

Nathan L. Harshman – Curriculum Vitae –2024/07/05

Department of Physics
American University
4400 Massachusetts Avenue NW
Washington, DC 20016-8058

harshman@american.edu
Phone: (202) 885-3479

Education:

- 1995-2001 Ph.D., Theoretical Particle Physics, University of Texas at Austin (degree, August 2001);
Dissertation: "On Representing Resonances and Decaying States"; Dissertation Advisor:
Professor Arno R. Bohm
- 1991-1995 B.S., Double major: Physics and English, Duke University (degree, May 1995)

Professional Positions:

- 2019-present Professor, Department of Physics, American University
- 2017-present Director, NASA DC Space Grant Consortium
- 2009-2019 Associate Professor, Department of Physics, American University

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2011	NASA DC Space Grant Consortium, AU Faculty STEM Award. Project Title: Promoting STEM Retention through Best Practices in Summer Research Experiences
2007	American University, Center for Teaching Excellence, Teaching with Technology Award
2006-2008	Research Corporation, Cottrell College Science Award. Project Title: Quantum Information Theory and Particle Physics: Entanglement in Multiparticle Scattering.
2004	American University, Faculty Research Award. Project Title: Applying Clebsch-Gordan Techniques to Composite Particles
2000, 2003	National Science Foundation, Travel Grant for Young Researchers

Publications:

In Submission

11. G. Bougas, N. L. Harshman, P. Schmelcher, "Impact of dark states on the stationary properties of quantum particles with off-centered interactions in one dimension," submitted to Physical Review A, arXiv:2403.10078.

Articles in Refereed Journals

- R1. S. Nagies, B. Wang, A.C. Knapp, A. Eckardt, N.L. Harshman, "Beyond braid anyons: A lattice model for one-dimensional anyons with a Galilean invariant continuum limit," SciPost Phys. 16, 086 (2024), arXiv:2309.04358.
- R2. N.L. Harshman, A.C. Knapp, "Topological Exchange Statistics in One Dimension," Physical Review A 105 (2022) 052214, arXiv:2108.05653.
- R3. D. Yampolsky, N.L. Harshman, V. Dunjko, Z. Hwang, M. Olshanii, "Quantum Chirikov Criterion," SciPost Physics 12 (2022) 035, arXiv: 2104.12193
- R4. T. Fogarty, M.A. Garcia-March, L.F. Santos, N.L. Harshman, "Probing the edge between integrability and quantum chaos in interacting few-atom systems," Quantum 5 (2021), 486, arXiv: 2104.12934.
- R5. X.M. Aretxabaleta, M. Gonchenko, N.L. Harshman, S.G. Jackson, M. Olshanii, G.E. Astrakharchik, "The dynamics of digits: Calculating pi with Galperin's billiards," Mathematics 8 (2020), 509.
- R6. N.L. Harshman, A.C. Knapp, "Anyons from Three-Body Hard-Core Interactions in One Dimension," Annals of Physics 412 (2020) 168003, arXiv: 1803.11000.
- R7. M.A. Garcia-March, N.L. Harshman, H. da Silva, T. Fogarty, Th. Busch, M. Lewenstein, A. Ferrando, "Graded-index optical fiber emulator of an interacting three-atom system: Classical non-separability and illumination control of particle statistics," Quantum 3 (2019), 210 (14 pages), arXiv: 1902.01748.
- R8. Artem G. Volosniev, Aksel S. Jensen, Nathan L. Harshman, Jeremy R. Armstrong, Nikolaj T. Zinner, "A Solvable Model for Decoupling of Interacting Clusters," Europhysics Letters 125 (2019), 20003 (7 pages), arXiv:1810.10281.
- R9. N.L. Harshman, A.C. Knapp, "Coincidence Structures and Hard-Core Few-Body Interactions," Few-body Systems 59 (2018), 79 (7 pages), arXiv: 1801.08753.
- R10. N.L. Harshman, Maxim Olshanii, A.S. Dehkharghani, A.G. Volosniev, Steven Glenn Jackson, N.T. Zinner, "Integrable families of hard-core particles with unequal masses in a one-dimensional harmonic trap," Physical Review X 7 (2017), 041001 (14 pages), arXiv: arXiv:1704.01433.
- R11. Molte Emil Strange Andersen, N. L. Harshman, and Nikolaj Thomas Zinner, "Hybrid model of separable, zero-range, few-body interactions in one-dimensional harmonic traps," Physical Review A 96 (2017), 033616 (10 pages), arXiv: 1706.04413.
- R12. N.L. Harshman, "Infinite Barriers and Symmetries for a Few Trapped Particles in One Dimension," Physical Review A 95 (2017), 053616 (15 pages), arXiv: 1608.07189.
- R13. N.L. Harshman, "Identical Wells, Symmetry Breaking, and the Near-Unitary Limit," Few-Body Systems 58, 41-47 (2017), arXiv: 1701.00949.
- R14. N.L. Harshman, "One-Dimensional Trap, Two-Body Interactions, Few-Body Symmetries I.: One, Two, and Three Particles" Few-Body Systems 57, 11-43 (2016), arXiv: 1501.00215.
- R15. N.L. Harshman, "One-Dimensional Trap, Two-Body Interactions, Few-Body Symmetries II.: *N*

