% Future CLAS I 2 <u>Pld</u> (V.Kubarovsky)

Hall-B

Hall-B 90% CLAS12 data preservation (H.Avagyan) 80% Physics analysis framework (V.Ziegler) 55% Novel tracking technologies (Y.Sharabian) -> requires on-site access CLAS12 CD/FD efficiency assessment

Run Grup support/integration

- RG-C support (V.Burkert)
- RG-I support (S.Stepanyan)
- RG-H support (E.Pasyuk)
- RG-L (ALERT) (D.Carman)
- RG-M support (V.Kubarovsky)
- RG-N support (H.Avagyan)
- PRAD-II support (S.Stepanyan)

		CLAS12 future	DAQ and	Frigger systems (June 24, 2	:020)		rized targ	gets task force report			graded injector Test Facility and will require const r modification of a UTIP beamline suitable for the in	ruction of a variable temperati	
	AI task force Report	Task force: S.Boyarinov (core), G.Gavalian (exte		s (external, co-PI), V.Kubarovsky (core), R. siternal)	Paremuzyan (core), N.Baltzell	Charge 1. Assess different option for CLAS12	Forward	Tracking Improvement T	ask Force Repor		7. Study forward tracker alignment	techniques (e.g. MILLIPE	DE, Kalman Filter)
	Gavalian, D.Lawrence, N.Baltzell, Britton, C. Fanelli, O. Hansen,	External advisors: 8. Sa	Software	Task Force Report		 For each option quantify: necessary steps to de timeline and mileston 					HIGH priority, 6 months, 0.3 FTE 8. Study effect of different torus fiel	d maps on resolution an	d choose best map
	Ziegler, D. Heddle, L. Elouadrhiri,	The current document), G. Gavalian, M. Ungaro, V. Ziegler, R.	De Vita (ext.), D. Heddle (ext.)	expected results	June 29, 2020			July 17, 2020	 Improve tracking efficiency 		
	M. Ungaro	DAQ Trigger scheme, an recommendations for 0	This task fore	e met between March and June in 2020	o identify CLAS12 software infrastructure limitati	 Evaluate the impact of each Estimate costs and identify 			Improvement Task Fo	orce Report	 Implement and validate CVT/SV 		
	ribes areas in our workflow where we can b ases it will provide speed up of reconstruc-	The current CLAS12 D		or increasing reliability, speed, and long	term maintenance. This document is the result	 Evaluate synergies with atk Members 	Maxence Vand	Members: Yurl Gotra (PI), Veronique Ziegle expert), Rafayel Paremuzyan (external), Mar	r (core), Mac Mestayer (core), pirms Deferme (external)	, Meurizio Ungaro (external, MC	 Develop and validate standalon Validate SVT geometry and star 	e Kalman Filter, HIGH priort relatione tracking, HIGH prior	y, 2 weeks, 0.5 FTE.
codes, in other cases it can pro	duce more maintainable code. The task fe	DAQ production event i				E. Pasyuk (PI), X. Wei (core), V. Burkert	Abstract	Abstract	Chronomiu	ng CLAS12 with GEMC Task	Earna Parant	Voltage vs time signa	al shape from a "geant4 hit"
major areas the A.I. can be u triggering, and detector simula	sed: offline data reconstruction, online di tions.	configuration, the even TDCs on the level of 70		Particle Ident	ification Task Force Report	Additional external members: M. Lown Approved Experiments	This document	This document identified areas in which the efficiency, momentum resolution, and execut		ng CLAST2 with GEMIC Tas	rorce kepon		
Offline Data Reconstr		100kHz, where the trigs	Note, this t			 Run Group C: Longitudinally pr 	of tracking effi	manpower requirements of the various tasks	Members: Maurizio Ungan	o (Pl), Sergey Boyarinov (core), Gagik Gavalia	n (core). Nethan Baltzell (core), Ben	steps.	ork to provide a voltage as a function of time based on
tationally intensive. Tracki processing time. A.L can p		considered. Software-wise, the ex	tracking, bu when appro	V. Kubarovsky, N. Baltzell,	D.S. Carman, N. Markov, Y. Sharabis	 Run Group G: Longitudinally pr 	the time-state	Tracking Improvement Goals We have identified five work areas to improv	Raydo (core)				
codes the main problem to a ground situations this is con		special attention requir components and for the			October 22, 2020	Run Group H: Transversely pol Run Group N(?): Polarized ³ He	Tracking Imp	 Improve track momentum and ang 	This document summar readout from the CLAS				
and hits. A.I. algorithms m	CLAS12 Upgrade for H	under control. To run al				 Run Group N(1): Polarized 'He Longitudinally polarized target 	We have ident	 Tune MC simulation of the tracker 	The ultimate goal is to p				 Study the depender accuracy on the ki
