

Joseph Rabara Bailey

Stanford University | Physics and Computer Science | josephrb@stanford.edu | (909) 664-3603
josephrbailey.com | github.com/josephbailey | linkedin.com/in/baileyjosephr

EDUCATION

Stanford University, Stanford, CA (Expected June 2027)

Coterminal B.S. in Physics and M.S. in Computer Science. Undergraduate cumulative GPA: 4.032; graduate cumulative GPA: 3.763.

- Selected advanced/relevant coursework: Natural Language Processing with Deep Learning, Machine Learning with Graphs, Deep Learning for Computer Vision, Information Theory, Theory of Computation, Cryptography, Real Analysis, General Relativity, Quantum Mechanics, Statistical Mechanics, and Scientific Communication in Physics.
- Autumn 2026 enrollment: Quantum Field Theory I, Theory of Probability I, Groups and Rings, Complex Analysis, Decision Making Under Uncertainty, Machine Programming, and Engineering AI Agents.

RESEARCH EXPERIENCE

Undergraduate Researcher, Stanford Physics, Prof. Benjamin Nachman (Stanford, CA | Winter 2026-Present)

- Machine learning-based unbinned unfolding for neutrino-nucleus cross section measurements: reproduced MINERvA's published double-differential muon-momentum cross section with an unbinned ML unfold (total-cross-section ratio 1.011; 95.6% of 205 bins within 10%) and built its uncertainty budget from 187 systematic universes plus statistical and ML components (6.87% median per bin).
- Extended the unfold to five simultaneous observables (adding available energy, three-momentum transfer and hadronic invariant mass); the central values pass closure checks, while uncertainty studies identified the background, regularization, coverage and seed limits that currently prevent a qualified five-dimensional measurement.
- Tested five event-generator predictions against the five-dimensional data with pseudo-experiment-calibrated hypothesis tests; directed AI agents and reviewed their validation tests. Funded by a 2026 Stanford VPUE Major Grant after external review.

Undergraduate Researcher, SLAC National Accelerator Laboratory, Prof. Ariel Schwartzman (Menlo Park, CA | June 2024-Jan. 2025)

- Generated 1,500,000 di-Higgs signal events for the XCC gamma-gamma Higgs factory in ROOT and Delphes; presented the work as a poster at the end-of-summer undergraduate research poster session.
- Characterized pileup at an average of 6.81 events per bunch crossing and produced the recommendation to remove all objects with $|\cos \theta| > 0.8$, suppressing pileup while preserving signal.

Research Intern, Caltech LIGO Lab, Dr. Gabriele Vajente (Pasadena, CA | June-July 2023)

- Authored LIGO technical note LIGO-T2300319v1, analyzing Gaussian beam interference to infer focal length; validated the method against a known 100.0 mm lens, recovering 98.3 mm.
- Built the analysis in Python: ABCD ray-transfer-matrix propagation, the complex beam parameter and Gouy phase, and image-based fringe-centroid detection from a single interference photograph.

PROFESSIONAL AND ENGINEERING EXPERIENCE

Product Management Intern, Digital Assets Team, WisdomTree (New York, NY | June-Aug. 2026)

- Researched the regulatory, market, custody, and client-experience questions behind WisdomTree's institutional tokenized-asset product, and co-built an internal prototype spanning product discovery, an operations workspace, and source-generated developer documentation.
- Built a diagnosis-first monitoring prototype that flags large on-chain redemptions and correlates cross-chain asset flows to give isolated transactions operational context.
- Produced the firm's competitor analysis on tokenized money market funds at the request of its President and COO, condensing a 36-slide study into a nine-slide comparison.
- Wrote an automated release check that ran before each version of the prototype, verifying generated documentation against its source, per-role data isolation, builds, and in-browser behavior; it caught regressions in three successive rounds.

Engineering Intern, Polytec (Pasadena, CA | June-Sept. 2023)

- Designed statistical tools for customers analyzing vibration data with Python, MATLAB, and Octave.

SELECTED TECHNICAL AND RESEARCH PROJECTS

SPLoRA: Parameter-Efficient Fine-Tuning of GPT-2 with LoRA

Trained 1.33M parameters, about 1% of GPT-2's 124M, to 0.873 test-set accuracy on QQP paraphrase detection (0.888 dev, within 0.6% of full fine-tuning); a LoRA configuration also beat our full fine-tuning baseline on sonnet generation at chrF 41.94 against 40.417.

Gaussian Process Bump Hunting

Built the signal-injection sensitivity study for a planned Jefferson Lab X17 search: a 9th-order background model and a mass-resolution parameterization over a background scaled to a 40-day run, adapting pyBumpHunter for a sideband-free search. Presented at the 2025 APS Far West Section Annual Meeting.

