

# Noah Wolfe

✉ newolfe@ncsu.edu • 📞 (704) 998-1322 • 🌐 @noahewolfe • 🐦 @noahewolfe

## Education

Aug 2018 - May 2022 **Physics B.S.; Mathematics B.S.**  
*NC State* With graduate-level Cosmology, General Relativity, & Computational Physics courses.

from Sept 2022 **Physics Ph.D. (committed)**  
*MIT* Planning to study gravitational-wave astrophysics under Professor Salvatore Vitale in the LIGO Astrophysics Lab at the Massachusetts Institute of Technology.

## Research

### Publications

**Wolfe, N. E., Fröhlich, C., et al. (2022).** *Gravitational Wave Eigenfrequencies from neutrino-driven core-collapse supernova. Manuscript in preparation.*

Meskhi, M. M., **Wolfe, N. E.**, Dai, Z., Fröhlich, C., Miller, J. M., Wong, R. K., & Vilalta, R. (2022). A New Constraint on the Nuclear Equation of State from Statistical Distributions of Compact Remnants of Supernovae. [arXiv preprint arXiv:2111.01815](#). (Accepted to [The Astrophysical Journal Letters](#))

Ghosh, S., **Wolfe, N.**, & Fröhlich, C. (2022). PUSHing Core-collapse Supernovae to Explosions in Spherical Symmetry. V. Equation of State Dependency of Explosion Properties, Nucleosynthesis Yields, and Compact Remnants. *The Astrophysical Journal*, 929(1), 43. [arXiv:2107.13016](#)

Curtis, S., **Wolfe, N.**, Fröhlich, C., Miller, J. M., Wollaeger, R., & Ebinger, K. (2021). Core-collapse Supernovae: From Neutrino-driven 1D Explosions to Light Curves and Spectra. *The Astrophysical Journal*, 921(2), 143. [arXiv:2008.05498](#)

### Presentations

**Wolfe, N. E.**, Golomb, J., Ghosh, S., Talbot, C., Fröhlich, C. "Physics in the Stellar Graveyard," McCormick Research Award Colloquium, Raleigh, NC, May 2022 (Talk) [Slides](#)

**Wolfe, N. E.**, Golomb, J., Talbot, C. "Testing General Relativity with Gravitational Wave Signals," LIGO SURF 2021 Final Presentations, Pasadena, CA, August 2021 [Slides](#)

**Wolfe, N. E.**, Curtis, S., Ghosh, S., Fröhlich, C. "Characterizing Gravitational Wave Signals from Core-Collapse Supernovae," McCormick Undergraduate Research Symposium, Raleigh, NC, May 2021 (Talk)

**Wolfe, N. E.**, Pinnell, S., Daddone, A. "Closing Air Quality Data Gaps with Ultra-High Density, Low-Cost Hybrid Mesh Networks," NC Breathe, Charlotte, NC, April 2021 (Poster) [Poster](#)

**Wolfe, N. E.**, Curtis, S., Ghosh, S., Fröhlich, C. "Characterizing Gravitational Wave Signals from Core-Collapse Supernovae," UMass Dartmouth Physics Colloquium, Dartmouth, MA, April 2021 (Talk)

**Wolfe, N. E.**, Curtis, S., Ghosh, S., Fröhlich, C. "Characterizing Gravitational Wave Signals from Core-Collapse Supernovae," McCormick Undergraduate Research Symposium, Raleigh, NC, May 2020 (Talk) [Slides](#)

**Wolfe, N. E.**, Curtis, S., Ghosh, S., Ebinger, K., Fröhlich, C. "Characterizing Gravitational Wave Signals from Core-Collapse Supernovae," American Physical Society Division of Nuclear Physics, Crystal City, VA, October 2019 (Poster)

**Wolfe, N. E.**, Curtis, S., Ghosh, S., Fröhlich, C. "Characterizing Gravitational Wave Signals from Core-Collapse Supernovae," Fifty-One Ergs, Raleigh, NC, May 2019 (Poster) [Poster](#)

