CURRICULUM VITAE
Paul M. Neves

Office Address:

Johns Hopkins University
Department of Physics and Astronomy
3400 North Charles Street
Baltimore, MD 21218
Email: pneves1@jhu.edu

Education:

Ph.D. Physics – Massachusetts Institute of Technology 2019–2025
Flat Bands and Magnetism in Frustrated Lattice Compounds

B.S. Physics – University of Maryland, College Park 2015–2019
Summa Cum Laude
Physics Departmental High Honors
Honors College Citation – University Honors

Appointments:

Postdoctoral Fellow – Johns Hopkins University; Baltimore, MD 2025–
Gordon and Betty Moore Foundation Postdoctoral Fellowship
Department of Physics and Astronomy
Institute for Quantum Matter
Advisor: C. Broholm

Graduate Student – Massachusetts Institute of Technology; Cambridge, MA 2019–2025
Thesis: Flat Bands and Magnetism in Frustrated Lattice Compounds
Advisor: J. Checkelsky

Extended Visit – Swiss Spallation Neutron Source, Paul Scherrer Institut, Switzerland 2024–2024
Project: In-Situ Strain for Small Angle Neutron Scattering of Incommensurate Magnets
Advisor: J. S. White

Research Mentor – Massachusetts Institute of Technology; Cambridge, MA 2021–2024
Mentored Undergraduate Student in J. Checkelsky Group

Student Mentor – Massachusetts Institute of Technology; Cambridge, MA 2020–2020
Physics Department (COVID-19 academic continuity)

Teaching Assistant – University of Maryland; College Park, MD 2019–2019
PHYS161 General Physics: Mechanics and Particle Dynamics

Workshop Coordinator/Manager – University of Maryland; College Park, MD 2017–2019
UMD Physics Makers

Research Assistant – University of Maryland; College Park, MD 2016–2019
Dept. of Physics Honors Thesis: Effect of Chemical Substitution on the Skyrmion Phase in Poly-Crystalline Cu_2OSeO_3
Advisor: N. Butch

Outreach Host – University of Maryland; College Park, MD 2016–2017
Physics Outreach
Student Assistant – University of Maryland; College Park, MD 2016–2017
Lecture Demonstration Facility
Tutor/Fundraiser – University of Maryland, College Park, MD 2015–2019
Society of Physics Students
Research Intern – NIST Center for Neutron Research, MD 2014–2014
Project: Direct Measurement of the Orientation of Atomic Vibrations Using Inelastic Neutron Scattering
Advisor: D. Parshall

Research Interests:

- Experimental condensed matter physics: superconductivity, (topological/correlated) electronic properties, (quantum/topological) magnetic phases, effects of extreme conditions (low temperature, high magnetic field, applied pressure, uniaxial strain). Electronic flat bands, frustrated magnetism, incommensurate/multi-q magnetism, interplay of electronic and magnetic degrees of freedom.
- Advanced electronic, magnetic, and structural characterization techniques: neutron scattering (small angle, spherical neutron polarimetry, single crystal, powder, inelastic), ARPES, quantum oscillations, electronic transport, magnetic torque.
- Instrumentation design/construction, analysis/data visualization software development.

National Facilities Experience:

- Neutron Scattering
  - ORNL: GP-SANS, HB-1, HB-1A, HB-2A, HB-2C, SEQUOIA, CORELLI
  - NIST: NG7 30m SANS, CHRNS MACS
  - PSI SINQ: SANS-I, DMC
  - ILL: ThALES + CryoPAD, D33 + PA, D3, D9, D20
  - ISIS: WISH
- X-ray Scattering
  - ALS: Beamline 7.0.2 (MAESTRO)
  - APS: Beamline 29-ID (IEX)
  - NSLS-II: Beamline 21-ID (ESM)
  - SSRL: Beamline 5-2 (ARPES)
- High Magnetic Fields
  - Tallahassee NHMFL: Resistive and Superconducting Magnets
  - Los Alamos NHMFL: 65 Tesla Short Pulse Magnet

Awards and Distinctions:

NSF Graduate Research Fellowship Honorable Mention 2019, 2021
Goldwater Scholar 2018
Society of Physics Students Undergraduate Research Award 2018

Baroni Scholarship	2016
University of Maryland, College Park Banneker/Key Scholarship	2015–2019
National Merit Scholar	2015
National Presidential Scholar Semifinalist	2015
National AP Scholar	2015

Professional Activities:

- Member: American Physical Society [Condensed Matter Physics Division, Magnetism Topical Group]
- Peer Reviewer: Nature Communications, Physical Review X, Physical Review B, Journal of Applied Crystallography
- Organizing Committee Member: JHU Quantum Matter Forum
- Expert Consulting: TED Ed educational video on magnetism

Publications:

ORCiD: 0000-0003-4637-5855
ResearcherID: W-8236-2018
Google Scholar: https://scholar.google.com/citations?user=TMutUG8AAAAJ&hl=en

Submitted

1. A Fermi Surface Driven Spiral Spin Liquid
   P. M. Neves*, C. I. J. Ip, T. Kurumaji, S. Fang, J. A. M. Paddison, L. M. Debeer-Schmitt, J. S. White, J. G. Checkelsky
   https://arxiv.org/abs/2603.03434, Under Review, Nature Communications (2026).

Accepted

2. A General Approach to Solving Spin Moiré Superstructures
   P. M. Neves*, T. Kurumaji, J. P. Wakefield, A. Hiess, P. Steffens, N. Qureshi, R. Cubitt, L. M. Debeer-Schmitt, J. C. Palmstrom, S. Hayami, M. Bartkowiak, M. Zolliker, J. S. White, J. G. Checkelsky
   https://arxiv.org/abs/2512.16990, Accepted, Physical Review X (2026).

3. Cascade of Spin Moiré Superlattices with In-Plane Field in Triangular Lattice Semimetal $EuAg_4Sb_2$
   P. M. Neves*, T. Kurumaji, J. P. Wakefield, C. I. J. Ip, R. Cubitt, S. Hayami , J. S. White, J. G. Checkelsky
   ACS Nano, **20**(19) 14029–14038 (2026).

4. High Field Triplet Superconductivity in a Transition Metal Dichalcogenide Superlattice
   S. Y. F. Zhao*, **P. M. Neves**, J. P. Wakefield, S. Fang, A. Chen, J. C. Palmstrom, D. E. Graf, A. Auslender, D. C. Bell, P. A. Volkov, T. Suzuki, J. G. Checkelsky
   Nature Physics **22**, 382–388 (2026).

5. Electronic Commensuration of a Spin Moiré Superlatice in a Layered Magnetic Semimetal
   T. Kurumaji*, N. Paul, S. Fang, **P. M. Neves**, M. Kang, J. S. White, T. Nakajima, D. Graf, L. Ye, M. K. Chan, T. Suzuki, J. Denlinger, C. Jozwiak, A. Bostwick, E. Rotenberg, Y. Zhao, J. W. Lynn, E. Kaxiras, R. Comin, L. Fu, J. G. Checkelsky

Science Advances, **11** eadu6686 (2025).

6. GRASP Integrated 3D Plotter: GRIP
P. M. Neves*, J. S. White
Applied Crystallography **57**, 2030-2042 (2024).

7. Measurements of the Quantum Geometric Tensor in Solids
M. Kang*, S. Kim, Y. Qian, **P. M. Neves**, L. Ye, J. Jung, D. Puntel, F. Mazzola, S. Fang, C. Jozwiak, A. Bostwick, E. Rotenberg, J. Fujii, I. Vobornik, J. H. Park, J. G. Checkelsky, B. J. Yang, R. Comin
Nature Physics **21**, 110-117 (2025).

8. Crystal Net Catalog of Model Flat Band Materials
P. M. Neves*, J. P. Wakefield, S. Fang, H. Nguyen, L. Ye, J. G. Checkelsky
npj Computational Materials **10**, 39 (2024).