AM CVn Time-Series Photometry

Reduced a 138-frame, 111.12-minute V-band run on the Stanford Student Observatory 0.7 m telescope: bias, dark and flat calibration, differential aperture photometry against six AAVSO comparison stars, and Lomb-Scargle period analysis. Recovered AM CVn's positive

superhump at 1050.05 ± 6.7 s (published value 1051.2 s), and reported the 111-minute baseline as too short to improve existing constraints.

LoRD: Video Person Re-Identification with LoRA-Adapted Vision Transformers
Three-person study of which components drive tracklet retrieval on MARS using self-supervised DINOv2 backbones; contributed the training architecture and the evaluation and plotting infrastructure. LoRA adapters on the DINOv2 MLP layers with mean pooling raised mAP from 1.8 zero-shot to 76.7 (80.6 Rank-1) while training 2.6M parameters, and a 12.6M-parameter learned temporal transformer head failed to beat mean pooling, locating the bottleneck in per-frame representation quality rather than temporal reasoning.

Cryptography and Smart Contract Systems
Built an end-to-end encrypted messenger implementing the Double Ratchet over Diffie-Hellman with HKDF chain keys, AES-GCM, and ECDSA certificate verification; a password manager using PBKDF2 derivation, HMAC-blinded domain lookup, and AES-GCM with domain binding against swap and rollback attacks; and a Solidity and Foundry wallet with ETH and ERC-20 transfers, m-of-n multisig, and an Aave integration.

Pintos Operating System Kernel
Built out an instructional x86 kernel in C with a three-person team across four projects: priority donation and multi-level feedback queue scheduling; user processes and the full system call table; virtual memory with a supplemental page table, clock eviction, swap, and memory-mapped files; and a file system with a write-behind buffer cache, indirect indexing with file extension, and subdirectories.

PRESENTATIONS, GRANTS, AND RESEARCH OUTPUTS

- Presenter, “Gaussian Process Regression-Based Bump Hunting in Future Searches for the X17 Boson,” APS Far West Section Annual Meeting, University of California, Santa Cruz, 12 October 2025.
- Presenter, “Multidimensional, unbinned cross section measurement with MINERvA data,” MINERvA Collaboration meeting, 16 July 2026.
- Presenter, high-dimensional unbinned unfolding results, Nachman group meeting, Stanford/SLAC, September 2026.
- Manuscript in preparation for Physical Review D (with B. Nachman): “Multidimensional unbinned unfolding of MINERvA inclusive charged-current neutrino data: validation and calibrated model tests.” Honors thesis in progress.

AWARDS AND HONORS

- Stanford Track and Field Heart and Hustle Award, 2025.
- All-ACC Academic Team: Indoor (2026) and Outdoor (2025).
- National Merit Finalist; ACS U.S. National Chemistry Olympiad National Finalist.
- Music Teachers' Association of California Certificate of Merit, Piano Level 10; State and Branch Honors.
- Black Belt in Karate.

LEADERSHIP, ATHLETICS, SERVICE, AND MUSIC

Student-Athlete, Stanford Track and Field, NCAA Division I (*Stanford, CA | Jan. 2024-Present*)

- Hurdler and sprinter, primarily the 400-meter hurdles; on Stanford's all-time top-10 list for the indoor 4x400-meter relay. Train more than 20 hours per week and travel to compete in the majority of weeks across winter and spring quarter.

Undergraduate Representative, Physics Department Undergraduate Studies Committee (*Stanford, CA | Sept. 2025-June 2026*)

- Served as the undergraduate voice on the department committee shaping the physics curriculum, course offerings, and advising; met monthly to review the undergraduate program and propose improvements.

Dorm Co-President, Stanford Freshman Dorm (*Stanford, CA | Sept. 2023-June 2024*)

- Helped lead a 90-person dorm community through weekly meetings, event planning, peer engagement, and community standards.

Musician, Stanford Jazz Orchestra & Combos; Certificate of Merit Level 10 classical piano (*Stanford, CA | 2023-Present*)

- Performed alto saxophone, flute, and clarinet in Stanford's top jazz ensemble; classically trained pianist and self-taught flute, clarinet, and soprano saxophone.

TECHNICAL SKILLS

Area	Tools and Methods
Programming	Python, C/C++, Java, JavaScript, Solidity, MATLAB, Octave
Machine Learning	PyTorch; CNNs, vision transformers, LLMs; LoRA; graph neural networks; OmniFold; Gaussian processes
Physics and Data Analysis	ROOT, Delphes, detector simulation, unfolding, differential photometry, bias/flat-field correction, periodograms, error propagation, covariance analysis, high-performance Unix computing

RESEARCH INTERESTS

- AI for fundamental science; scientific machine learning; particle and neutrino physics; uncertainty quantification; interpretable statistical inference; secure systems.