Hall-B Status Report

- News from Hall-B Group and Collaborations
- Research Output from Hall B

Patrick Achenbach

July 21, 2025

News from Hall-B Group and Collaborations

Hall-B Group

NEW APPOINTMENTS

- **New Bridge Appointment with Lamar University**
  - 5-year assistant professor position with Hall B

POSTDOCS

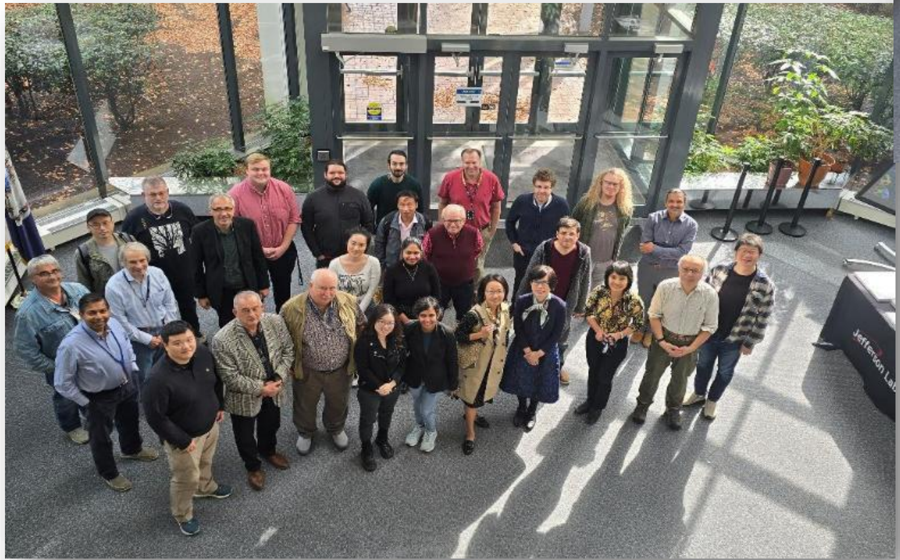
- **Pierre Chatagnon** left for CEA in Paris-Saclay
- **Bhawani Singh** started in Feb 2025
- **Richard Tyson** will leave in mid October

GROUPS IN HALL B

CLAS Collaboration:

HPS Collaboration *(not pictured)*

PRad Collaboration:



News from Hall-B Collaborations

CLAS COLLABORATION

- Collaboration meetings in Nov 2024, Mar 2025 and July 2025
- More than 200 members and new institutions joined
- **Bryan McKinnon from Glasgow U** elected as next chair
- **ALERT** detector installation in Nov 2024
- **~46 of 55 PAC days of DIS data taken** on track to complete in July
- Expected **to complete SRC data taking** by end of run

The ALERT detector is transported to its new home in Hall B.

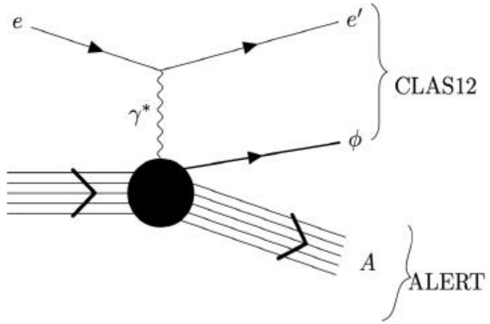
<table>
<tr><th>Proposal</th><th>Physics</th><th>Exp. Contact</th><th>Rating</th><th>PAC</th><th>Group Days</th><th>Equip-ment</th><th>Energy</th><th>Group Contact</th><th>Target</th></tr>
<tr><td>E12-17-012</td><td>Partonic structure of light nuclei</td><td>Z. Meziani</td><td>A-</td><td>45</td><td rowspan="4">55</td><td rowspan="5">CLAS12 ALERT</td><td rowspan="4">11</td><td rowspan="4">L
R. Dupre</td><td rowspan="5">High pressure gaseous H, D, ^{4}He</td></tr>
<tr><td>E12-17-012A</td><td>Tagged EMC measurements on light nuclei</td><td>R. Dupre</td><td></td><td>45</td></tr>
<tr><td>E12-17-012B</td><td>Spectator-tagged DVCS on light nuclei</td><td>W. Armstrong</td><td></td><td>45</td></tr>
<tr><td>E12-17-012C</td><td>Other physics opportunities with ALERT</td><td>M. Defurne</td><td></td><td>45</td></tr>
<tr><td>E12-23-013</td><td>Measuring short-range correlations with ALERT</td><td>F. Hauenstein</td><td>A</td><td>51</td><td>17</td><td>6.6</td><td>F. Hauenstein</td></tr>
</table>

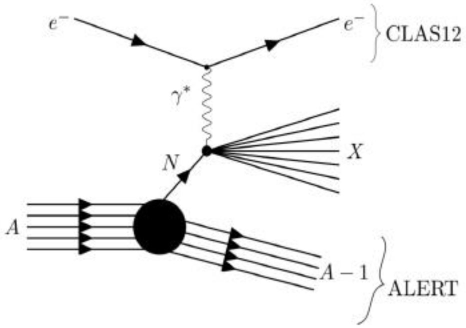
Physics Opportunities with ALERT

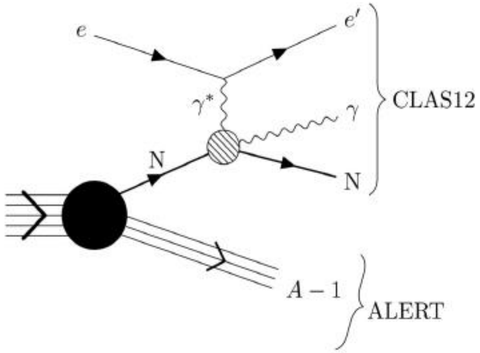
A Low Energy Recoil Tracker (ALERT)

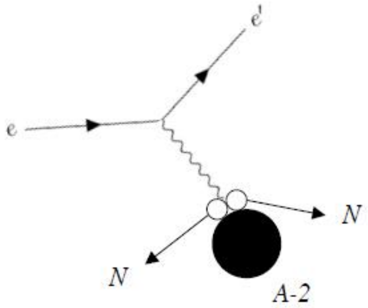
- Hyperbolic **drift chamber**
- **Time-of-Flight** array
- **Target straw** for H_2, D_2, and ^{4}He

Measurement	Particles detected	p range	θ range
Nuclear GPDs	^{4}He	$230 < p < 400 MeV/c$	$\pi/4 < \theta < \pi/2$ rad
Tagged EMC	p, ^{3}H, ^{3}He	$70 < p < 250\ MeV/c$	As close to π as possible
Tagged DVCS	p, ^{3}H, ^{3}He	$70 < p < 250 MeV/c$	As close to π as possible









Coherent Processes on ^{4}He

- ^{4}He(e,e'γ)^{4}He
- ^{4}He(e,e'ϕ)^{4}He

DIS on ^{4}He and ^{2}H: Tagged EMC Effect

- ^{4}He(e,e'^{3}H)X
- ^{4}He(e,e'^{3}He)X
- ^{2}H(e,e'p)X

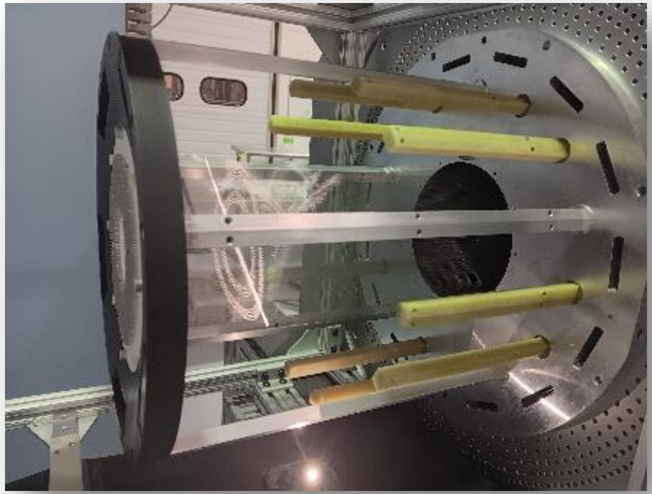
Incoherent Processes on ^{4}He and ^{2}H

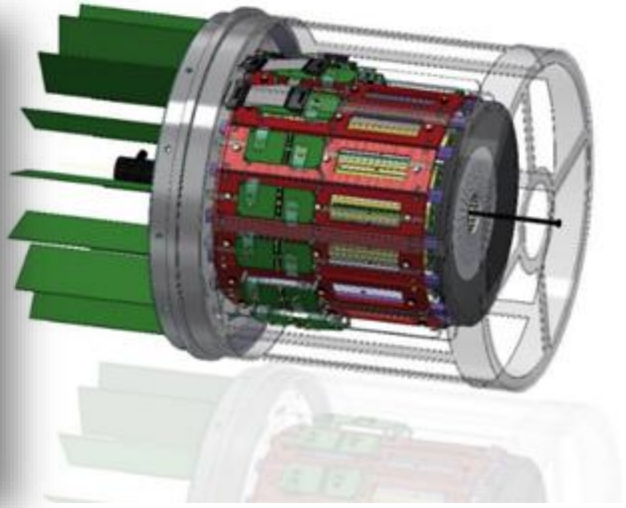
- ^{4}He(e,e'γp^{3}H)
- ^{4}He(e,e'γ^{3}He)n
- ^{2}H(e,e'γp)n

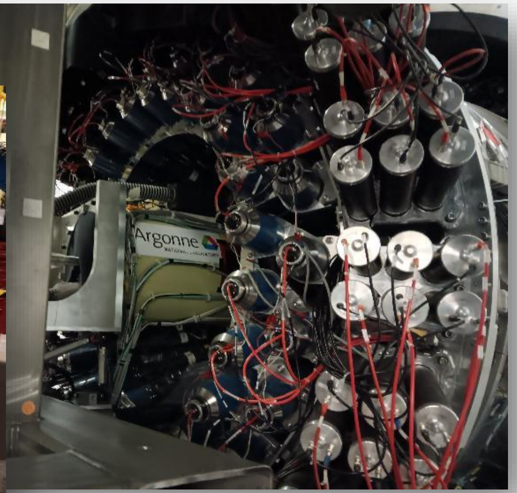
Short Range Correlations on ^{4}He

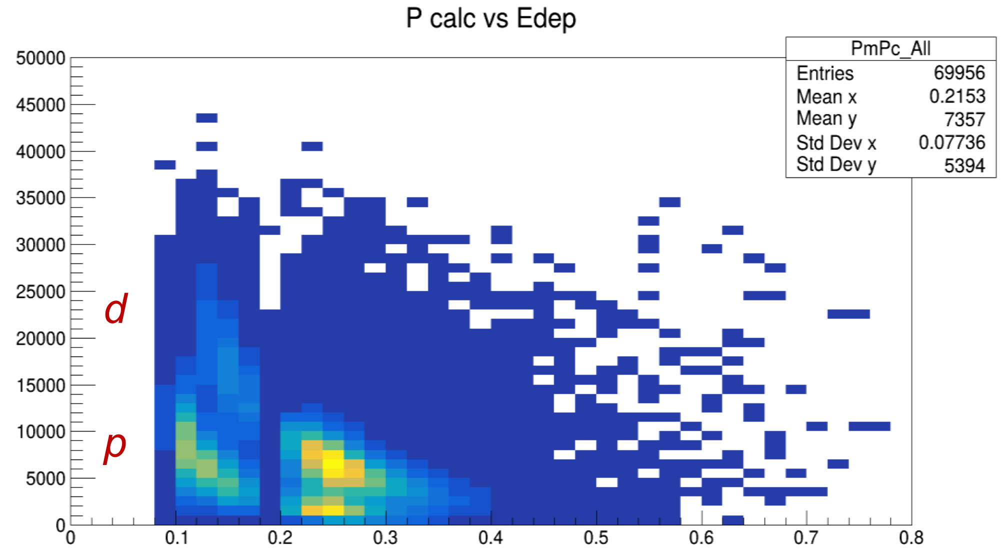
- ^{4}He(e,e'pd)n
- ^{4}He(e,e't)p
- ^{4}He(e,e'p)

