Nathaniel Selub
Berkeley, CA
https://nathanielselub.com
nathanielselub@berkeley.edu
(954) 895-4718

Education

The University of California, Berkeley
Ph.D. in Physics — August 2024 - Present

The University of Chicago
B.S. in Mathematics with Honors, B.A. in Physics with Honors — June 2024
GPA: 3.86/4.00 (*cum laude*)
Graduate Coursework: Advanced Classical Mechanics; Advanced Electrodynamics I - II; Advanced Mathematical Methods in Physics; Advanced Quantum Information and Computation; Analysis I: Measure Theory and Functional Analysis; Analysis III: Complex Analysis, Measure-Theoretic Probability, and Conformally Invariant Stochastic Processes; Geometry and Topology I: Algebraic Topology; Geometry and Topology II: Differential Topology; Mathematics of Quantum Computing; Physics of Computation; Quantum Field Theory I - II - III; Quantum Mechanics I - II; Random Matrix Theory; Statistical Mechanics; Stochastic Calculus

Awards and Honors

National Science Foundation Graduate Research Fellowship — 2024
- Reviewer feedback: "This proposal is the best one I reviewed."

Hertz Fellowship Finalist — 2024
- Selected as one of 45 finalists for the Hertz Fellowship from a pool of over 860 applicants.

Phi Beta Kappa — 2024
Churchill Scholarship Nominee — 2023
- Selected as the University of Chicago's campus nominee to apply for the Churchill Scholarship.

Selove Prize Summer Research Scholarship — 2023
- Awarded to outstanding physics undergraduates by the University of Chicago Physics Department to support summer research.

Student Marshal — 2023
- Awarded for academic excellence and contributions to the campus community. Highest honor awarded to undergraduate students by the University of Chicago. Granted to less than 1% of all undergraduates.

Astronaut Scholarship Nominee — 2023
- Selected as one of the University of Chicago's two campus nominees to apply for the Astronaut Scholarship.

Quad Undergraduate Research Scholar (3x) — 2021, 2023, 2023
Enrico Fermi Institute Summer Research Fellowship (2x) — 2021, 2022
Dean's List — 2022, 2023
National Merit Scholar — 2019

Research Experience

The University of Chicago, Department of Physics
Supersymmetric Particle Phenomenology Research — June 2023 - June 2024
Advisors: Professor David Miller and Assistant Professor Keisuke Harigaya
Constructed supersymmetric effective field theories of axions, a hypothetical new particle that can solve the Strong CP Problem in the Standard Model of Particle Physics, and axinos, a hypothetical particle that is a candidate for dark matter. Utilized analytical and computational methods to constrain their properties and derive observable signatures of these particles, facilitating their potential detection at colliders.

The University of Chicago, Department of Mathematics
Topology and Graph Theory Research June 2022 - June 2024
Advisor: Dr. Michael Klug
Studied the computational complexity of foundational constructions in 3-manifold topology. Attempted to determine the existence of the Conway 99-Graph by encoding the question of its existence as an instance of a Boolean satisfiability problem that can then be solved using computational methods.

The University of Chicago, Department of Mathematics
Research Experience for Undergraduates (REU) June - August 2022, 2023
Advisor: Dr. Michael Klug
2022: Studied Riemann surfaces, Riemannian geometry, and the spectrum of the Laplacian. Wrote an expository paper on a proof of the uniformization theorem for surfaces with Riemannian metrics. 2023: Studied Conway's 99-Graph Problem. Wrote an original paper on how it can be efficiently encoded as a Boolean satisfiability problem.

The University of Chicago, Department of Physics
Vortex Dynamics Research April - December 2022
Advisor: Professor William Irvine
Analyzed the efficiency of energy transported and the ratios of mass, energy, and vorticity carried by vortex structures using theoretical methods. Simulated dynamics of systems of point vortices.

The University of Chicago, Kavli Institute for Cosmological Physics
Cosmology Research March 2020 - June 2024
Advisors: Professors Craig Hogan and Stephan S. Meyer
Derived constraints on angular correlations in the cosmic microwave background (CMB) based on hypothesized properties of quantum gravity. Designed high performance algorithms to analyze satellite maps of the CMB to detect novel physical symmetries. Created testable hypotheses based on theoretical predictions from a new holographic model of cosmology.

Publications, Presentations, and Expository Writing

Causal Boundaries of Cosmological Angular Correlation
C. Hogan, O. Kwon, S. S. Meyer, **N. Selub**, F. Wehlen (Alphabetical co-first authorship)
arXiv:2312.16147 (Submitted to Class. Quantum Grav.)

Angular Spectrum of Quantum Fluctuations in Causal Structure
C. Hogan, O. Kwon, and **N. Selub** (Alphabetical co-first authorship)
Phys. Rev. D 109, 123505 (June 2024)

Angular Correlations on Causally-Coherent Inflationary Horizons
C. Hogan, S. S. Meyer, **N. Selub**, and F. Wehlen (Alphabetical co-first authorship)
Class. Quantum Grav. 40 165012 (July 2023)

Conway's 99-Graph Problem: A Boolean Satisfiability Approach
Original paper written during the 2023 University of Chicago Mathematics REU
Available at: `https://math.uchicago.edu/~may/REU2023/REUPapers/Selub.pdf`

Uniformization of Surfaces with Riemannian Metrics by Extremizing Determinants of Laplacians
Expository paper written during the 2022 University of Chicago Mathematics REU
Available at: `https://math.uchicago.edu/~may/REU2022/REUPapers/Selub.pdf`

Measurements of Holographic Symmetries in CMB Temperature Fluctuations
Presented at the University of Chicago Undergraduate Research Symposium (May 2022)

Anomalies of Cosmic Anisotropy from Holographic Universality of Great-Circle Variance
N. Selub, F. Wehlen, C. Hogan, and S. S. Meyer
Class. Quantum Grav. 39 075016 (March 2022)