

Gage Siebert

gsiebert@asu.edu + Website + Github + 1(920)479-0231

EDUCATION

Arizona State University

8/22-Present

PhD Candidate in Astrophysics

Advisor: Sara Walker, NSF Fellow

University of Wisconsin-Madison

9/18-5/22

Bachelor of Science in Physics and Mathematics

GPA of 3.837/4.0.

RESEARCH EXPERIENCE

PhD Thesis

8/22-Present

ASU: Algorithmic Complexity

Formalizing and characterizing interpretable substrate-specific languages of computation. Developing software to make complexity theoretic analyses with these languages accessible. Applied these methods to identify and characterize hierarchical structure in biological systems.

Secondary Graduate Student Project

11/22-12/24

ASU: Testing the Born Rule

Most models in physics, including quantum mechanics, use numbers drawn from the continuum. However, since we cannot physically construct an infinite continuum, some are motivated to find alternative theories. I designed and executed a search for observational signatures of such an alternative theory using LIGO data.

Undergraduate Researcher

1/20-9/22

UW-Madison: NASA's EXCLAIM Mission

Modeled the optical system of NASA's EXperiment for Cryogenic Large-Aperture Intensity Mapping (EXCLAIM), a balloon-borne microwave telescope. Designed and performed electromagnetic simulations and diffractive analysis on campus supercomputer.

Undergraduate Researcher

3/19-8/22

UW-Madison: Tianlai Array

Simulated Tianlai dishes to understand beam pattern. Created assays of the interferometer's data classifying radio frequency interference and other systematics. Lead the Tianlai Periodicity Search (TPS): a novel untargeted search for astronomical radio sources with periods ranging from minutes to hours, using more than 200 days of data.

Summer Intern

5/19-8/19

Arecibo Observatory: Single-Pulse Analysis of Millisecond Pulsars

Observed the millisecond pulsars with the late Arecibo telescope. Developed and performed statistical single pulse analyses of the pulsars to study their stability.

Undergraduate Researcher

9/18-5/19

UW-Madison: Origin of Life Project

Ran experiments that mimic the chemistry of early Earth to replicate the origin of life. Imaged chemical growths using a Scanning Electron Microscope (SEM). Created population simulations to model observations.

PUBLICATIONS

- “Using Semantics to Select Reference Machines” **Siebert, G.**, Walker, S., 2026 (In Preparation)
- “Assembly Spaces as a Basis for Physical Complexity” **Siebert, G.**, Walker, S., 2026, (In Preparation)
- “Assembly Spaces: Formal Definitions and Fast Methods for Approximating Assembly Indices” **Siebert, G.**, Chowdhury R., Slocombe L., Walker S., 2026, arXiv.org/abs/2606.15499
- “Practical Assembly Theory, Including Protocols, and a Python Toolkit” Slocombe, L., **Siebert, G.**, *et al.*, 2026, (Under Review at Nature Protocols)
- “A Firefly-inspired Model for Deciphering the Alien” Brooks C., Janin E., **Siebert G.**, *et al.* 2025, arxiv.org/abs/2511.06139
- “Rapid Exploration of the Assembly Chemical Space of Molecular Graphs” Seet, I., Patarroyo, K. Y., **Siebert, G.**, *et al.* 2025, Jcim doi.org/10.1021/acs.jcim.5c01964
- “Single-Pulse Studies of Three Millisecond-Pulsars” Palliyaguru, N. T., Perera, B. B. P., McLaughlin, M. A., Osowski, S., **Siebert, G.**, 2023, MNRAS doi.org/10.1093/mnras/stad194
- “Experiment for Cryogenic Large-Aperture Intensity Mapping: Instrument design” Switzer, E., *et al.* 2021, JATIS doi.org/10.1117/1.JATIS.7.4.044004
- “The Tianlai Dish Pathfinder Array: design, operation and performance of a prototype transit radio interferometer” Wu, F., *et al.* 2021, MNRAS doi.org/10.1093/mnras/stab1802
- “Modeling the Optical System of NASA’s EXCLAIM Mission” **Siebert, G.**, *et al.* 2022, Proceedings of the Wisconsin Space Conference doi.org/10.17307/wsc.v1i1.351
- “Optical design of the EXperiment for Cryogenic Large-Aperture Intensity Mapping (EXCLAIM)” Essinger-Hileman, T., Oxholm, T., **Siebert, G.**, *et al.* 2020, SPIE doi.org/10.1117/12.2576254
- “Overview and status of EXCLAIM, the experiment for cryogenic large-aperture intensity mapping” Cataldo, G., *et al.* 2020, SPIE doi.org/10.1117/12.2561069