9. Photoinduced Dynamics of Flat Bands in the Kagome Metal CoSn
D. Puntel*, W. Bronsch, M. Tuniz, M. Kang, **P. M. Neves**, S. Fang, E. Kaxiras, J. G. Checkelsky, R. Comin, F. Parmigiani, F. Cilento
Physical Review B **109**, L081104 (2024).

10. Hopping Frustration-Induced Flat Band and Strange Metallicity in a Kagome Metal
L. Ye*, S. Fang, M. Kang, J. Kaufmann, Y. Lee, C. John, **P. M. Neves**, S. Y. F. Zhao, J. Denlinger, C. Jozwiak, A. Bostwick, E. Rotenberg, E. Kaxiras, D. C. Bell, O. Janson, R. Comin, J. G. Checkelsky
Nature Physics **20**, 610–614 (2024).

11. Three-Dimensional Flat Bands in Pyrochlore Metal $CaNi_2$
J. P. Wakefield*, M. Kang*, **P. M. Neves***, D. Oh*, S. Fang, R. McTigue, S. Y. F. Zhao, T. N. Lamichhane, A. Chen, S. Lee, S. Park, J. H. Park, C. Jozwiak, A. Bostwick, E. Rotenberg, A. Rajapitamahuni, E. Vescovo, J. L. McChesney, D. Graf, J. C. Palmstrom, T. Suzuki, M. Li, R. Comin, J. G. Checkelsky
Nature **623**, 301–306 (2023).

12. Symmetry of Magnetic Correlations in Spin-Triplet Superconductor UTe_2
N. P. Butch*, S. Ran, S. R. Saha, **P. M. Neves**, M. P. Zic, J. Paglione, S. Gladchenko, Q. Ye, J. A. Rodriguez-Rivera
npj Quantum Materials **7**, 39 (2022).

13. Topologically Driven Linear Magnetoresistance in Helimagnetic FeP
D. J. Campbell*, J. Collini, J. Sławińska, C. Autieri, L. Wang, K. Wang, B. Wilfong, Y. S. Eo, **P. M. Neves**, D. Graf, E. E. Rodriguez, N. P. Butch, M. B. Nardelli, J. Paglione
npj Quantum Materials **6,** 38 (2021).

14. Effect of Chemical Substitution on the Skyrmion Phase in Cu_2OSeO_3
P. M. Neves*, D. A. Gilbert, S. Ran, I. L. Liu, S. Saha, J. Collini, M. Bleuel, J. Paglione, J. A. Borchers, N. P. Butch
Physical Review B **102,** 134410 (2020).

15. Extreme Magnetic Field-Boosted Superconductivity

S. Ran*, I. L. Liu, Y. S. Eo, D. J. Campbell, **P. M. Neves**, W. T. Fuhrman, S. R. Saha, C. Eckberg, H. Kim, D. Graf, F. Balakirev, J. Singleton, J. Paglione, N. P. Butch
Nature Physics **15,** 1250-1254 (2019).

16. Precipitating Ordered Skyrmion Lattices from Helical Spaghetti and Granular Powders
D. A. Gilbert*, A. J. Grutter, P. M. Neves, G. J. Shu, G. Zimanyi, B. B. Maranville, F. C. Chou, K. Krycka, N. P. Butch, S. Huang, J. A. Borchers
Phys. Rev. Materials **3,** 014408 (2019).

17. Mechanical Control of Crystal Symmetry and Superconductivity in Weyl Semimetal $MoTe_2$
C. Heikes*, I. L. Liu, T. Metz, C. Eckberg, **P. M. Neves**, Y. Wu, L. Hung, P. Piccoli, H. Cao, J. Leao, J. Paglione, T. Yildirim, N. P. Butch, W. Ratcliff II
Phys. Rev. Materials **2,** 074202 (2018); Editor's Suggestion.

Other (Non-Peer Reviewed)

18. Four-Point AC Resistance Measurements
P. M. Neves*
Stanford Research Systems Technique Papers (2024).

19. MANiACS: A Multi-Application Neutron in-situ AC Susceptometer,
P. M. Neves*, J. Leao, N. P. Butch
Neutron News **30,** 17-18 (2019).