ALERT Detector Operation

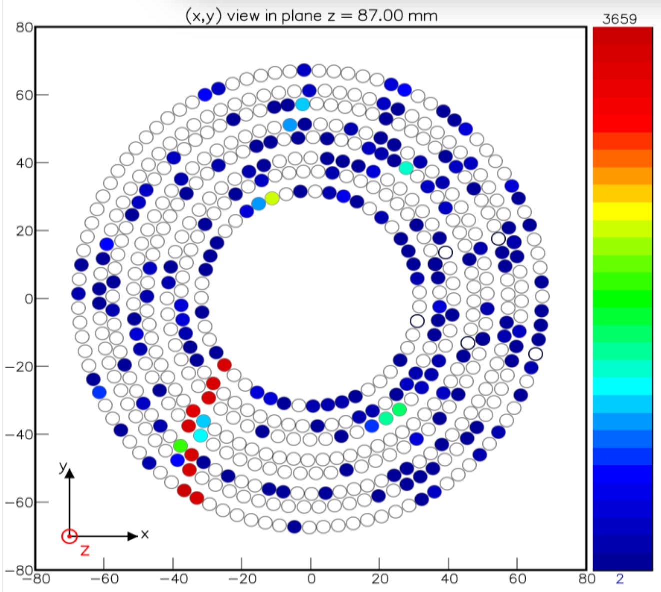


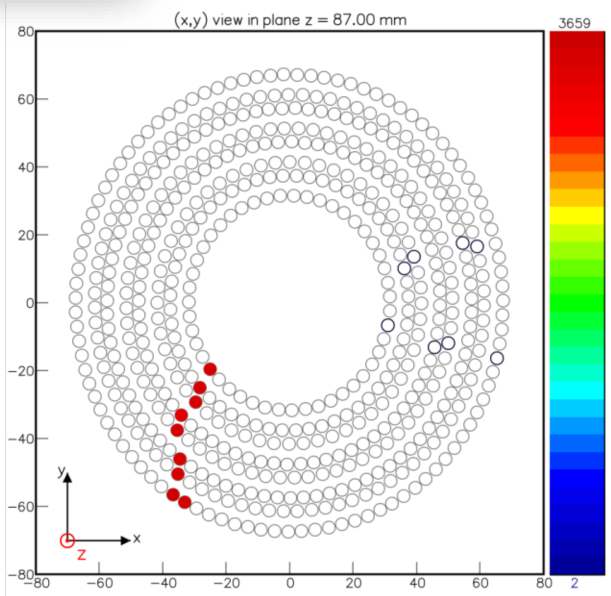






Energy loss vs. calculated momentum in ALERT

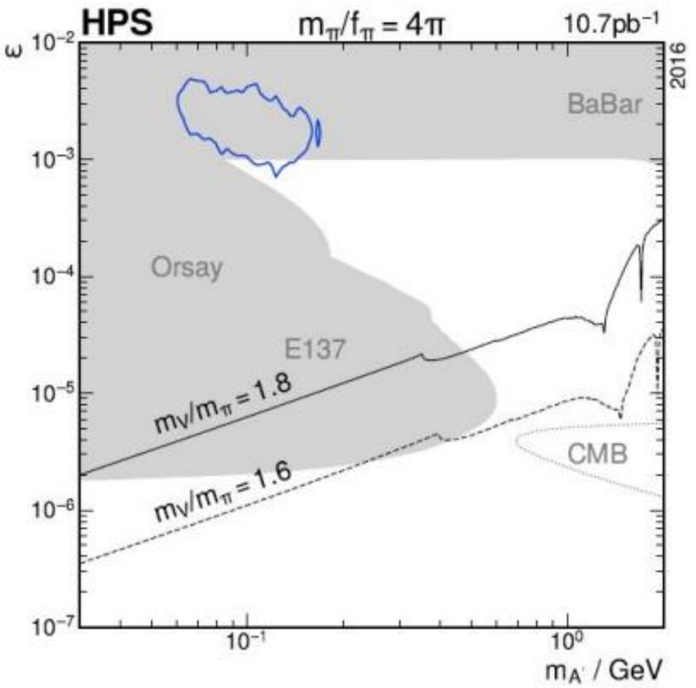


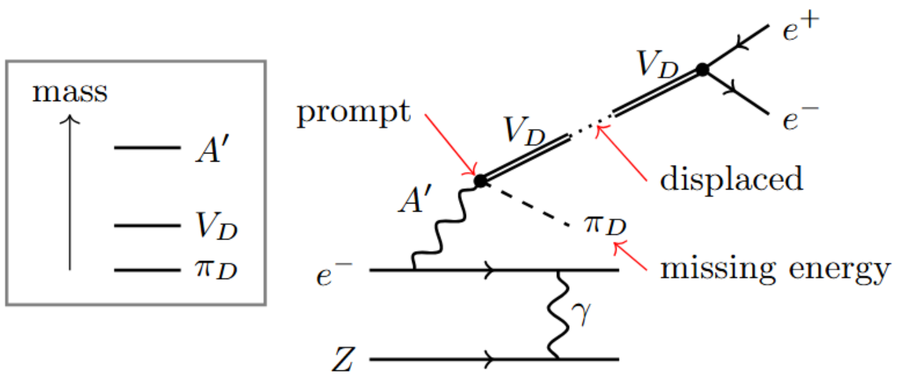


Hits with large ionization energy loss in AHDC

HPS COLLABORATION

- Semi-annual collaboration meetings in Nov 2024 and June 2025
- **Reapproved in jeopardy hearing of PAC 52** with "A" rating and all originally approved 180 PAC days
- **Requested and planning 60 out of remaining 105 PAC days of 4.4 GeV running**
- Draft "*Displaced Vertex Searches for Electroproduced Strongly Interactive Massive Particles with the 2016 HPS Dataset*" based on analysis notes from **Alec Spellmann** and **Tom Eichlersmith**:

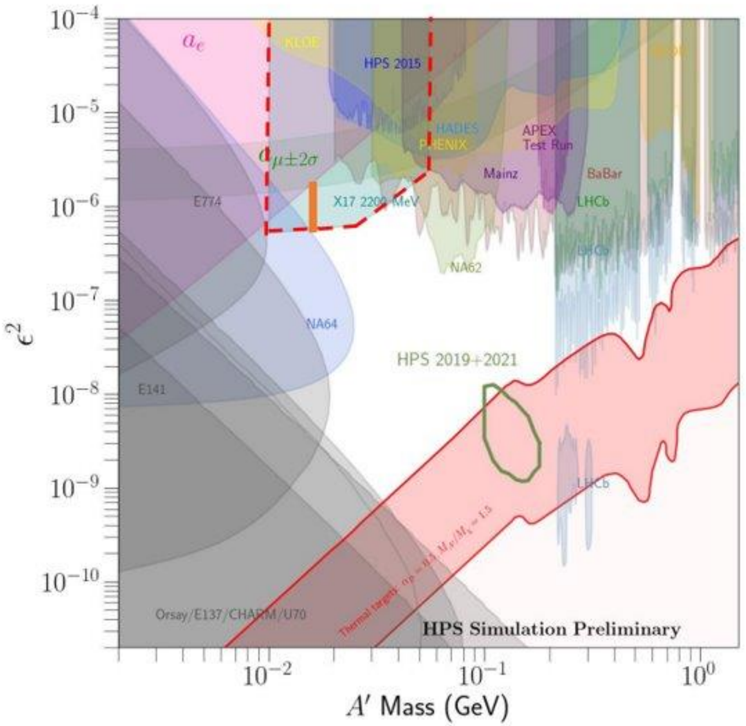


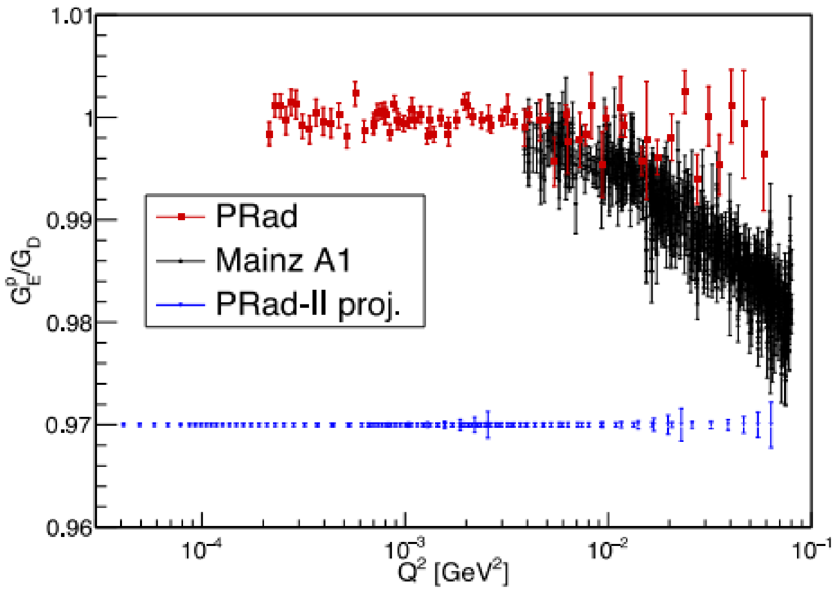


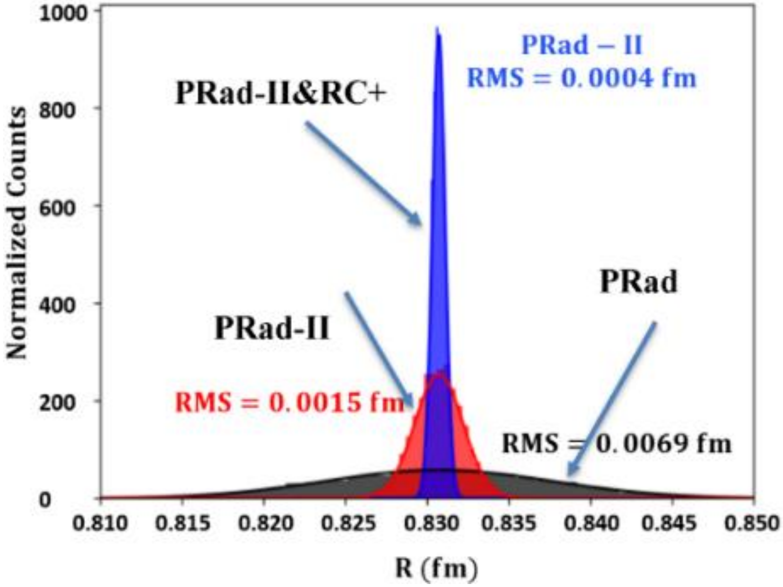
First search for strongly interacting dark sector particles

