

Diana Forbes, PhD

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Education

University of Illinois Urbana-Champaign (UIUC) | Urbana, IL Physics PhD | 08/2025

Relevant coursework: mathematical methods of physics, quantum mechanics, quantum field theory, particle physics, and general relativity- 3.91 GPA

University of Illinois at Urbana-Champaign | Urbana, IL Physics Masters | 12/2023

Purdue University | West Lafayette, IN BS in Physics Honors and Mathematics | 05/2020

Relevant coursework: computational physics, mathematical methods of physics, calc 1-3, vector calc, linear algebra, differential equations, discrete math, probability, abstract algebra- 3.77 GPA

Research Interests

- Long-term research goal: To contribute to the reformulation of quantum field theory in an algebraic setting that extends or replaces the traditional Clifford algebra, aiming for a more coherent and broadly applicable mathematical formalism.
- Exploring extensions of the Standard Model through the design of novel search strategies for light, weakly coupled particles, with applications to proton beam dump experiments, fixed-target facilities, and precision spectrometers.

Publications

Forbes, D., Kahn, Y., and Nguyen, R. (2024). "Exotic particles at the DUNE near detector from charged pion scattering," *Phys. Rev. D* 110, 095029. <https://doi.org/10.1103/PhysRevD.110.095029>

- Outlined two searches which could be performed at Fermilab's DUNE near detector to look for millicharged particles or heavy axion-like particles.

Forbes, D., Herwig, C., Kahn, Y., Krnjaic, G., Mantilla Suarez, C., Tran, N., & Whitbeck, A. (2023). New searches for muonphilic particles at proton beam dump spectrometers. *Physical Review D*, 107(11), 116026.

<https://doi.org/10.1103/PhysRevD.107.116026>

- Proposed a novel search strategy for Fermilab's SpinQuest detector to look for a new scalar particle that couples to muons which could explain the discrepancy between the experimentally measured vs. theoretically calculated magnetic moment of the muon.

Research Experience

Graduate Research Assistant, UIUC (2020–2024)

- Conducted theoretical and computational particle physics research under the supervision of Dr. Yonatan Kahn, resulting in first-author publications in *Physical Review D*.
- Designed and implemented simulations of novel particle interactions using MadGraph and CalcHEP, incorporating modified Lagrangians to evaluate potential detection sensitivity.
- Collaborated closely with Fermilab experimentalists to calibrate simulation parameters to real detector conditions and translate theoretical models into testable experimental frameworks.
- Performed large-scale data analysis of particle 4-vectors with Mathematica and Python, applying advanced statistical cuts and optimization techniques to maximize experimental signal significance.
- Led the development of search strategies for millicharged particles and muonphilic scalars, producing quantitative sensitivity projections that informed ongoing experimental efforts.

Graduate Research, Independent Study with Dr. Helvi Witek, UIUC (2023)

- Explored numerical relativity tools by installing and running test simulations with the Einstein Toolkit, with a focus on superradiance of rotating black holes.

Undergraduate Researcher with Dr. Francis Robicheaux, Purdue University (2018 - 2019)

- Conducted computational physics research under Dr. Francis Robicheaux (Purdue University) in support of the ALPHA Collaboration's antihydrogen confinement experiments at CERN.
- Developed and optimized C-based simulation code to model magnetic fields in antihydrogen traps, enhancing reproducibility and computational efficiency.
- Implemented Runge–Kutta (RK4) and velocity Verlet integration algorithms to solve coupled differential equations governing particle trajectories in complex magnetic field geometries.
- Refactored and documented legacy C code to improve readability, structure, and maintainability, enabling clearer simulation workflows and supporting future researchers on the project.
- Analyzed simulation outputs to identify magnetic field configurations ("cuts") that maximized experimental signal while minimizing particle loss, contributing to trap optimization strategies.

Undergraduate Researcher with Dr. Nausheen Shah and Dr. James Osborne, Wayne State University (2018)

- Conducted undergraduate research in theoretical particle physics under Dr. Nausheen Shah and Dr. James Osborne, investigating spin-dependent WIMP dark matter models during a summer REU program.
- Developed and annotated Mathematica notebooks to verify quantum field theory calculations, ensuring accuracy and reproducibility of results.
- Maintained clear code structure and documentation, facilitating knowledge transfer and mentoring a successor to continue the project beyond the summer.
- Presented research findings to the REU cohort, receiving positive feedback from peers and faculty on clarity, rigor, and insight.