20. Construction of a Kibble Balance—The Device that Redefined the Kilogram
J. Evans, B. Easterday, **P. M. Neves**, B. Grinkemeyer, M. Marks, M. Spooner, S. Williams, P. Zhou, B. V. Hook, D. Long
Journal of Undergraduate Reports in Physics **28,** (2019).

21. SURFing from Susceptometers to Skyrmions: The Making of a Neutron MANiAC
P. M. Neves*
NIST Taking Measure Blog (2018).

Talks/Presentations

1. Invited Talk: "Fermi Surface Driven Magnetism And Spiral Spin Liquid In $EuAg_4Sb_2$" Polarized Neutron for Condensed Matter Investigations Conference (2026), *scheduled*.

2. Invited Talk: "Flat Bands and Magnetism in Frustrated Lattice Materials" Polarized Neutron for Condensed Matter Investigations Conference (2026), *scheduled*.

3. Invited Talk: "Fermi Surface Driven Magnetism And Spiral Spin Liquid In $EuAg_4Sb_2$" NIST Center for Neutron Research Condensed Matter Physics Physics Seminar (2026).

4. Talk: "The Nature and Origin of Spin Moiré Superlattices in the Europium Triangle Lattice Material $EuAg_4Sb_2$" APS March Meeting (2026).

5. Invited Talk: "Small Angle Neutron Diffraction (SAND) Studies of Multi-q Magnetism in a Layered Magnetic Semimetal: The Adventures of Paul Neves Across the 3rd Dimension," NIST Center for Neutron Research Low-Q Seminar (2026).

6. Talk: “Fermi Surface Driven Magnetism and Spiral Spin Liquid in $EuAg_4Sb_2$” Quantum Matter Forum, Johns Hopkins University (2025).
7. Invited Talk: “Flat Bands and Magnetism in Frustrated Lattice Materials” Condensed Matter Seminar, Johns Hopkins University (2025).
8. Talk: “Solving the Nature and Origin of Multi-q Incommensurate Magnetism in a Europium Triangle Lattice Material” Workshop on Real and Momentum Space Topology, University of Notre Dame (2025).
9. Invited Talk: “Flat Bands and Magnetism in Frustrated Lattice Materials” Condensed Matter Seminar, University of Brittish Columbia (2025).
10. Talk: “Neutron Scattering of Multi-*q* Incommensurate Magnetism in Itinerant Metal Compounds” APS March Meeting (2025).
11. Talk: “Solving Multi-q Incommensurate Magnetism in a Europium Triangle Lattice Material” Flipper 2024 polarized neutron workshop (2024).
12. Talk: “Getting a GRIP on 3D Small Angle Neutron Scattering Data,” American Conference on Neutron Scattering (2024).
13. Poster: “Frustrated Flat Bands in Intermetallic Materials,” AFOSR Joint Review for Materials with Extreme Properties and Condensed Matter Physics (2024).
14. Poster: “A Graph Theory Approach to High Throughput Crystal Motif Identification,” ORNL User Meeting (2023).
15. Talk: “Searching for Electronic Flat Bands Beyond the Kagome Framework,” APS March Meeting (2023).
16. Poster: “Catalogue of Flat Band Models in Real Materials,” Quantum Science Summer School (2022).
17. Talk: “Comprehensive Catalogue of Nearest Neighbor Uniform Hopping Flat Band Models,” APS March Meeting (2022).
18. Talk: “All Tied Up in Knots: Skyrmions in Chemically Substituted Cu2OSeO3,” UMD Physics Department Research Showcase (2019).
19. Talk: “Multi-Application Neutron in-situ AC Susceptometer (MANiACS) for Simultaneous Neutron Measurements at Low Temperatures and High Pressure at the NCNR,” 10th International Workshop on Sample Environment at Scattering Facilities (2018).
20. Plenary Talk: “All Tied Up in Knots: Skyrmions in Chemically Substituted Cu_2OSeO_3,” NIST Summer Undergraduate Research Fellowship Colloquium (2018).
21. Poster: “Simultaneous In Situ Neutron Measurement of AC Susceptibility at High Pressures and Low Temperatures at the NIST Center for Neutron Research,” American Conference on Neutron Scattering (2018).
22. Talk: “Characterization of Zn Doped Insulating Magnetic Skyrmion Material Cu_2OSeO_3,” APS March Meeting (2018).

