

Anthony Burrow

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EDUCATION

- **Ph.D. in Physics; GPA: 3.92** Aug. 2019 – Present (Expected Summer 2024)
University of Oklahoma Norman, OK
- **B.S. in Astrophysics; GPA: 3.91** Aug. 2014 – May. 2017
University of Oklahoma Norman, OK

TECHNICAL SKILLS

Programming	Platforms	Technologies
Python, C/C++, C#, SQL, Bash, Fortran, IDL, Make/Makefiles, CMake	Linux/UNIX, Windows	Git (Version Control), L ^A T _E X, RStudio, Microsoft Office, Mathematica, IRAF

Experience with Python Libraries

NumPy	SciPy	scikit-learn	Astropy	Tensorflow	pandas
matplotlib	Jupyter	Cython	pybind11	GPY	george

Strengths

Data Analysis ◦ Data Visualization ◦ Cluster Analysis ◦ Classification ◦ Hierarchical Bayesian Modeling
Statistics ◦ Machine Learning ◦ Interpolation & Extrapolation ◦ Numerical Computation
Software Development ◦ Unit Testing ◦ Debugging ◦ Scripting ◦ Automation ◦ Optimization

RESEARCH EXPERIENCE

- **Graduate Research Assistant** July 2019 – Present
University of Oklahoma, Advised by Dr. Eddie Baron Norman, OK

My research focuses on a statistical treatment of observations of Type Ia supernovae (SNe Ia). As a result, I identified correlations between many spectroscopic and photometric properties of these supernovae, which will lead to the enhancement of supernova models all around the scientific community.

- **Develop Python software** to implement several **machine-learning** techniques to **model** the behavior of SNe Ia.
- **Statistically analyze data**, resulting in two first-author **publications** and a dissertation that illustrate the effectiveness of my results in performing **classifications** and **predictions**.
- Work in conjunction with the Precision Observations of Infant Supernova Explosions (POISE), a larger **collaboration** between several other universities and facilities around the world.
- Utilize the PHOENIX radiative transfer code in a **supercomputing** environment with **Slurm** workload management scripts to generate synthetic spectrum **models** to better understand the diversity of SNe Ia.

Products:

- **SNEx** (Python): Spectrum **extrapolation** into the near-infrared using PCA ([Burrow et al., 2024](#)).
- **Spextractor** (Python): **Fast spectrum-smoothing** using Gaussian processes; spectrum **preprocessing**; other useful features.
- **SNiaDCA** (Python): Wrapper for **classifying** SNe Ia with Gaussian mixture models ([Burrow et al., 2020](#)).

- **Undergraduate Research Assistant** June 2015 – May 2017
University of Oklahoma, Advised by Dr. John Wisniewski Norman, OK

My work concentrated on the observation, reduction, and analysis of data taken of star clusters to improve our understanding of stars with variable circumstellar disks.

- **Reduce** observed data by removing multiple sources of noise from raw **FITS** images of star clusters using **IRAF**.
- **Model** the light profile of stars on images to calculate their PSF photometry using **IRAF**.
- Create Python and IDL scripts needed to **analyze data** and propagate errors derived from observations.
- Conduct multiple remote **observations** using a 0.5m telescope at the Apache Point Observatory

ADDITIONAL PROJECTS

- **Rad1D**: A 1D radiative transfer code written in C++ featuring a Python wrapper for easy implementation into Python for analysis and plotting. This program converges a solution to wavelength-dependent radiative transfer equations, which describes how light behaves as it passes through a medium as a function of optical depth.
- **Hydro1D**: A 1D hydrodynamical code written primarily in C++ with some Python additions. This program models the fluid dynamics of a massive ($10 M_{\odot}$) star undergoing a collapse and a shock event, which leads to a core-collapse supernova.