PRAD COLLABORATION

- Semi-annual collaboration meetings in Nov 2024 and March 2025
- Collaboration charter adopted in November 2024
- More than 60 members including new U.S. and international collaborators
- **Experimental Readiness Review for PRad-II/X17 on May 8–9, 2025**
- Updated projections for PRad-II/X17 runs:



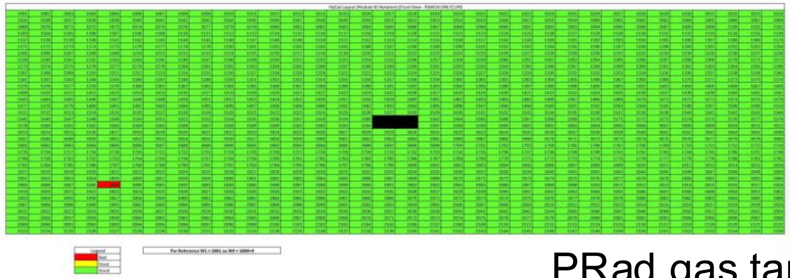




PRad-II / X17 Instrumentation

- Preparations on track for the **installation of PRad-II/X17 setup during SAM 2025**
- **PRad-II** scheduled **for completion of the experiment** including non-standard beam energies
- **X17 Search** scheduled for **~50% of the experiment** with one of two planned beam energies

HyCal:

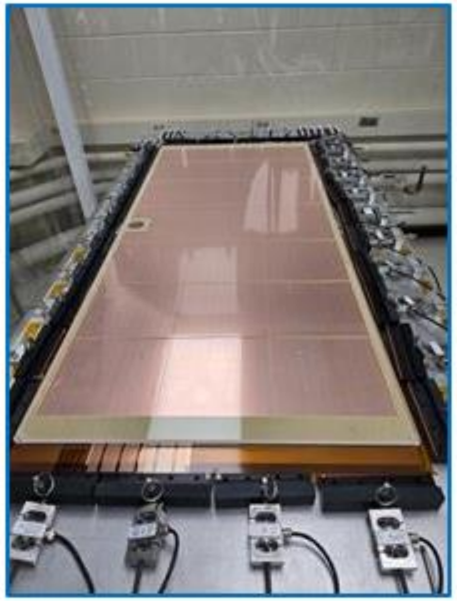


X17 foil targets:

Beamline:

PRad gas target:

GEMs:



PhD Theses

Completed Theses in CLAS Collaboration

MEASURING CLAS12 $D(E, E'\Pi^{\pm})$ CROSS SECTIONS FOR $E4NU$

by

Caleb Fogler
B.S. December 2016, Old Dominion University
M.S. May 2019, Old Dominion University

A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

PHYSICS

OLD DOMINION UNIVERSITY
December 2024

Timelike Compton Scattering from a Longitudinally Polarised Target with CLAS12 at Jefferson Lab

Kayleigh Gates

Submitted in fulfilment of the requ
Degree of Doctor of Philo

ysics and Ast
ience and Eng
sity of Glasgo

Univers
Glasg

2024

université PARIS-SACLAY

Nucleon Structure Studies at Jefferson Lab and the Electron Ion Collider

ns au laboratoire
eur électrons-ions

université Paris-Saclay

THE STRUCTURE FUNCTION OF THE FREE NEUTRON AT HIGH X-BJORKEN

by

Madhusudhan Pokhrel
B. Sc. December 2013, Tribhuvan University, Nepal
M. Sc. December 2016, Tribhuvan University, Nepal
M. S. May 2019, Old Dominion University, USA

A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

PHYSICS

OLD DOMINION UNIVERSITY
May 2025

Approved by:

Stephen Bueltmann (Director)

Sebastian Kuhn (Member)

Raul Briceno (Member)

Yuan Zhang (Member)

Sylvain Marsillac (Member)

Differential Cross Sections from (
Inclusive Electron Scatt

Valerii Kilimenko

B.S. Physics, Moscow State Universit
M.S. Physics, Moscow State Universit

A Dissertation
Submitted in Partial Fulfillment of
Requirements for the Degree of
Doctor of Philosophy
at the
University of Connecticut
2024

UNIVERSITY OF CALIFORNIA
SANTA CRUZ

SEARCHING FOR STRONGLY-INTERACTING DARK MATTER WITH THE HEAVY PHOTON SEARCH EXPERIMENT

A dissertation submitted in partial satisfaction of the
requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Peter F. Biehl
Vice Provost and Dean of G

FIRST CLAS12 DOUBLE-PION ($N\pi\pi$) ELECTROPRODUCTION ANALYSIS

by

Krishna Chandra Neupane

Bachelor of Science
Tribhuvan University, 2011

Master's Degree in Physics
Tribhuvan University, 2014

Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy in
Physics
College of Arts and Sciences
University of South Carolina
2025

Accepted by:

Ralf Gothe, Major Professor

Fred Myhrer, Committee Member

Steffen Strauch, Committee Member

Viktor Mokeev, Committee Member

Ann Vail, Dean of the Graduate School

CLAS: since Oct 2024

- Valerii Klimenko
- Caleb Fogler
- Kayleigh Gates
- Noémie Pilleux
- Madhusudhan Pokhrel
- Krishna Neupane

HPS: December 2025

- Alec Spellman

Publications

Only listings because of limited time,
more information available in the backup

Publications using CLAS Data

- A.V. Golda, …, V.I. Mokeev *et al.*, "*Cross Section Evaluation for Exclusive Channels of $K^+\Lambda$ and $K^+\Sigma^0$ Electroproduction off Protons Using CLAS Detector Data*", **Moscow Univ. Phys. 79, 450 (Aug 2024)**, DOI: https://doi.org/10.3103/S0027134924700577
- L. Clark *et al.* (CLAS Collaboration), "*Photo-production of the Σ^+ hyperon using linearly polarized photons with CLAS*", **Phys. Rev. C 111, 025204 (Feb 2025)**, DOI: https://doi.org/10.1103/PhysRevC.111.025204
- A. Deur *et al.* (CLAS Collaboration), "*Measurement of the nucleon spin structure functions for $0.01 < Q^2 < 1$ GeV^2 using CLAS*", **Phys. Rev. C 111, 035202 (Mar 2025),** DOI: https://doi.org/10.1103/PhysRevC.111.035202
- A.V. Sarantsev *et al.* (CLAS Collaboration), "*Photoproduction of two charged pions off protons in the resonance region*", **Phys. Rev. C 111, 035203 (Mar 2025),** DOI: https://doi.org/10.1103/PhysRevC.111.035203
- A.V. Sarantsev, E. Klempt, K.V. Nikonov, T. Seifen, U. Thoma, Y. Wunderlich, P. Achenbach, V.D. Burkert, V. Mokeev, V. Crede, "*Decays of N^* and Δ^* Resonances into $N\rho$, $\Delta\pi$, and $Nf_0(500)$*", **Phys. Rev. C 112, 015202 (July 2025)**, DOI: https://doi.org/10.1103/qfpf-tcs3
- P. Roy *et al.* (CLAS Collaboration), "*Measurement of Single- and Double-Polarization Observables in the Photoproduction of $\pi^+\pi^-$ Pairs off the Proton Using CLAS at Jefferson Laboratory*", arXiv:2504.21119, DOI: https://doi.org/10.48550/arXiv.2504.21119, **submitted to Phys. Rev. C**
- T. Mineeva *et al.* (CLAS Collaboration), "*Suppression of Neutral Pion Production in Deep-Inelastic Scattering of Nuclei with the CLAS Detector*", arXiv:2406.04512, https://doi.org/10.48550/arXiv.2406.04513, **submitted to Phys. Rev. C**

Publications using CLAS12 Data

- A. Hobart *et al. (CLAS Collaboration)*, "*First Exclusive Measurement of Deeply Virtual Compton Scattering on the Neutron*", **Phys. Rev. Lett. 133, 211903 (Nov 2024)** , DOI: https://doi.org/10.1103/PhysRevLett.133.211903
- V. Klimenko *et al*. (CLAS Collaboration), "*Inclusive Electron Scattering in the Resonance Region off a Hydrogen Target with CLAS12*", **accepted in Phys. Rev. C (June 2025)**
- D.S. Carman *et al.* (CLAS Collaboration), "*Recoil Polarization in K^+Y Electroproduction in the Nucleon Resonance Region with CLAS12",* arXiv: 2505.12030, DOI: https://doi.org/10.48550/arXiv.2505.12030, **submitted to Phys. Rev. C**
- A. Kripko *et al.* (CLAS Collaboration), "*Multi-dimensional Measurements of Beam Single Spin Asymmetries in Semi-Inclusive Deep-Inelastic Charged Kaon Electroproduction off Protons in the Valence Region",* arXiv: 2504.0858, DOI: https://doi.org/10.48550/arXiv.2504.08580, **submitted to Phys. Rev. Lett.**

Other Publications

- V. Burkert, G. Eichmann, E. Klempt, "*The impact of γN and $\gamma^* N$ interactions on our understanding of nucleon excitations*", arXiv: 2506.16482, DOI: https://doi.org/10.48550/arXiv.2506.16482, **submitted to Prog. Part. Nucl. Phys.**
- P. Achenbach, D.S. Carman, R.W. Gothe, K. Joo, V.I. Mokeev, C.D. Roberts, "*Electroexcitation of Nucleon Resonances and the Emergence of Hadron Mass*", **Symmetry 17, 1106 (July 2025),** DOI: https://doi.org/10.3390/sym17071106
- V. Kubarovsky, J. Rittenhouse West, and S.J. Brodsky, "*Quantum chromodynamics resolution of the ATOMKI anomaly in ^{4}He nuclear transitions*", **Phys. Rev. C 111, 024320 (Feb 2025)**, DOI: https://doi.org/10.1103/PhysRevC.111.024320
- V. Burkert, S. Diehl, P. Schweitzer, "*Quarks unter Hochdruck im Proton*", **Phys. Unserer Zeit 55, 298–306 (Nov 2024)**, https://doi.org/10.1002/piuz.202401699
- R. De Vita, "*The CLAS12 Experiment at Jefferson Lab*", **to appear in Encyclopedia of Particle Physics (2026)**
- P. Achenbach, "*Experiments at Jefferson Lab*", **to appear in Encyclopedia of Particle Physics (2026)**

