Calder Lenhart

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EDUCATION

2025–2027 **M.S. Physics**; Ohio State University
Coursework funded by the Faculty and Staff Tuition Assistance Plan – all courses taken for credit, concurrently with my full-time employment in the Department of Astronomy

Graduate-level coursework: Elementary Particle Physics, Differential Geometry (Math Dept.), Quantum Mechanics 1-2, Electromagnetic Field Theory, Analytic and Numeric Methods of Physics, Classical & Statistical Physics I

2020–2024 **B.S. Physics, Astronomy & Astrophysics**; Ohio State University
Minor in Mathematics, Minor in History
Magna cum laude, with Research Distinction in Astronomy & Astrophysics
Thesis: Phase-Resolved Cross-Correlation Transmission Spectroscopy of KELT-20b

Coursework: Applied Differential Geometry, Cosmology, Honors Quantum Mechanics I-II, Honors Intermediate E&M I-II, Statistical Mechanics, Real Analysis, Big Data Analytics in Physics

PUBLICATIONS

Journal Articles

[1] **C. Lenhart**, M. C. Johnson, J. Wang, A. P. Asnodkar, S. Petz, A. Duck, K. G. Strassmeier, and I. Ilyin. "PEPSI Investigation, Retrieval, and Atlas of Numerous Giant Atmospheres (PIRANGA). II. Phase-resolved Cross-correlation Transmission Spectroscopy of KELT-20b". In: *The Astronomical Journal* 171.2 (Jan. 2026), p. 81. DOI: 10.3847/1538-3881/ae2252.

[2] C. Basinger, M. C. Johnson, J. Wang, A. Duck, A. Pai Asnodkar, S. Petz, **C. Lenhart**, I. Ilyin, and K. Strassmeier. "PEPSI investigation, retrieval, and atlas of numerous giant atmospheres (PIRANGA) – III. Composition and winds in the atmosphere of TOI-1518 b". In: *Monthly Notices of the Royal Astronomical Society* 543.4 (Sept. 2025), pp. 4136–4143. DOI: 10.1093/mnras/staf1648.

[3] V. Bonidie, M. C. Johnson, J. Wang, S. Petz, J. Kamen, **C. Lenhart**, A. Duck, C. Badenes, K. Strassmeier, and I. Ilyin. "PEPSI Investigation, Retrieval, and Atlas of Numerous Giant Atmospheres (PIRANGA). IV. High-resolution Phased-resolved Spectroscopy of the Ultra-hot-Jupiter KELT-20 b". In: *The Astronomical Journal* 171.1 (Dec. 2025), p. 34. DOI: 10.3847/1538-3881/ae21be.

Conference Abstracts

[1] C. Basinger, M. Johnson, J. Wang, A. Duck, A. Pai Asnodkar, S. Petz, **C. Lenhart**, and K. Strassmeier. "Composition and Winds in the Atmosphere of TOI-1518 b". In: *American Astronomical Society Meeting Abstracts*. Vol. 247. American Astronomical Society Meeting Abstracts. Feb. 2026, 443.69, p. 443.69.

[2] J. Kamen, M. Johnson, V. Bonidie, S. Petz, **C. Lenhart**, J. Wang, and K. Strassmeier. "Chemistry and dynamics from high-resolution emission spectra of the ultra-hot Jupiters KELT-20b and TOI-1518b from the PIRANGA project". In: *American Astronomical Society Meeting Abstracts*. Vol. 247. American Astronomical Society Meeting Abstracts. Feb. 2026, 114.06, p. 114.06.

[3] **C. Lenhart**, M. Johnson, S. Petz, J. Wang, A. Pai Asnodkar, K. Strassmeier, and I. Ilyin. "Analysis of KELT-20b's Atmospheric Dynamics Using PEPSI: Line Profiles During Transit and Velocity Offsets". In: *American Astronomical Society Meeting Abstracts*. Vol. 243. American Astronomical Society Meeting Abstracts. Feb. 2024, 179.09, p. 179.09.

Theses

[1] **C. Lenhart**. “Phase-Resolved Cross-Correlation Transmission Spectroscopy of KELT-20b”. Undergraduate Thesis. The Ohio State University, Dec. 2024.

TNS Discovery Reports

[1] K. Z. Stanek and **C. Lenhart**. *ASAS-SN Transient Discovery Report for AT 2026lru / ASASSN-26df*. Transient Name Server. May 8, 2026.

PRESENTATIONS

Talks

[1] **C. Lenhart** and M. C. Johnson. *Analysis of an Ultra-Hot Jupiter’s Atmosphere*. Ohio State Department of Astronomy Summer Undergraduate Research Program Symposium (Columbus, OH, USA). July 2023.