## Projects

- Oct 2018 - Present  
*with Professor Carla Fröhlich, NC State*
- Characterizing Gravitational Wave Signals from Core-Collapse Supernovae**
- Modified and extended 1D core-collapse models written in FORTRAN.
  - Modified and extended code to calculate gravitational wave eigenfrequencies given hydrodynamic data from a simulated supernova.
  - Compared spacetime geometry assumed in eigenfrequency calculation code to that of our models, verifying their approximate equivalence numerically and with pen-and-paper.
  - Applied active subspace analysis, a novel method of sensitivity analysis.
  - "Poster-Blitz Advertisement" & poster presentation at Fifty-One Ergs (FOE) in May 2019
  - Created a system to automatically run a suite of models on multiple computers.
  - Writing the final manuscript, with an anticipated publication date in Fall 2022.
- June 2020 - Present  
*with collaborators at NC State, LANL, and University of Houston*
- Parameter Inference with Core-Collapse Supernovae Models**
- Interdisciplinary astrophysics & data science collaboration using machine learning and modern statistical methods to constrain key physical parameters like the nuclear equation of state.
  - Identified and collected astronomical data that can be compared to the results of 1D core-collapse models.
  - Performed simulations of core-collapse and post-processed them to extract relevant quantities for analysis in Meskhi, Wolfe et al. (2022), accepted to the Astrophysical Journal Letters.
- Dec 2020 - Present  
*with Professors Carla Fröhlich and Ralph Smith, NC State*
- Uncertainty Quantification for Core-Collapse Supernova Models**
- Independently ideated and proposed to address gaps in understanding of core-collapse simulation uncertainties, to better connect simulation results to astronomical observations.
  - Built first machine learning autoencoder models to predict core-collapse supernova explosion energies with the Python Keras library, with little prior machine learning experience.
  - Performed Bayesian parameter estimation using my machine learning model and Monte Carlo Markov Chain sampling to quantify uncertainty in explosion energy predictions.
- June 2021 - Present  
*with Dr. Colm Talbot, Caltech LIGO Astrophysics Lab dcc.ligo.org/T2100339*
- Testing General Relativity with Gravitational Wave Signals using Hybrid Sampling**
- Implemented the TaylorF2 waveform approximant to modify post-Newtonian inspiral parameters.
  - Implemented, from scratch, a unique method to combine multiple parameter estimation techniques in a new hybrid fashion.
  - Integrated my sampling code with LIGO BILBY software and ran it on the LIGO Data Grid.
  - Wrote two interim written reports and a final report for the Lab.
  - Gave two interim progress talks and a final talk to the Lab.
- Sept 2021 - Dec 2021  
*with Dr. Jonah Miller, LANL and Professor Carla Fröhlich, NC State*
- Identifying Black Hole Formation in Core-Collapse Supernova Simulations**
- Converted the metric of the general relativistic hydrodynamics code AGILE into the ADM 3+1 formalism, identifying the lapse  $\alpha$  and shift  $\beta^i$
  - Rederived an expression for the expansion  $H$ , that characterizes apparent horizon formation, in the coordinate system of AGILE
  - Calculated the expansion  $H$  in Python to identify black hole formation in previously completed spherically-symmetric core-collapse supernova simulations
- Aug 2019 - Aug 2021  
*with Somdutta Ghosh and Professor Carla Fröhlich, NC State*
- Studying the Equation of State Dependence of Core-Collapse Supernovae Outcomes**
- Modified post-processing software used to calculate model explosion energy software
  - Created suite of core-collapse models across six equations of state, supplying the simulation data used Ghosh et al. (2022).
- June 2019 - Oct 2020  
*with Dr. Elena Murchikova, Member, Institute for Advanced Study*
- Investigating Neutral Hydrogen in the Cold Accretion Disk around Sagittarius A\***
- Studied the description and observational consequences of the H30 $\alpha$  transition of hydrogen from  $n = 31$  to  $n = 30$ , in the environment around a black hole, in the presence of significant *non-blackbody* background radiation.
  - Applied statistical mechanics, in a "pen-and-paper" manner, to understand how transition probabilities are modified by the non-blackbody background.
  - Independently began this collaboration with Dr. Murchikova, during a conversation following her presentation at NC State.
- June 2020 - September 2020  
*with Dr. Sanjana Curtis, University of Amsterdam*
- Applying Sensitivity Analysis Methods to Core-Collapse Supernova Lightcurves**
- Applied a novel method for sensitivity analysis, known as active subspace analysis to analyze the light curves resulting from 1D core-collapse supernovae models.
  - Identified the ejected  $^{56}\text{Ni}$  mass as the primary determinant of lightcurve properties.
  - Contributed a subsection and appendix as second author on Curtis, Wolfe et al. (2021), in the Astrophysical Journal.