reconstructed data. Develop Hall-B (code speed up by fa	Task Force S	Existing technologies	Other Track Geometry 1		Abstract	For RGC and RGG the target is essential material: Run Group C will utilize NH ₂ a	 Improve tr Improve eff 	 Reduce the event reconstruction t Validate tracking software and imp 	 a realistic estima a battlepround t 				using experimenta incorrient and mis
SBS GEM trackers in Hall-J	Task Force a	on available hardware, i the streaming DAQ at th			nmendations for the short and long term tasks to tification capabilities as identified by the CLASE	RGC target	 Improve th 	We identified specific studies listed below to	challenges on h	CLAS12 FD charge	e particle reconstruction		and the moments
Another A.I. application segments of tracks, which e		except MM and TDCs, o	Magnetic F	task form.	and the operation of the control of the Control	The design and construction of the targ Group Laboratory. The tests included a	 Improve th Validate tr 	priority: HIGH (CY2020), MEDIUM (1-2 yrs),	The Boar cau ne active	efficiency and the be	sam background merging		yields, SEDIS pior denous of the effici
nosity runs and can improve	Task Force member	streaming mode can be TDCs upgrade can make				Target and Fast Electronics Groups, and		. Income local memory of an	estimates. Given the in opportunity for synergy	Task F	orce report		The dependence w
in CLAS12 tracking using 1 potential of discerning track	L. Elouadrhiri, M. N Advisors: N. Liy	to switch to streaming it in parallel with DAQ or	Manual Street, or other	1 Time-of-Flight Co	ounters	effort on the target will focus on constr final, beam-ready versions, and dynami	We identify 33 priority: HIGH	Geometry and Local Reconstruction Standardize helix definition and prop					Reconstruction off final state lower ti
Besides tracking, A.I. can such as in calorimeter clust	Contributors: K. Gnanvo, S.	be used in current trigg	Decoding	 Short term work: 		Timeline and resources for System Q	be assigned as	initialization, HIGH priority, 2 weeks,	Event generators "stre		epanyan (PI), M. Ungaro (core),), H. Avagyan (core),		Validate backprose
based on detector responses.	E. Pasyuk,	development of the tra and L3 software-based	Beckground		FTOF combined panel-1b/panel-1a timing:	Workforce resources: JLab Target Group Oct. 2020: System tests with electronics	 Improve 1 	 Implement and validate the methods geometry framework, HIGH priority, 3 	Description: provide a r	N. Markov (external), V. Burk	ert (external), R. De Vita (external)		cics with versils o nexity data:
The above mentioned alg of track reconstruction espe	Octol	Possible DAQ improve	Event Build		sect up to 15% improvement in timing resolut rus map: 6 months of work to complete includ	Dec. 2020: Lower half target cart compl		 Improve cluster selection (BMT centry Lorentz angle corrections), HIGH price 	time, using the cross-se		taell, FX. Girod, J. Newton		There have been a
where fast response is impor-		current and upcoming (Fast MC	ing shifted 4-momentum in momentum resolution	vs. $p, \theta, \phi, \text{ and } z\text{-vertex}, expect up to 20% in$	Dec. 2020: Design and fabrication of be Jan. 2021: Final version of Jlab Q-meter	1. Finish up		The authors are interest	Oeto	ber 5, 2020		and physics reactly exclusive and semi
Online: The track ident Combined with calorimeter	RG-A took data at 0.6 of the	expected in a two-year TDCs have to be upgrad		 Finalize alignment of 6- 	layer FMT: 6 months of work to complete, es	Nov. 2020: Lower half target cart comp Feb. 2021: Beam-appropriate helium ba	HIGH pri	 Document SVT/BMT calibration prop months, 0.2 FTE 	Resources estimate: 0.1				rised as follows:
tests in Hall-B showed that	task force (TF) charged to study w upgrade. The task force activitie	2.5GB/s. Although this (OF timing resolution due to improved vertex TOF hit time on hit position along bar; 3 mon	Feb. 2021: Shim coils installed (55k) March 2021: Tests in EEL (510k)	 Finalize t HIGH pri 	 Study calibration stability*, MEDIUM Central Tracker Alignment and Spleng 		Introduction			I. the reconstru