Posters

[1] **C. Lenhart**, M. C. Johnson, J. Wang, A. P. Asnodkar, S. Petz, K. G. Strassmeier, and I. Ilyin. *Analysis of KELT-20b’s Atmospheric Dynamics Using PEPSI: Line Profiles During Transit and Velocity Offsets*. 243rd Meeting of the American Astronomical Society (New Orleans, LA, USA). Jan. 2024.

AWARDS & GRANTS

2026	Honorable Mention, NSF Graduate Research Fellowship Program, Astronomy & Astrophysics
2025	Artist Grant, Greater Columbus Arts Council
2024	Ann Slusher Tuttle Undergraduate Scholarship, Ohio State University Department of Astronomy
2023	Undergraduate Research Scholarship, Ohio State University College of Arts and Sciences
2023	1st Place, MakeOHI/O 2023
2020	Eagle Scout, Boy Scouts of America
2019	Youngstown CityScape Beautification Watch Award

RESEARCH EXPERIENCE

2025– **Post-baccalaureate researcher, ASAS-SN**, Department of Astronomy, Ohio State University
(Advisors: Prof. Christopher Kochanek, Prof. Krzysztof Stanek)

- Built a parallelized processing pipeline for > 17 million ASAS-SN light curves to search for transient brightenings from gravitational microlensing, irregular dimmings from circumstellar dust obscuration, and long-term or periodic variability from magnetic activity, rotation, and starspots.
- Developed hierarchical Gaussian Process models to separate quiescent stellar and systematic variability from anomalous brightness changes.
- Built a Bayesian event-detection framework using marginalized log-likelihood grids, Bayes factors, and posterior probabilities to identify statistically significant dimmings and brightenings relative to each source’s quiescent baseline.
- Built injection-recovery tests by injecting synthetic dip and jump morphologies into real light curves to measure detection efficiency as a function of event depth, event duration, baseline magnitude.
- Used catalog cross-matches, infrared colors, dust-extinction corrections, and a `LightGBM` model trained on 107 features to classify candidates as microlensing events, dusty dimming events, flares, YSOs, CVs, starspot variables, or other variable classes.

2025– **Post-baccalaureate researcher, Exoplanet Atmospheres**, Department of Astronomy, Ohio State University
(Advisor: Dr. Marshall C. Johnson, Co-advisor: Prof. Ji Wang)

- Building a modular GPU-accelerated Bayesian atmospheric retrieval pipeline in Python using `JAX`, `NumPyro`, and `ExoJAX`, with SVI and HMC-NUTS posterior inference.
- Implemented multiple atmospheric chemistry models, including free-retrieval abundances, altitude-dependent abundances, FastChem thermochemical equilibrium, and hybrid equilibrium/free-chemistry models.
- Performing Bayesian retrievals of ultra-hot Jupiter atmospheres, including KELT-9b, KELT-20b, TOI-1431b, and more, using high-resolution PEPSI/LBT spectroscopy.
- Constraining temperature-pressure profiles, atomic and molecular abundances, C/O ratio, metallicity, and atmospheric velocity structure in transmission and emission geometries.
- Developing joint retrievals combining high-resolution spectroscopy with public low-resolution optical/infrared spectra and broadband photometry to probe atmospheric structure across multiple pressure levels.

2023–2024 **Undergraduate Researcher, Exoplanet Atmospheres**, Department of Astronomy, Ohio State University
(Advisor: Dr. Marshall C. Johnson, Co-advisor: Prof. Ji Wang)

- Led a first-author study using PEPSI/LBT spectroscopic time-series observations to extract Doppler-shifted atmospheric absorption from thousands of weak lines in the ultra-hot Jupiter KELT-20b.
- Built an end-to-end high-resolution spectroscopy processing pipeline to remove telluric and stellar contamination, inject and recover model signals, and cross-correlate residual spectra with `petitRADTRANS` forward-modeled spectra.
- Detected atmospheric absorption at high significance, including Fe and Fe^{+}, and phase-resolved the strongest signals to map atmospheric velocity structure across the transit.
- Identified statistically significant start/end-of-transit asymmetries, supporting altitude-dependent atmospheric structure, ion-neutral differences, and the scale-height effect.
- Showed that adopted literature system parameters can bias measured atmospheric velocities; defined a standardized measurement procedure that improved consistency across observations.

2022–2023 **Undergraduate Research Assistant, Materials Science**, Department of Materials Science and Engineering, Ohio State University
(Advisor: Prof. Sheikh Akbar)

- Performed hydrothermal synthesis of metal-oxide nanostructures for gas sensors; characterized resistivity, response time, and selectivity of analytes.
- Cleanroom trained at Nanotech West Lab; managed safe handling of hazardous gases and materials.

