ALEX ROSS

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EDUCATION

University of Washington   Seattle, WA
- *Bachelor of Science* in Physics & Astronomy with Interdisciplinary Honors   Graduation June 2027
- *Minors* in Aeronautics & Astronautics and Applied Mathematics
- *Courses:* Classical Mechanics, Mathematical Physics, Thermal Physics, Analog Electronics, Extragalactic Astronomy, Quantum Mechanics, General Relativity, Particles and Symmetries, Astronomical Data Analysis

RESEARCH EXPERIENCE

NASA Goddard Space Flight Center *Gravitational Astrophysics Intern, Greenbelt, MD*   Jun 2025 - Present
PI: Eleonora Castelli (NASA GSFC), John Baker (NASA GSFC, L2IT France)
- Engineering a novel data analysis pipeline to process real-time signals from the upcoming Laser Interferometer Space Antenna (LISA) gravitational wave observatory using Python.
- 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 detection accuracy by up to **40%**.
- 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.

40 hours per week during Summer, 10 hours per week currently

Institute for Nuclear Theory *Neutron Star Research Intern, Seattle, WA*   Mar 2025 - Present
PI: Sanjay Reddy (UW INT), Tianqi Zhao (UW INT)
- Developing a physics-constrained Variational Autoencoder using Python and Tensorflow to model the neutron star equation of state.
- Expanded on previous VAE NS studies by incorporating physical constraints such as causality into the training.
- 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 adiabatic sound speed to pressure-energy density behavior for consistent EoS reconstruction across nuclear models.
- Preparing results for a first-author journal paper on data-driven neutron star modeling in collaboration with a team of post-docs and professors at UC Berkeley and the UW INT.

20 hours per week

UW Astronomy Department, JWST LEGGOS *Gravitational Lensing Researcher, Seattle, WA*   Nov 2024 - Present
PI: Gourav Khullar (UW)
- Conducting research with a multi-disciplinary team of 25+ professors, post-docs, and undergraduate students focused on high-redshift strongly lensed galaxies. Using Bayesian spectral energy fitting tools, JWST photometry and spectroscopy, and Python to understand early universe star formation and galactic dynamics.
- Assisted with 3 James Webb Space Telescope observation proposals, reviewing scientific arguments, ensuring clarity of language, and compiling references.
- Writing a novel Python software pipeline using machine learning to automatically map and identify star forming clumps in strongly lensed galaxies.

- Working on a first-authorship paper detailing the software pipeline in collaboration with a team composed of post-docs, graduate, and undergraduate students, alongside researchers from NASA Goddard, with submission planned for mid-2026.

8 hours per week

PUBLICATIONS

"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-Thorson, et al. - *ApJ https://arxiv.org/abs/2512.02000*

"Data-Driven Generation of Neutron Star Equations of State Using the Variational Autoencoder" Alex Ross (<u>first author</u>)**, Tianqi Zhao, Sanjay Reddy - *ApJ, In preparation, submission planned for **<u>Dec 2025</u>***

"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 (<u>first author</u>), Gourav Khullar, Taylor Hutchison, Michael Florian, Matt Bayliss, Dylan Berry, Juliana Karp - *ApJ, In preparation, submission planned for **<u>May 2026</u>***

PRESENTATIONS

"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*

"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*

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.
- Completed thermodynamics research on propellants, determining R-134a to be the ideal compound to maximize thrust for complex maneuvers around the moon while minimizing power requirements and mass.
- Simulated low-gravity fluid dynamics in Ansys in order to design a multi-stage propellant management 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
- Ensured integration between instrumentation, electronics, and structures through itemized reports of power and weight requirements for each component, resulting in efficient testing and **20%** more weight to allocate to a stronger chassis.
- Conducted research on Raman spectroscopy, using Ansys to develop a cooling method utilizing TECs that reduces thermal noise by **30%** and offers a higher signal-to-noise ratio, resulting in clean spectra and simpler data analysis.
- 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

- 2024-2025: University of Washington Annual Dean's List, Seattle, WA
- 12/2024: Triangle Fraternity Brother of the Quarter, Seattle, WA
- 06/2023: Quincy Jones Jazz Musicianship award, Spokane, WA

VOLUNTEER EXPERIENCE

UW Triangle Fraternity *Philanthropy Committee Chair*   May 2024 - Present
- Organized and executed fundraising events to raise money for STEM mental health awareness, LA wildfire victims, and blood cancer research.
- Orchestrated blood and plasma donation drives by advertising events, leading brother organization, and communicating with donation banks

Sloan Digital Sky Survey-V Local Volume Mapper *Remote Observer*   Oct 2024 - June 2025
- Observed remotely for the Local Volume Mapper, an integral-field spectroscopic survey that has the goal of mapping the interstellar gas emissions of the Milky Way, and the Large and Small Magellanic clouds.
- Operated and serviced remotely cryogenic tanks, monitoring pressure levels and fill rate to ensure the spectrograph system was properly cooled, reducing thermal noise and further optimizing data collection and resolution.

SKILLS AND AFFILIATIONS

Programming: Python, MATLAB, Julia, C
Hardware: Circuit theory, PCB design, Arduino, CNC Machining, 3D Printing (SLM, DMLS), mills, lathes
CAD & Simulation: Siemens NX, Onshape, Solidworks, Aerospace Toolbox, Ansys Workbench, Simscale, LaTeX, GMAT
Mathematics Advanced linear algebra, vector and complex calculus, mathematical modeling and simulation, differential geometry
Physics: Thermodynamics, fluid mechanics, statistical mechanics, quantum mechanics, electromagnetism, classical mechanics, nuclear and particle physics
Additional Skills: Leadership, communication, perseverance, academic writing, problem-solving, teamwork, time management
Affiliated Organizations: NASA PWEE Academy participant, Society of Physics Students, Triangle Fraternity, Astronomy Undergraduate Engineering Group, American Physical Society, American Astronomical Society