Katherine Elder – Curriculum Vitae

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Research Interests

- **Known for:** low frequency radio cosmology instruments MWA and OVRO-LWA.
- **Science Areas include**: Cosmology and astrophysics during the epoch of reionization and cosmic dawn using the 21cm Hydrogen line. General radio astronomy and instrumentation, particularly at sub GHz frequencies.
- **Areas of technical experience include**: Radio instrumentation and data analysis, data intensive computing and visualization, repeatability in science analysis, electromagnetic software modeling (FEKO, COMSOL).
- **Programming languages**: Python, CASA, Latex, C, Fortran.
- **Areas of experience**: Mentoring, teaching, scientific writing, science communication.

Education

2020-Pres. Astrophysics PhD Program - Arizona State University
Research Advisor: Dr. Daniel Jacobs

2015-2019 Bachelor of Sciences in Physics - Fresno State
Minors in Astronomy and Mathematics
Graduated Magna Cum Laude

Professional Affiliations

- Sigma Pi Sigma, Maryland, USA 2019 – Present
- American Astronomical Society, Washington D.C., USA 2019 – Present

Research

Dissertation

2020-Pres. *Systematics in Radio Telescopes* - Under the supervision of Dr. Daniel Jacobs
Original research in the field of Radio Astronomy Instrumentation, studying the effects of cable reflections and mutual coupling in the observations.
Status: In process. Submitted 1st paper for publication in MNRAS.

Other Research Projects

2021-2022 Low reflectivity surface treatments for a spectrograph optical table
Research done under the supervision of Dr. Nathaniel Butler
Short term research project at Arizona State University.

Fall 2019 Maintenance on a 16-inch optical telescope
Research done under the supervision of Dr. Fredrick Ringwald
Fall semester research at Fresno State.

Sum. 2019 Stress in transition edge sensor-based bolometers
Research done under the supervision of Dr. Edward J. Wollack and Dr. Karwan Rostem
Summer research internship at NASA Goddard Space Flight Center.

Sum. 2018 Signal leakage in the Hydrogen Epoch of Reionization Array
Research done under the supervision of Dr. Daniel Jacobs .
Summer research internship at Arizona State University.

Publications

In Press **K. Elder and D. Jacobs**
Investigating mutual coupling in the MWA Phase II compact array
Pre-print *arXiv:2411.04193*

2018 **K. Elder**
Constant Offset in Cross-Polarized HERA IDR2.1 Data
HERA Project Memos, 058

Employment

Research Associate

2022-Pres. Arizona State University, SESE
Research Associate

I work with Dr. Daniel Jacobs on studying systematics in the MWA radio telescope. I have focused on studying how much excess correlation mutual coupling and antenna-to-antenna reflections contributes to the 21-cm observations. I have built models in FEKO determine how much mutual coupling changes the beam as more antennas are added. These results are compared to a semi-analytic model of mutual coupling to determine which model will be most effective for reducing mutual coupling in the calibration pipeline. The first paper reporting results of this analysis is being prepared for submission to journals, and a second paper is in the planning stages.

2021-2022 Arizona State University, SESE
Research Associate

I worked with Dr. Daniel Jacobs during the Phase 3 EoR commissioning of the OVRO-LWA radio telescope. I used observations to study how the upgrade affected the amount of cable reflections present. I wrote code in Python to create 2-D power spectra of the Phase 3 observations and compared to historic observations to determine if the severity of cable reflections had been reduced with the upgrade. My results are in the process of being published as a memo.

Sum. 2019 NASA Goddard Space Flight Center
Research Associate Intern

Summer intern working with Dr. Edward J. Wollack and Dr. Karwan Rostem. I studied sources of stress in cryogenically cooled transition edge sensor (TES) based bolometers. I built models in COMSOL and simulated the fabrication process of the bolometers to determine what caused the existing bolometers produced by the HIRMES team for an experiment on SOFIA to deform.

Sum. 2018 Arizona State University, SESE
Research Associate Intern

Summer intern working with Dr. Daniel Jacobs. I worked with the HERA radio telescope to study the source of signal leakage in the cross-polarization data. I wrote code in CASA and Python to create 2-D and 3-D power spectra. I then created a mathematical model of the possible sources and compared to the real observations. I published a memo of my final results.