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- R17. N.L. Harshman, "Symmetries of Three Harmonically-Trapped Particles in One Dimension," *Physical Review A*, 86 (2012), 052122 (10 pages), arXiv: 1209.1398.
- R18. Gary A. Morris, Nathan Harshman, Lee Branum-Martin, Eric Mazur, Taha Mzoughi and Stephen D. Baker, "An Item Response Curves Analysis of the Force Concept Inventory," *American Journal of Physics*, 80 (2012), 825-831.
- R19. N.L. Harshman and Kedar Ranade, "Observables can be tailored to change the entanglement of any

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- R40. Arno R. Bohm and N.L. Harshman, "On the mass and width of the Z-boson and other relativistic resonances," Nuclear Physics B 581 (2000) 91-115, arXiv: hep-ph/0001206.

Book Chapters

- B1. N.L. Harshman, "Symmetry, Structure, and Emergent Subsystems," in *Quantum Worlds*, eds. Olimpia Lombardi, Sebastian Fortin, Cristian Lopez

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- P3. N.L. Harshman, "Introduction to Quantum Mechanics (3 Ed.)," American Journal of Physics 87 (2019), 237.
- P4. Nathan Harshman, "Structure and Symmetry in Geometry and Dynamics," De Physicus (Technical University Delft) 28 (2), (July 2017), pp. 54-56.
- P5. Matt Leifer and Nathan L. Harshman, "Quantum Mechanics Interpretation Survey: Point/CounterPoint," Quantum Times, Topical Group on Quantum Information, American Physical Society, September 2013.
- P6. Nathan L. Harshman, "Charting the path of our geometric knowledge," Chicago Tribune Books Section, March 19, 2007.
- P7. Nathan L. Harshman, "Crunching numbers--as well as lines, angles and shapes" Chicago Tribune Books Section, December 3, 2006.

Courses Taught:

Bridging the Two Cultures: Science and Literature (undergraduate, American U., 2012, 2013)
Classical Mechanics (undergraduate, American U. 2003, 2005, 2007, 2011)
Electromagnetism (undergraduate, American U., 2004)
Conceptual Physics (undergraduate, traditional and workshop style, U. Texas at Austin and American U., 1997-2001, 2010, 2015)
Group Theory in Quantum Mechanics (graduate, U. Trento, Aarhus U, 2006, 2017)
How Physicists Work (undergraduate, American U., 2012, 2019-2023)
Introductory Physics with Algebra (undergraduate, American U., 2004)
Introductory Physics with Calculus (undergraduate, Rice U. and American U., 2001-2008, 2011, 2012, 2014)
Introductory Physics Laboratories (with and without calculus, undergraduate, U. Texas at Austin and American U., 1995-7, 2004-2005, 2012)
The Material World/What is the Matter with Us? (undergraduate, American U., 2011, 2017-2022)
Physics Capstone Seminar (undergraduate, American U., 2012, 2015)
Quantum Computation (undergraduate, Rice U., 2003)
Quantum Mechanics (undergraduate, American U., 2005, 2013, 2014, 2016)
Waves and Optics (undergraduate, American U., 2005, 2007-2009, 2011, 2014, 2018, 2020-2023)

Selected Departmental, College and University Service:

2008-2009, 2012-2016 Chair of Department of Physics, College of Arts and Sciences, American University
2017-2020, 2022-2023

2022-2023 CAS Research Committee, College of Arts and Sciences, American University

2021-2023 CAS Capital Campaign Committee, College of Arts and Sciences, American University

2021-2022 Strategic Imperative 4 Workstream: Faculty-Student Rese

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2008-2009	Member of Faculty Senate Joint Committee on Curriculum and Academic Policy, American University
2008-2009	Member of Educational Policy Committee, College of Arts and Science, American University
2006-2008	Chair of Curriculum Committee of Department of Computer Science, Audio Technology, and Physics
2005-2007	Member of Educational Policy Committee – Curriculum Committee, College of Arts and Science, American University

Selected STEM Recruitment, Retention and Outreach

2022-2023	Member of Advisory Board for AU NSF IUSE Project: Enhanced Teaching and Learning Through Problem-Based Pedagogy (PI Carolyn Parker)
2018-2023	Co-founder and member, Initiative for STEM Education, Equity and Ethics.
2021	Co-organized "Preparing for Quantum Technology Education: A 21st Century Learning Challenge," STARBASE Hanscom AFB (virtual), May 2020.

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Contributed talk (co-authors E. Feder, S. Watkins, L. Weis, N.L. Harshman, A. Bentley, & K. Walters-Conte): "Creating an AU STEM Identity Embedded with Equitable and Inclusive Principles. In Ann Ferren CTRL Conference. American University, January 2023.

Invited talk: "Topology vs. Dynamics in One-Dimensional Anyons," Topology and Non-Equilibrium Dynamics, Max Planck Institute for the Physics of

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- DAMOP, Milwaukee, June 2019

Poster: “Anyons from Three-Body Hard-Core Interactions in One Dimension,” International Conference on Atomic Physics, Barcelona, Spain, July 2018

Invited seminar: “Hard-Core Few-Body Physics: Geometry, Symmetry and Topology,” Triangle Nuclear Theory Colloquium, Duke University, February 2018.

Invited Lecture: “Topology, Symmetry, and Control in Few-Body Configuration Space,” Critical Stability in Few-Body Systems, Max Planck Institute for Complex Systems, Dresden, October 2017.

Invited Lecture: “My Year of Researching Danishly: Geometry and Topology in Few-Body Systems,” Physics Department Colloquium, American University, August 2017.

Invited Lecture: “Symmetry, Solvability and Emergent Subsystems,” International Workshop: Identity, Indistinguishability and Non-Locality in Quantum Physics, Buenos Aires, June 2017.

Lecture: “Integrable families of hard-core particles with unequal masses in a one-dimensional harmonic trap,” Integrable Systems and Quantum Symmetries 25, Prague, Czech Republic, June 2017.

Invited Lecture: “Symmetry and Combinatorics for Identical Quantum Systems,” Quantum Math Seminar, University of Copenhagen, May 2017.

Invited Lecture: “Symmetry, Solvability and Integrability for Cold Atoms Trapped in One Dimension”

- Mathematical Physics Seminar, Department of Physics, Lund University, May 2017.
- Structure and Constituents of Matter Seminar, University of Barcelona, April 2017.