PUBLICATIONS

First-Authored Papers:

- **Burrow, Anthony**, Baron, E., Burns, Christopher R., et al. (2024). *Extrapolation of Type Ia Supernova Spectra into the Near-Infrared Using PCA*. arXiv e-prints , doi: [10.48550/arXiv.2404.04724](https://doi.org/10.48550/arXiv.2404.04724)
- **Burrow, Anthony**, Baron, E., Ashall, C., et al. (2020). *Carnegie Supernova Project: Classification of Type Ia Supernovae*. ApJ , doi: [10.3847/1538-4357/abafa2](https://doi.org/10.3847/1538-4357/abafa2)

Relevant Co-Authored Papers:

- DerKacy, James M., ..., **Burrow, Anthony**, et al. (2024). *JWST MIRI/Medium Resolution Spectrograph (MRS) Observations and Spectral Models of the Underluminous Type Ia Supernova 2022xkq*. ApJ , doi: [10.3847/1538-4357/ad0b7b](https://doi.org/10.3847/1538-4357/ad0b7b)
- Shahbandeh, Melissa, ..., **Burrow, Anthony**, et al. (2024). *JWST NIRSpec+MIRI Observations of the nearby Type IIP supernova 2022acko*. arXiv e-prints , doi: [10.48550/arXiv.2401.14474](https://doi.org/10.48550/arXiv.2401.14474)
- Yarbrough, Zach, ..., **Burrow, Anthony**, et al. (2023). *Direct analysis of the broad-line SN 2019ein: connection with the core-normal SN 2011fe*. MNRAS , doi: [10.1093/mnras/stad758](https://doi.org/10.1093/mnras/stad758)
- DerKacy, J. M., ..., **Burrow, Anthony**, et al. (2023). *JWST Low-resolution MIRI Spectral Observations of SN 2021aefx: High-density Burning in a Type Ia Supernova*. ApJ , doi: [10.3847/2041-8213/acb8a8](https://doi.org/10.3847/2041-8213/acb8a8)
- Burns, C., ..., **Burrow, Anthony**, et al. (2021). *Introducing POISE: Precision Observations of Infant Supernova Explosions*. ATel

TECHNICAL PRESENTATIONS

- **POISE Collaboration Meeting, August 2023**: *Extrapolation of Type Ia Spectra into the Near-Infrared Using PCA*; a final discussion leading to [Burrow et al. \(2024\)](#).
- **POISE Collaboration Meeting, July 2022**: *Extrapolation of Type Ia Spectra into the Near-Infrared Using PCA*; the beginning of the project leading to [Burrow et al. \(2024\)](#).
- **CSP Collaboration Workshop, September 2020**: *Carnegie Supernova Project: Classification of Type Ia Supernovae*; a presentation of the publication by [Burrow et al. \(2020\)](#).
- **American Astronomical Society Winter Conference, January 2017**: Poster presentation highlighting my undergraduate research.
- **OU REU Program, Summer 2015**: Several presentations describing the results of my undergraduate research during this program.

TEACHING EXPERIENCE

- **Graduate Teaching Assistant** Aug. 2019 – Dec. 2021
University of Oklahoma Norman, OK
 - Provide lectures and guide group discussions on topics in-class to undergraduate students in Introductory Astronomy and Physics courses.
 - Lead students with hands-on operation of telescopes during astronomy labs.
 - Grading and evaluation for higher-level undergraduate astronomy courses, such as Galaxies & Cosmology and Stellar Astrophysics.

RELEVANT COURSEWORK

- **Machine Learning:** (See [repository](#).)

Discusses advanced statistical techniques and machine learning concepts such as:

- Regression Analysis
- Cluster Analysis
- Kernel Density Estimation
- Gaussian Processes
- Probabilistic Classification
- Neural Networks

- **Numerical Methods:** (See [repository](#).)

Discusses the most common problems that arise in computation and methods to address them, such as root-solving, solving systems of equations, and numerically solving ordinary and partial differential equations. This course also provides an introduction to high-performance computing, describing the architecture of modern supercomputing and giving practice with parallelization of computation using interfaces such as MPI and OpenMP.

- **Stellar Atmospheres:**

Largely focuses on understanding the physics of light propagating through a medium by solving mathematically complex systems of equations that describe radiative transfer, which are only solvable numerically in application. This is a fundamental approach to understanding and modeling spectra observed from astronomical objects.

- **Core & Advanced Physics Courses:**

An assortment of courses that allow for the fundamental understanding of physics at the post-graduate level, including Classical Mechanics, Statistical Mechanics, Quantum Mechanics, and Electrodynamics, and classes covering advanced topics in physics, including Quantum Mechanics of Atoms and General Relativity.