Ravjit (Rav) Kaur

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EDUCATION

University of California, Santa Cruz — Santa Cruz, CA
PhD in Astronomy and Astrophysics — *Expected 2030*

University of California, Berkeley — Berkeley, CA
BA in Astrophysics with Honors; BA in Music — *May 2024*

RESEARCH INTERESTS

I am interested in multimessenger astrophysics, gravitational waves, and prospects for future gravitational wave observations and events. I am also largely interested in cosmology, compact objects, the Hubble tension, and X-ray binaries.

PUBLICATIONS

1. **Kaur, Ravjit**, Brendan O'Connor, Antonella Palmese, & Keerthi Kunnumkai. (2024). *Detecting prompt and afterglow jet emission of gravitational wave events from LIGO/Virgo/KAGRA and next generation detectors.* arXiv preprint arXiv:2410.10579. [Submitted to Physical Review D; In review]

2. Palmese, A., **Kaur, R.**, Hajela, A., Margutti, R., McDowell, A., & MacFadyen, A. (2024). *Standard siren measurement of the Hubble constant using GW170817 and the latest observations of the electromagnetic counterpart afterglow.* Physical Review D, 109(6), 063508. https://doi.org/10.1103/PhysRevD.109.063508

RESEARCH EXPERIENCE

Astrophysics Honors Thesis — September 2023 – Present
University of California, Berkeley & Carnegie Mellon University

- **Prospects for multimessenger observations for next generation gravitational wave detectors:** For my honors thesis, I am working closely with Prof. Antonella Palmese at Carnegie Mellon University and Prof. Raffaella Margutti at UC Berkeley to simulate afterglows at different wavelengths in combination with gravitational wave (GW) simulations. The goal of this project is to assess the promise of different electromagnetic counterpart detections for future GW events in the O5 LVK observing run and in next-generation GW detectors.

Harvard CfA/SAO REU — June 2023 – Present
Harvard Center for Astrophysics & Smithsonian Astrophysical Observatory

- **A streamlined process for X-ray lightcurve extraction:** In my summer research, I worked closely with Dr. Rosanne Di Stefano to develop and automate an accurate process for extracting X-ray lightcurves from Chandra Source Catalog data. The code will be available on GitHub for the wider astronomy community to use.
- **Intriguing Time Variability in X-ray binaries in 47 Tucanae:** The main goal of this project was to search through X-ray source lightcurves to find potential transiting planets. I discovered an unusual transit in the X-ray binary eclipsing system X5 and we are conducting hardness ratio and ingress/egress analysis to determine the possibility of a 3-body system. REU paper can be found [here.](here)

Optical and Infrared Laboratory Projects — September 2023 – December 2023
University of California, Berkeley

- **Spectroscopy Project:** In this project, I used a spectrograph to collect spectral data from common objects and the sky under different astronomical conditions, and investigated noise in CCD detectors.
- **Exoplanet Transit Project:** In this project, I observed the exoplanet transit of WASP 33-b, created a lightcurve, and calculated the planetary radius. As part of this project, I am trained to operate the 30 inch telescope at Leuschner Observatory.

Undergraduate Researcher with Prof. Antonella Palmese — January 2023 – May 2023
Carnegie Mellon University

- Continuation of Perlmutter Group project

Undergraduate Researcher in Perlmutter Group — February 2022 – December 2022
University of California, Berkeley & Lawrence Berkeley National Lab

- **Multimessenger Constraints on H_0 from GW170817:** In this project I worked closely with Antonella Palmese and under Prof. Saul Perlmutter to re-analyze constraints on the Hubble Constant (H_0) derived from electromagnetic emission of the gravitational wave event GW170817. In addition to using MCMC sampling, we developed a hierarchical Bayesian formalism and 2D posterior reconstruction and derived a 6.5% precision measurement of H_0 from x-ray and radio afterglow data.

Undergraduate Lab at Berkeley - Theoretical Astrophysics Project   September 2020 – May 2021
ULAB mentee at University of California, Berkeley

- **Measuring Cosmic Distances using Gravitational Waves:** In this research experience, I learned Python and applied that to construct software to determine distances from LIGO strain data for 10 GW events. From this data, I calculated Hubble parameter estimates and derived an inclination angle equation to amplify strain data.

Python for Astronomers Final Project   March 2021 – May 2021
University of California, Berkeley

- **Summary:** In this course, I learned Python and applied it by plotting 3D animated Hertzsprung-Russell and CMD diagrams from the Gaia dataset for the star clusters M45 and M15.

POSTERS AND TALKS

- **243rd American Astronomical Society Meeting iPoster Presentation:** I will present my research on X-ray binary systems that I did over the summer at the Harvard CfA/SAO REU.

- **Harvard CfA/SAO REU Summer Talk:** Presented my research to CfA/SAO research scientists, mentors in the program, and fellow REU interns. Talk can be found here.

- **2022 American Association of Physics Teachers Summer Meeting Talk:** Gave an 8 minute talk on the structure and effectiveness of ULAB as an organization. Abstract can be found here.