Teaching Experience

DePauw University | Greencastle, IN

Assistant Professor of Physics and Astronomy | 08/2025 - Present

- Designed and delivered calculus-based introductory physics lecture & lab course (PHYS 120).
- Created custom lecture examples, problem-solving activities, and supplemental group exercises to maximize student engagement and conceptual understanding.
- Implemented weekly low-stakes reading quizzes and posted graded homework to monitor progress and reinforce learning outcomes.
- Facilitated labs and data analysis sessions, guiding students through experiments, error analysis, linear regressions, and theory-to-experiment connections.
Coordinated with STEM Guides (teaching assistants) and held office hours to provide targeted academic support for diverse learners.
- Adapted course delivery for students with disabilities or distress via Zoom access, accommodations, and outreach to academic counselors.
- Fostered an inclusive, student-centered learning environment, promoting engagement, conceptual mastery, and equitable access to physics education.

Self-Employed

Private math tutor | 08/2016 - Present

- Delivered over hundreds of hours of online and in-person one-on-one instruction in Calculus, Probability & Statistics, and Linear Algebra, to high school and undergraduate students.
- Designed customized curricula, lesson plans, and assessments tailored to individual student needs, aligning with course objectives, learning styles, and institutional standards.
- Helped students achieve measurable gains in their academic performance on tests and final class grade.
- Integrated technology tools like Desmos graphing calculator and Mathematica to illustrate abstract concepts, run simulations, and reinforce theoretical understanding.
- Received positive feedback and repeat engagements from dozens of clients, with many referrals and continuing tutoring relationships over multiple semesters.

Parkland College | Champaign, IL

Lead Instructor & Course Coordinator – Physics (E&M) | 06/2025 - 07/2025

- Coordinated a team of five instructors to design and deliver an online Electricity & Magnetism summer course, ensuring alignment with the lead lecturer's expectations and course objectives.
- Provided structured instruction in vector calculus, ensuring students developed the mathematical fluency needed for rigorous engagement with upper-level physics coursework.
- Maintained the online gradebook and managed Cobra LMS settings, including granting special access and accommodations (e.g., extended exam time) to support diverse learners.

- Monitored online discussion boards in collaboration with teaching staff, scheduling coverage and responding to student questions on course material, labs, policies, and homework.
- Developed and co-authored exams with instructional staff, writing original physics problems and solution keys to assess conceptual understanding and problem-solving skills.
- Reviewed online proctoring flags (Respondus) to ensure academic integrity while supporting students during remote testing.
- Acted as a liaison between instructional staff and the lead lecturer, reporting issues, communicating expectations, and maintaining instructional quality across the team.

University of Illinois at Urbana-Champaign | Urbana, IL
Graduate Physics Teaching Assistant | 08/2020 - 05/2025

- Designed and delivered undergraduate physics instruction for groups of ~24 students, covering introductory physics, mathematical methods, special relativity, and group theory, using student-centered and active learning strategies.
- Facilitated interactive lectures, problem-solving sessions, and office hours; developed custom lesson plans, review sessions, and assessments to enhance student understanding and engagement.
- Collaborated with faculty to revamp the sophomore-level course “Special Relativity & Mathematical Applications”, including selecting new textbooks, creating problem sets and solution keys, and restructuring the syllabus to optimize learning outcomes.
- Monitored student progress and provided support through scaffolding and evidence-based teaching practices.
- Recognized by university leadership for excellence in teaching, mentorship, and research contributions, reflecting strong pedagogical and professional impact.

Technical Skills

- Python (Programming Language)
- R (Programming Language)
- C (Programming Language)
- LaTeX
- CalcHEP (Particle Event Simulation Software)
- MadGraph (Particle Event Simulation Software)
- Mathematica
- Monte Carlo Methods
- Detector design (fixed-target/beam dumps)
- Statistical Analysis
- Back of the Envelope Estimates
- Sensitivity Estimates

Community Presentations

Paper Writing Workshop at DePauw University

- Fall 2025
- Taught a group of undergraduate physics students how to write and format scientific physics papers. Reviewed basic information like writing abstracts, organization, formatting equations, LaTeX, and including references.

Seminar at DePauw University

- Spring 2025
- Discussed search strategies for new physics and summarized two novel Fermilab-based search strategies that I developed over the last several years to look for a new scalar particle in response to g-2 and to look for millicharged particles produced by charged pion scattering within a beam dump.

Seminar at Bucknell University

- Spring 2025
- Discussed the current status of the SpinQuest experiment I proposed with Fermilab collaborators to search for a muon-philic scalar particle in response to g-2.

Theoretical Minimums Seminar at University of Illinois at Urbana-Champaign

- Fall 2022

- Discussed a novel Fermilab-based search for a scalar particle whose coupling to the muon could explain the muon's anomalous magnetic moment (g-2).