WORK EXPERIENCE

2025– **Research Technician I**, The Ohio State University, On-site
Prof. Christopher Kochanek, Prof. Krzysztof Stanek (Department of Astronomy)

- Perform daily quality control on images from 20 cameras on 5 ASAS-SN telescopes; remotely recalibrate telescopes; verify supernova and other transient candidates; release confirmed discoveries to the public.

2025 **Physics AI Trainer**, Mercor Intelligence

- Trained a top AI research organization's LLM on undergraduate and graduate-level physics and math problems.

2022–2023 **Private Tutor**, Grade Potential Tutoring

- Tutored middle school, high school, and college students in-person in STEM.

2022–2023 **Private Tutor**, Wyzant
- Maintained a 5.0/5.0 rating across 30+ reviews and earned recognition as a top tutor in Columbus, OH.
- Created customized study plans for students ranging from middle school to college level in math, physics, and standardized test prep.

2021–2022 **Math Tutor**, Ohio State University Mathematics and Statistics Learning Center
- Tutored Calculus I–III students, managing scheduling, lesson planning, and teaching of more than 20 students per week.

PROJECTS

2026– **malcat**, GitHub
- Developing an astronomical time-series multimodal foundation model for light curves.

2026– **DustyCult**, GitHub
- Built Julia tools for modeling transient stellar dimming from circumstellar dust occultation, including dust forward models, light-curve containers, likelihoods, priors, and Turing sampling support.

2026– **mlexo**, GitHub
- Developing MLX-based astronomical time-series and light-curve modeling tools.

2026– **atmo-retrieval**, GitHub
- Building a Bayesian exoplanet atmosphere retrieval pipeline using `ExoJAX`, `NumPyro`, and `PySysRem` for high-resolution exoplanet spectra.

2026– **exoJAX**, GitHub
- Contributed to the auto-differentiable high-resolution spectrum modeling code for exoplanets/brown dwarfs using JAX. This code is the backend for `atmo-retrieval`.

2023–2026 **atmo-analysis**, *private GitHub repository*
- Developed LBT/PEPSI high-resolution exoplanet atmospheric transit analysis code for phase-resolved cross-correlation spectroscopy.

2025– **malca**, GitHub
- Built `MALCA`, a Bayesian multi-timescale ASAS-SN light-curve analysis pipeline for detecting dimming/dipping events, microlensing candidates, and long-term variability using Gaussian-process baselines, marginal-likelihood scoring, multi-stage filtering, and multi-wavelength characterization.

2023 **Machine Learning: Linking Writing Processes to Writing Quality**, GitHub
- Developed a Histogram-based Gradient Boosting Regression Tree with Scikit-learn to predict writing quality of mock SAT essays using keystroke logs.
- Engineered features proposed in computational linguistics literature and tuned hyperparameters.
- Placed in the 63rd percentile in Kaggle competition efficiency leaderboard.

2023 **Make OHI/O Makeathon (Intel Challenge)**
- 1st Place Winner: Prototyped an updated cleanroom garment with tear sensors, improved boot covers, and redesigned masks for use in Intel's semiconductor fabrication plants.
- Designed prototype using Arduino boards and authentic cleanroom garment materials.

2021–2022 **Buckeye Solar Racing**, Aerodynamics Team
- Researched solar car geometries and designed canopy/aeroshell components in SolidWorks.
- Ran CFD simulations with STAR-CCM+ and meshed existing canopy with photogrammetry software to validate physical prototypes.

2021 **NASA L'SPACE Mission Concept Academy**, Engineering Team Lead

- Collaborated with a 10-person interdisciplinary team to conceptualize a mission to drill water-ice from the lunar south pole.
- Modeled entry, descent, and landing of a lunar rover; designed a compact lunar regolith drill with SolidWorks; and formulated the CONOPS.
- Performed risk analysis, integration and test, verification and validation.

SKILLS

Programming & Software: Python, Julia, HTML, CSS, LaTeX, Bash/Shell, Linux, Git, SolidWorks, Darktable

Research Methods: Exoplanetary atmospheric retrieval, Bayesian inference, MCMC (HMC-NUTS, SVI), Gaussian processes, spectroscopy, photometry, high-performance computing, machine learning, Principal Component Analysis

INTERESTS

Fine Art Photography: Recent exhibitions in Columbus, OH include *Exposure*, a two-person show at Wild Gallery in Oct. 2025; *ImageOHIO*, a group show at ROY G BIV in Oct. 2025. Forthcoming three month solo exhibition in Columbus, OH, Nov. 2027 - Jan. 2028.

Other Activities: Biking, backpacking, radio show hosting, soccer, tennis, website design

Groups: Epsilon Tau Pi (Eagle Scout Service Organization), Ohio Art League, OSU Mountaineers, AROUSE Student Radio