hard to achieve with conven an electron trigger. A.I. bas	meetings, and the related documer	As mentioned above,	Train Shires	to complete, expect up (to 20% improvement in timing resolution.	April 2021: FPGA NMR ready for tests	3. Determin	 Stage 1: define initial SVT internal all define global SVT alignment in X and 	Working around Gean		software group, achieved its goals of de-		the beam cur This has been
and online data calibration. Detector Simulations:	A full report on the options for the	more valuable as a test in streaming DAQ mode			and alignment updates of CVT: 4 months in CTOF timing resolution TBD.	May 2021: Beam-ready bath for target: June 2021: Tests in EEL (\$10k)	4. Study cal	standalone tracking, validate beam p	Description: a framewo		ackages to account for background hits in data and MC. The software package and		studies. In by ity data repre
tors that take long time to	as CLAS12 Note 2020-006 (also an of TF, the Stage-1 upgrade can be	direction. An additional	Enteretari	 Recover lost signal in the 	e CTOF due to remnant field: studies to be T installed, effect on CTOF performance TB	Aug. 2021: Pumps on pump cart (\$20k) Sept. 2021: Dress rehearsal Complete	MEDIUN	MEDIUM priority, 7 months, 0.2 FTE • Stage 3: develop and validate Kalma	Resources estimate: 0.1		tware group wiki. With the background astruction officiency and the momentum		2. the SIDIS MC
simulating calorimeters is the total computational time).	\sim \$2M. The Stage-2, while more st	for online data monitor without L3, but L3 impli				Nov. 2021: Construction and installation Nov 2021: Design and construction for I		 Gage 3: develop and variable karne priority, 12 months, 0.5 FTE Quantify CVT misalignments on coan 		resolution at high luminosities are	reproduced within a few %. The largest		of pion recom
up simulations, using GAN	full implementation is possible with	Changes in the curren	Event Togg	Long term work:	IDCs with high resolution TDCs: Plans inch	Jan. 2022: System ready for installation Feb. 2022: System ready for beam in Ha	5. Devise pr	 Study effects of misalignments and L 	Streaming Readout Us	discrepancy was between the inclu- data and background merged MC.	nive electron reconstruction efficiency in amounting $\sim 4\%$ at 40 nÅ.		ing mass rost 3. electron rocor
experimental Halls. A.L cau tance and resolutions, for fa	Goals for the Upgrades	were identified. Existing	Documents	being considered, expect	5% improvement in FTOF timing resolution	ROG target	HIGH pri 6. Study eff	 define most important degrees of here Study CVT momentum, angular, vert MEDIUM priority, 6 months, 0.5 FTE 		Below is the charge for the tas			reproduced is
		development. External Streaming readout back	GROOT		echnologies for Central Detector: New detecto r of 3 improvement in timing resolution and a	While the modifications to the longitud	HIGH pri	 Devise procedure to align CVT relativ 	network. The project has three st		ing hits in fADCs and TDCs in CLASI2		4. different pro- and show the
	Stage-1: Achieve luminosity of ~ running with charged particle reco		Miscellane	momentum acceptance.	Multiple years to investigate and complete RI:	prepare the "LiH and "LiD samples for d irradiation must be used to create the F		 Study effects of track propagation in t 	1. organize geant4	background (from the random			5. track reconst
	running with thargod particle reco		A Testing by	if there is support.				FTE (with Software task force) Beamline and Shielding Improvement	 write SRU stream broadcast each 		a been developed and used to validate the The tool is in use now by large group of		nA of backgr
	Stage-2: Configuration of CLAS12		t				• Long to	 Study tagger dump shielding options priority, 6 months, 0.2 FTE (with High 	Resources estimate: 0.3	collaboration,	the cost is in the new cy serie from or		 Document the work
	nitude higher luminosity $(10^{37} \text{ cm}^{-2})$	s 1).									9 out hits in fADCs and TDC associated		A note has been w More on the task
	Charge to the Task Forc	e			showed promisi performance.	ng results, more studies are need	ed to evaluate	the detector			undom trigger events: the "ttrigger-filter" gen are for filtering and organizing the		https://clasue0 Forces.2020B
U.S. D	5									background events into hipo			
	 Assess the current CLAS12 lun (tracker granularity, integratio) 			actors	Define a t milestone	vork plan to test the proposed sol s for:	ution with a to	me chart and				Jett	erson Lab
	(•	