Publications on Detectors and Methods

- K. Gnanvo, F. Hauenstein, S. Liyanaarachchi, N. Liyanage, H. Nguyen, R. Paremuzyan and S. Stepanyan, *“µRWELL detector developments at Jefferson Lab for high luminosity experiments”*, **PoS QNP2024, 014 (Mar 2025)**, https://pos.sissa.it/465/014

- G. Gavalian, P. Thomadakis, A. Angelopoulos and N. Chrisochoides, *“Charged Track Reconstruction with Artificial Intelligence for CLAS12”*, **EPJ Web of Conferences 295, 09038 (May 2024)**, DOI: https://doi.org/10.1051/epjconf/202429509038
- R. Tyson, G. Gavalian, B. McKinnon and D. Ireland, *“Level-3 Trigger for CLAS12 with Artificial Intelligence”*, **EPJ Web of Conferences 295, 02018 (May 2024)**, DOI: https://doi.org/10.1051/epjconf/202429502018
- G. Gavalian, *“High-performance data format for scientific data storage and analysis”*, **Comp. Phys. Comm 315, 109732 (Oct 2025)**, https://www.sciencedirect.com/science/article/pii/S0010465525002346
- F. Rossi, M. Battaglieri, E. Ragusa, P. Gastaldo, G. Gavalian, *“Artificial Intelligence Data Reduction Algorithm for Streaming Readout in High Energy Physics Experiment”*, **Commun. Comput. Inf. Sci. 2253, 50–58 (Apr 2025)**, https://doi.org/10.1007/978-3-031-85856-7_5
- G. Gavalian, *“Real-Time Charged Track Reconstruction for CLAS12”*, **JINST 19, C05050 (May 2024)**, DOI: https://doi.org/10.1088/1748-0221/19/05/C05050

Publications on Methods

- D.I. Glazier, R. Tyson, *“Converting sWeights to Probabilities with Density Ratios”*,arXiv: 2409.08183, DOI: https://doi.org/10.48550/arXiv.2409.08183, **submitted to Comput. Phys. Commun.**
- G. Gavalian and R. Tyson, “*Online Electron Reconstruction at CLAS12*”, , arXiv: 2507.05274, DOI: https://doi.org/10.48550/arXiv.2507.05274, **submitted to Comput. Phys. Commun.**
- G. Matousek and A. Vossen, *“AI-Assisted Object Condensation Clustering for Calorimeter Shower Reconstruction at CLAS12”,* arXiv: 2503.11277, DOI: https://doi.org/10.48550/arXiv.2503.11277
- V.D. Burkert, A. Camsonne, P. Chatagnon, K. Cichy, M. Constantinou, H. Dutrieux, I. M. Higuera-Angulo, C. Mezrag, D. Richards, P. Sznajder, “*Open database for GPD analyses*”, arXiv: 2503.18152, DOI: https://doi.org/10.48550/arXiv.2503.18152

Concluding Remarks

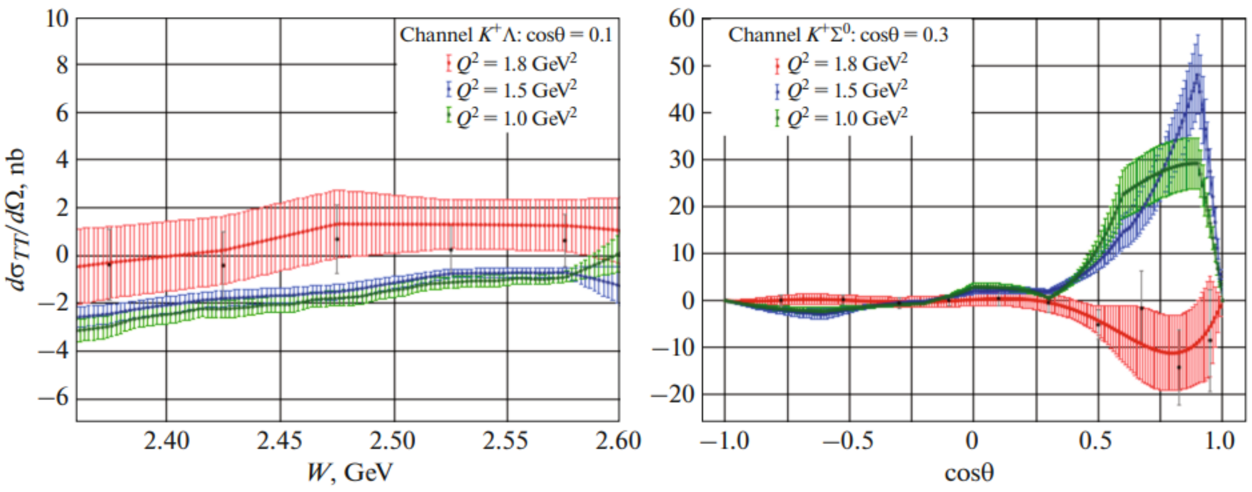
- Hall B is scheduled to **complete all ALERT experiments** in this run period
- **Installation of PRad-II/X17 setup** is planned for this SAM
- **CLAS Collaboration in Hall B** continues to **deliver high-level physics results**

- **CLAS-approved proposals to PAC53:**
  - Stepan Stepanyan *et al.*: "*Electro- and photo-production of muon pairs with μCLAS12: Double Deeply Virtual Compton Scattering, Timelike Compton Scattering, and J/ψ production*"
  - Marco Contalbrigo *et al.* (Run Group H): "*Experiments with a Transversely Polarized Target*"
  - Harut Avakian *et al.* (Run Group H addition): "*Measurements of Single Spin Asymmetries in exclusive production of hadrons with RGH*"
  - Sangbaek Lee *et al.*: "*Measurement of the Coherent J/ψ Electroproduction off ^{4}He*"

BACKUP

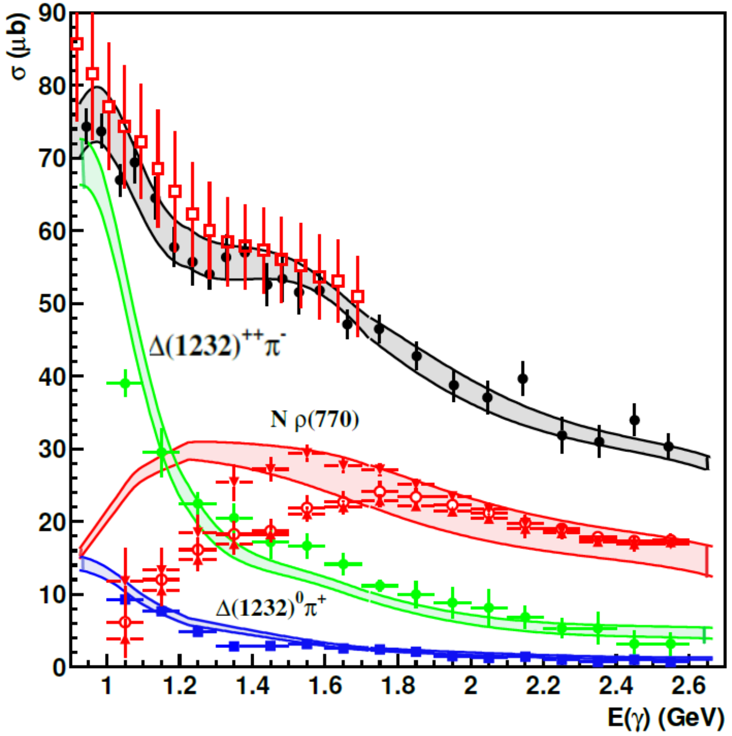
Publications Using CLAS Data

A.V. Golda, …, V.I. Mokeev *et al.*, "*Cross Section Evaluation for Exclusive Channels of $K^+\Lambda$ and $K^+\Sigma^0$ Electroproduction off Protons Using CLAS Detector Data*", **Moscow Univ. Phys. 79, 450 (Aug 2024)**, DOI: https://doi.org/10.3103/S0027134924700577



Estimates of the structure function $d\sigma_{TT}/d\Omega_K$ for $K^+\Lambda$ channels (left) and $K^+\Sigma^0$ channels (right)

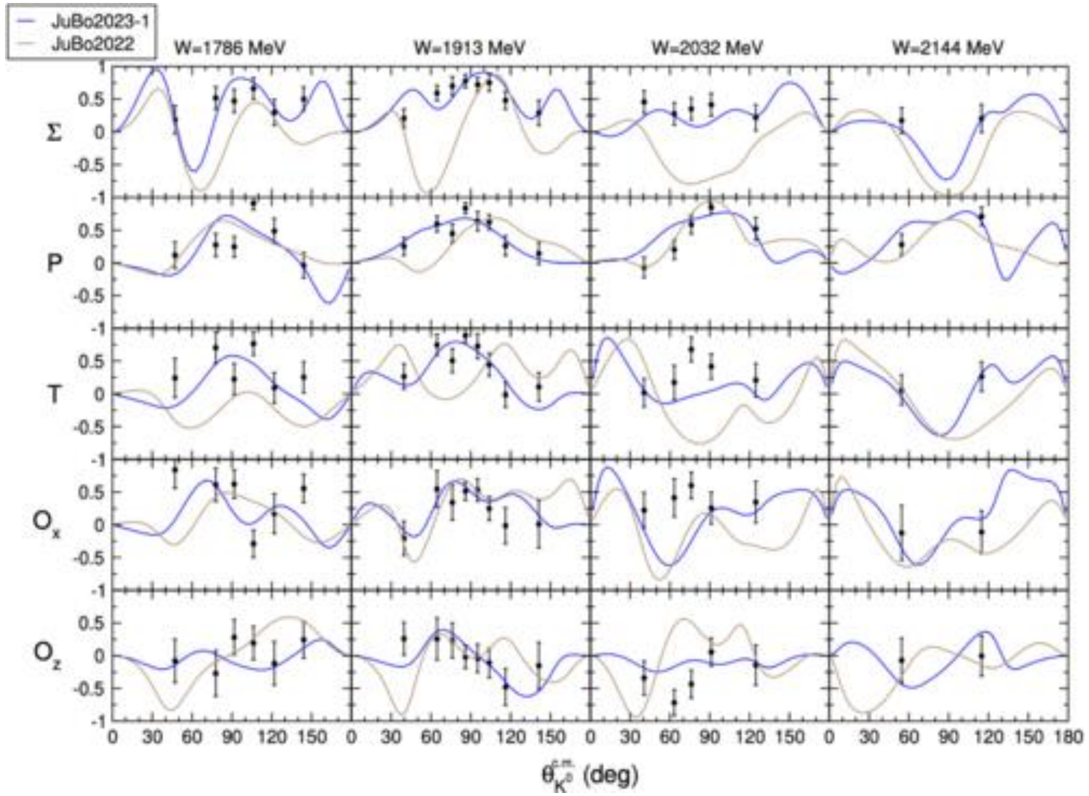
A.V. Sarantsev *et al.* (CLAS Collaboration), "*Photoproduction of two charged pions off protons in the resonance region*", **Phys. Rev. C 111, 035203 (Mar 2025)**, DOI: https://doi.org/10.1103/PhysRevC.111.035203



