

Mariana Khachatryan

Curriculum vitae

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Certifications

- Erdos Institute Fall 2024 Data Science Bootcamp; Data collection, Exploratory data analysis, Data cleaning, Regression, Inferential Statistics, Time Series, Classification, Ensemble learning, Neural Networks.
- Udemy - The Complete SQL Bootcamp (URL), April 2024; Learned reading and writing complex queries to a database
- Udemy - Python for Machine Learning & Data Science Masterclass (URL), May 2024; Completed projects for topics including LinearRegression, Logistic Regression, KNN, SVM, Tree Based Methods, Naive Bayes Classification and Natural Language Processing (NLP), Unsupervised Learning (K-means clustering, Hierarchical clustering, DBSCAN, Principal Component Analysis)
- Udemy - Complete Tensorflow 2 and Keras Deep Learning Bootcamp (URL), July 2024; Covered topics include ANNs, CNNs, RNNs, NLP, Forecasting, AutoEncoders, Generative Adversarial Networks

Selected Machine learning and Deep learning Projects

- Car sales price prediction Nov. 2024 GitHub URL; Predicted car sales price based on various features.
- Facemask identification, July 2024 GitHub URL; Used convolution neural network (CNN) from keras, tensorflow to predict whether the person in the picture wears a face mask.

Education

Degree Doctor of Philosophy in Physics
Dates 12/2015 to 14/2019
Thesis title Validation of neutrino energy estimation using electron scattering data
Advisor Lawrence Weinstein
Degree Master of Science in Physics
Dates 01/2014 to 12/2015
Organization Old Dominion University (ODU); 5115 Hampton Blvd., Norfolk, VA 23529, USA

Degree Master of Science in Physics
Dates 09/2011 to 05/2013
Thesis title Simulation and method study of Aerogel Cherenkov detector for SHMS magnetic spectrometer
Advisor H. Mkrtchyan
Degree Bachelor of Science in Physics
Dates 09/2007 to 05/2011
Organization Yerevan State University; Alek Manukyan 1, Yerevan, 0025 Armenia

Relevant Experience

Position Postdoctoral Research Associate
Dates December 2025
Organization Old Dominion University (ODU); Department of Physics, 4111 Monarch Way Suite 204, Norfolk, VA 23508

- Projects
- Analyzed CLAS12 data to study charged particle track reconstruction efficiency as a function of luminosity for validation of AI/ML workflow for CLAS12 track reconstruction and electron identification in real-time and comparison of results with conventional tracking and reconstruction algorithms at Jefferson Lab experimental Hall B.
 - Using up to date available Deeply Virtual Compton Scattering (DVCS) observable measurements such as DVCS cross sections and polarization asymmetries from spin-polarized and unpolarized electron beam and proton target, to parametrize DVCS Compton Form Factors (CFFs) and subtraction constant via Artificial Neural Networks (ANNs). Have speedup ANN training in python based Gepar package by 30 times via replacing for loop over data points with Pytorch tensor operations for batches of data points sharing same physics observable formulas. Implementing DVCS CFF fitting in C++ based PARTONS package.

Position Postdoctoral Research Associate

Dates January 2020-May 2023

Organization Florida International University (FIU); Department of Physics, 11200 SW 8th Street, CP 204, Miami, FL 33199, USA

- Projects
- Hadron photoproduction studies at JLab experimental Hall-D.
 - Play a leading role in Partial Wave Analysis (PWA) efforts of GlueX experiment, in search of exotic mesons.
 - Least Squares and unbinned Likelihood statistical methods to separate signal from background via Probabilistic Event Weightings.
 - Developed C++ libraries to fit data using unbinned maximum Likelihood for PWA analysis at GlueX.
 - Used bootstrap samples for error estimation.
 - Mentoring a PhD student in data analysis.
 - Obtained preliminary results on PWA analysis of $\eta' \pi^0$ data.
 - Experimental shift taking at Hall-D during 2020-2021 runs.
 - Organizing the quality check of the GlueX and PrimEx data.

