James W Kennington

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Education

2020 - 2026 Ph.D. Physics, **The Pennsylvania State University**, University Park
Coursework includes: Classical Mechanics, Quantum Mechanics, E&M, GR, QFT
Intended Thesis Research: Low Latency Detection of Exotic Gravitational Waveforms

Summer 2024 Summer School on Quantum Gravity, **Florida Atlantic University**, Boca Raton
Coursework included: Spinfoams, Covariant LQG, Quantum Cosmology, and Quantum Gravity, QFT in Curved Spacetime, 3D Gravity and Quantum Groups.

Summer 2019 Summer School on Quantum Gravity, **Bard College**, Red Hook
Coursework included: Covariant LQG, Quantum Cosmology, Soft Modes and Quantum Gravity, QFT in Curved Spacetime, 3D Gravity and Quantum Groups.

2013 - 2015 B.S. Physics, **The University of Texas at Austin**, Austin
Departmental Honors | Major: Physics
Thesis: *Brownian Motion in a Non-Newtonian Fluid* | Advisor: Prof. Mark Raizen
GPA, IN-MAJOR GPA: 3.7/4.0

2011 - 2013 Physics Major, **United States Naval Academy**, Annapolis
Studied physics and mathematics curriculum and participated in research efforts in astrophysics and algebra.

Research Experience

2021 - Now Institute for Gravitation and the Cosmos, Penn State, University Park PA
Graduate Fellow, Hanna Research Group - PSU LIGO
Studied gravitational wave detection methods for compact binary coalescences and exotic sources. Contributed to next-generation pipeline designed for low-latency signal analysis. Implemented information-geometric techniques to improve template placement in bank generation, enhancing detection performance and efficiency.

2020 - 2023 Institute for Gravitation and the Cosmos, Penn State, University Park PA
Graduate Fellow, Bojowald Research Group
Studied causal dynamical triangulations using numerical simulations. Investigated gravitational coupling to a scalar field via a dilaton interaction and related phenomenology in 2D.

2019 - 2021 Institute for Theoretical Physics, Frierich-Schiller Universität, Jena DE
Research Collaborator, Steinhaus Research Group
Studied applications of tensor network renormalization to lattice gauge theory and spinfoam models of quantum gravity. Investigated high-performance algorithms for coarse graining in various bases, written primarily in Julia.

2013-2015 Center for Nonlinear Dynamics, University of Texas, Austin TX
Undergraduate Researcher, Raizen Lab
Researched brownian motion under various non-Newtonian fluid model assumptions. Assisted with atomic optics experiments, focused on the optical tweezing of micrometer-scale beads to understand short-timescale behavior transition of fluids. Also conducted exploratory work in nanofluid and graphene manipulation.

2014-2015 Directed Reading Program, University of Texas, Austin TX
Undergraduate Researcher, Department of Mathematics
Researched topics in graduate mathematics with a personal (then) graduate student mentor, Dr. César Garza. Research culminated in two 15-minute, AMS format talks explaining research to undergraduate peers. Topics researched include topology, category theory, smooth manifolds, and dynamical systems.

2011-2013 Gravitational Microlensing Lab, United States Naval Academy, Annapolis MD
Undergraduate Researcher, Morgan Lab

Researched the structure of quasars and the use of gravitational microlensing as a tool for resolving physical characteristics of active galactic nuclei. Responsible for reducing data and writing scripts to manipulate data obtained from U.S. Naval Observatory. Implemented perl and IRAF solutions resulting in significant error reduction in light-curve data. Supervised by Dr. Christopher Morgan.

Fall 2012 United States Naval Observatory, Flagstaff AZ
Undergraduate Researcher, Kaj-Strand Astrometric Reflector

Operated the 1.55-m Kaj Strand astrometric reflector telescope to take infrared images of several quasar systems. Participated in colloquia. Visited Navy Precision Optical Interferometer at Lowell Observatory.