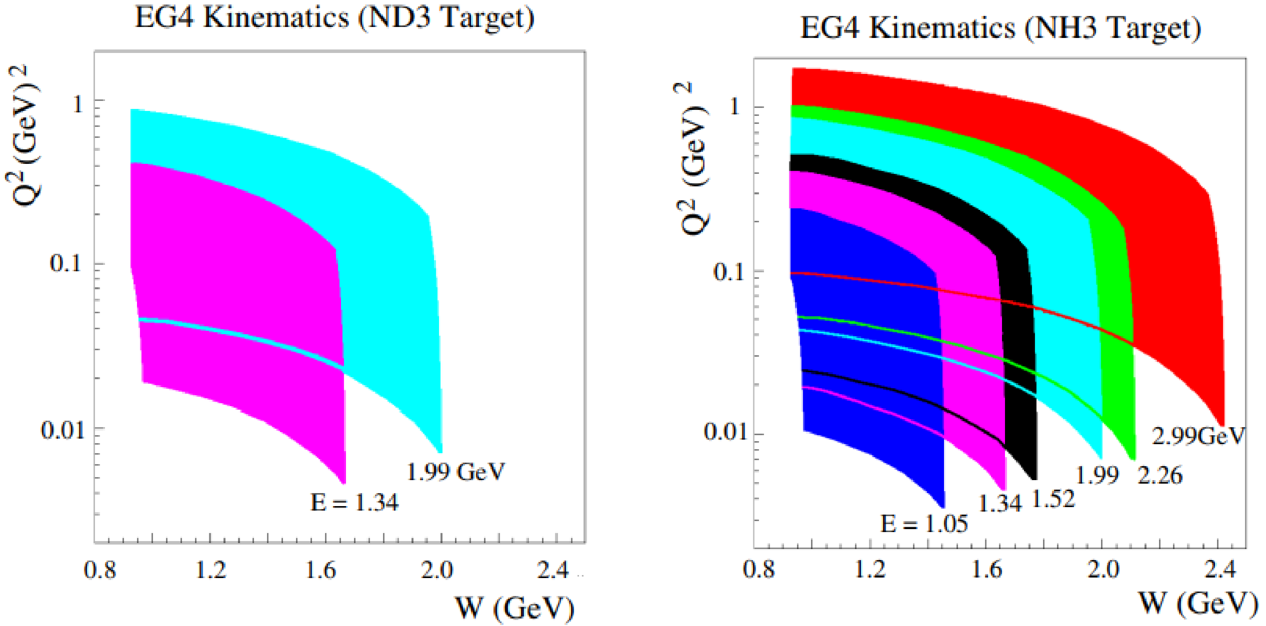
Total cross section for the reaction $\gamma p \rightarrow p\pi^+\pi^-$ including different isobar contributions

Publications Using CLAS Data

L. Clark *et al.* (CLAS Collaboration), "*Photo-production of the Σ^+ hyperon using linearly polarized photons with CLAS*", **Phys. Rev. C 111, 025204 (Feb 2025)**, DOI: https://doi.org/10.1103/PhysRevC.111.025204



A. Deur *et al.* (CLAS Collaboration), "*Measurement of the nucleon spin structure functions for 0.01 < Q^2 < 1 GeV^2 using CLAS*", **Phys. Rev. C 111, 035202 (Mar 2025)**, DOI: https://doi.org/10.1103/PhysRevC.111.035202

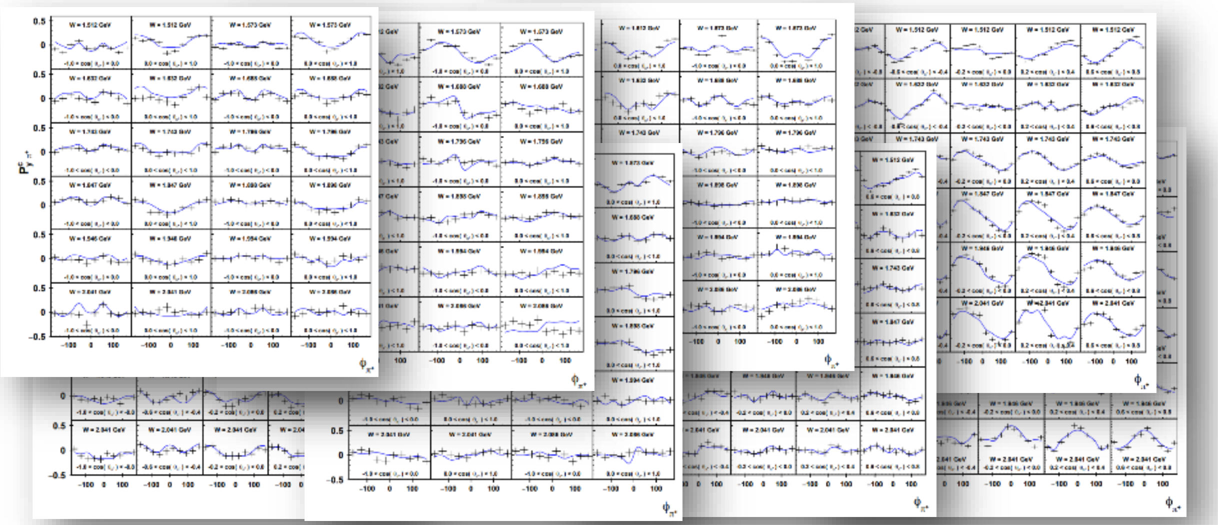


Archival paper with details of the CLAS EG4 experiment from 2006 and final results for **proton and deuteron spin structure function** data

Publications Using CLAS Data

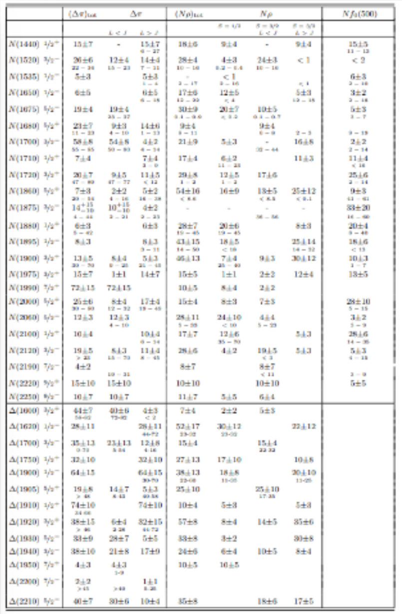
P. Roy *et al.* (CLAS Collaboration), “*Measurement of Single- and Double-Polarization Observables in the Photoproduction of $\pi^+\pi^-$ Pairs off the Proton Using CLAS at Jefferson Laboratory*”, arXiv:2504.21119, DOI: https://doi.org/10.48550/arXiv.2504.21119, submitted to Phys. Rev. C

- Beam and target asymmetries, and beam-target double-polarization observables measured using a transversely polarized target (FROST)



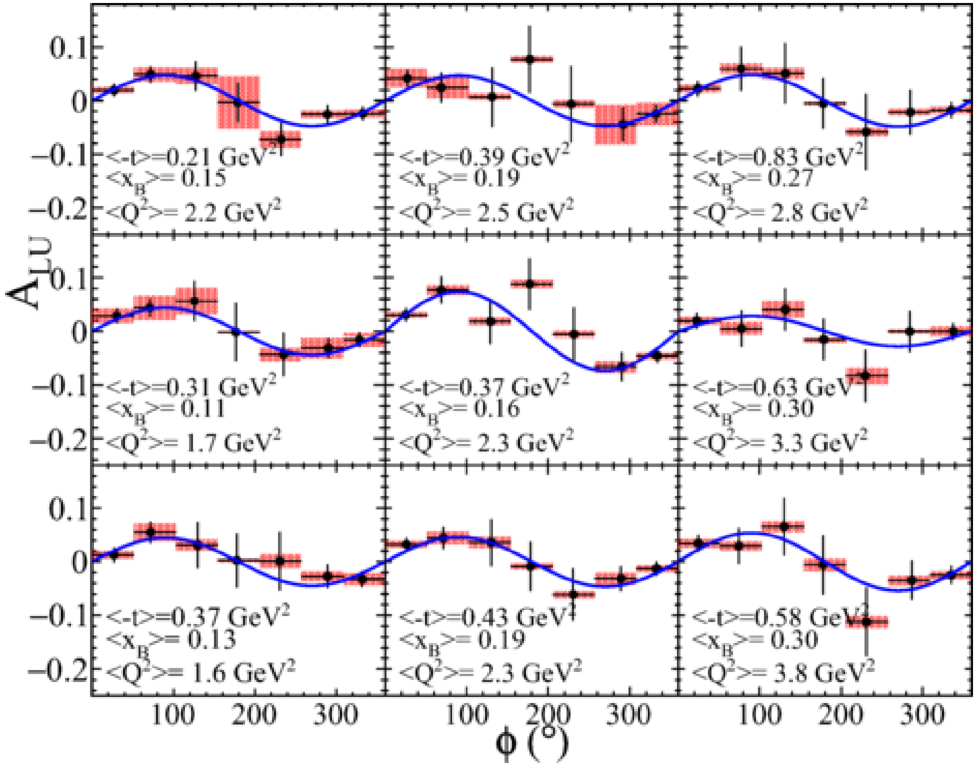
A.V. Sarantsev, E. Klempt, K.V. Nikonov, T. Seifen, U. Thoma, Y. Wunderlich, P. Achenbach, V.D. Burkert, V. Mokeev, V. Crede, “*Decays of N* and Δ* Resonances into Nρ, Δπ, and $Nf_0(500)$*”, **Phys. Rev. C 112, 015202 (July 2025)**, DOI: https://doi.org/10.1103/qfpf-tcs3