Position Graduate Research Assistant

Dates June 2014-December 2019

Organization Old Dominion University; 5115 Hampton Blvd., Norfolk, VA 23529, USA

- Projects
- Electron scattering nuclear physics research at JLab
 - Analyzed data from the CLAS6 spectrometer.
 - Two nucleon Short Range Correlations (SRC) studies of light nuclei.
 - Studies of neutrino energy estimation using electron scattering data.
 - Paper based on PhD thesis published in Nature journal
 - Mentored an undergraduate student in data analysis.
 - Neutron detection studies
 - Detector calibrations
 - Data replay and processing
 - Experimental shift taking at JLab in experimental Halls A and B
 - Helped assemble the Backward Angle Neutron Detector (BAND) for Hall B.

Position Graduate Teaching Assistant

Dates Spring 2016

Organization Old Dominion University; 5115 Hampton Blvd., Norfolk, VA 23529, USA

- Projects
- Teaching introductory general physics lab

Position Trainee researcher

Dates Feb 2012- Dec 2013

Organization Yerevan Physics Institute; 2 Alikhanian brothers, Yerevan, 0036 Armenia

- Project
- Helped construct aerogel Cherenkov detector for SHMS magnetic spectrometer in JLab experimental Hall C.
 - Simulation
 - Prototyping
 - Materials and component testing
 - Assembly

Honors & Awards

- First place prize; Annual JLab User Group Meeting Poster Competition; June 19th, 2018.
- Jefferson Science Associates Graduate Fellowship award; Jefferson Science Associates; 2018-2019.
- Certificate of Appreciation; FIU dean of the College of Arts, Sciences and Education; October 11, 2021.

Volunteer work

- Tour Guide at JLab Hall D; Showing Hall D complex to graduate students from ODU physics department during their CEBAF tour; (April 2022)
- Serve as an officer at GlueX collaboration Diversity and Inclusion group, November 2021- Present.
- Tour Guide at JLab Hall B; Undergraduate Woman in Physics Conference; College of William & Mary; (January 2019)
- Volunteer; JLab Open House; (2016, 2018)
- Mentor; Old Dominion University Global Monarch Club; August-December 2017)

Presentations

- Invited
- Plenary talk at QNP meeting: Search for exotic-quantum-number mesons with the GlueX experiment; September 6, 2022, Tallahassee, FL, USA.
 - 2022 JLab Users Organization Meeting: Validation of neutrino energy estimation using electron scattering data; June 13, 2022, JLAB, VA, USA.
 - 2022 CLAS Collaboration Meeting: Validation of neutrino energy estimation using electron scattering data; March 4, 2022, JLAB, VA, USA.
 - 2021 American Physics Society (APS) meeting: Photoproduction of Hadrons with the GlueX experiment; April 19, 2021, virtual.
 - 2019 JLab Users Organization Meeting: Constraining neutrino-nucleus interactions with electron scattering data; June 24, 2019, JLAB, VA, USA.
 - Photonuclear reactions: Validation of neutrino energy estimation using electron scattering data; Gordon Research Conference; August 7, 2018, Holderness, NH, USA.
 - NuInt 11th International Workshop on Neutrino-Nucleus Scattering in the Few-GeV Region: Validation of neutrino energy estimation using electron scattering. Toronto, Canada, 25-30 June, 2017.
- Seminar
- JLab seminar: Partial Wave Analysis studies of $\eta' \pi^0$ system in GlueX; JLab; VA, USA; (June. 8, 2022).
 - FIU seminar: Photoproduction of hadrons with the GlueX experiment; Florida International University; FL, USA; (Jan. 21, 2022).
 - FIU seminar: Validation of neutrino energy estimation using electron scattering data; Florida International University; FL, USA; (Nov. 22, 2019).
 - ODU Physics Department Nuclear Group Seminar: Comparing proton and neutron momentum distributions in ^3He using the Large Angle Calorimeter (LAC); March 31, 2016, Old Dominion University, Norfolk, VA, USA.
 - ODU Physics Department Nuclear Group Seminar: Studies of nucleon-nucleon Short range correlations in $A=3$ nuclei; February 25th, 2015, Old Dominion University, Norfolk, VA, USA.

