

# Lukas Mesicek

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## EDUCATION

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### University of Utah

*Honors Bachelor of Science in Physics, Minor in Music (presumed)*

*Cumulative GPA: 4.00 / 4.00*

Salt Lake City, Utah

*Aug. 2022 - Present*

### University of Utah

*Honors Bachelor of Science in Applied Mathematics, Minor in Astronomy (presumed)*

*Cumulative GPA: 4.00 / 4.00*

Salt Lake City, Utah

*Aug. 2022 - Present*

## RESEARCH

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### Axisymmetric Critical Collapse with Finite Difference Methods

*Sep. 2022 - Present*

- Developed advanced codebase from scratch for numerically solving PDEs.
- Designed and implemented novel methods for adaptively refining domains.
- Applied the Z4 extension of General Relativity to axisymmetric scalar fields.

Advisor: **Dr. John Belz**

### Formal Verification of Operating Systems

*Sep. 2022 - May 2024*

- Verified correctness of low-level OS code by building proofs with Dafny and Verus.
- Built formally verified abstractions for memory allocators and linked lists.
- Coauthored paper on work presented at SOSR 2023, a leading conference in operating systems programming.

Advisor: **Dr. Anton Burtsev**

## PUBLICATIONS

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- **Atmosphere: Towards Practical Verified Kernels in Rust.** Xiangdong C., Zhaofeng L., Mesicek L., Narayanan V., and Burtsev A. Published in *KISV '23: Proceedings of the 1st Workshop on Kernel Isolation, Safety and Verification*.

## PRESENTATIONS

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- **Simulating Black Hole Collapse from Axisymmetric Scalar Fields using Modern Finite Difference Techniques.**

*American Physical Society (4 Corners Conference) - Logan, Utah. Oct. 2023*

Lukas Mesicek, Sean Johnson, John Belz.

- **Axisymmetric Critical Phenomena using High Order Finite Difference Methods.**

*University of Utah Undergraduate Research Symposium - Salt Lake City, Utah. Aug. 2023*

Lukas Mesicek, Sean Johnson, John Belz.

## TECHNICAL SKILLS

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**Languages:** C/C++, Python, Rust, Julia

**Libraries:** NumPy, SciPy, Pandas, Matplotlib

**Miscellaneous:** LaTeX, ParaView

## ADVANCED COURSEWORK

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- **General Relativity.** Graduate level course in general relativity, covering manifolds, differential geometry, the Einstein Field Equations, the Schwarzschild solution, the Kerr solution, and gravitational radiation. *Designation: PHYS 7720, Grade: A*
- **Electrodynamics and Special Relativity.** Graduate level course in electrodynamics and special relativity, covering the tensorial formulation of electromagnetic fields, Lagrangian formulation of relativistic mechanics, electrostatics, magnetostatics, and multipole expansions. *Designation: PHYS 7110, Grade: A*
- **Analysis of Numerical Methods II.** Graduate level course in numerical analysis, focusing on solving PDEs numerically. Topics covered included Runge-Kutta methods, multistage methods, interpolation, finite difference approximations, and continuous galerkin spectral methods. *Designation: MATH 6620, Grade: A*
- **Classical Mechanics.** Undergraduate course in classical mechanics, covering advanced Newtonian mechanics, Lagrangian mechanics, Hamiltonian mechanics, rigid-bodies, and central-force problems. *Designation: PHYS 4410, Grade: A*
- **Quantum Mechanics.** Undergraduate course in quantum mechanics, covering the harmonic oscillator, free particles, scattering, three dimensional quantum mechanics, the hydrogen atom, spin, and Dirac notation. *Designation: PHYS 5450, Grade: A*
- **Computational Physics.** Undergraduate course in computational methods for physics, including NumPy and Matplotlib, statistical methods, data fitting, numerically integrating ODEs, and extracting waves via fourier transforms. *Designation: PHYS 3730, Grade: A*
- **Thermodynamics & Statistical Mechanics.** Undergraduate course on thermodynamics and statistical mechanics, covering the laws of thermodynamics, entropy, temperature, heat engines, refrigerators, phase transitions, Boltzmann statistics, Bose-Einstein statistics, and Fermi-Dirac statistics. *Designation: PHYS 3760, Grade: A*
- **Observational Astronomy.** Undergraduate lab in observational astronomy, covering the operation of telescopes and cameras, image processing, and data analysis through code. *Designation: PHYS 4060, Grade: A*
- **Computational & Statistical Methods.** Graduate level course in statistical methods, covering stochastic process simulations, Monte Carlo methods, Bayesian analysis, and machine learning algorithms. *Designation: PHYS 7730, Grade: In Progress*
- **Stars & Stellar Populations.** Graduate level course in stellar astronomy and physics, covering stellar structure, formation, energy transport, nucleosynthetic reactions, energy production, and stellar ensembles. *Designation: ASTR 5560, Grade: In Progress*

## AWARDS AND RECOGNITION

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### James B. & Betty Debenham Scholarship

2024

*Awarded by the University of Utah's Honors College for outstanding student involvement and achievement on the path to an Honors Degree.*

### University Opportunity Research Program

2024

*Awarded by the University of Utah's Office of Undergraduate Research to fund my work with Dr. Belz in the spring and summer of 2024.*

### College of Science Dean's Scholarship

2023 & 2024

*Awarded by the University of Utah's College of Science for outstanding undergraduate academic achievement in science classes.*

**Summer Undergraduate Research Fellowship***2023*

*Awarded by the University of Utah's Department of Physics and Astronomy for academic merit and research experience to fund my work with Dr. Belz over the summer of 2023.*

**Sweet Candy Scholarship***2023*

*Awarded by the University of Utah's Honors College for outstanding student involvement and achievement on the path to an Honors Degree.*

**Physics and Astronomy Recognition of Excellence***2022 & 2023*

*Awarded by the University of Utah's Physics and Astronomy for outstanding undergraduate academic achievement in physics classes.*

**University of Utah Flagship Scholarship***2022 - 2026*

*A merit scholarship awarded by the University of Utah to incoming freshman for academic achievement in high school.*