# 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  $K_S^0$  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 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) photo-production. Physics Letters B, **863**, 139368. DOI: 10.1016/j.physletb.2025.139368

GlueX Collaboration, (2025). First Measurement of  $a_2^0(1320)$  Polarized Photoproduction Cross Section (Version 1). arXiv. DOI: 10.48550/ARXIV.2501.03091

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  $J/\psi$  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) Title: Spectroscopy with K-short Mesons from GlueX (invited)	June 25, 2025
PWA13/ATHOS8 Title: Photoproduction of $K_S$ Pairs at GlueX	May 28, 2024
APS April Meeting Title: Photoproduction of Mesons Decaying into $K_SK_S$ at GlueX	April 17, 2023
Jefferson Lab Users Organization Meeting at APS Title: GlueX/Hall D Overview (invited)	April 16, 2023
APS Division of Nuclear Physics  Title: Meson and Baryon Photoproduction using $\gamma p \to K_S K_S p$ at GlueX	October 14, 2021

# 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

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Dr. Giuseppe Strangi Department of Physics Case Western Reserve University giuseppe.strangi@case.edu, +1 (216) 368-6918 Dr. Curtis Meyer Department of Physics Carnegie Mellon University cmeyer@cmu.edu, +1 (987) 654-3210

Dr. Mohamed ElKabbash Quantum Photonics Group Massachusetts Institute of Technology melkabba@mit.edu