- Other talks
- APS DNP meeting: Partial Wave Analysis studies with simulated $\eta' \pi^0$ events in GlueX; October 31, 2020, virtual.
 - GlueX collaboration meeting: Partial Wave Analysis studies of $\eta' \pi^0$ system in GlueX; VA, USA; (May 2020, October 2020, February 2021, May 2021).
 - NPWG: Validation of neutrino energy estimation using electron scattering data; CLAS collaboration meeting; VA, USA; (March 2017, June 2017, March 2018, July 2018, March 2019, June 2019).
 - Fifth Joint Meeting of the Nuclear Physics Divisions of the APS and the JPS: Study of neutrino energy reconstruction using electron scattering; October 23-27, 2018, Waikoloa, Hawaii.
 - JLAB CLAS Nuclear Data Mining Group meeting: Validation of neutrino energy estimation using electron scattering data; August 2, 2018, Cambridge, MA.
 - APS meeting: Validation of neutrino energy estimation using electron scattering data; April 17, 2018, Columbus, OH, USA.
 - JLAB CLAS Nuclear Data Mining Group meeting: Validation of neutrino energy estimation using electron scattering data; October 16, 2017, Cambridge, MA.
 - JLAB CLAS Nuclear Data Mining Group meeting: Comparing proton and neutron momentum distributions in ^3He using the Large Angle Calorimeter (LAC) and using Forward Electromagnetic Calorimeter (EC); October 16, 2017, Cambridge, MA.
 - NPWG: Nucleon momentum distributions in ^3He using the Large Angle Calorimeter (LAC); CLAS collaboration meeting; 25 February, 2016, JLAB, VA, USA.
 - JLAB CLAS Nuclear Data Mining Group meeting: CLAS Large Angle Calorimeter time Calibration; July 27, 2015, Buffalo, NY.

Posters

- "Validation of neutrino energy estimation using electron scattering data"; Jlab users group meeting poster session; June 19, 2018, JLAB, VA, USA.
- "Validation of neutrino energy estimation using electron scattering data"; SURA Board of Trustees (BOT) meeting; April 25, 2018, JLAB, VA, USA.
- "Comparing proton and neutron momentum distributions in ^3He using the Large Angle Calorimeter (LAC)"; Jlab users group meeting poster session; June 22, 2016, JLAB, VA, USA.

Summer Student Programs

- Hampton University Graduate Program; Summer 2012 and Summer 2013, JLab, VA, USA.
- Deutsch Electron Synchrotron July 20-Sep. 9 of 2010; Germany, Hamburg.

Additional skills & training

- Software
 - C/C++
 - Python
 - Perl
 - Shell
 - html
 - Latex
 - Microsoft Office
- Memberships
 - GlueX collaboration.
 - APS
- Languages
 - Armenian - Native
 - English - Fluent
 - Russian - Fluent

Publications

**M. Khachatryan *et al.* [CLAS and e4v], Nature 599, no.7886, 565-570 (2021)
doi:10.1038/s41586-021-04046-5**

A. Papadopoulou *et al.* [electrons for neutrinos], Phys. Rev. D **103, 113003 (2021) doi:10.1103/PhysRevD.103.113003 [arXiv:2009.07228 [nucl-th]].**

D. Abrams *et al.* [MARATHON], [arXiv:2104.05850 [hep-ex]].

T. B. Hayward, C. Dilks, A. Vossen, H. Avakian, S. Adhikari, G. Angelini, M. Arratia, H. Atac, C. A. Gayoso and N. A. Baltzell, *et al.* Phys. Rev. Lett. **126**, 152501 (2021) doi:10.1103/PhysRevLett.126.152501 [arXiv:2101.04842 [hep-ex]].

S. Diehl *et al.* [CLAS], [arXiv:2101.03544 [hep-ex]].

W. B. Li, G. M. Huber, J. R. Stevens, K. Semenov-Tian-Shansky, L. Szymanowski, B. Pire, M. Amarian, D. Androic, K. Aniol and D. Armstrong, *et al.* [arXiv:2008.10768 [nucl-ex]].

N. Zachariou *et al.* [CLAS], Phys. Lett. B **808**, 135662 (2020) doi:10.1016/j.physletb.2020.135662

S. Diehl *et al.* [CLAS], Phys. Rev. Lett. **125**, no.18, 182001 (2020) doi:10.1103/PhysRevLett.125.182001 [arXiv:2007.15677 [nucl-ex]].

T. Hu *et al.* [CLAS], [arXiv:2006.01361 [nucl-ex]].

I. Korover *et al.* [CLAS], [arXiv:2004.07304 [nucl-ex]].

A. Celentano *et al.* [CLAS], Phys. Rev. C **102**, no.3, 032201 (2020) doi:10.1103/PhysRevC.102.032201 [arXiv:2004.05359 [nucl-ex]].