ACADEMIC AWARDS AND SCHOLARSHIPS

IPAM Travel Funding (2024): Funding to attend a Mathematics of Intelligences workshop entitled Theory and Practice of Deep Learning

NSF Graduate Research Fellowship (2022, \$138,000): Recognizes and supports outstanding graduate students in STEM disciplines.

Goldwater Scholarship (2021, \$7,500): One of 409 selected nationally based on scientific, mathematic, and engineering achievement.

Astronaut Scholarship (2021, \$15,000): One of 60 scholars selected nationally, primarily on the basis of graduate-level research achievement.

Wisconsin Space Grant Consortium Research Grant (2021, \$4,000): Awards research support to create and implement a research study of the student’s design.

Hilldale Undergraduate/Faculty Research Fellowship (2021, \$3,000): Research Fellowship to support undergraduate research done in collaboration with UW-Madison faculty.

Hagengruber Scholarship (2021, \$2,000) Awarded to an undergraduate Wisconsin resident that shows exceptional promise for a future in physics.

Wisconsin Space Grant Consortium Scholarship (2021, \$2,000): Awarded to outstanding undergraduate students who are pursuing space-related studies.

Liebenberg Family Research Award (2020, \$3,000): Awarded annually based on merit to a junior majoring in Physics.

Henry and Eleanor Firminhac Physics Award (2019, \$2,000): Awarded for quality of physics course work and financial need.

Kemper K. Knapp Scholarship (2018): Awarded to incoming freshman based on academic merit.

Arnold P. Stamm Scholarship (2018): Awarded to top students of graduating class.

Manawa Lodge Scholarship (2018): Awarded based on academic merit.

PRESENTATIONS

“Computer Languages and the Physical World”, Seminar, 2026, Santa Fe Institute
“Using Semantics to Select Reference Machines”, Talk, 2026, Third Symposium on Machine Learning and Algorithmic Information Theory
“Mapping the Space of Programming Languages”, Talk, 2026, Diverse Intelligences Summer Institute
“Avoiding Agnosticism: When Can a Threshold for Life be Meaningfully Defined?”, Talk, 2026, AbSciCon
“Alien Life: Will We Know It When We See It?”, Invited Talk, 2025, ASU
“Abiotic Limits in Assembly Theory”, Talk, 2024, ALIFE Conference
“Randomly Sampling Assembly Paths”, Accepted Talk (Declined), 2024, SIAM Discrete Math Conference
“Why Assembly Theory”, Talk, 2024, Santa Fe Institute Summer School
“String Assembly”, Talk, 2023, Astrobiology Graduate Student Conference
“The Tianlai Array, a radio cosmology experiment”, Invited Talk, 2022, Madison Astronomical Society
“Constraining the Expansion of the Universe by Mapping Neutral Hydrogen”, Talk, 2021, Astronaut Scholar Technical Conference
“Modeling the Optical System of NASA’s EXCLAIM Mission”, Talk, 2021, Wisconsin Space Conference
“Tianlai Periodicity Search”, Talk, 2021, UW-Madison Physics Department Board of Visitors
“Multifrequency Single-Pulse Study of Millisecond Pulsars”, Poster, Siebert, G. L., Palliyaguru, N. T., & Perera, B. B. 2020, American Astronomical Society Meeting Abstracts #235
“Multifrequency Single-Pulse Analysis of Millisecond Pulsars”, Talk, 2019, Arecibo Observatory

SOFTWARE EXPERIENCE

Python, Slurm, Latex, Mathematica, Linux/Unix, HTCondor, MATLAB, CST, HTML