Sylvia Mesicek

+1 (385) 495-1215 | sylvia.mesicek@utah.edu | Salt Lake City, UT

Education

University of Utah — Salt Lake City, Utah
Honors Bachelors of Science in Physics & Mathematics — *Aug. 2022 - Present*
Minor: Astronomy
Cumulative GPA: ***4.00 / 4.00***

Salt Lake Center for Science Education — Salt Lake City, Utah
High School Diploma — *Aug. 2019 - June 2022*
Cumulative GPA: ***4.00 / 4.00***

Research

Critical Collapse of Black Holes with Finite Difference Methods — *Sep. 2022 - Present*

- *Developed advanced codebase (20,000 lines of code) from scratch for numerically solving PDEs.*
- *Derived a novel hyperbolic formulation of the Z4 extended Einstien Field Equations in axisymmetry.*
- *Designed and implemented innovative methods for adaptively refining domains using interpolating wavelets.*

Advisor: ***Dr. John Belz***

X-ray Spectral Analysis of AGN in the NEP field — *May. 2025 - Present*

- *Performed x-ray spectroscopic analysis on XMM-Newton observations of 62 selected AGN in the JWST-North Ecliptic Pole field.*
- *Used Bayesian analysis and frequentist best-fit models to measure and constrain N_H values of these AGN.*
- *Supplemented prior work studying obscured AGN in the NEP field.*

Advisor: ***Dr. Dan Wik***

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 SOSP 2023, a leading conference in operating systems programming.*

Advisor: ***Dr. Anton Burtsev***

Publications

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

[1] Citation under previous name.

Presentations

- **Simulating Black Hole Collapse from Axisymmetric Scalar Fields using Modern Finite Difference Techniques**.
  American Physical Society (4 Corners Conference) - Logan, Utah. Oct. 2023
  L. Mesicek[1], 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
  L. Mesicek[1], Sean Johnson, John Belz.

Technical Skills

Languages: C/C++, Python, Rust, Julia, Fortran
Libraries: NumPy, SciPy, Pandas, Matplotlib, AstroPy, SymPy
Miscellaneous: LaTeX, ParaView, Xspec

Advanced Coursework

- **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: A*
- **Cosmology**. Graduate level course in modern cosmology, covering dark matter, dark energy, cosmological density fields, growth of density perturbation, inflation, anisotropy in the cosmic microwave background, galaxy formation, and cosmic reionization. *Designation: ASTR 5580, Grade: In Progress*
- **General Relativity**. Graduate level course in general relativity, covering manifolds, differential geometry, the Einstein Field Equations, the Schwarschild 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*
- **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: A*
- **Analysis of Numerical Methods**. 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*

Awards and Recognition

Barry Goldwater Scholarship *2025*
Awarded by the Barry Goldwater Scholarship and Excellence in Education Foundation for outstanding career and research potential in physics and astronomy.

Walter W. Wada Endowed Scholarship *2025*
Awarded by the University of Utah's Department of Physics and Astronomy to an outstanding undergraduate student.

Michael Zhao Memorial Scholarship *2025*
Awarded by the University of Utah's Department of Mathematics to an outstanding undergraduate student.

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, 2025*
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 acedemic achievement in high school.