## Grants & Funding

April 2020 **NC State Office of Undergraduate Research Award**  
Awarded \$2,000 to perform research with Dr. Elena Murchikova at the Institute for Advanced Study during the summer of 2020. This travel was ultimately canceled due to the COVID-19 pandemic.

April 2020 **NC State Sustainability Fund Grant**  
Awarded \$5,820 to deploy a network of outdoor particulate matter sensors across NC State's campus, from July 2020 to December 2021. This funding is still active despite the COVID-19 pandemic.

## Service & Leadership

### Outreach

**Wolfe, N.E.** "Science in the Stellar Graveyard," student-oriented spark talk for the North Carolina Science & Engineering Fair, Raleigh, NC (virtual) March 2022 [Recording](#)

**Wolfe, N.E.** "The Second Lives (and deaths) of Stars" talk and Q&A with middle-school class at Martin GT Magnet Middle School, Raleigh, NC (virtual) 3 February 2022. [Slides](#)

**Wolfe, N.E.** "The Deaths of Stars" talk and Q&A with middle-school class at Martin GT Magnet Middle School, Raleigh, NC (virtual) 8 February 2021.

**Wolfe, N.E.** "The Deaths of Stars" talk and Q&A with middle-school class at Martin GT Magnet Middle School, Raleigh, NC (virtual) 12 October 2020.

**Wolfe, N.E.** "Solar Astronomy Tutorial" guided special-needs students in use of a telescope with solar filter at Athens Drive Magnet High School, Raleigh, NC 27 February 2020.

**Wolfe, N.E.** "Lunar & Planetary Astronomy Tutorial" guided young students in telescope observations of the moon and Saturn, at Millbrook Magnet Elementary School, Raleigh, NC 30 January 2020.

**Wolfe, N.E.** "Astronomy Days Outreach" public booth at Astronomy Days event at the North Carolina Museum of Natural Sciences, Raleigh, NC 26 January 2020.

### Activities

January 2020 - Present **President & Co-Founder, Scivir (*see-ver*)**

- Scivir is a 501(c)(3) nonprofit organization, with a mission to create new technologies to accelerate environmental justice.
- Ideated Scivir's key technical goal, to develop low-cost mesh networks of particulate matter monitors to address critical data gaps in air quality data in rural regions.
- Led the organizational and technical vision of Scivir.
- Led firmware development, including LoRa networking capabilities.
- Completed multiple successful small grant applications.
- Identified external partnerships in affected communities and other organizations.

May 2019 - September 2021 **President, Astronomy Club at NC State**  
Led the club towards a focus on science outreach; led multiple outreach events in Raleigh, and additional remote outreach events during the fall 2020 and spring 2021 semesters.

Sep 2018 - Present **Co-Chair, Park Scholars Class of 2022 Legacy Committee**

- Led the definition and implementation of a class legacy for the Park Scholars Class of 2022.
- Led our partnership with the Interfaith Food Shuttle in Raleigh, which harnesses the wide-ranging interests of our class towards addressing problems of food insecurity and sustainability.

January 2020 **Small-Group Leader, Triangle Youth Leadership Conference**  
[triangleleadership.com](http://triangleleadership.com)

- Volunteer small-group leader for high school students at an intensive, two-day conference where students learn effective leadership in the context of solving community issues.
- Encouraged bonding, teamwork, and the development of critical leadership skills among a small student group, and guided these students in the proposal of a service prototype project.

March 2020 **Alternative Service Break - Alaska**

- Volunteered at the local school and Boys & Girls Club in the Tlingit-majority community of Hoonah, Alaska, to understand the roots of social injustice in Native American communities.
- Learned about the intersection of social justice and educational environments relevant to being an effective mentor for students in a university setting.

## Awards & Honors

April 2022 **National Science Foundation Graduate Research Fellowship**

The NSF GRFP recognizes and supports outstanding graduate students in NSF-supported STEM disciplines who are pursuing research-based master's and doctoral degrees at accredited US institutions. The five-year fellowship includes three years of financial support including an annual stipend of \$34,000 and a cost of education allowance of \$12,000 to the institution.