23. Talk: "The Hunt for Magnetic Skyrmions," NIST Summer Undergraduate Research Fellowship Colloquium (2017).

24. Talk: "Prototyping A Compact Superconducting Multidirectional Helmholtz Coil for SANS Skyrmion Measurements, a SURF Summer Project," NIST Center for Neutron Research Low-Q Seminar (2017).

25. Best Poster: "Simultaneous in situ Neutron Measurement of AC Susceptibility at High Pressures and Low Temperatures at the NIST Center for Neutron Research," 9th International Workshop on Sample Environment at Scattering Facilities (2016).

26. Talk: "Designing an AC Magnetic Susceptometer Measurement Technique in Conjunction with High Pressures and Low Temperatures in Neutron Beam Experiments," NIST Summer Undergraduate Research Fellowship Colloquium (2016).

27. Poster: "Recreating the IceCube Search for Neutrino Point-Sources," Honors Seminar - Re-discovering the Higgs & Searching for Invisible Matter Poster Session (2016).

28. Poster/talk: "Direct Measurement of the Orientation of Atomic Vibrations Using Inelastic Neutron Scattering," NIST Summer High School Internship Program Colloquium (2014).

Service/Outreach

1. April 2026: TED Ed, expert consulting on magnetism

2. April 2026: MIT Physics News, 3D Graphics for "Electrons in moiré crystals explore higher-dimensional quantum worlds"

3. September 2024: MIT Physics News, 3D Graphics for "New material sports wavy layers of atoms."

4. May 2024: MIT Physics News and Phys.org, 3D Graphics for "Physicists discover new way to make strange metal."

5. November 2023: MIT News, 3D Graphics for "Physicists trap electrons in a 3D crystal for the first time."

6. Fall 2020: MIT Physics Mentoring Program

7. January 2020: IAP Physics Directed Reading Program

8. December 2018: University of Maryland Physics Makers Workshop Leader - College Park, Maryland. Lecture: "Digital and Analog I/O, Pulse Width Modulation (PWM), and RC Filters."

9. September 2018: University of Maryland Physics Makers Workshop Leader – College Park, Maryland. Lecture: "Arduino Programming Basics."

10. July 2018: National Institute of Standards and Technology Taking Measure Blog – Gaithersburg, Maryland. "SURFing from Susceptometers to Skyrmions: The Making of a Neutron MANiAC."

11. February 2018: University of Maryland Solid State Physics Seminar (PHYS838C) - College Park, Maryland. Presentation: "The Hunt for Magnetic Skyrmions."

12. November 2017: University of Maryland Physics Makers Workshop Leader – College Park, Maryland. Lecture: "Digital and Analog I/O, Pulse Width Modulation (PWM), and RC Filters."

13. July 2017: NIST Center for Neutron Research Middle School Teacher Outreach Speaker – Gaithersburg, Maryland. "Crystal Growth."

14. April 2017: University of Maryland Physics Makers Workshop Leader – College Park, Maryland. Lecture: "Arduino Basics."

15. March 2017: University of Maryland Physics Outreach Maryland Day Co-Host – College Park, Maryland. Lecture: "The Physics of Fantastic Worlds: From Star Wars to Harry Potter."

16. March 2017: University of Maryland Physics is Phun Co-Host – College Park, Maryland. Lecture: "The Physics of Fantastic Worlds: From Star Wars to Harry Potter."

17. December 2016: University of Maryland Physics Discovery Day Host – College Park, Maryland. Lecture: "Electricity & Magnetism."

18. October 2016: University of Maryland Physics is Phun Host – College Park, Maryland. Lecture: "Full Spectrum."