





# Matthew Scoggins

## Contact

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## About Me

I am a third-year PhD Student in the Department of Astronomy at Columbia. My research interests span most areas of computational astrophysics and cosmology. Specifically, I am interested in questions involving supermassive black holes, the early universe, and Population III stars.

## Matthew T. Scoggins Education

2021– **PhD** Astrophysics Columbia University, New York, NY  
2015–2020 **BS** Physics, Math, **BA** Philosophy Western Washington University, Bellingham WA

## Positions

2021– **Graduate Researcher** Columbia University, New York, NY  
– Supermassive star formation and their role in seeding supermassive black holes  
– Learning the Universe: Using machine learning to accelerate forward modeling of cosmological simulations  
– Observable consequences of the heavy seed origin for supermassive black holes  
– SETI: Numerical investigations of star-lifting, identifying observable features of star-lifting  
– Advised by Zoltan Haiman, Greg Bryan, David Kipping  
2021-2023 **Graduate Teaching Assistant** Columbia University, New York, NY  
– Spring 2023: TA for Astro I Lab  
– Fall 2022: Observational TA for Astro I Lab  
– Spring 2022: Astrophysics II for Mary Putman  
– Fall 2021: Another Earth for Caleb Scharf  
2015–2021 **Undergraduate Researcher** Western Washington University, Bellingham, WA  
– Projects on machine learning applied to astronomy, flare cycles, quantum dynamics, and quantum foundations.  
– Developed 2 open source simulators, **no\_wave\_qm** which simulates a no-wave approach to QM and **qubit\_simulation** which applies Monte-Carlo methods to find paths which optimally prepare a desired state.

## Honors & Awards

2023-2024	<b>Explore Computing Time: 400,000 CU</b>	ACCESS
2022-2023	<b>Edith and Robert Fehr Fellowship</b>	Columbia U.
2020	<b>Magna Cum Laude in both BS &amp; BA</b>	WWU
2019	<b>Material Science Undergraduate Research Grant</b>	WWU
2018-2019	<b>Oscar Edwin Olson Scholarship (x2)</b>	WWU
2018	<b>Willard A. and Anne W. Brown Astronomy Scholarship</b>	WWU
2018	<b>Summer Student Research Stipend</b>	WWU

## Software

- star\_lifting**      **Repository**  
– A MESA wrapper which evolves the star with a time-depended mass loss rate, keeping flux on a habitable planet constant.
- qubit\_simulation****Repository**  
– Simulating the evolution of a superconducting chip with the goal of finding patterns in the optimal protocols (values of the controls over time which evolve an initial state into a target state in the shortest possible time) over a variety of initial and target combinations.
- no\_wave\_qm**      **Repository**  
– Simulating the evolution according to a hamilton-jacobi formulation of QM which replaces the wave with a configuration space density and equations of motion. Trajectory tracking using a 4-th order Runge Kutta technique.

## Outreach & Press

- 2022      **Lazarus Stars - Extending Stellar Lifespans by Billions of Years**      Youtube
- 2023      **Could reducing the Sun's mass stop it destroying Earth in the future?** BBC Sky at Night
- 2023      **Aliens Could Build Massive Megastructures to Save Dying Stars**      Inverse
- 2022      **Introduction to Computational Astronomy**      Online

## Teaching & Service

- 2023      **Journal Reviewer:** ApJ
- 2023-      **Associate Director:** Science Research Mentoring Program      Columbia University
- 2021-2023      **Graduate Teaching Assistant**      Columbia University
- 2020-2021      **Mathematics Teaching Assistant**      WWU
- 2017-2020      **Physics Teaching Assistant**      WWU  
– Responsible for facilitating/grading a section of the weekly lab for Physics w/ Calc 161-163, 220, and Tools and Data Analysis 322
- 2019      **Student Faculty Hiring Committee**      WWU
- 2018-2019      **Physics Study Group Facilitator**      WWU  
– Responsible for creating content and leading a 2 hour weekly study group for Physics w/ Calc 161-163
- 2018-2019      **Math Tutoring Fellow**      WWU  
– Responsible for tutoring a majority of the undergraduate math classes, Calculus I up to Intro. to Abstract Algebra.

