

BEN MESSERLY

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University of Minnesota ◊ PAN 350 ◊ Minneapolis, MN 55413

ACADEMIC APPOINTMENTS

University of Minnesota Particle Physics Postdoctoral Associate	Minneapolis, MN <i>2020 - Present</i>
Carleton College Visiting Assistant Professor of Physics	Northfield, MN <i>2023</i>
St. Olaf College Adjunct Assistant Professor of Physics	Northfield, MN <i>2022</i>

EDUCATION

University of Pittsburgh M.S. & Ph.D in Physics <i>Single Charged Pion Production by Muon Neutrinos in the MINERvA Detector Using the NuMI Beam</i> K. P. Dietrich School of A & S Fellow	Pittsburgh, PA <i>2019</i>
Bowdoin College B.A. in Physics Minor in Philosophy	Brunswick, ME <i>2011</i>

RESEARCH INTERESTS

Experimental high energy nuclear and particle physics
High performance and scientific computing
Data science, machine learning, data visualization, statistics
Open science

RESEARCH

Mu2e Experiment <i>Collaboration member</i>	Univ. of Minnesota, Fermilab <i>2020 - Present</i>
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- **Calibration and Analysis Groups**

- Neural network based track alignment and energy calibrations.
- Analysis infrastructure tools development.

- **Detector Construction**

Lead postdoc in the Heller UMN lab for construction of the Mu2e straw tube electron tracking detector during key phases and completion between 2020-2022. Responsibilities and tasks included:

- Develop detector construction lab procedures, troubleshoot equipment, solve QA/QC problems, and write documentation.
- Hire, supervise, schedule, and train ~100 undergraduate employees.
- Mentor graduate, undergraduate, and REU student researchers.

- Convene weekly group staff meetings, and present weekly production status to collaboration.
- Work with university services, scientists, and technicians to acquire parts and services and to solve lab problems.
- Use python to analyze and visualize production data for rapid QA/QC decisions.
- Develop, manage, and deploy custom lab data collection software and SQL database in a production environment serving dozens of concurrent users. Train, manage, and mentor 2-3 student software development employees to build features and manage app stability. Code link.
- Lab equipment: including high voltage supplies, circuits, soldering, arduinos, high-pressured gas cylinders, DAQs, epoxies, laser machining, temperature controls, power tools, precision-measurement tools.

- **Collaboration Activities**

- Attend collaboration meetings at Fermilab, deliver tracker working group plenary reports.
- Deliver Mu2e presentations and posters at several conferences and university colloquia.
- Young Mu2e group member for early career collaborators.

MINERvA Experiment

Fermilab

Collaboration member

2013 - Present

- **Pion Production Analysis Group** - Measurement of neutrino-induced charged pion production. Publication in advanced drafting stage.
- **MINERvA Analysis Toolkit** - As a part of MINERvA's data preservation and open science effort, designed and built a toolkit for standardization, centralization, and calculation of systematic errors, used for all collaboration publications, and adopted by other experiments. Code link.
- **Neutrino Beam Flux Simulation Group** - Regular contributor; extensive studies of G4NuMI beam simulation, focusing uncertainties, hadron production uncertainties, and beam particle composition. Code link.
- **Calibrations Group** - Expert; emphasis on raw data, pedestals, and PMT gains.
- **Test Beam Group** - Led data validation group; aided in detector installation.

Author on 47 collaboration publications, including several more in preparation, and 10+ as primary author or with direct involvement in analysis, writing, and internal review.

Neutrino Scattering Theory-Experiment Collaboration (NuSTEC)

Remote

Analyzer, Publications Working Group

2016-Present

- Performed cross-experiment neutrino scattering data analysis for 2016 and 2019 Tensions workshops and publications.
- Co-author and editor of three NuSTEC publications summarizing priority topics in neutrino scattering with a goal of identifying community funding priorities.

NuMI-X Group

Fermilab

Collaboration member

2014 - 2020

- Inter-experimental effort to advance knowledge of the NuMI Beam.
- MINERvA liaison and regular contributor to simulation and modeling improvements.

- Data-taking run operations and data validation.
- Included in author list on 25 collaboration publications.

- Mapped acoustic wave propagation on the surfaces of various anisotropic crystalline solids.

SELECT PUBLICATIONS

A. Bercellie, K.A. Kroma-Wiley *et al.* [MINERvA Collaboration], *Simultaneous measurement of muon neutrino ν_μ charged-current single π^+ production in CH, C, H₂O, Fe, and Pb targets in MINERvA*, Phys.Rev.Lett. 131 (2023) 1, 011801, e-Print: arXiv:2209.07852.

M. B. Avanzini, *et al.*, *Comparisons and challenges of modern neutrino-scattering experiments (TENSIONS report)*, Phys.Rev.D 105 (2022) 9, 092004, e-Print: arXiv:2112.09194.

B. Messerly, *et al.* [MINERvA Collaboration], *An Error Analysis Toolkit for Binned Counting Experiments*, EPJ Web Conf. 251 (2021) 03046. e-Print: arXiv:2103.08677.

