# ALEXANDER ROSS

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## EDUCATION

**University of Washington** Seattle, WA

- *Bachelor of Science* in Physics & Astronomy with College Honors Graduation June 2027
- *Minors* in Aeronautics & Astronautics and Applied Mathematics

## RESEARCH EXPERIENCE

**Los Alamos National Laboratory** *Nuclear Astrophysics Summer Research Fellow, Los Alamos, NM* Jun 2026 - Present

PIs: Dr. Marko Ristić (LANL), Dr. Ryan Wollaeger (LANL)

- Building an end-to-end computational pipeline (Fortran, Python) using supercomputers to predict the light curves and spectra of kilonovae, the radioactive afterglows of neutron star mergers.
- Simulating the general relativistic magnetohydrodynamics of merger ejecta (vbhlight), then propagating the thermodynamic trajectories into a nucleosynthesis code (PRISM) to model the r-process that forges heavy elements.
- Performing radiative transfer (SuperNu) on the resulting abundances to compute observable signatures across different nuclear mass models, quantifying how nuclear physics uncertainties propagate into astronomical observables.
- Preparing results for a first-author journal paper and professional conference presentation.

**NASA Goddard Space Flight Center** *Gravitational Astrophysics Intern, Greenbelt, MD* Jun 2025 - Present

PIs: Dr. Eleonora Castelli (NASA GSFC, UMBC), Dr. John Baker (NASA GSFC, L2IT France)

- Engineering open-source data analysis software (Python and C++) to process real-time signals from the upcoming Laser Interferometer Space Antenna (LISA) gravitational wave observatory.
- Developing and integrating software components including time series generation, dynamic spectrograms for transient signal detection, adaptive whitening filters, and Q-transform–based anomaly detection.
- Applying advanced signal processing and spectral estimation to enable low-latency characterization of weak signals in high-noise environments, increasing event and glitch detection accuracy by up to **40%** over previous iterations.
- Optimizing system performance for deployment in mission-critical environments requiring autonomous detection, rapid data interpretation, and astrophysical event-driven response, decreasing anomaly detection times by up to **20%.**
- Collaborating with 20+ LISA scientists from around the world to expand the pipeline for integration into the mission's end-to-end data analysis framework.

**Institute for Nuclear Theory** *Neutron Star and Machine Learning Research Intern, Seattle, WA* Mar 2025 - May 2026

PIs: Professor Sanjay Reddy (INT), Dr. Tianqi Zhao (INT)

- Developing a physics-constrained Variational Autoencoder (VAE) using Python and Tensorflow to generate and test new candidate neutron star (NS) equations of state (EOS).
- Expanded on previous VAE studies by quantifying how latent perturbations map to decoded EOS and NS observables.
- Implemented KL-annealing and custom loss weighting to improve training stability and latent space reconstruction, achieving considerably faster structure simulations than traditional TOV solvers and a reconstruction accuracy of **~99%**
- Derived thermodynamic relations linking the sound speed to pressure-energy density behavior for consistent EOS reconstruction across nuclear models.
- Architected an open-source repository for the code to be disseminated to the nuclear astrophysics community.
- Co-author on submitted journal paper detailing the framework and its ability to accurately reconstruct known EOS.

**UW Astronomy Department, JWST LEGGOS** *Gravitational Lensing Researcher, Seattle, WA* Nov 2024 - Present
PI: Dr. Gourav Khullar (UW)

- Working in a 25+ person team (faculty, postdocs, undergraduates) studying distant galaxies whose light is magnified by gravitational lensing, using JWST imaging and spectroscopy to probe star formation and dynamics in the early universe.
- Developing a novel machine-learning pipeline (Python) to automatically map and classify star-forming clumps across lensed galaxies, work that turns a manual, subjective task into a reproducible one.
- First author on a submitted research note introducing this pipeline, and a co-author on three submitted collaboration papers covering the LEGGOS survey and galaxies within the survey.

## PUBLICATIONS

**"LEGGOS III: Mapping Star Formation and Dust in Gravitationally Lensed Galaxies with SUMAC, a UMAP and Clustering Framework" Alex Ross**, Gourav Khullar, Taylor Hutchison, Dylan Berry, Aritra Ghosh et al. - *Research Notes of the American Astronomical Society*, *submitted* *https://arxiv.org/abs/2606.20801*

**"LEGGOS II: Strong Lens Model and Source-Plane Projection of the Clumpy Star-Forming Galaxy SGAS J111020.0+645950.8 at z = 2.481"** Pedram Abedi, Keren Sharon, Taylor Hutchison, Matthew Bayliss, Michael Florian, Gourav Khullar … **Alex Ross** et al. - *The Astrophysical Journal*, *submitted* *https://arxiv.org/abs/2606.20804*

