Nathaniel Dene Hoffman

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Education

Carnegie Mellon University
Ph.D., Physics, 2019–Present.
Field: Nuclear and Particle Physics
M.S., Physics, 2021.

Case Western Reserve University
B.S., Physics, 2019.
B.A., Music, 2019.

Research

Department of Physics, CMU 2019–Present
Ph.D. Candidate (Advisor: Reinhard Schumacher)
Thesis: *Photoproduction of K^0_S Pairs at GlueX* (in progress)

Department of Physics, CMU 2020
Research Assistant (Advisor: Michael Widom)
Project: *Cluster Variation Method Analysis of BCC Heusler Alloys*

Department of Physics, CWRU 2016–2019
Research Assistant (Advisor: Giuseppe Strangi)
Project: *Material Properties and Fabrication of Thin-Film Metamaterials*

Teaching

Department of Physics, CMU 2019–2020
Teaching Assistant, Basic Experimental Physics

Department of Physics, CWRU 2017–2019
Teaching Assistant, Honors Introduction to Electromagnetism

Awards and Fellowships

Michelson-Moreley Scholarship CWRU 2015–2019

Languages

English (native), French (intermediate), Spanish (beginner)

Skills

Rust, Python, C/C++, LaTeX, Mathematica, ROOT, MPI

Publications

ElKabbash, M., **Hoffman, N.**, Lininger, A. R., Jalil, S. A., Letsou, T., Hinczewski, M., Strangi, G., & Guo, C. (2023). *Fano Resonant Optical Coatings Platform for Full Gamut and High Purity Structural Colors.* Nature Communications, **14**(1). DOI: 10.1038/s41467-023-39602-2

ElKabbash, M., Letsou, T., Jalil, S. A., **Hoffman, N.**, Zhang, J., Rutledge, J., Lininger, A. R., Fann, C.-H., Hinczewski, M., Strangi, G., & Guo, C. (2021). *Fano-Resonant Ultrathin Film Optical Coatings.* Nature Nanotechnology, **16**(4), 440–446. DOI: 10.1038/s41565-020-00841-9

Hoffman, N., & Widom, M. (2021). *Cluster Variation Method Analysis of Correlations and Entropy in BCC Solid Solutions.* Metallurgical and Materials Transactions A, **52**(5), 1551–1558. DOI: 10.1007/s11661-021-06182-z

ElKabbash, M., Sreekanth, K. V., Fraiwan, A., Cole, J., Alapan, Y., Letsou, T., **Hoffman, N.**, Guo, C., Sankaran, R. M., Gurkan, U. A., Hinczewski, M., & Strangi, G. (2020). *Ultrathin-Film Optical Coating For Angle-Independent Remote Hydrogen Sensing.* Measurement Science and Technology, **31**(11), 115201. DOI: 10.1088/1361-6501/ab9fd8

ElKabbash, M., Ilker, E., Letsou, T., **Hoffman, N.**, Yaney, A., Hinczewski, M., & Strangi, G. (2017). *Iridescence-Free and Narrowband Perfect Light Absorption in Critically Coupled Metal High-Index Dielectric Cavities.* Optics Letters, **42**(18), 3598. DOI: 10.1364/ol.42.003598

ElKabbash, M., Sousa-Castillo, A., Nguyen, Q., Mariño-Fernández, R., **Hoffman, N.**, Correa-Duarte, M. A., & Strangi, G. (2017). *Tunable Black Gold: Controlling the Near-Field Coupling of Immobilized Au Nanoparticles Embedded in Mesoporous Silica Capsules.* Advanced Optical Materials, **5**(21). DOI: 10.1002/adom.201700617

Collaboration Publications

GlueX Collaboration, (2025). *First Measurement of* $a_2^0(1320)$ *Polarized Photoproduction Cross Section.* Physical Review C, **112**(1). DOI: 10.1103/jfzb-rfl4

GlueX Collaboration, (2025). *First Measurement of the Total Compton Scattering Cross Section between* 6 *and* 11 *GeV* (Version 1). arXiv. DOI: 10.48550/ARXIV.2505.07994