- Almost all TF concluded the assessment phase
- Some moved to the execution
- New RGs support TFs
- Compiled a Hall-B TF Agenda for 2021
- Priorities, timelines, milestones, resources, ...
- Updated every ~3 months

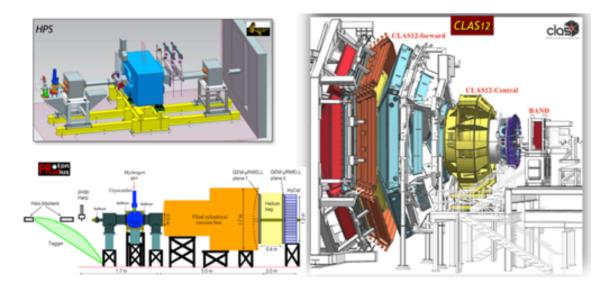






Hall B Task Force Agenda

Hall B staff members and external collaborators



Executive Summary

This document reports on the Task Force (TF) results. The TFs were set to address issues related to Hall-B data collection, processing, and preservation. A selected group of Hall-B staff members, supported by external experts, were charged to make an assessment of the current situation and propose some actions to address issues indicating resources and timelines. The TF final reports were used to define an action plan with priorities and timelines to guide and organize the work of the Hall-B staff members in the next year. This document is supposed to be reviewed and updated every month, based on task progress and include any further tasks not known at the time of the compilation.

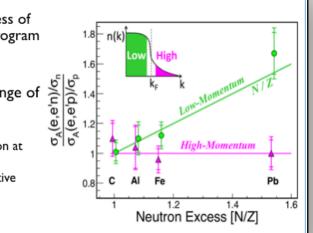




Near future: RG-M

Short Range Correlations

- Build on the tremendous success of the CLAS6 data mining SRC program (Science, several Nature, ...)
- Take far more (e,e'pN) and (e,e'pNN) data on a wider range of (c,e)
 - Three nucleon SRCs?
 - · Constraining the NN interaction at short distances
 - Understanding factorized effective theories
 - SRC formation mechanisms
 - SRCs and the EMC Effect



Electrons for neutrinos

- Take (e,e'X) data to test vector-current part of neutrino-nucleus event generators
 - Energy reconstruction techniques
 - Event generators key to reconstructing oscillation parameters
- Scheduled for 30 PAC days: fall 2021
- D, 4He, C, [O,] 40Ar, 40Ca, 48Ca, Sn
 - Targets designed and under development
 - Standard liquid target cell
 - Short 0.5-cm Ar liquid target cell
 - Solid target C, Sn insertion mechanism
 - Special Ca target holders

Credit: V.Kubarovsky





- RG-M support Task force (PI: V.Kubarovsky)
- CLASI2 configuration completed: No FT, no LTCC, TORUS in-bending and out-bending
- Target
- Mechanical design completed, target foils production in progress
- Mechanical support production March 2021
- Target test together with slow motor control—April 2021
- MC (target geometry, trigger parameters, DC roads) started
- Target slow control April 2021
- Detailed draft of run plan is ready (lumi scan, empty target, trigger validation, beam energy, targets, torus etc)
- Off-line analysis and trigger validation software – ongoing
- Analysis coordinator and chef identified
- Data calibration during run discussed with CALCOM, D. Carman made report on the RG-M meeting. Engineering runs will be cooked soon and sent to Daniel for calibration to practice