Lecture: “Solvable Models for a Few Atoms in a Few One-Dimensional Wells”

- Institute for Photonic Science (ICFO), Castelldefels, Spain, January 2017. (invited)
- Institute for Quantum Physics, Ulm University, Germany; December 2016. (invited)
- Institute for Theoretical Nuclear Physics,

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Invited Lecture: "Solvability, Symmetry and Information in Quantum Few Body Systems," Department of Chemistry, American University, November 2013.

Poster: "Symmetry, entanglement & privileged subsystems applied to few-body physics," Noise, Information and Complexity at the Quantum Scale, Erice, Italy, October 2013.

Lecture: "Books that Shaped America: Franklin's Experiments," AU Library, September 2013.

Lecture: "Observables, Entanglement and Subsystem Clustering in Few-Body Systems," Quantum Theory and Quantum Foundations, Linnaeus University, Växjö, Sweden, June 2013.

Invited Lecture: "Entanglement in a Few Cold Atoms," Johns Hopkins Applied Physics Laboratory, Laurel, Maryland, May 2013.

Poster (with B. Weinstein* and J. Uscinski): "Symmetries of Four Harmonically-Trapped Particles in One Dimension," APS March Meeting, Baltimore, March 2013.

Lecture: "Symmetry methods for harmonically trapped, interacting particles," APS March Meeting, Baltimore, March 2013.

Invited Lecture: "Physics Conceptual Assessments for Dummies," Harvard PER Mini-Conference, November 2012.

Invited Lecture: "Symmetries in a Quantum Three-Body Problem," Department of Mathematics and Statistics, American University, October 2012.

Invited Lecture: "Determinism, Entropy and Chaos in *Arcadia*," Annual Literature Department Colloquium, American University, October 2012.

Lecture: "Tailored Observables and Entanglement in the Quantum Two-Body System," 6th Conference on Quantum Theory: Reconsideration of Foundations, Linnaeus University, Växjö, Sweden, June 2012.

Poster (with N. Klingler*): "Entanglement in Quantum Harmonic Chains," APS March Meeting, Boston, March 2012.

Invited Colloquium: "Maximizing Information, Minimizing Correlation: I Come to Bury Entanglement, Not to Praise It," Valparaiso University, February 2012.

Invited Lecture: "Classical Correlations, Quantum Correlations, and Magical Correlations," Spring 2011 Info-Metrics Workshop, Info-Metrics Institute, American University, May 2011.

Invited Colloquium: "Entanglement is in the Observables of the Quantum Beholder," Department of Mathematics and Statistics, American University, April 2011.

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Lecture: "The consequences of space-time symmetries and time-asymmetric boundary conditions for entanglement in particle scattering," Quantum Theory and Symmetries 5, Valladolid, Spain, July 2007.

Lecture: "Entanglement in One-Dimensional Scatter," Workshop on Quantum Information Theory, Pedro Pascual Benasque Center for Science, Benasque, Spain, June, 2007.

Invited Lecture: "The Many Faces of Entanglement in Particle Collisions," Quantum Information/Bose-Einstein Condensate Talk Series, National Institute of Standards and Technology, March 2007.

Invited Lecture: "Entanglement of Particles, or 'Dude, Where's My Subsystem?'" Department of Mathematics and Statistics, American University, October 2006.

Lecture: "Tensor Product Structures, Entanglement, and Particle Scattering," 3rd Feynman Festival, University of Maryland, College Park, August 2006.

Invited Lecture: "Scattering, Entanglement, and Irreversibility," XXV Workshop on Geometric Methods in Physics, Białowieża, Poland, July 2006.

Lecture: "Symmetry Constraints for Entanglement in Non-relativistic, Elastic Particle Scattering," XXXVIII Symposium on Mathematical Physics: Quantum Entanglement and Geometry, Toruń, Poland, 2007.

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