- Masses, widths and branching ratios of N^* and Δ^*

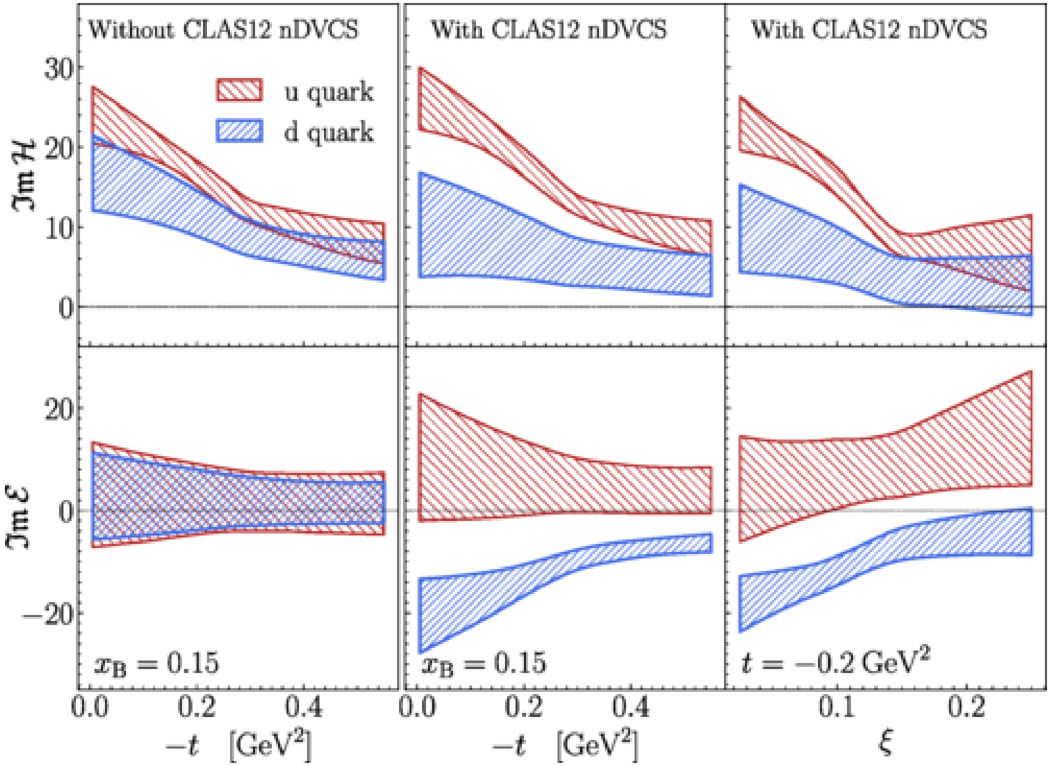


Publications Using CLAS12 RG-B Data

A. Hobart *et al. (CLAS Collaboration)*, "*First Exclusive Measurement of Deeply Virtual Compton Scattering on the Neutron*", **Phys. Rev. Lett. 133, 211903 (Nov 2024),** DOI: https://doi.org/10.1103/PhysRevLett.133.211903



Beam-spin asymmetry for nDVCS versus ϕ for 3 bins in $-t$, 3 bins in x_B , and 3 bins in Q^2



Extraction of up and down quark contributions to the Compton Form Factors ℑm H and ℑm E

Media Coverage of this Publication

Русский Паблик ВК Телеграм Канал

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Революционный детектор открывает новые возможности изучения внутренней структуры нейтрона через первые измерения глубокого виртуального комптоновского рассеяния

24 Ноя в 00:40 Техника и IT Прокомментировать 16

Протоны и нейтроны, известные под общим названием нуклоны, являются основополагающими элеме
материи. Тем не менее в ядерной физике нейтронам традиционно уделялось меньше внимания по сра
протонами. В недавно опубликованной статье в Physical Review Letters описывается новаторский подхо
изучению внутренней структуры нейтрона, достигнутый благодаря созданию специального детектора,
разработку которого потребовалось 10 лет.

INTERESTING ENGINEERING

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SCIENCE

A reaction that only measured protons detected neutrons for the first time

For the last 10 years, scientists have been working on a neutron detector. Finally, they tested it, and it worked like magic.

Updated: Nov 24, 2024 07:40 AM EST

Rupendra Brahambhatt

5 days ago

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NEWS RELEASE 22-NOV-2024

Accessing the lesser known nucleon

An inaugural measurement of the neutron will help physicists learn about nucleon structure and spin

Peer-Reviewed Publication

DOE/THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY

Protons and neu
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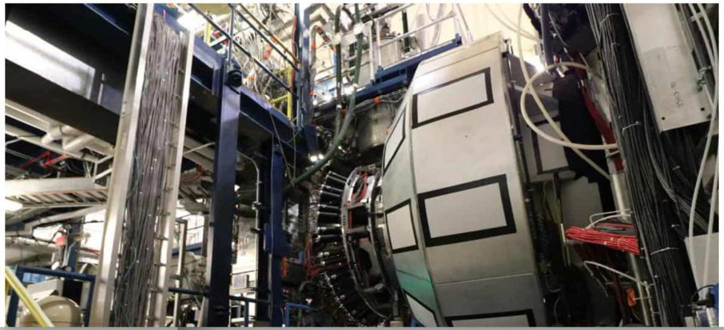
physicsworld

PARTICLE AND NUCLEAR RESEARCH UPDATE

Inner workings of the neutron illuminated by Jefferson Lab experiment

17 Dec 2024



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Accessing the lesser known nucleon: New neutron measurement can help physicists learn about nucleon structure and spin

by Chris Patrick, Thomas Jefferson National Accelerator Facility

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PHYSICS

Inside the Neutron: Scientists Discove Hidden Layers of Matter

BY THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY — NOVEMBER 24, 2024 NO COMMENTS 9 MINS READ

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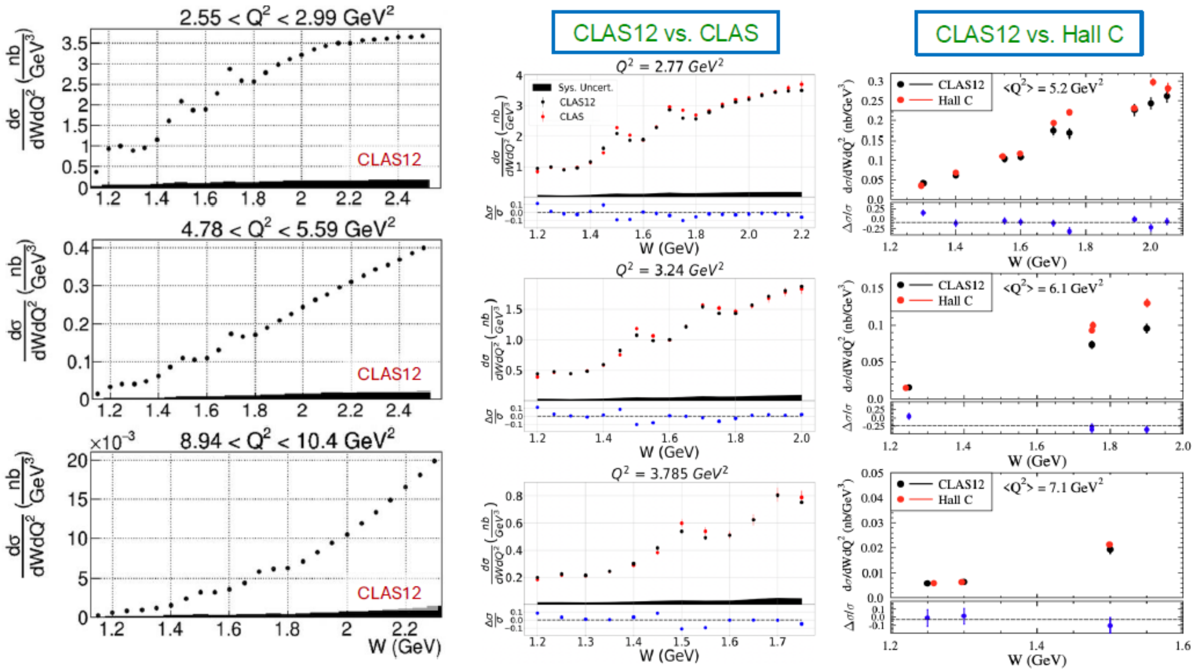
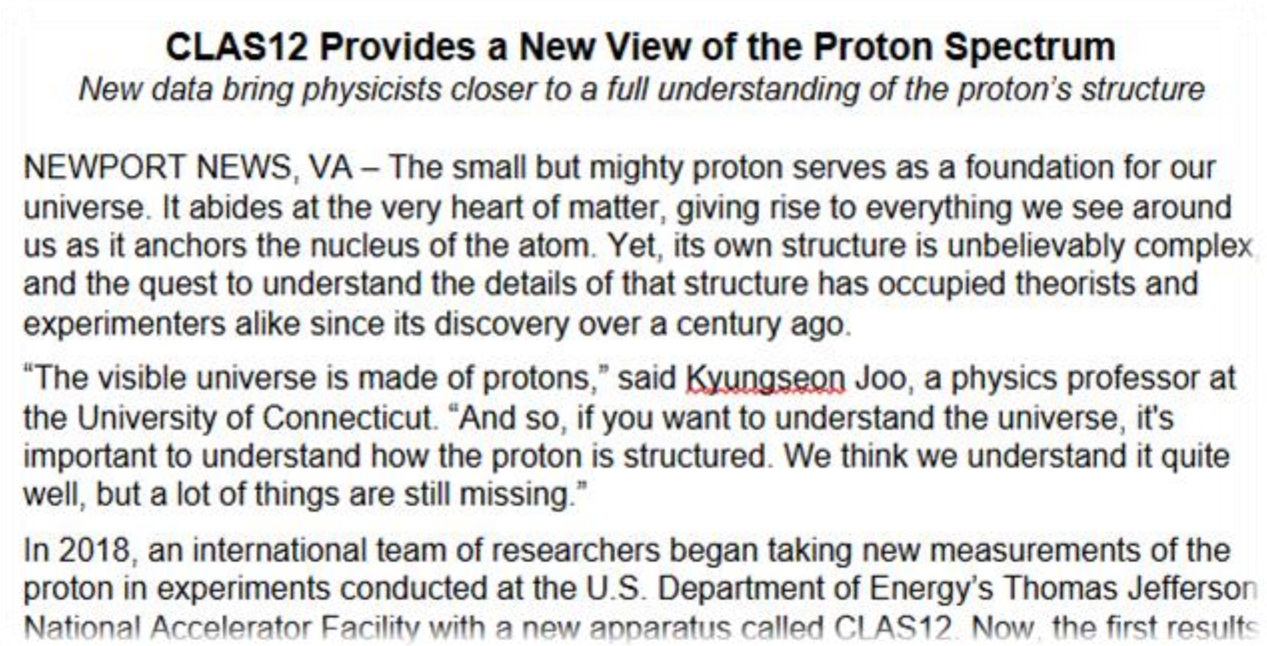
Publication Using CLAS12 RG-A Data

V. Klimenko *et al*. (CLAS Collaboration), "*Inclusive Electron Scattering in the Resonance Region off a Hydrogen Target with CLAS12*", **accepted in Phys. Rev. C (June 2025)**

- First inclusive electron scattering cross sections
- **JLab press release is prepared**





CLAS12 Provides a New View of the Proton Spectrum

New data bring physicists closer to a full understanding of the proton's structure