Professional Development

Supporting Student Success: Executive Function, Behavior, and Neurodiversity — DePauw University, Spring 2026

- Completed training on recognizing and supporting neurodivergent learners in higher education
- Explored inclusive teaching strategies including growth-oriented feedback, transparent expectations, accessible course materials, and appropriate disability accommodations
- Developed approaches for flexibility in deadlines and communication to support executive functioning differences

Inclusive Pedagogy and Anti-Racist Teaching Workshop — DePauw University, Spring 2026

- Gained training in recognizing and effectively responding to microaggressions and race-related conflict in classroom settings.
- Learned systematic approaches to identify and address bias in curriculum.
- Discussed inclusive teaching practices that promote belonging and accessibility across diverse student identities, including race, culture, and neurodivergence.

AI in Higher Education Workshop — DePauw University, Fall 2025

- Participated in a semester-long professional development workshop focused on *Teaching with AI*.
- Engaged in 4+ hours of expert-led sessions exploring the impact of AI on pedagogy, research practices, academic integrity, creativity, and institutional policy development.
- Collaborated with faculty across disciplines to evaluate opportunities and challenges of integrating AI tools in teaching, scholarship, and student engagement.
- Applied insights to strengthen classroom practices, support ethical student use of AI, and inform policy conversations within the academic community.

Mentorship

- Minh (Mark) Mai- DePauw, Fall 2025
- Kenzo Massuda Palhares- DePauw, Fall 2025
- Sofia Vera- DePauw, Fall 2025
- Naoya Murakami- UIUC, Spring 2025
- Abhay Agarwal- UC Berkeley, Fall 2024
- Chinmay Ambasht- UIUC, Fall 2024
- Coda Tanquary- UIUC, Spring 2024
- Linnea Marsh- UIUC, Spring 2024
- Katherine Powers- UIUC, Fall 2023
- Cheryl Martinez- UIUC, Fall 2023
- Qinglan (Kenn) Yu- UIUC, Fall 2023
- Hannah Kittivanichkulkrai- UIUC, Spring 2023
- April Wu- UIUC, Spring 2023
- Katie Peterson- UIUC, Spring 2022
- Nicholas Tedesco- Wayne State University, Summer 2018

Community Engagement

- Society of Physics Students (SPS) Faculty Sponsor at DePauw University: Assisting the club by reserving rooms, setting up/tearing down for events, reviewing their budget and plans, advertising, and doing community outreach (Fall 2025 - current)
- Baja SAE Faculty Sponsor at DePauw University: Assisting the club by helping them build go-karts, fundraise, do community outreach, and more (Fall 2025 - current)
- Women in STEM Faculty Sponsor at DePauw University (Fall 2025 - current)
- Pre-Engineering Club Faculty Sponsor at DePauw University (Fall 2025 - current)
- McKim Observatory at DePauw: Helping the physics faculty by taking attendance at astronomy viewing nights several times a month, explaining the observatory artifacts and equipment to patrons of the observatory, recording talks for them, and digitizing projector slides to make a searchable online database for the public (2025 - current)
- Organizing monthly group hikes with DePauw undergraduate students at the DePauw Nature Park (2025 - present)

- Gummy Bear Explosion: Worked with a student to help her with a scholarship project. Helped her to understand how an engine worked, reviewing thermodynamics, mechanics, and combustion reactions with her. Carried out a combustion reaction involving sucrose and potassium chlorate under a fume hood in the chemistry department (Fall 2025)
- Participated in talks and meetings in Champaign Illinois' Fish Enthusiast group. Learned about newts, fishkeeping, and tank-related chemistry. (Spring 2023 - Fall 2025)
- Randolph St Community Garden: Grew beans, melons, tomatoes, and peppers for local food pantries. Helped others by pulling weeds, cleaning up trash, putting equipment away, and hauling compost (2020 - 2022)
- Participated in the Purdue Boilermaker Half-Marathon (2018)
- Participated in Purdue's Philharmonic Orchestra (2016 - 2020)
- Attended mass at St. Thomas Aquinas Church at Purdue and participated in a weekly Catholic apologetics club (2016 - 2020)

Interests

- Music Performance: Voice and Cello
- Chemistry
- Fish keeping: Raising and breeding shrimp
- Hiking
- Art: Acrylic Painting, Cross Stitching, Crocheting
- Baking and Cooking
- Astronomy
- Differential Geometry

Honors, Awards, and Fellowships

- Fellowship for Outstanding Research and Teaching (UIUC, Fall 2021)
- Kenneth S. and Paula D. Krane Physics Scholarship: awarded to an outstanding physics upperclassman (Purdue, 2017-18)
- David G. Seiler Scholarship: awarded to top upperclassman female in physics (Purdue, 2016-17)
- Presidential Scholarship (Purdue, 2016-20)
- Dean's List (Purdue, 2016-20)