"Online" l	Detec
There is a push to reduce the taking to readiness for pass-	
⇒ the quicker the detecto processed, and the sooner	
The <i>ideal</i> would be doing calib	pration
	Where for pas
	• Wait
	• Wait a give
	• Wait
	• Perfo
	• Cook
	 Howe import
	• Tł da
	• W F1

NO II



tector Calibrations									
	For some systems, in principle, calibrations can be done very close to online, e.g. beam offsets, RF, BMT, FMT, SVT								
alibrations, the sooner the data can be a analysis can begin	For the bulk of the detailed timing calibrations, i.e. FTOF, ECAL, CTOF, HTCC, FT, LTCC, RICH, a complete picture is								
ions online - <i>i.e. during data taking</i>	needed based on the full set of timelines to properly apply the calibration constants over the appropriate run ranges								
ere do the delays come from betweer pass-1 data processing?	collecting the data and being ready								
/aiting for necessary reconstruction s	oftware developments								
/aiting for calibration procedures of n given physics run	ew detector systems implemented for								
/aiting for detector alignment work									
erforming the detector calibrations or	ver multiple iterations								
ooking the data, performing pass-0, ge	enerating the timelines								
owever, another contribution to the t nportant) is not beginning the work	ime delay (and perhaps the most								
The Analysis Coordinator has to aggressively push the effort and maintain daily oversight to reduce the delays									
	We are getting better with the new oversight role of CALCOM (e.g. RG-B F19/W20, RG-A Spr19, RG-F Sum20/W20)								
How can we do better??									
A goal would be to have all calibration: more than 6 months after the run ena	s done and ready for pass-1 cooking no								





Medium future: RG-C

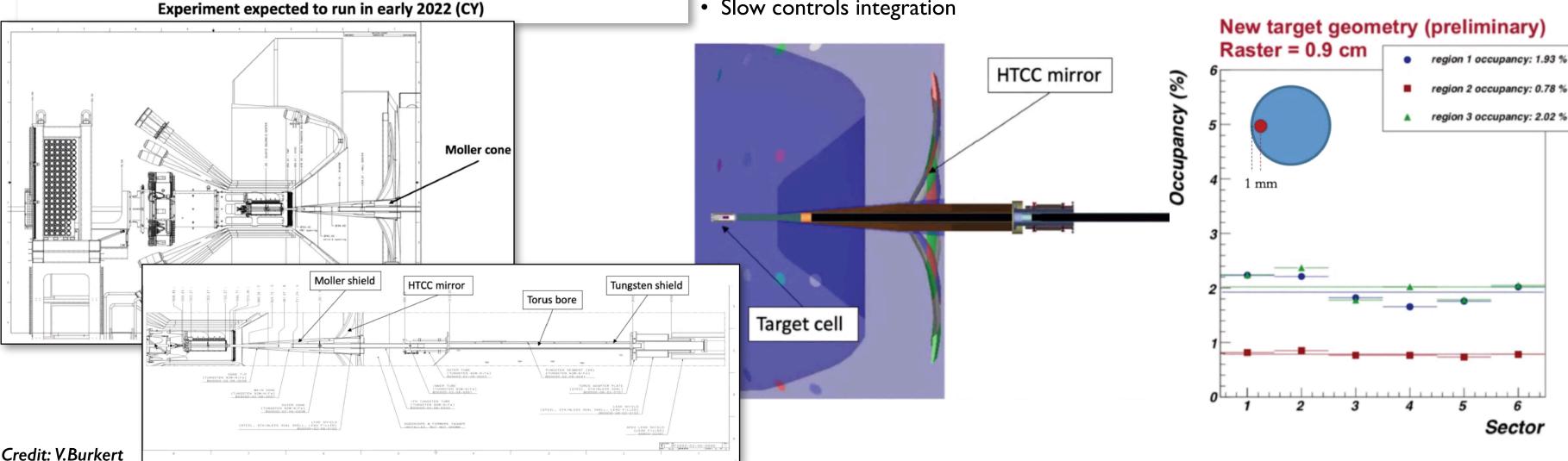
Experiments will use longitudinally polarized NH3/ND3 target