A. Schmidt *et al.* [CLAS], Nature **578**, no.7796, 540-544 (2020) doi:10.1038/s41586-020-2021-6 [arXiv:2004.11221 [nucl-ex]].

V. D. Burkert, L. Elouadrhiri, K. P. Adhikari, S. Adhikari, M. J. Amarian, D. Anderson, G. Angelini, M. Antoniolli, H. Atac and S. Aune, *et al.* Nucl. Instrum. Meth. A **959**, 163419 (2020) doi:10.1016/j.nima.2020.163419

R. Cruz-Torres *et al.* [Jefferson Lab Hall A Tritium], Phys. Rev. Lett. **124**, no.21, 212501 (2020) doi:10.1103/PhysRevLett.124.212501 [arXiv:2001.07230 [nucl-ex]].

N. Markov *et al.* [CLAS], Phys. Rev. C **101**, no.1, 015208 (2020) doi:10.1103/PhysRevC.101.015208 [arXiv:1907.11974 [nucl-ex]].

B. Schmookler *et al.* [CLAS Collaboration], Nature **566**, no. 7744, 354 (2019). doi:10.1038/s41586-019-0925-9

R. Cruz-Torres *et al.* [Jefferson Lab Hall A Tritium Collaboration], Phys. Lett. B **797**, 134890 (2019) doi:10.1016/j.physletb.2019.134890 [arXiv:1902.06358 [nucl-ex]].

B. Zhao *et al.* [CLAS Collaboration], Phys. Lett. B **789**, 426 (2019). doi:10.1016/j.physletb.2018.12.065

M. Hattawy *et al.* [CLAS Collaboration], Phys. Rev. Lett. **123**, no. 3, 032502 (2019) doi:10.1103/PhysRevLett.123.032502 [arXiv:1812.07628 [nucl-ex]].

P. Roy *et al.* [CLAS Collaboration], Phys. Rev. Lett. **122**, no. 16, 162301 (2019) doi:10.1103/PhysRevLett.122.162301 [arXiv:1812.02106 [nucl-ex]].

M. Duer *et al.* [CLAS Collaboration], arXiv:1811.01823 [nucl-ex].

M. Duer *et al.* [CLAS Collaboration], Phys. Rev. Lett. **122**, no. 17, 172502 (2019) doi:10.1103/PhysRevLett.122.172502 [arXiv:1810.05343 [nucl-ex]].

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- M. Duer *et al.* [CLAS Collaboration], Nature **560**, no. 7720, 617 (2018). doi:10.1038/s41586-018-0400-z
- S. Lombardo *et al.* [CLAS Collaboration], arXiv:1808.01918 [hep-ex].
- E. Golovatch *et al.* [CLAS Collaboration], arXiv:1806.01767 [nucl-ex].
- D. H. Ho *et al.* [CLAS Collaboration], arXiv:1805.04561 [nucl-ex].
- E. O. Cohen *et al.* [CLAS Collaboration], Phys. Rev. Lett. **121**, no. 9, 092501 (2018) doi:10.1103/PhysRevLett.121.092501 [arXiv:1805.01981 [nucl-ex]].
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- S. Chandavar *et al.* [CLAS Collaboration], Phys. Rev. C **97**, no. 2, 025203 (2018) doi:10.1103/PhysRevC.97.025203 [arXiv:1712.02184 [nucl-ex]].
- K. Park *et al.* [CLAS Collaboration], Phys. Lett. B **780**, 340 (2018) doi:10.1016/j.physletb.2018.03.026 [arXiv:1711.08486 [nucl-ex]].
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- Z. Akbar *et al.* [CLAS Collaboration], Phys. Rev. C **96**, no. 6, 065209 (2017) doi:10.1103/PhysRevC.96.065209 [arXiv:1708.02608 [nucl-ex]].
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doi:10.1016/j.physletb.2017.05.045 [arXiv:1703.00433 [nucl-ex]].

M. Mayer *et al.* [CLAS Collaboration], Phys. Rev. C **95**, no. 2, 024005 (2017)
doi:10.1103/PhysRevC.95.024005 [arXiv:1610.06109 [nucl-ex]].