Teaching Experience

Instructor of Record

2021-2024 Arizona State University, School of Earth and Space Exploration (SESE)
Head Teaching Associate

Spring 2021, Spring 2024: Teaching Introduction to Solar Systems Astronomy - Laboratory. Included teaching two sections of the course, writing my own lesson plans, and collaborating with other instructors on quizzes and lab reports. As Head TA, I was in charge of prep discussions for labs, setting up the Canvas shell for the courses, editing existing quizzes and assignments, and prepare equipment for each lab. This prep also included going over an outline of the topics each lab needed to cover and providing tips on how to help the students get through the lab script to prepare the TAs each week. In Spring 21, the course was run entirely over Zoom.
Fall 2023: Teaching Introduction to Stars, Galaxies, and Cosmology - Laboratory. Included teaching two sections of the course, writing my own lesson plans, and collaborating with other instructors on quizzes and lab reports. As Head TA, I was in charge of prep discussions for labs, setting up the Canvas shell for the courses, editing existing quizzes and assignments, and prepare equipment for each lab. This prep also included going over an outline of the topics each lab needed to cover and providing tips on how to help the students get through the lab script to prepare the TAs each week.

Fall 2020 Arizona State University, SESE
Teaching Associate

Fall 2020: Teaching Introduction to Stars, Galaxies, and Cosmology - Laboratory. Included teaching three sections of the course, writing my own lesson plans, and collaborating with other instructors on the assignments.

Recitation Leader

2017-2019 Fresno State Learning Center
Supplemental Instructor and Tutor for Undergraduates in Mathematics and Physics

Spring 2017: I led Supplemental Instruction sessions for Calculus II. This included preparing additional material for the class, and working with the professor to make sure I presented the correct ideas.
Fall 2017 - Fall 2018: I led Supplemental Instruction sessions for Introduction to Thermodynamics and Electromagnetism. This included preparing additional material for the class, and working with the professor to make sure I presented the correct ideas.
Spring 2019 - Fall 2019: I led tutoring sessions for lower division Physics courses. I kept track of the course material so that I could answer any questions the students might have.

Summer 2017 Fresno State Educational Opportunities Program
Tutor of Math Remediation

For three weeks, I tutored Math Remediation to incoming Freshmen to help them pass the Math Placement Exam. I worked with them for 3 hours each day, for five days each week.

Science Communication and Outreach

2015-2017 Fresno State Downing Planetarium
Student Assistant

I worked with the head of the Planetarium, Dr. White, on the science communication aspects of running the Planetarium. This included leading visiting school groups through crafts about astronomy, leading guided tours of the museum, and giving science demonstrations. During the monthly shows open to the public, I assisted with customer service aspects of the job as well as setting up and operating the telescope.

Service to the Profession

Science Communication and Outreach

2021-Pres. Arizona State University, SESE
Low Frequency Cosmology (LoCo) Lab Graduate Student Representative

I have represented the LoCo lab at various outreach events with SESE, along with other students. This includes answering questions about the research in the lab, leading demonstrations, and overseeing the undergraduate student representatives. I have participated in an average of two events a year over three years.

Jan. 2024 243rd Meeting of the American Astronomical Society
SESE Graduate Student Representative

I helped to organize a SESE booth at the Graduate School Fair at the 243rd AAS meeting. I was also one of the graduate student representatives who manned the booth for the length of the event. This included talking to potential graduate students and answering questions about the department and research.

Committee and Organizer Roles

Jan. 2023 241st Meeting of the American Astronomical Society
Cal-Bridge Alumni Volunteer

I was in charge of organizing and overseeing the Cal-Bridge presence at the 241st AAS Meeting. This included giving a welcome speech to the undergraduate scholars, answering questions, guiding them around the conference center, photographing the students at their presentations, and organizing group meals.

Mentoring

2021-Pres. Arizona State University, SESE
Low Frequency Cosmology (LoCo) Lab Mentor

Since the summer of 2021, I have acted as a mentor to the undergraduate students working in the LoCo lab. During the school year, I provide advice and answers to research questions for the ASU students who conduct research as part of the lab. During the summers, I act as a research mentor to the summer interns who are employed in the lab.

2020-Pres. Cal-Bridge
Alumni Volunteer

Since the fall of 2020, I have volunteered as a Cal-Bridge Alumni at various events. These have included workshops on applying to graduate school, mental health in college, and research and scientific coding. I have also provided one-on-one mentorship to undergraduate students.