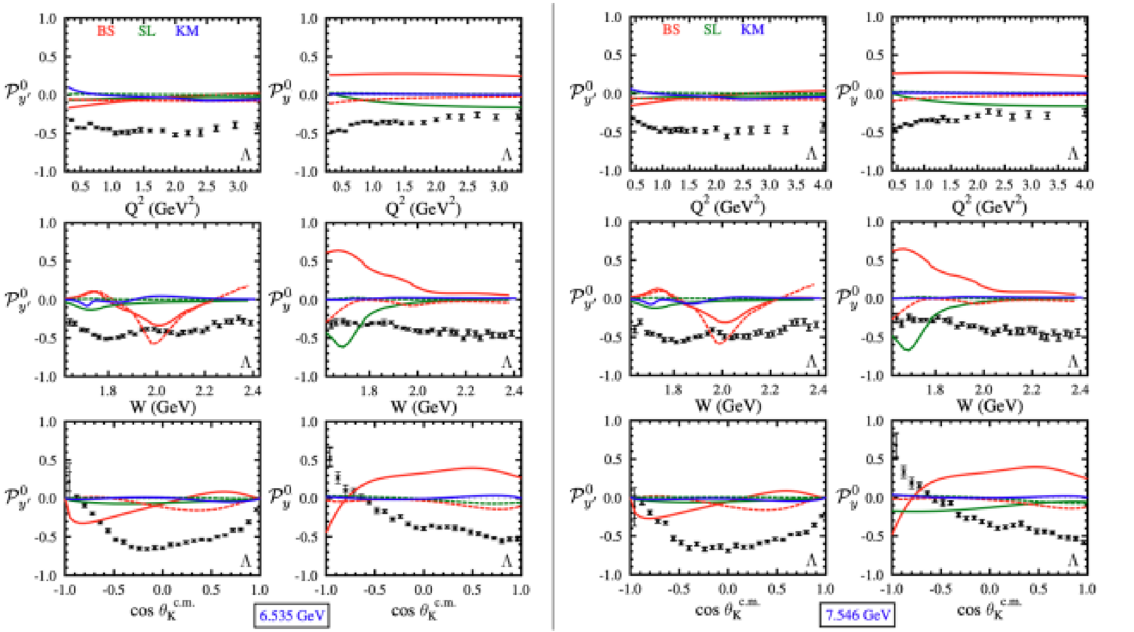
NEWPORT NEWS, VA – The small but mighty proton serves as a foundation for our universe. It abides at the very heart of matter, giving rise to everything we see around us as it anchors the nucleus of the atom. Yet, its own structure is unbelievably complex and the quest to understand the details of that structure has occupied theorists and experimenters alike since its discovery over a century ago.

"The visible universe is made of protons," said Kyungseon Joo, a physics professor at the University of Connecticut. "And so, if you want to understand the universe, it's important to understand how the proton is structured. We think we understand it quite well, but a lot of things are still missing."

In 2018, an international team of researchers began taking new measurements of the proton in experiments conducted at the U.S. Department of Energy's Thomas Jefferson National Accelerator Facility with a new apparatus called CLAS12. Now, the first results

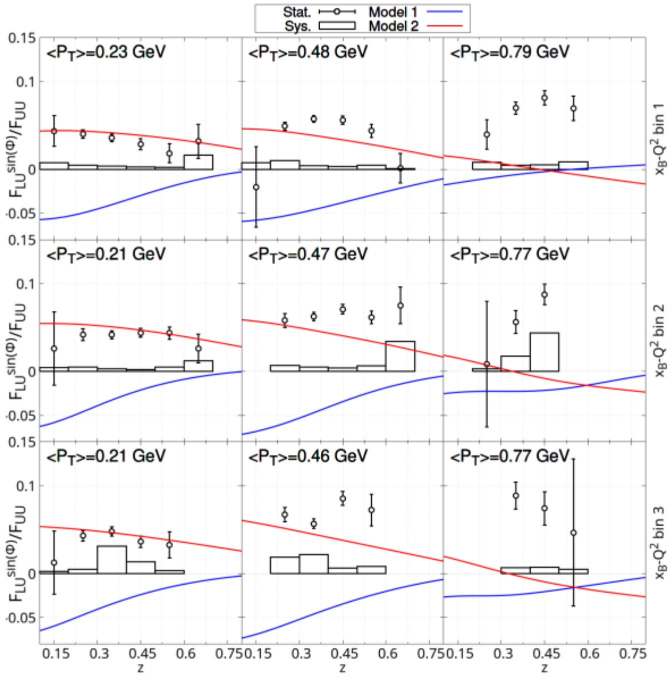
Publications Using CLAS12 Data

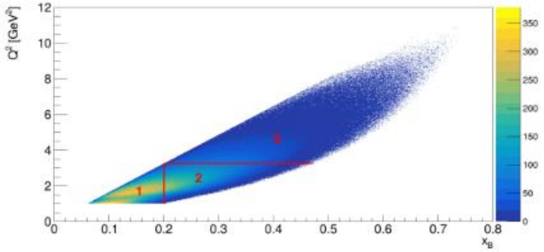
D.S. Carman *et al.* (CLAS Collaboration), “*Recoil Polarization in K⁺Y Electroproduction in the Nucleon Resonance Region with CLAS12”*, arXiv: 2505.12030, DOI: https://doi.org/10.48550/arXiv.2505.12030, submitted to Phys. Rev. C



- Polarization observables extend existing data on Λ and first electroproduction measurements for Σ^0

A. Kripko *et al.* (CLAS Collaboration), “*Multi-dimensional Measurements of Beam Single Spin Asymmetries in Semi-Inclusive Deep-Inelastic Charged Kaon Electroproduction off Protons in the Valence Region”*, arXiv: 2504.0858, DOI: https://doi.org/10.48550/arXiv.2504.08580, submitted to Phys. Lett.



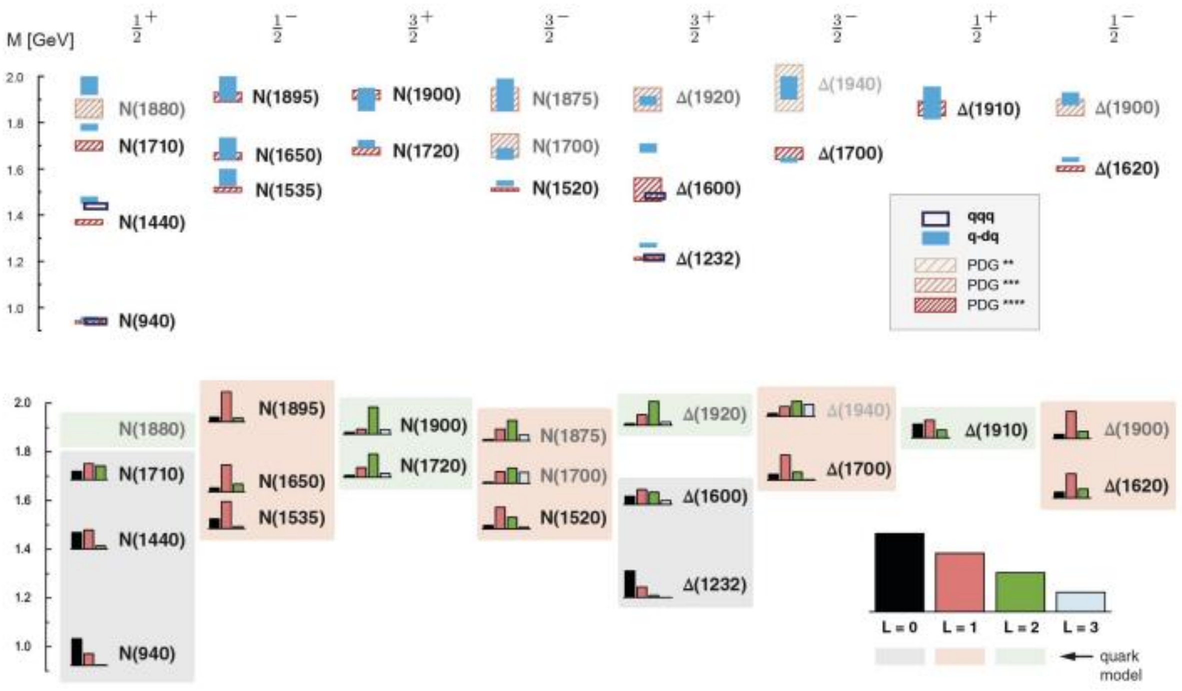


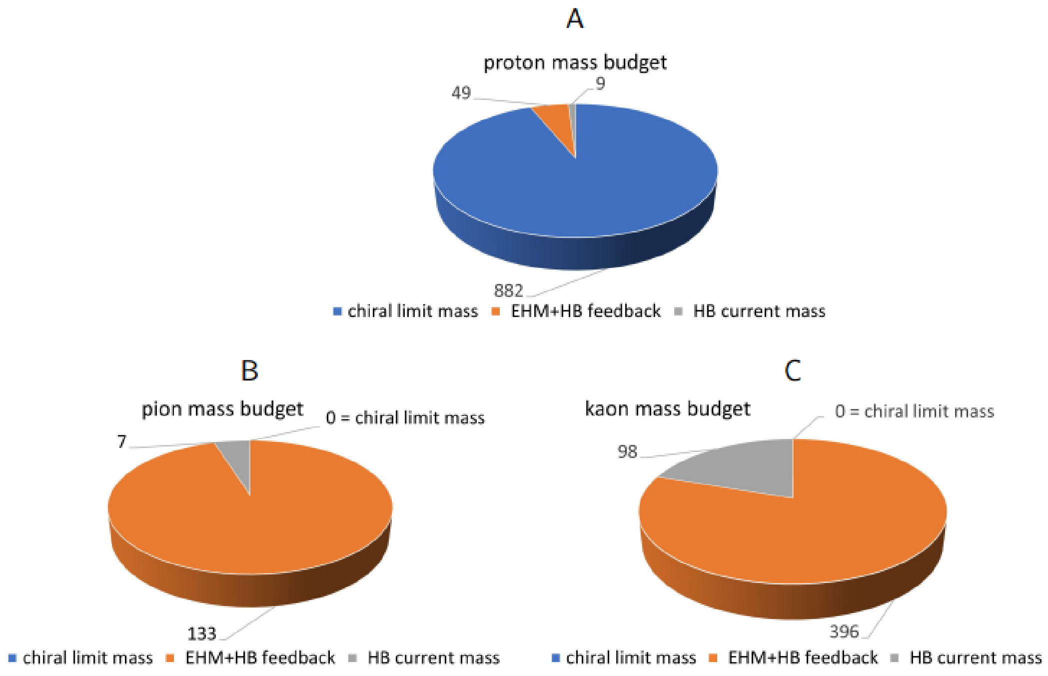
- Large kinematic range of z, x_B, p_T and Q^2
- Constrains on twist-3 PDFs

Review Publications

V. Burkert, G. Eichmann, E. Klempt, "*The impact of γN and γ*N interactions on our understanding of nucleon excitations*", arXiv: 2506.16482, DOI: https://doi.org/10.48550/arXiv.2506.16482, submitted to Prog. Part. Nucl. Phys.