Publications & Talks

Publications[1]

- †C. Hanna et. al. *Template bank for sub solar mass compact binary mergers in the fourth observing run of Advanced LIGO, Advanced Virgo, and KAGRA*, arXiv:2412.10951
- Y. Huang et. al. *Scalable matched-filtering pipeline for gravitational-wave searches of compact binary mergers*, arXiv:2410.16416
- S. Schmidt et. al. *Searching for asymmetric and heavily precessing Binary Black Holes in the gravitational wave data from the LIGO and Virgo third Observing Run*, arXiv:2406.17832
- The LIGO Scientific Collaboration et al., *Ultralight Vector Dark Matter Search Using Data from the KAGRA O3GK Run*, arXiv:2403.03004.
- S. Sakon et al., *Template Bank for Compact Binary Mergers in the Fourth Observing Run of Advanced LIGO, Advanced Virgo, and KAGRA*, arXiv:2211.16674.
- A. Ray et al., *When to Point Your Telescopes: Gravitational Wave Trigger Classification for Real-Time Multi-Messenger Followup Observations*, arXiv:2306.07190.
- The LIGO Scientific Collaboration et al., *Search for Eccentric Black Hole Coalescences during the Third Observing Run of LIGO and Virgo*, arXiv:2308.03822.
- L. Tsukada et al., Improved Ranking Statistics of the GstLAL Inspiral Search for Compact Binary Coalescences, Phys. Rev. D 108, 043004 (2023).
- B. Ewing et al., *Performance of the Low-Latency GstLAL Inspiral Search towards LIGO, Virgo, and KAGRA's Fourth Observing Run*, arXiv:2305.05625.
- The LIGO Scientific Collaboration et al., *Open Data from the Third Observing Run of LIGO, Virgo, KAGRA and GEO*.
- †C. Hanna et al., *A Binary Tree Approach to Template Placement for Searches for Gravitational Waves from Compact Binary Mergers*, Phys. Rev. D 108, 042003 (2023).
- †Jeevanjee, N., Kennington, J. *Solutions Manual for "An Introduction to Tensors and Group Theory for Physicists"*. 2019, Published electronically on Overleaf.
- Manickam, V., Grinaski, I., MacLeod, C., et al. *Optical Microlensing and Accretion Disk Structure in the Lensed Quasar SDSS 1520+530*. 2015, American Astronomical Society Meeting Abstracts, 225

Talks

- *Measuring Holes: Constructing Homology Groups from Chain Complexes and Comparisons with Homotopy Groups*, Mar. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *The objects of algebraic topology: Simplices, cells, Simplicial Complexes, CW Complexes, and Related Substructures*, Feb. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Fiber Bundles, Section, Bundle Homomorphisms, and the Soldering Form*, Nov. 2024, Mathematical Aspects of Physics Seminar, Penn State University

[1]First or second author papers indicated with †.

- *Vector Fields, Lie Groups, and Lie Algebras as Left-Invariant Vector Fields*, Oct. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Connecting Manifolds and Subspaces: Submersions, Immersions, Embeddings, and Maps of Constant Rank*, Sep. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Tangent Vectors as Derivations, Tangent Bundle, and Categorical Implications*, Aug. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Differential Geometry Applications in Cosmology: Homogeneity, Isotropy, and Petrov Classification*, Apr. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Introduction to Bundles and Fiber Bundles*, Apr. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *A Review of Smooth Functions and Partitions of Unity on Smooth Manifolds*, Mar. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Projective Groups and Quotients in Gauge Theory*, Mar. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Quotient Groups in Physics, including Symmetric Spaces, Projective Spaces, and Diffeomorphism Invariance*, Mar. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Smooth Structures on Topological Manifolds with Application to Surface Flatness Measurements*, Mar. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Measures of a Polygon's Convexity and Regularity with Applications to Covering Problem Algorithms*, Feb. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Riemann Tensor Symmetries and the Young Symmetrizer*, Feb. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Relationships between compactness and separability, a topological duality*, Feb. 2024, Mathematical Aspects of Physics Seminar, Penn State University
- *Elements of Information Geometry*, Aug. 2023. Primordial Universe and Gravity Seminar, Penn State University
- *Gravitational Wave Detection as a Covering Problem, with Relation to Sphere Packing*, Sep. 2022. Mathematical Aspects of Physics Seminar, Penn State University
- *Git Flow and Modern Code Contribution Patterns*, Mar. 2022. Institute for Gravitation and the Cosmos Technical Seminar, Penn State University
- *Unit Testing for Improved Code Quality*, Aug. 2021. Institute for Gravitation and the Cosmos Technical Seminar, Penn State University
- *Tensorial methods in optimization*, Nov. 2019. Annual Conference, Society of Industrial and Applied Mathematics, Texas-Louisiana Section, Dallas.
- *Lyapunov stability in dynamical systems*, May. 2014. Directed Reading Program Talks, Department of Mathematics, University of Texas at Austin.
- *Topological construction in the language of categories*, Dec. 2013. Directed Reading Program Talks, Department of Mathematics, University of Texas at Austin.