2023, 2024 Arizona State University, SESE
Visitation Weekend Host

For two years, I have hosted a potential graduate student at my apartment during the SESE visitation weekend. This included driving the student to and from events, acting as a SESE representative at various events, answering questions, and giving advice regarding graduate school in general.

Awards, Honors, and Scholarships

Nov. 2024 USNC-URSI National Radio Science Meeting 2025 Travel Fellowship

Aug. 2024 Best Talk - Annual MWA Collaboration Meeting

Sp. 2021 Honorable Mention for the Graduate Research Fellowship Program - National Science Foundation

Fall 2019 Fresno State Louise and Dick Avakian Scholarship

Jan. 2020 Honorable Mention in the Chambliss Astronomy Achievement Student Award
235rd Meeting of the American Astronomical Society

2018-2019 Fresno State Louise and Dick Avakian Scholarship

2018-2019 Fresno State Physics Millennium Scholarship

2017-2018 Fresno State Physics Millennium Scholarship

2016-2017 Fresno State Cheunjit Katkanant Memorial Scholarship

2015-2016 Fresno State Improving the Image of Science in Our Society Scholarship

Presentations

Talks

(Those with an * were invited talks)

Jan. 10, 2025 *Using beam simulations to model mutual coupling coefficients in the MWA Phase II compact array*
University of Colorado, Colorado, 51st Annual National Radio Science Meeting

Aug. 28, 2024 *Using beam simulations to model mutual coupling coefficients in the MWA Phase II compact array*
EPFL Lausanne, Switzerland, MWA Project Meeting

Jan. 9, 2024 *The Effect of Mutual Coupling on the Murchison Widefield Array Beam Pattern*
New Orleans Ernest N. Morial Convention Center,
243rd Meeting of the American Astronomical Society

July 25, 2023 *The Effect of Mutual Coupling on the Murchison Widefield Array Beam Pattern*
Virtual, MWA Project Meeting

Mar. 22, 2023 *Data Processing*
Arizona State University, Radio Astronomy Bootcamp, 2023

Feb. 1, 2023 *Initial results from commissioning upgraded OVRO-LWA for 21cm Cosmology**
Virtual, LWA Friends meeting

Jan. 11, 2023 *Initial results from commissioning upgraded OVRO-LWA for 21cm Cosmology*
Washington State Convention Center, 241st Meeting of the American Astronomical Society

Aug. 28, 2021 *CHAMP Summer Research, Moderator*
Virtual, 9th Annual CAMPARE, CHAMP, and Cal-Bridge Research Symposium

Nov. 12, 2019 *Modeling Stress in Silicon Membranes **
Fresno State, Astronomy Research Group Meeting

Feb. 2, 2019 *Cal-Bridge and CAMPARE Programs Advertisement and Student Panel*
CSU East Bay, SPS Zone 18 Meeting, 2019

Sep. 8, 2018 *Constant Offset in Cross-Polarized HERA Data*
Cal Poly Pomona, 6th Annual CAMPARE, CHAMP, and Cal-Bridge Research Symposium

Mar. 3, 2018 *Graduate and Undergraduate Student Panel*
Fresno State, Sonia Kovalevsky Mathematics Day, 2018

Posters

Jan. 5, 2020 *Modeling Stress in Silicon Membranes*
Hawai'i Convention Center, 235th Meeting of the American Astronomical Society
Poster Session

Aug. 1, 2019 *Modeling Stress in Silicon Membranes*
NASA Goddard Space Flight Center, Summer Intern Poster Session

Feb. 2, 2019 *Identifying and Modeling Constant Additive Offset in HERA Visibility Data*
CSU East Bay, SPS Zone 18 Meeting, 2019

Jan. 9, 2019 *Identifying and Modeling Constant Additive Offset in HERA Visibility Data*
Washington State Convention Center, 233rd Meeting of the American Astronomical Society
Poster Session

Nov. 8, 2018 *Identifying and Modeling Constant Additive Offset in HERA Visibility Data*
Arizona State University, HERA Annual Meeting

Nov. 4, 2016 *Astronomy Outreach Through the Downing Planetarium*
Hyatt Regency San Francisco, The Physics Congress (PhysCon) Poster Session, 2016