## Mentoring

2023 **Undergraduate Students**  
– Andrea Dubbels - Abnormal Photometry in the GAIA DR3 Catalog (in prep)

2023 **High School Students**  
– Students took part in 2-12 month projects designed to expose them to astrophysics and research skills. Some projects have been (or will be) submitted to high school journals.  
– Junhao Lei - A review of dark matter (accepted, International Journal of High School Research)  
– Iulia Achim - Exploring the potential for habitability around a black hole (under review, Journal of Emerging Investigators)  
– Estefania Olaiz - A new triple star system (in prep).  
– Pratham Aggarwal - The origins of supermassive black holes (in prep)  
– Jiarui Shi - Could Earth's transit be detected by known exoplanets? (in prep)  
– Hiep Duc Nguyen - "missing mass" and the need for dark matter  
– Jai Nair - The search for biosignatures  
– Weibo Qin - Do astrological signs correlate with personality?  
– Elenes Diana - A review of black hole vs. host galaxy relations  
– William Li - Using ML to predict Solar Cycles

## stats Publications

Total Pubs **9**  
First Author **7**  
Citations **46**  
h-index **3**

- **Scoggins, M. T.**, Ho, M., Bryan, G., Modi, C., & Doerer, L., 2024, [Correcting halo catalogs generated from a field-level emulator](#), (in prep)
- **Scoggins, M. T.**, & Kipping, D., 2024, [Lazarus Stars: Searching for signs of engineered stars in the Milky Way](#), (in prep)
- 1 **Scoggins, M. T.**, & Haiman, Z., 2023, [Diagnosing the Massive-Seed Pathway to High-Redshift Black Holes: Statistics of the Evolving Black Hole to Host Galaxy Mass Ratio](#), arXiv:2310.00202
- **Scoggins, M. T.**, & Kipping, D., 2023, [Lazarus Stars: Numerical Investigations of Stellar Evolution With Star-Lifting as a Life Extension Strategy](#), MNRAS, **523**, 3251
- Roser, P., & **Scoggins, M. T.**, 2023, [Non-Quantum Behaviors of Configuration-Space Density Formulations of Quantum Mechanics](#), arXiv:2303.04959
- 7 **Scoggins, M. T.**, Haiman, Z., & Wise, J., 2023, [How Long Do High Redshift Massive Black Hole Seeds Remain Outliers in Black Hole Versus Host Galaxy Relations?](#), MNRAS, **519**, 2155
- **Scoggins, M. T.**, & Rahmani, A., 2021, [Topological and Geometric Patterns in Optimal Bang-Bang Protocols for Variational Quantum Algorithms: Application to the X X Z Model on the Square Lattice](#), Physical Review Research, **3**, 43165
- 34 Olney, R., Kounkel, M., Schillinger, C., **Scoggins, M. T.**, et al., 2020, [APOGEE Net: Improving the Derived Spectral Parameters for Young Stars Through Deep Learning](#), AJ, **159**, 182
- 4 **Scoggins, M. T.**, Davenport, J., & Covey, K., 2019, [Using Flare Rates to Search for Stellar Activity Cycles](#), Research Notes of the American Astronomical Society, **3**, 137

## Selected Talks

[Lazarus Stars: Numerical investigations of stellar evolution with star-lifting](#), Astronomy on Tap, Penn State, June 20, 2023

[How long do high redshift massive black hole seeds remain outliers in black hole versus host galaxy relations?](#), AAS Winter 2023, Seattle, WA, January 13, 2023

[Lazarus Stars](#), Pizza Lunch Talk, Columbia University, November 01, 2022

[Lazarus Stars: Numerical investigations of stellar evolution with star-lifting](#), NASA's Technosignature Seminar Series, Online, October 19, 2022

The DCBH formation mechanism for supermassive black holes, Pizza Lunch Talk, Columbia University, December 01, 2021

Simulating Strongly Correlated Fermions and Spins with an Optimally Controlled Superconducting Device, American Physical Society, WWU, June 01, 2019

Simulating Strongly Correlated Fermions and Spins with an Optimally Controlled Superconducting Device, WWU Physics Symposium, WWU, May 01, 2019

Applying Deep Learning to Improve Stellar Parameters from APOGEE spectra, WWU Physics Symposium, WWU, May 01, 2019