_										
	E12-06-109	Longitudinal Spin Structure of the Nucleon	Kuhn	Α	80		Polarized			NH ₃
	E12-06-109A	DVCS on the neutron with polarized deuterium target	Niccolai		(60)		target RICH (1 sector)			ND ₃
	E12-06- 119(b)	DVCS on longitudinally polarized proton target	Sabatie	А	120	185	Forward	11	С	
	E12-07-107	Spin-Orbit Correl. with Longitudinally polarized target	Avakian	A-	103		tagger		S. Kuhn	
	E12-09-007(b)	Study of partonic distributions using SIDIS K production	Hafidi	A-	80					
	E12-09-009	Spin-Orbit correlations in K production w/ pol. targets	Avakian	B+	103					

RGC:

- Originally approved for 185 days of beam time
- PAC48-Jeopardy: - Reduced beam time to 120 days w/ focus on DVCS (proton, neutron)
 - For remaining beam time return to PAC with new impact study
 - Emphasizes availability of Forward Tagger

- RG-C support Task Force (PI:V.Burkert): polarized target, design of the beamline (raster magnets, Moller cone), simulations
- Current run plan: 90/120 PAC days FT-Off configuration; 30/120 PAC days FT-On configuration
- comparable to the simulations for RG-A
- So far optimised the FT-off configuration: next step FT-on Installation/preparation plan defined (+2 months for DNP target) • New tungsten Moller cone, optimized raster size and target geometry: DC occupancies
- Still working on DC3 background
- Slow controls integration











CLAS12

CLASI2 at Hi-Lumi Task Force (PI: S.Stepanyan)

- Two-stages work-plan: I) Lx2, II) Lx100
- new tracker (GEM, uRwell) to replace DC (+improved FE electronics)

CLAJIZ	Upgrade to H	nyn	iuiii	1105	ny U	peru		5				
Sect.1: tim	eline, milestone	s, dep	oende	nces,	resou	rces,	funds					
	December 2020	•••										
Goals			25									
reconstructio	eve luminosity of ~ on efficiency of > 85 figuration of CLAS1	%.										
Task Force	CLAS12 High	Lumir	osity (Operat	ions							
PI	S. Stepanyan											
Members	V. Burkert, L. E	louad	rhiri, M	I. Mest	ayer, M	I. Unga	ro, V. Z	iegler				
Advisors	N. Liyanage, E.											
Contributors	K. Gnanyo, S. B	loyarir	lov, D.S	S. Carm	ian, V. J	Kubaro	vsky, E	. Pasyı	ık, R. De	Vita, M		
Tasks/	Subtasks	2020		2	021	_		2	022		2023	202
1 45K5/	Sublasks	IV	Ι	II	III	IV	Ι	II	III	IV		
1. Improve exis	ting FD tracking sy	stem (S1):									
1.1 Test DC time-over-t	hreshold readout				M1.1							
 Develop software fo threshold readout 	r analysis of time-over-				M1.2							
2. New tracking	g solutions (S1):								•	•		
2.1 Define MPGD config FD	uration for the CLAS12			M2.1								
2.2 Define readout conf	iguration for MPGD					M2.2						
2.3 Fabricate large GEM	and µRWELL prototypes				D3.1/2	D2.1/2			M2.3			
2.4 Test prototypes and	readout systems						D2.3			M2.4		
	lation and reconstru	uction	(S1):									
3.1 Full GEMC develop tracker	ment of the MPGD				M3.1							
3.2 Tracking with FPGE	R1 detectors				M3.2							
4. Full impleme	ntation of the MPC	D tra	cker (S	1):								-
4.1 Final design of the tr									D2.4	M4.1		
4.2 Procurement of com	ponents									D4.1	M4.2	
4.3 Fabrication of detect	ors										D4.2	M4
5. MC studies of	f rates, occupancies	s and I	BG for	S2:	•	•						
	\$12 at v10									M5.1		
5.1 GEMC studies of CLA												

Hall-B project

- with charged particle reconstruction efficiency of > 85%.
- Hall-B staff: previous TF + new members

- Bi-weekly meeting to discuss design and progres

Plan for the first year FD tracking

1. improve existing DC readout - time-over-threshold

- a. test with cosmics (ongoing)
- b. test with beam, parasitically with HPS and then with RG-M (Mac, Sergey, Ben, ?)
- c. develop offline software to use time-over-threshold information to improve BG reduction (Veronique, ?)