Scholarships & Awards

Scholarships

- 2020 - 2026 **Mildred Dresselhaus Science Achievement Graduate Fellowship in Physics**, given by the Eberly College of Science to recognize and promote outstanding graduate students seeking a doctoral degree in physics. Awards named in honor of an outstanding woman scientist or mathematician who not only made groundbreaking discoveries, but also blazed the trail for others who have followed in their footsteps.

- 2022 - 2025 **Nellie H. and Oscar L. Roberts Scholarship**, given by the Graduate School of the Pennsylvania State University for recognition as one of the most academically outstanding graduate students matriculating at the institution
- 2021 - 2022 **David H. Rank Memorial Physics Award**, given by the Graduate School of the Pennsylvania State University for recognition as one of the most academically outstanding graduate students matriculating at the institution
- 2020 - 2021 **Bert Elsbach Distinguished University Graduate Fellowship in Physics**, given by the Graduate School of the Pennsylvania State University for recognition as one of the most academically outstanding graduate students matriculating at the institution.
- 2020 - 2021 **University Graduate Fellowship**, given by the Eberly College of Science and the Graduate School of the Pennsylvania State University for academic excellence.
- 2014 **Ethel Gene Kahmer Endowed Scholarship**, usually given to graduate students in the College of Natural Sciences who have demonstrated leadership and shown interest in a career involving mathematics, physics, or chemistry.
- 2011 - 2013 **United States Naval Academy**, Department of Defense supplied full tuition and expenses as well as an undergraduate stipend.

Awards

- 2015. Honors Thesis Award, Department of Physics, University of Texas
- 2014. Honors Book Award, College of Natural Sciences, University of Texas *Chaos in Dynamical Systems*, Ott. | Awarded by Prof. Roger Bengtson
- 2013-2014 Dean's Scholar Program Membership, University of Texas
- 2012-2013. Dean's List Award, United States Naval Academy. Given for academic performance
- 2011-2012. Superintendent's List Award, United States Naval Academy, given for combined academic, physical, and military performance

Outreach & Service

Academic Service

2022 - Now — Founder and Co-Organizer, Mathematical Aspects of Physics Seminar Series **Pennsylvania State University**, University Park

Founded and organized a seminar series dedicated to deep-dives into the mathematics underlying modern theoretical physics. Managed sponsorship from the Physics Department, Math Department, and the Institute for Gravitation and the Cosmos. Topics discussed included group theory, Lie theory, smooth manifold theory and related structures, as well as research motivated details.

2020 - Now — Co-Webmaster, Physics and Astronomy Women + **Pennsylvania State University**, University Park

Modernized, reorganized, and updated the appearance of the club website. Supported ongoing club activities by implementing publicly-visible shared event calendars.

2020 - 2022 — Graduate Student Member, Physics Department Colloquium Committee **Pennsylvania State University**, University Park

Co-hosted a post-colloquium discussion segment between the graduate students and the colloquium speaker. Created pre-talk posters to improve engagement from graduate students and advertise the colloquium talks.