A. Bashyal, D. Rimal, B. Messerly, *et al.* [MINERvA Collaboration], *Use of Neutrino Scattering Events with Low Hadronic Recoil to Inform Neutrino Flux and Detector Energy Scale*, Journal of Instrumentation 16 P08068 (2021). e-Print: arXiv:2104.05769.

R. Fine, B. Messerly, and K. S. McFarland, *Data Preservation at MINERvA* (2020), e-Print: arXiv:2009.04548.

M. Betancourt, *et al.*, *Comparisons and challenges of modern neutrino scattering experiments (TENSIONS report)*, Physics Reports, 0370-1573 (2018). e-Print: arXiv:1805.07378.

C. L. McGivern, *et al.* [MINERvA Collaboration], *Cross sections for ν_μ and $\bar{\nu}_\mu$ induced pion production on hydrocarbon in the few-GeV region using MINERvA*, Phys. Rev. D **94**, no. 5, 052005 (2016). e-Print: arXiv:1606.07127.

In Preparation

B. Messerly, E. Granados, *et al.* [MINERvA Collaboration], *High statistics measurement of ν_μ induced pion production in MINERvA*.
Oct 2024

Neutrino Scattering Theory-Experiment (NuSTEC) Collaboration, *Current Experimental and Theoretical Challenges of Neutrino-Nucleus Scattering*.
Early 2025

B. Messerly, A. Lister, A. Rothman, *Livingston-style numerical and historical survey of neutrino detection*.
2025

TALKS AND PRESENTATIONS

Invited Talks

- *Dethroning the Standard Model: Neutrinos and Muons at Fermilab* Univ. of Minnesota Duluth
Postdoc Science Seminar Series Oct 2024
- *Understanding Neutrino Cross Sections* Otranto, IT
Neutrino Oscillation Workshop Sep 2024
- *Dethroning the Standard Model: Neutrinos and Muons at Fermilab* St. Olaf College
Physics Colloquium May 2023
- *An Error Analysis Toolkit for Binned Counting Experiments* Remote
International Conference on Computing in High-Energy Physics (vCHEP) May 2021
- *Studying Neutrinos in the MINERvA Detector* Bowdoin College
Physics Colloquium Nov 2016
- *Studying Neutrinos in the MINERvA Detector* Franklin & Marshall College
Physics Colloquium Nov 2016
- *MINERvA in 10 Minutes* Fermilab
New Perspectives Conference Jun 2016
- *Charged Pion Production in MINERvA* Fermilab
New Perspectives Conference Jun 2016
- *Shaking Surfaces: Investigating Crystalline Solids with Ultrasound* Bowdoin College
President's Science Symposium Oct 2010

Conference Presentations and Posters

- ν_μ Charged Current Pion Production on Different Nuclei with MINERvA Univ. Hamburg, DE
European Physical Society Conference on High-Energy Physics Aug 2023
- *The Mu2e Straw Tube Tracking Detector* Univ. Hamburg, DE
European Physical Society Conference on High-Energy Physics Aug 2023
- *Charged Kaon Production By Neutrinos at MINERvA* Chicago, IL
International Conference on High Energy Physics 2016 Aug 2016

Lecture Series

- *Particle Physics Lecture Series* Univ. of Minnesota
Bi-weekly seminars for summer research students 2021
Introduction to Mu2e, The Standard Model, Physics of the Mu2e Lab, Particle Physics Detectors, The Mu2e Tracker, Data Science in Experimental Particle Physics

TEACHING

- PHYS 4511 – Intro to Nuclear and Particle Physics** Univ. of Minnesota
Course design, co-teaching, for senior undergraduate and early Ph.D students Fall 2024
- Instructor PHYS 145 – Mechanics and Waves** Carleton College
Newtonian mechanics for non-majors Spring 2023

Instructor PHYS 386 – Advanced Lab*For senior physics majors*

St. Olaf College

Fall 2022

- Explored advanced topics in physics with emphasis on lab technique, analytical skills, independent work, and scientific writing.
- Students conducted two short experiments in the first half of the course and one self-designed experiment in the second half.
- Topics: laser technology and spectroscopy; atomic emission spectroscopy and energy splitting; positron spectroscopy; noise and entropy; Faraday rotation; liquid drop formation with a high-speed camera; scanning electron microscope.

Instructor MINERvA 101*Led annual week-long schools for new collaborator onboarding*

Fermilab

2015-2019

- Seminars and full day activities to introduce MINERvA experiment concepts.
- Topics: detector calibrations, neutrino beam flux, systematic uncertainties.
- Organized social events and tours.

Teaching Assistant*Lab and recitation instructor, grader*

Univ. of Pittsburgh

2013 - 2014

- PHYS 1371 - Introduction to Quantum Mechanics
- PHYS 0212 - Intro to Laboratory Physics
- PHYS 0175 - Basic Physics for Science and Engineering II
- PHYS 0110 - Intro to Physics 1

Teaching Assistant*Held office hours, grader*

Bowdoin College

2009 - 2011

- PHYS 104 - Introductory Physics II
- PHYS 223 - Electric Fields and Circuits
- PHYS 224 - Quantum Physics and Relativity

STUDENT ADVISING, MENTORSHIP, AND RESEARCH**Mu2e Physics Lab***Manager and Mentor (Hired Student Researchers)*

Univ. of Minnesota

2020 - Present

- Klara Northrup (Fermilab), Emma Martin (Fermilab), Hanna Hass (Fermilab), Zach Carpenter (Arizona State Univ. Physics), Aseila Awad (UMN).