- **2022 American Physical Society April Meeting Poster:** Presented research that was done on the effectiveness of ULAB as an organization. Abstract can be found here.

- **Physics Innovators Initiative (Pi^2) Summer Poster:** Presented my research on Hubble constant constraints and gravitational waves to the UC Berkeley Physics department. Poster can be found here.

- **ULAB Physics and Astronomy Division Poster session:** Presented our group research on gravitational waves and cosmic distances to the Astronomy and Physics departments at UC Berkeley. Poster can be found here.

LEADERSHIP AND OUTREACH

Research Director, ULAB: Physics and Astronomy Division   May 2022 – Present
University of California, Berkeley – Undergraduate Lab at Berkeley

- **Research director and lead instructor for ULAB:** As head instructor, I lead ULAB, which is a course that seeks to make research accessible to students traditionally underrepresented and unsupported in academia.
- Along with course staff, I develop Python assignments, teach over 60 students, and oversee 10+ staff members and mentors.
- I lead intro to research, Python, LaTeX, Statistics, and Professional Development workshops for mentees.
- In addition to course management, I help secure funding through the Berkeley Discover Grant to pay mentors, and I coordinate with faculty, grad students, postdocs, and department administration.
- **Lab Manager:** Held this position from August 2021-May 2022 and assisted with duties listed above.

President, Undergraduate Astronomy Society   May 2022 – Present
University of California, Berkeley

- As president, I manage club staff of 12+ officers, organize and plan club meetings, and coordinate with the astronomy department to hold professional and community outreach events.
- I developed and managed a cluster program that allows students to form mentorship groups with an experienced mentor, and fosters a safe and accepting environment within the astronomy community.
- I plan and help run star parties by operating the 17 inch telescope on the roof of the astronomy department, and we host local high school students for astronomy talks and viewing parties.
- **Club Officer:** Held this position from **August 2021-May 2022** and assisted with cluster program and planning meetings.
- **Clusterhead:** Held this position from August **August 2021-May 2022**. I mentored a group of students new to Berkeley.

Undergraduate Representative for Astronomy Department   August 2023 - Present
University of California, Berkeley

- I serve as a liaison between the astronomy faculty and astronomy major students, and raise concerns and questions that students have. As part of this role, I provide advice and suggestions to astronomy faculty and advocate on behalf of the astronomy undergraduates.

Undergraduate Climate Advisor for Astronomy Department   August 2022 – May 2023
University of California, Berkeley

- I served as a non-confidential department resource for students that experience harassment or other climate issues. As part of this role, I organized meetings with the Climate Advisor Committee monthly to report climate issues, suggestions, and feedback from students, and raised important concerns and harassment cases to the committee.

TEACHING

Undergraduate Student Instructor for Astro C12   Spring 2024
University of California, Berkeley   *Berkeley, CA*

- I will be a TA/UGSI for the Introduction to the Planets course taught by Prof. Courtney Dressing and Prof. Raymond Jeanloz at UC Berkeley.

Undergraduate Student Instructor for Astro C10   Fall 2022, Fall 2023
University of California, Berkeley   *Berkeley, CA*

- I am a TA/UGSI for the Introduction to General Astronomy course taught by Prof. Alex Filippenko at UC Berkeley. I teach 4 discussion sections of 30+ students each, hold weekly office hours, and lead homework help sessions. I also operate various telescopes for telescope viewing nights, and manage course logistics for 900+ students.

Course Reader for Astron C12   Spring 2022, Spring 2023
University of California, Berkeley   *Berkeley, CA*

- I was a grader for the Introduction to the Planets course taught by Prof. Courtney Dressing at UC Berkeley. I graded 160+ homework assignments weekly, and 4 exams/projects throughout the semester. I also delegated responsibilities to fellow graders and organized homework logistics.

English Tutor   June 2019 – May 2023
City Kidz World Writing Studio   *Kendall Park, NJ*

- As an English tutor/teacher, I corrected writing work for groups of 10-12 students in K-12 during writing workshops and summer camp. I also created grade-specific engaging writing prompts and lessons for students. As part of this job, I taught private lessons for SAT prep.

AP Chemistry Tutor   November 2019 - May 2020
South Brunswick High School   *Monmouth Junction, NJ*

- As an AP Chemistry private tutor, I created individual lesson plans for students and helped them with concepts and homework in weekly sessions, while preparing them for the AP exam.

AWARDS AND CONFERENCES

Daniel Edward Wark Award Recipient   University of California, Berkeley
$10,000 awarded on the basis of academic merit and character

FUTURE Women in Physics 2022 Cohort   California Institute of Technology
Invited to FUTURE conference for women in physics; member of the 2022 cohort

Physics Innovators Initiative (Pi^2) Summer Scholar   University of California, Berkeley
$5,500 grant received to fund summer research. Final paper can be found here.

SKILLS

Programming Languages: Python, UNIX, LaTeX
Libraries: CIAO, NumPy, Pandas, astropy, SciPy, Pickle, emcee, Matplotlib, Jupyter
Tools: GitHub, SAOImageDS9, Microsoft Office Programs, Google Suite