April 2021 **Astronaut Scholarship**

[go.ncsu.edu/newolfe-astronaut-scholar](https://go.ncsu.edu/newolfe-astronaut-scholar)

The Astronaut Scholarship, first established by Mercury 7 astronauts, seeks to identify burgeoning scientific leaders. Astronaut Scholars are chosen based on their ability to move into unknown territory, their motivation, imagination, and exceptional performance in research, and their conveyance of intellectual daring and a genuine desire to positively change the world around them.

April 2020 **Goldwater Scholarship**

[lnnk.in/@goldwater-interview](https://lnnk.in/@goldwater-interview)

The Goldwater Scholarship Program, one of the oldest and most prestigious national STEM scholarships in the United States, seeks to identify college sophomores and juniors with exceptional promise of becoming next-generation research leaders, who show

- strong commitment to a research career in the natural sciences, mathematics, and engineering,
- effective display of intellectual intensity in the sciences, mathematics, and engineering, and
- potential for a significant future contribution to research in their chosen field.

Aug 2018 - Present **Park Scholarship**

[park.ncsu.edu](https://park.ncsu.edu)

NC State's Park Scholarship is a highly selective, full merit scholarship awarded based on outstanding accomplishments and potential in scholarship, leadership, service, and character. Park Scholars participate in a four-year, executive-style leadership academy; diversity training; a year-long service project; and intensive learning laboratories exploring leadership challenges regionally and nationally.

April 2022 **McCormick Award for Undergraduate Research**

Co-recipient of this award for senior physics undergraduate students, recognizing outstanding research accomplishments.

April 2022 **Yusor Abu-Salha Award for Outstanding Community Engagement**

Recipient of this award for senior mathematics undergraduate students who used their time, talents, and intellect to improve their community, recognizing significant accomplishments in the realm of service.

May 2021 **1st Place - McCormick Undergraduate Physics Research Symposium**

Awarded for my three-minute presentation on Gravitational Waves from Core-Collapse Supernovae.

September 2020 **Math Honors Program at NC State**

May 2020 **Phi Beta Kappa**

[pbk.org](https://pbk.org)

Invited to join Phi Beta Kappa, the oldest and best-known society for academic excellence and scholarly achievement in the United States, and one of the highest student honors at NC State.

Aug 2018 - Present **University Scholars Program**

[uhsp.dasa.ncsu.edu](https://uhsp.dasa.ncsu.edu)

The NC State University Scholars Program exposes students to diverse experiences, from local orienteering to talks by National Geographic journalists.

## Skills

### General Computing

Unix (incl. Ubuntu Linux, CentOS, Raspbian Linux)  
Bash (scripting)  
L<sup>A</sup>T<sub>E</sub>X

*7+ years, 3.5 years in class & research* (Advanced)  
*3+ years in research* (Advanced)  
*3.5 years in class & research* (Advanced)

### Scientific Computing

Python (incl. Scipy, Numpy, Pandas)  
Machine learning with Python Keras library  
Mathematica  
Julia  
MPICH

*7+ years, 3.5 years in class & research* (Advanced)  
*1 year in research* (Intermediate)  
*3.5 years in class & research* (Intermediate)  
*0.75 years in research* (Fundamental)  
*0.75 years in research* (Fundamental)

### Firmware Development

C & C++  
Arduino & ESP32 Microcontrollers  
Digital sensing  
Soldering  
Autodesk EAGLE

*5+ years with Scivir* (Advanced)  
*5+ years with Scivir* (Advanced)  
*5+ years with Scivir* (Advanced)  
*5+ years with Scivir* (Intermediate)  
*1 year with Scivir* (Fundamental)

### Web Development

Javascript  
node.js  
HTML & template engines (incl. ejs)

*3+ years with independent projects* (Advanced)  
*3+ years with independent projects* (Advanced)  
*3+ years with independent projects* (Advanced)

### Data Systems & Formats

HDF5  
PostgreSQL  
MongoDB

*2 years in research* (Intermediate)  
*1.5 years with independent projects* (Intermediate)  
*0.5 years in web development* (Fundamental)

### Languages

English  
Spanish

*Native, incl. scientific writing & presentation* (Advanced)  
*2 years in class* (Fundamental)