2013 - 2015 — Assistant Editor, Natural Sciences, **Texas Undergraduate Research Journal**, Austin

Interviewed various undergraduate and graduate researchers in the College of Natural Sciences. Reviewed submitted research papers from undergraduates and helped select the final papers to be accepted for publication.

Outreach Activities

2021 - 2022 Science Communication Course, **Penn State University**, Remote

Completed a 15-week course covering science communication and outreach topics, including preparing press releases for scientific advances, forming and executing lesson plans for a young general audience, and giving public talks that distill sophisticated topics into engaging material.

2021 Science Achievement Fellowship Annual Event, **Penn State University**, Remote

Prepared and co-hosted trivia rounds with information designed to highlight the role of women in the natural sciences. Specifically, topics included graduation rates in different fields, notable women scientists and their contributions, and other relevant data.

2020 - 2021 Wiki Scientist, **Wiki Education and American Physical Society**, Remote

Completed and immersive course on wikipedia training, including editing and contribution workflows, guidelines, and ethics. Personally edited over 50 pages in various scientific fields, including classical physics, relativity theory, and Lie algebra.

2014 - 2019 Guest Speaker, **Plano Independent School District**, Plano TX

Taught several invited class sessions to advanced students in 8th grade mathematics. Various topics included symmetries of permutation groups, elementary combinatorics, non-Euclidean spaces, and probability theory.

2011 - 2013 Astro-Kids Program, **United States Naval Academy**, Annapolis MD

Planned and lead multiple events per year for local children in grades 5-10 aimed at developing their interest in astronomy and astrophysics. Gave public-oriented talks on "high-interest" topics such as black holes, general relativity, galaxy formation, etc.

Industry & Leadership Experience

2014 - 2020 Quantitative Developer, **HBK Capital Management**, Dallas TX

Designed and implemented high-performance, deferred computation libraries in Python for heterogeneous computing environments. Conducted research into systematic currency trading, statistical arbitrage equity models, and various quantitative fixed-income models. Also contributed yield and credit spread curve models and calibration techniques in Python. Proposed thermodynamics-based portfolio optimization methodology.

2016 - 2019 Co-founder and Researcher, Poincaré Research LLC, Dallas TX

Built and operated deferred calculation framework in Python, experimenting with techniques from computational topology. Applied computational geometry to various problems in physics.

Teaching Experience

2021 - 2023, 2025 Graduate Teaching Assistant, **Penn State University**, University Park PA

Taught recitation and lab sections for introductory electricity and magnetism courses. Oversaw 200+ students, graded lab assignments and homeworks, and gave short lectures at the beginning of each section to motivate work. Received exemplary reviews from students.

Sum. 2013 Science Instructor, **Guthrie Gifted Education**, Plano TX

Developed and taught physics curriculum for summer program for students in grades 5 - 10. Primarily used demonstrations in mechanics, electricity and magnetism, and optics to introduce foundational physical concepts, such as conservation laws.

2011 - 2012 Undergraduate Teaching Assistant, **United States Naval Academy**, Annapolis MD

Conducted bi-weekly recitation sections for Mechanics I course, including answering questions from peers and completing sample exercises. USNA does not have a formal TA program; however, these activities were conducted with the explicit approval of Prof. Daryl Hartley.

Skills

Programming Languages	Python (advanced), Julia, Mathematica, C++, Bash, Rust
Scientific Python Packages	GstLAL, AstroPy, GWpy, LALsuite, NumPy, SciPy
Other Scientific Tools	LaTeX, Git, make, brew, Condor HTC, IRAF
Languages	English (fluent), French, Russian, German (elementary)

Memberships & Participation

Memberships

2017 - Now American Physical Society

2018 - Now American Mathematical Society

2016 - Now Society for Industrial and Applied Mathematics

2012 - Now The Planetary Society

Conferences Attended

Fall 2020 APS Eastern Section, *Pennsylvania State University - Virtual*, State College PA

Spring 2019 APS Texas Section, *Stephen F. Austin University*, Nacogdoches TX

Spring 2019 Texas Geometry and Topology Conference, *Texas Christian University*, Fort Worth TX