Neutrino Research*Principle Investigator*

Carleton College

2023 - Present

- *Numerical and Historical Review of Neutrino Detection Methods with Livingston-style Mass and Position Resolution Visualization.*
- Research collaboration with Adam Rothman (Carleton College) and Dr. Adam Lister (Univ. of Wisconsin Madison).
- Publication in preparation.

Ph.D Students

- Everardo Granados Vazquez (Univ. de Guanajuato Ph.D 2024, now at Florida State Univ.). *Multidimensional Differential Cross Section Measurement of Neutrino Pion Production at MINERvA*.
- Faraz Samavat (Univ. of Minnesota Ph.D expected 2025). *Machine Learning Based Calibration of the Mu2e Detector*.

Summer REU Students

Primary Advisor (under supervision of PI)

Univ. of Minnesota
2023-2024

- Haley Harms (Univ. of Northern Iowa), Synnove Hunnes (Gustavus Adolphus College). *Booster Neutrino Beam Monitoring with the Short Baseline Neutrino Detector Cosmic Ray Tagger*.
- Will Leija (Texas State Univ.). *Tension & Leak Material Assessment of Mu2e Drift Straws*.

Applied Computer Science for the Mu2e Experiment

Manager and Mentor (Hired Student Researchers)

Univ. of Minnesota
2020-2023

- Trained and managed undergraduate research assistants in various computer science projects used by the Mu2e experiment.
- Python, app and full stack software development, version control, data management, data science.
- Isaiah Wardlaw (Boston Univ. Physics), Adrian Leal (Microsoft), Adam Arnett (Medtronic), Himanshu Joshi (Perficient), Matthew Breach (UMN), Oscar Wiestling (UMN).

OUTREACH

Climate and Diversity Committee Member

Department of Physics and Astronomy

Univ. of Minnesota
Oct 2021 - Present

- Advocacy group building welcoming and supportive environment with special emphasis on inclusion, diversity, and community building. Organizes activities, hosts workshops, distributes resources, and facilitates conflict mediation.
- Postdoc representative. Organize postdoc coffee hours and social events.

Minnesota State Science Fair Judge

Minnesota Academy of Science

St. Paul, MN
Mar 2023

High School Colloquia on Particle Physics

Mu2e lab tours and hour-long lectures introducing particle physics

Univ. of Minnesota
2021 - 2022

- Quarknet High School Teachers Group - Aug 2021, Jun 2022, Aug 2024
- Blake High School Student Group - May 2022
- College in the Schools: Physics by Inquiry High School Teachers Group - Nov 2021

Neutrino Hall Underground Tour Guide

Fermilab
Aug 2016 - 2019

Affirmative Action and Diversity Committee Member

Department of Physics and Astronomy

Univ. of Pittsburgh
Nov 2015 - 2018

News Article

"The Flux of the Matter"

Fermilab Today
Dec 2015

Investing Now High School Outreach Volunteer

Physics demos and discussions with K-12 groups in the Pittsburgh area

Univ. of Pittsburgh
Apr 2013

SCHOLARSHIPS AND AWARDS

Postdoc Association Award <i>For outstanding contributions to teaching and mentoring</i>	Univ. of Minnesota <i>Aug 2022</i>
Computational and Data Science School for HEP (CoDaS-HEP)	Princeton Univ. <i>Jul 2022</i>
International Neutrino Summer School Director Award <i>Historical survey of neutrino detector mass and position resolution</i>	Fermilab <i>Aug 2017</i>
U.S. DOE Office of Science Graduate Student Research Award <i>Full support to pursue Ph.D. studies at Fermilab</i>	Fermilab <i>2016 - 2017</i>
PITT PACC Fellowship <i>For Dissertation Research in Neutrino Physics</i>	Univ. of Pittsburgh <i>2015</i>
K. P. Dietrich School of A & S Fellowship <i>Full support in recognition of outstanding undergraduate record</i>	Univ. of Pittsburgh <i>2012 - 2015</i>
Surdna Fellowship <i>For Research in Solid State Physics</i>	Bowdoin College <i>2010</i>

GRADUATE COURSEWORK

Advanced Classical Electricity and Magnetism	Mathematical Methods in Physics
Advanced Particle Physics	Non-Relativistic Quantum Mechanics
Computational Methods	Teaching of Physics
Dynamical Systems	Thermodynamics & Statistical Mechanics
Field Theory	

TECHNICAL SKILLS

Python	Web scraping	Bash/Unix
C++	Data cleaning	Linux
Jupyter Notebooks	Data visualization	CERN Root
Google Colab	Grid computing	Geant4
Version control (git, svn)	Python-based GUIs	NI LabVIEW
SQL Databases	Monte Carlo simulation	Mathematica
Pandas		