Kevin Nelson, Ph.D.

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Kevin Nelson
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Education

2018 – 2023 **Ph.D. Experimental Particles and Fields** University of Michigan
Thesis title: *A Search for Exotic Decays of the 125 GeV Higgs Boson in the 2b2τ Final State Using the ATLAS Detector at* $\sqrt{s} = 13$ *TeV.*
GPA: 4.0 / 4.0.

2014 – 2018 **B.S. Physics**, The College of William and Mary

B.S. Computer Science, The College of William and Mary
Thesis title: π^- *Charge-Exchange Cross Section on Liquid Argon.*
GPA: 3.92 / 4.0.

Employment

2023 – present **Postdoctoral Research Fellow.** University of Michigan Physics Department.

- Boosted precision by 70% with new methods for multi-task learning and message passing in transformers.
- New transformer methods will accelerate the timeline for discovery by 10 years by requiring less data.
- Reduced uncertainty in ML predictions by 75% (to the 3% level), with novel methods in domain adaptation.
- Analyze 100s of millions of GB of data on millions of distributed computing cores in 42 countries.

2024 – 2025 **Software engineer, technical lead, group leader.** CERN ATLAS experiment.

- Selected from a competitive pool of 14 nominees to lead critical software modernization.
- Accelerated feedback for GB/s data streams from months to hours by automating processing.
- Saved estimated $10M in computing hours with automated framework that flags problems earlier.
- Brought 5 students projects back on schedule (≈12 months) with technical leadership and written feedback.

Leadership

2024 – current **HDBS/HIGP liaison to MCP.** Review all physics analyses published by the HDBS and HIGP groups for the proper use of muons including calibration and the application of systematic uncertainties.

Muon identification subgroup convener. Co-chair group focused on performance of muon identification working points. Advise ATLAS PhD students on authorship qualification tasks including automated data monitoring and improvement of working point efficiency.

2021 – 2024 **Analysis contact for** $h \to bb\tau\tau$**.** Co-chair the group searching for the BSM decay mode of the Higgs boson $h \to bb\tau\tau$. Responsibilities of an analysis contact include chairing meetings, coordinating with ATLAS editorial board, and ensuring that the publication of the results is on schedule.

Research Publications

Journal Articles

1. F. Anulli, H. Beauchemin, C. Bini, *et al.*, "A high-precision, fast, robust, and cost-effective muon detector concept for the fcc-ee," 2025. arXiv: 2504.10448 [hep-ex]. URL: https://arxiv.org/abs/2504.10448.
2. ATLAS Collaboration, "Search for triple Higgs boson production in the $6b$ final state using pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector," *Phys. Rev. D*, vol. 111, p. 032 006, 3 Feb. 2025. DOI: 10.1103/PhysRevD.111.032006.
3. ATLAS Collaboration, "Search for decays of the Higgs boson into a pair of pseudoscalar particles decaying into $b\bar{b}\tau^+\tau^-$ using pp collisions at $\sqrt{s}$=13 TeV with the ATLAS detector," *Phys. Rev. D*, vol. 110, p. 052 013, 5 Sep. 2024. DOI: 10.1103/PhysRevD.110.052013.
4. D. Amidei, N. Anderson, A. Chen, *et al.*, "Construction of precision sMDT detector for the ATLAS Muon Spectrometer upgrade," *JINST*, vol. 18, no. 01, P01041, 2023. DOI: 10.1088/1748-0221/18/01/P01041.
5. C. Wei, A. Chen, D. Amidei, *et al.*, "Construction and testing of sMDT tubes at the University of Michigan for the ATLAS Muon Spectrometer upgrade," *JINST*, vol. 17, no. 10, P10010, 2022. DOI: 10.1088/1748-0221/17/10/P10010.
6. ATLAS Collaboration, "Search for resonances decaying into photon pairs in 139 fb1 of pp collisions at s=13 TeV with the ATLAS detector," *Physics Letters B*, vol. 822, p. 136 651, 2021, ISSN: 0370-2693. DOI: https://doi.org/10.1016/j.physletb.2021.136651.
7. S. Malik, S. Meehan, K. Lieret, *et al.*, "Software Training in HEP," *Computing and Software for Big Science*, vol. 5, no. 22, 2021. DOI: 10.1007/s41781-021-00069-9.
8. K. Nelson, Y. Guo, D. Amidei, and E. Diehl, "Performance of Michigan sMDT prototype chambers for the HL-LHC ATLAS muon detector upgrade," *JINST*, vol. 16, no. 11, P11027, 2021. DOI: 10.1088/1748-0221/16/11/P11027.