2. develop MPGD detectors for R1 DC

- a. build and test large area µRWELL, test in Hall-B (Kondo, ...)
- b. study options for light weight detector, test solutions (Kondo, Rui?, ...)
- c. study options for the readout (Kondo, INFN, Stepan, FE group)

3. develop software for R1 MPGD

- a. implementation of a μRWELL plane in GEMC (Maury)
- b. development of FD tracking with µRWELL plane (Veronique)
- c. study track reconstruction efficiency with the new detector using BG merging (?)

Credit: S.Stepanyan





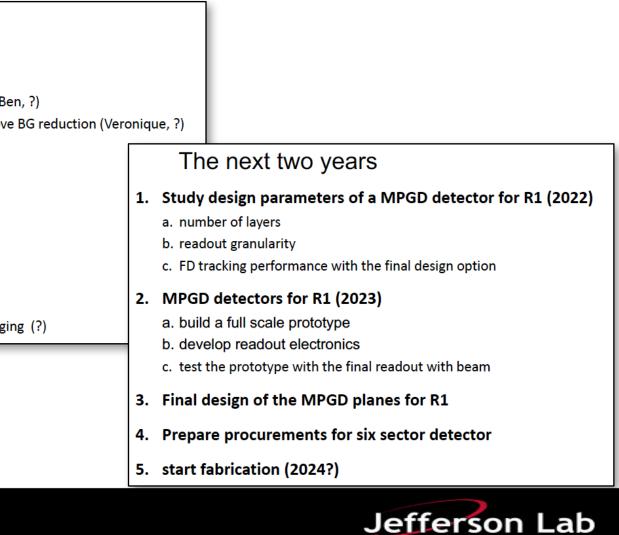




- Focus on Stage I: Achieve luminosity of ~ 2×10^{35} cm⁻²s⁻¹ for normal running conditions of CLAS12

- UVA, INFN expressed interest for building a prototype and develop a new FE electronics

- Preliminary work plan aiming to develop a detector in \sim 1y time and test it on-beam in CLAS12



Hall B Long range - FY21 schedule

• Plans

- No solid plans are possible due to the COVID-19 uncertainty
- FY21: SAD is progressing with the scheduled maintenance
- The ACC schedule will be published soon
- HPS and RG-M in CY21 and RG-C in CY22
- Working to support RG-L (ALERT) ERR
- Staffing CLAS shifts for next run can be an issue

In summary:

from November 2020 CLAS Collaboration meeting

- Schedule
- FY21: long CEBAF shutdown for CHL Cold Box repair (Scheduled Accelerator Down - SAD)
- Decommissioning of installed components: BONUS
- Maintenance of several detectors
- Installation of the next experiments (HPS, RG-M requires nuclear targets)
- Weekly meeting to plan the activity
- Regular report at Monday meeting - Update on a dedicated wiki page: https://www.jlab.org/Hall-B/clas12-web/sad-2021-update.html
- FY21: 20 weeks (Jun-Oct), 10.9 max E_b, only two RGs that requires low beam energy will be able to run (HPS and RGM)
- FY22 (tentative): polarized longitudinal target
- ... : nuclear targets, transverse polarized target, completion of RGA, RGB, RGK, HPS, ...
- ...: new proposals (PRAD-II, polarized 3He, tritium target, ...)
- Lesson learned: CLAS12 remote shifts went pretty well Remote shifts for monitoring and support onsite personnel
 - only monitoring (no DAQ or control detectors)

- home-like network connection + BJ to communicate with the Counting House Should we extend the remote shifts to regular CLAS12 operations?

In summary:

- ... difficult time but:
- Difficult times but JLab was able to complete the experimental program planned for FY20 Hall-B staff members and collaborators are doing their best to provide data ready for physics analysis
- Progressing in CLASI2 data preparation for physics analysis (first two letters submitted): strong support from HAII-B SW and CALCOM for new reconstruction sw release, calibration suites, MC simulations on OSG
- PassI data reconstruction almost concluded for the all data sets (RGA/B/K and soon RGF) and preparation for a Pass2 Preparing the near- (HPS, RG-M, RG-C and RICH-II), medium- (RG-L, RG-H, PRAD-II) as well as the far-future (RG-N, CLAS12@hi-lumy) of CLAS12