**"LEGGOS I: The JWST LEGGOS Survey -- LEnsing and Galaxy Growth: Observing Substructures -- Unpacks the Nature of Clumpy Star Formation and Quenching in Gravitationally Lensed Galaxies beyond Cosmic Noon"** Gourav Khullar, Michael Florian, Matthew Bayliss … **Alex Ross**, et al. - *The Astrophysical Journal, submitted* *https://arxiv.org/abs/2606.20845*

**"A Semi-Supervised Variational Autoencoder for Generating Neutron Star Equations of State**" Tianqi Zhao, Fanglida Yan, **Alex Ross**, James Lattimer - *Machine Learning: Science and Technology, submitted* *https://arxiv.org/abs/2605.27562*

**"JWST and The Waz Arc I: Spatially Resolving the Physical Conditions within a Post-Starburst Galaxy at Redshift 5 with NIRSpec IFS"** Taylor A. Hutchison, Gourav Khullar, Jane R. Rigby, Michael K. Florian, … **Alex Ross**, T. Emil Rivera-Thorsen, et al. - *The Astrophysical Journal, submitted* *https://arxiv.org/abs/2512.02000*

**"Propagating Nuclear Mass Model Uncertainties from r-Process Nucleosynthesis to Kilonova Emission" Alex Ross**, Andrew Imai, Marko Ristić, Ryan Wollaeger - *The Astrophysical Journal, in prep. for submission in August 2026*

## PRESENTATIONS

**"Stellar Biographies: a Tour of the Strangest Star Remnants in the Universe**" Alex Ross - *Public Talk, Theodor Jacobsen Observatory Open House, May 2026, Seattle, WA*

**"A Semi-Supervised Variational Autoencoder for Generating Neutron Star Equations of State**" Alex Ross - *Talk, Mary Gates Research Symposium, May 2026, Seattle, WA*

**"Data-Driven Generation of Neutron Star Equations of State Using Variational Autoencoders**" Alex Ross - *Talk, INT INTURN Lecture Series, September 2025, November 2025, May 2026, Seattle, WA*

**"LISA at a Glance: A Quick-Look Tool for Low Latency Gravitational Wave Data Analysis"** Alex Ross - *Poster, NASA Goddard Space Flight Center Summer Research Symposium, August 2025, Greenbelt, MD*

**"Software for the Uniform Manifold Approximation of Clusters - Using Machine Learning to Map Star Formation in the Early Universe with UMAP and Gravitational Lensing"** Alex Ross - *Talk, Mary Gates Research Symposium, May 2025, Seattle, WA*

## LEADERSHIP EXPERIENCE

**Husky Satellite Lab** *Student Organization: Lead Propulsion Engineer, Seattle, WA* Sep 2024 - Present

- Leading a team of 20 undergraduate students in engineering a hot-gas CubeSat propulsion system.
- Performed cis-lunar orbital simulations in MATLAB and GMAT, applying vector calculus and orbital mechanics to reduce system wet mass requirement by **15%** and total impulse demand by **10%.**

**Husky Robotics Team** *Student Organization: Instrumentation Science Lead, Seattle, WA* June 2024 - Present

- Constructing a Mars rover, leading the instrumentation team for soil and atmospheric analysis. Spearheading the research and development for data processing methods, in-situ spectroscopy, geochemical analysis, and manufacturing.
- Taught **25+** students about the principles of spectroscopy, instrumentation, geochemistry, and research methods.
- Designed and led experiments for geochemical analysis, Raman spectroscopy, and fluorimetry, allowing the team to determine the target molecule that will be most indicative of biological life, reducing our identification time by **75%.**

## AWARDS

- Apr 2026: **Husky 100 Recipient,** University of Washington, Seattle, WA
- Nov 2025: **Barry Goldwater Scholarship Nominee**, University of Washington, Seattle, WA
- Nov 2025: **Mary Gates Research Scholar**, University of Washington, Seattle, WA
- May 2026: **UW Extragalactic Research Symposium Best Visual Award**, University of Washington, Seattle, WA

## VOLUNTEER EXPERIENCE

**UW Science Explorers** *Lesson Planner and Instructor* Jan 2026 - Present

- Created and taught 5 hands-on lessons in engineering to over 50 students in an underserved West Seattle elementary school.
- Organized transportation, material acquisition, communications, and lesson plans in collaboration with other instructors.

**UW Undergraduate Physics Mentoring Program** *Director of Communications* Jan 2026 - Present

- Optimized mentor-mentee pairings by analyzing interests and skills, promoting a sense of community in the department.
- Guided undergraduates interested in research to opportunities that best suited their skillset and area of interest.