GlueX Collaboration, (2025). *Measurement of spin-density matrix elements in* $\Delta^{++}(1232)$ *photoproduction.* Physics Letters B, **863**, 139368. DOI: 10.1016/j.physletb.2025.139368

GlueX Collaboration, (2024). *Upper Limit on the Photoproduction Cross Section of the Spin-Exotic* $\pi_1(1600)$. Physical Review Letters, **133**(26). DOI: 10.1103/physrevlett.133.261903

Pybus, J. R., et al. (GlueX Collaboration), (2024). *Search for axion-like particles through nuclear Primakoff production using the GlueX detector.* Physics Letters B, **855**, 138790. DOI: 10.1016/j.physletb.2024.138790

GlueX Collaboration, (2023). *Measurement of spin-density matrix elements in* $\rho(770)$ *production with a linearly polarized photon beam at* $E_\gamma = 8.2$—8.8 *GeV.* Physical Review C, **108**(5). DOI: 10.1103/physrevc.108.055204

GlueX Collaboration, (2023). *Measurement of the* J/ψ *photoproduction cross section over the full near-threshold kinematic region.* Physical Review C, **108**(2). DOI: 10.1103/physrevc.108.025201

GlueX Collaboration, (2022). *Search for Photoproduction of Axionlike Particles at GlueX.* Physical Review D, **105**(5). DOI: 10.1103/physrevd.105.052007

GlueX Collaboration, (2022). *Measurement of Spin Density Matrix Elements in* $\Lambda(1520)$ *Photoproduction at* 8.2—8.8 *GeV.* Physical Review C, **105**(3). DOI: 10.1103/physrevc.105.035201

Talks

Jefferson Lab Users Organization Annual Meeting (upcoming) June 25, 2025
Title: *Spectroscopy with K-short Mesons from GlueX* (invited)

PWA13/ATHOS8 May 28, 2024
Title: *Photoproduction of* K_S *Pairs at GlueX*

APS April Meeting April 17, 2023
Title: *Photoproduction of Mesons Decaying into* $K_S K_S$ *at GlueX*

Jefferson Lab Users Organization Meeting at APS April 16, 2023
Title: *GlueX/Hall D Overview* (invited)

APS Division of Nuclear Physics October 14, 2021
Title: *Meson and Baryon Photoproduction using* $\gamma p \to K_S K_S p$ *at GlueX*

Work Experience

Engineer at Folio Photonics 2019
Activities included data reading/writing experiments on multilayer films and developing software for testing and automation. I was tasked with developing programs to scan through layered disks and measure layer positions and thicknesses, as well as programs which ran testing procedures on physical devices using LabVIEW.

Projects

laddu is a library for analysis of particle physics data. It is intended to be a simple and efficient alternative to some of the other tools out there. `laddu` is written in Rust with bindings to Python via PyO3 and maturin. The goal of this project is to allow users to perform complex amplitude analyses (like partial-wave analyses) without complex code or configuration files. It additionally supports the Message Passing Interface (MPI) protocol for parallelization in high-perfomance computing environments. `laddu` prioritizes the Parquet data format while providing methods to read and convert ROOT files.
Link: https://github.com/denehoffman/laddu

ganesh is a Rust crate providing common optimization algorithms as well a straightforward, trait-based interface to create extension algorithms. It provides pure-Rust implementations of the L-BFGS-B and Nelder-Mead minimization algorithms along with implementations of the Affine-Invariant Ensemble Sampler and Ensemble Slice Sampler for Markov chain Monte Carlo analyses.
Link: https://github.com/denehoffman/ganesh

modak is a Python library with a Rust backend used to generate data pipelines for scientific computing workflows. It uses a Rust-based task scheduler to create Python subprocesses which perform individual tasks such as data processing and plotting.
Link: https://github.com/denehoffman/modak

References

Dr. Reinhard Schumacher
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Dr. Curtis Meyer
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Dr. Mohamed ElKabbash
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