Talks and Posters

1. K. Nelson on behalf of the ATLAS Collaboration, "Searches for new Higgs bosons in ATLAS," in *Talk presented at Physics in Collisions conference*, 2024.
2. K. Nelson, "Construction and testing of the sMDT system for the HL-LHC ATLAS muon detector upgrade," in *Poster presented at Pisa Meeting on Advanced Detectors*, 2022.
3. K. Nelson, "Measurement of tracking resolution in an atlas smdt chamber," in *Talk presented at APS April Meeting*, 2021.
4. K. Nelson, "Performance studies on muon tracking reconstruction of smdt detector," in *Poster presented at European Physical Society Meeting*, 2021.
5. K. Nelson, "Pion charge exchange cross section on liquid argon," in *Talk presented at College of William & Mary REU, SESAPS Annual Meeting 2016, APS April Meeting 2017*, 2017.

Skills

Computing — C++, python, ROOT, git/gitlab, docker, CMake, bash, C, dOxygen documentation, Haskell, LaTeX

Skills (continued)

Instrumentation
- Experience in construction and quality control for precision detectors, analyzing DAQ level data, and managing a team of graduate students.

Professional Development

2022 **ISOTDAQ School**. International School of Trigger and Data Acquisition. Topics include: DAQ, trigger, FPGA, GPU, modular electronics and data storage.

2020 **MLHEP School**. This summer school was forced online due to COVID-19, but I asynchronously viewed video lectures and participated in assignments.

2019 **US ATLAS Computing Bootcamp**. Learned how to apply computing knowledge specifically to data analysis and software development on the ATLAS experiment.

2017 **CERN Summer School**. Attended daily lectures on accelerator technologies, particle detectors, and phenomenology.

Professional Service/Outreach

2023 **Michigan Math and Science Summer Scholars**. Two week summer school for high-achieving high school students from around the globe. Designed curriculum with Prof. Qian and taught laboratory sections including photoelectric effect, radioactivity, muon lifetime, statistics and data analysis.

2020 **HEP Software Foundation**. As part of the effort towards a unified software training curriculum, I assisted in the development computing curriculum for the High Energy Physics community. Record lectures and facilitate discussion for workshop attendees.

Awards and Achievements

2024 **Stephanie Zimmerman Memorial Thesis Award**, best ATLAS thesis involving muon upgrades

ATLAS software grant Awarded to 5-6 young researchers in ATLAS to address specific crucial software development projects.

2017 **Phi Beta Kappa**, Recognition for high academic achievement ($\approx$ top 7%).

Don Edward Harrison Jr. Award, Highest achievement in physics, undergraduate.

Omicron Delta Kappa, Inducted into National Leadership Honor Society.

E. G. Clark Memorial Scholarship, Awarded to highest achieving senior physics major

Goldwater Scholarship Honorable Mention, Awarded to $\approx$ top 300 STEM undergraduate students in the USA annually.

Undergraduate Research Grant, Grant awarded to fund research trip to Fermilab.

2016 **Best Oral Presentation**, College of William & Mary REU.

Best Undergraduate Oral Presentation, SESAPS Annual Meeting.

2015 **Best Oral Presentation**, College of William & Mary REU.

Best Undergraduate Oral Presentation, SESAPS Annual Meeting.