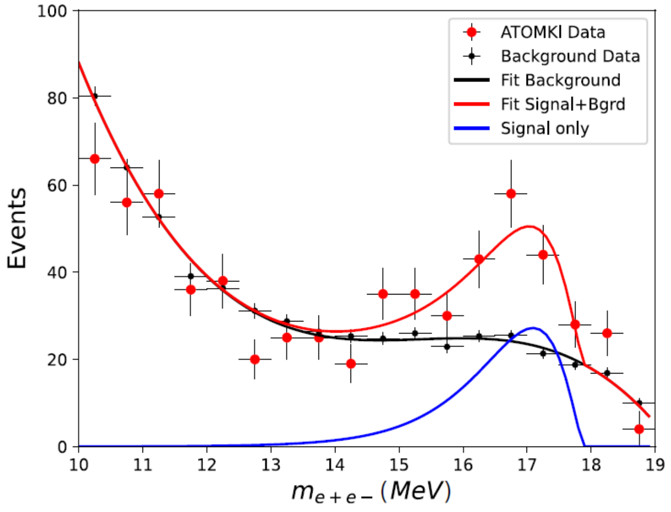
P. Achenbach, D.S. Carman, R.W. Gothe, K. Joo, V.I. Mokeev, C.D. Roberts, "*Electroexcitation of Nucleon Resonances and the Emergence of Hadron Mass*", **Symmetry 17, 1106 (July 2025),** DOI: https://doi.org/10.3390/sym17071106





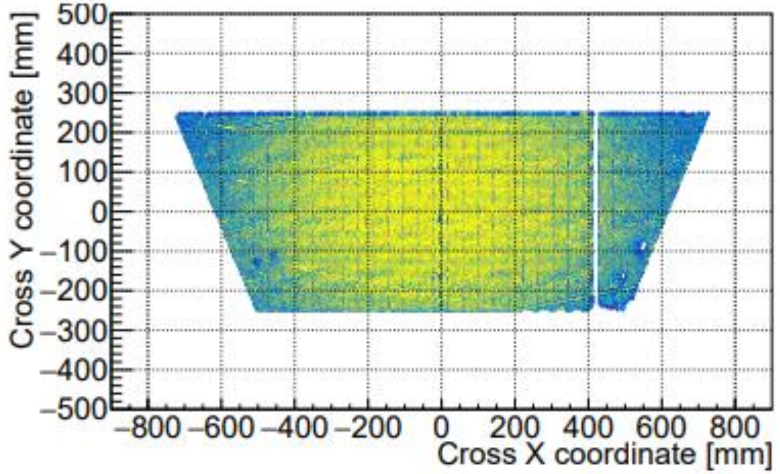
Other Publications

V. Kubarovsky, J. Rittenhouse West, and S.J. Brodsky, "*Quantum chromodynamics resolution of the ATOMKI anomaly in ^{4}He nuclear transitions*", **Phys. Rev. C 111, 024320 (Feb 2025)**, DOI: https://doi.org/10.1103/PhysRevC.111.024320



Description of ATOMKI invariant mass distribution with electromagnetic transition hexadiquark*(17.9) → ^{4}He + (e^+e^-)

K. Gnanvo, F. Hauenstein, S. Liyanaarachchi, N. Liyanage, H. Nguyen, R. Paremuzyan and S. Stepanyan, "*μRWELL detector developments at Jefferson Lab for high luminosity experiments*", **PoS QNP2024, 014 (Mar 2025)**, https://pos.sissa.it/465/014



Distribution of hit coordinates on the detector surface from the cosmic rays

Outreach Publications

V. Burkert, S. Diehl, P. Schweitzer, *“Quarks unter Hochdruck im Proton”*, **Phys. Unserer Zeit 55, 298–306 (Nov 2024)**, https://doi.org/10.1002/piuz.202401699

Mechanische Struktur des Protons

Quarks unter Hochdruck im Proton

VOLKER BURKERT | STEFAN DIEHL | PETER SCHWEITZER

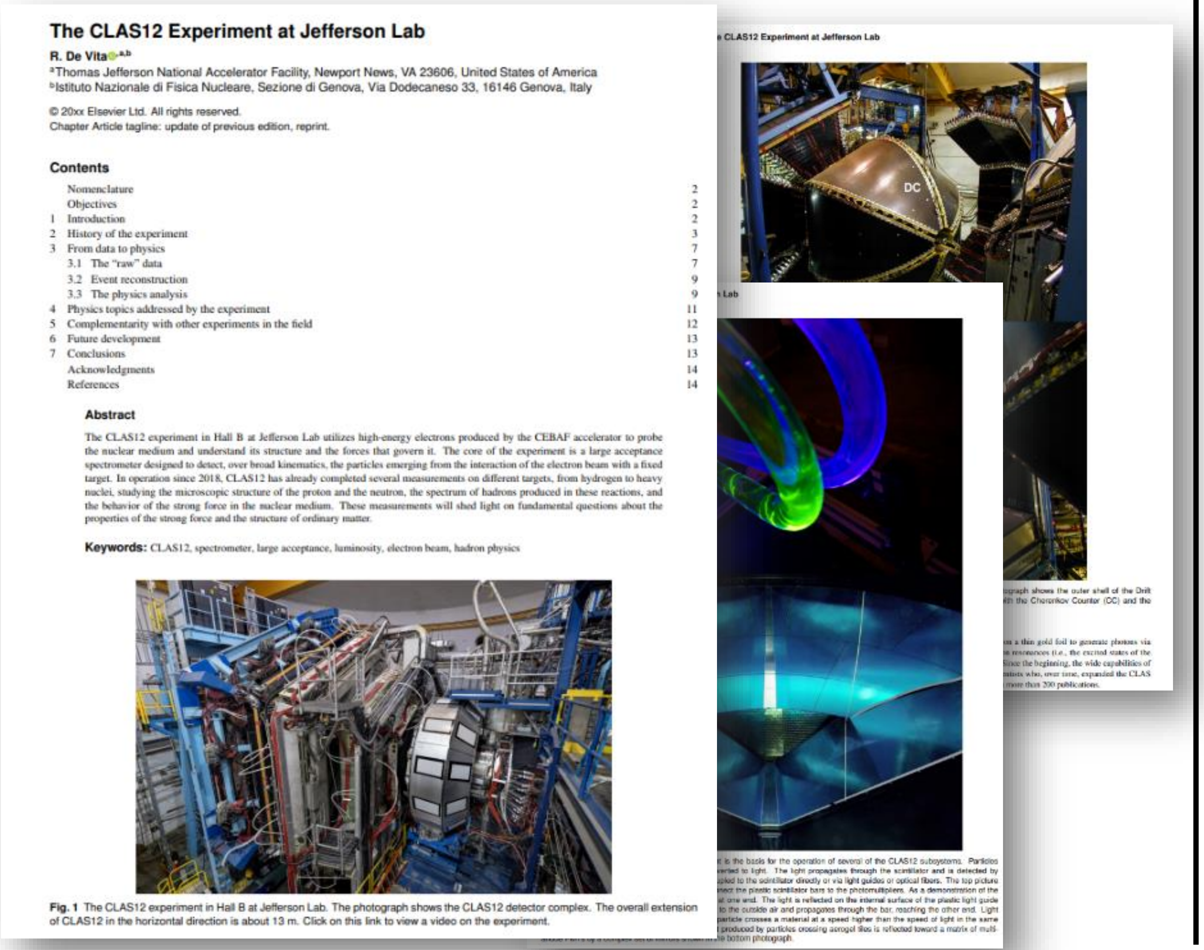
Schon vor etwa 90 Jahren haben Experimente gezeigt, dass das Proton kein punktförmiges Elementarteilchen ist, wie das Elektron, sondern eine innere Struktur aufweist. Dies war der Beginn der Protonstrukturforschung, die vor Kurzem mit der Messung des Drucks im Innern des Protons

nen sind verantwortlich für mehr als 99,9 % der Masse der Materie im sichtbaren Universum. Damit sind Nukleonen natürlich auch die am meisten experimentell untersuchten Objekte der Hadronenphysik. Im Folgenden beziehen wir uns auf das Proton, aber viele der diskutierten Fragen gelten gleichermaßen auch für das Neutron.

Ein wichtiger Meilenstein auf dem Gebiet der Proton-

Outreach Publications

R. De Vita, "*The CLAS12 Experiment at Jefferson Lab*", to appear in Encyclopedia of Particle Physics (2026)



The CLAS12 Experiment at Jefferson Lab

R. De Vita[a,b]
[a]Thomas Jefferson National Accelerator Facility, Newport News, VA 23606, United States of America
[b]Istituto Nazionale di Fisica Nucleare, Sezione di Genova, Via Dodecaneso 33, 16146 Genova, Italy

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Chapter Article tagline: update of previous edition, reprint.

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Abstract

The CLAS12 experiment in Hall B at Jefferson Lab utilizes high-energy electrons produced by the CEBAF accelerator to probe the nuclear medium and understand its structure and the forces that govern it. The core of the experiment is a large acceptance spectrometer designed to detect, over broad kinematics, the particles emerging from the interaction of the electron beam with a fixed target. In operation since 2018, CLAS12 has already completed several measurements on different targets, from hydrogen to heavy nuclei, studying the microscopic structure of the proton and the neutron, the spectrum of hadrons produced in these reactions, and the behavior of the strong force in the nuclear medium. These measurements will shed light on fundamental questions about the properties of the strong force and the structure of ordinary matter.

Keywords: CLAS12, spectrometer, large acceptance, luminosity, electron beam, hadron physics

Fig. 1 The CLAS12 experiment in Hall B at Jefferson Lab. The photograph shows the CLAS12 detector complex. The overall extension of CLAS12 in the horizontal direction is about 13 m. Click on this link to view a video on the experiment.

P. Achenbach, "*Experiments at Jefferson Lab*", to appear in Encyclopedia of Particle Physics (2026)

Experiments at Jefferson Lab

Patrick Achenbach[1,a]
[a]Thomas Jefferson National Accelerator Facility, Experimental Nuclear Physics Division, Newport News, Virginia 23606, USA

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Abstract

This chapter presents experiments conducted at Thomas Jefferson National Accelerator Facility (Jefferson Lab), a U.S. Department of Energy national laboratory in Newport News, Virginia. There, physicists exploring the nature of matter make use of the Continuous Electron Beam Accelerator Facility (CEBAF), a DOE Office of Science user facility that enables the research of more than 1,650 scientists worldwide. CEBAF's precise electron beams can reach energies up to 12 billion electron-volts and exhibit high degrees of polarization. Jefferson Lab's first experiment began taking data in 1995. Since then, the facility has become a world leader in the study of quantum chromodynamics. Today, experiments are carried out simultaneously in four experimental halls, each with specialized capabilities. The primary instruments in use are focusing or large-acceptance magnetic spectrometers, many of which feature superconducting elements. Jefferson Lab's physics program provides unprecedented insight into the particles and forces that shape the visible universe.

Keywords: Jefferson Lab, electron scattering, magnetic spectrometer, quarks and gluons, hadron structure, hadron spectroscopy, Standard Model tests, nuclear structure, QCD spectroscopy

[1]patricka@jlab.org