SANAH A. BHIMANI

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AREAS OF RESEARCH

I am a cosmologist specializing in millimeter-wave (mm-wave) measurements, where I lead aspects of instrument development, automation, and systematics characterization for ground-based Cosmic Microwave Background (CMB) experiments like the Simons Observatory. I also extend this work to high-frequency mm-wave instrumentation for line-intensity mapping (LIM) experiments.

EMPLOYMENT

Sept 2024 - Present — **University of Chicago, Chicago, IL**
Postdoctoral Research Associate

EDUCATION

Yale University, New Haven, CT; *Advisor: Laura Newburgh*
Aug 2024 — Doctor of Philosophy in Physics
Jun 2023 — Master of Philosophy in Physics
Dec 2020 — Master of Science in Physics

University of California Berkeley, Berkeley, CA
Dec 2017 — Bachelor of Arts in Physics & Astrophysics

APPOINTMENTS

Sept 2024–Present — **University of Chicago**, Chicago, IL
Postdoctoral Research Associate

Jul 2018 – Jul 2019 — **Yale University**, New Haven, CT
Post-baccalaureate Research Assistant

Dec 2017 – Jun 2018 — **University of California Berkeley**, Berkeley, CA
Post-baccalaureate Research Assistant

RESEARCH EXPERIENCE

General Millimeter-Wave Optical Instrumentation & Software
Sept 2024 - present

- Prototyping high-frequency AR-coated optical components at 850 GHz for line-intensity mapping (LIM) experiments such as CCAT
- Developing ML-driven fabrication tools for metamaterial coatings, integrating microscope imaging to automate calibration, reduce human intervention, and halve production time
- Built `mml-automation`, the first Python-based control system for the Metamaterials Lab, enabling direct Aerotech hardware command removing dependence on proprietary vendor code
- Refactored `SawPy`, a 10+ year legacy codebase, into `MetaLens`–a modular software package that streamlines fabrication workflow, organized by optical component type, materials-specific process, and calibration methods
- Fabricated the first high-frequency 350GHz alumina filter for CCAT, demonstrating AR-coating feasibility beyond CMB bands

Simons Observatory (SO)
Jul 2018 - present

- Developing ML pipelines for time-domain anomaly detection that classify detector systematics and open sensitivity to astrophysical transients in timestreams
- Fabricated AR-coated lenses for Advanced-SO deployment (planned 2026), advancing SO optics readiness
- Developed a PCA-based clustering algorithm to identify sky-coupled detectors, applicable across all 4 telescopes to standardize data-quality cuts/calibration
- Member of small commissioning team that deployed to Chile and brought online SO's distributed data acquisition and telescope control software, supporting first-light operations for all 4 telescopes
- Developed new software technology for data acquisition and telescope control—primarily for cryogenic instrumentation—for stable performance of observatory operations
- Developed SQL database framework centralizing all non-detector metadata (cryogenics, calibration, environmental, platform health) at per-telescope and site-wide levels
- Led construction, calibration, and error analysis of a 280-sensor cryogenic thermometry system, achieving ±7 mK accuracy; enables precise detector monitoring and stable cryogenic performance

Hydrogen Probe of the Epoch of Reionization (HYPERION)
2016 - 2018

- Designed and constructed absorber baffles for HYPERION's 30-150 MHz band, comparing pyramidal Zotefoam geometries vs ferrite tiles; performed in-lab and on-site characterization at Owens Valley Radio Observatory with antenna return-loss (S11) measurements
- Applied PCA of simulated Epoch of Reionization signals to classify HYPERION instrument noise

Analyzing Stellar Magnetic Activity via *Kepler* Space Mission
2016 - 2018

- Developed an IDL algorithm combining autocorrelation and periodogram techniques to derive rotation periods of low-mass (cool, low-amplitude) stars from Kepler photometry

Calibrating SNO Detector Response
2015 - 2016

- Constrained changes in angular response for the Sudbury Neutrino Observatory (SNO) using MiniSim, a Monte Carlo program in C++ to help inform calibration methods in support of next-generation experiment SNO+

HONORS & AWARDS

2022 **PEO State Scholar Candidate**
Gained Connecticut state recognition by the Philanthropic Educational Organization for demonstrating potential to make significant contributions in the chosen field of study as a woman in a doctoral program.

2021 – 2022	**Yale Physics Graduate Diversity Fellowship** Awarded for implementing a framework for a long-term climate survey and database analyzed by social scientists to support tangible diversity and belonging efforts in the Physics Department.
2020 – 2021	**Warren A. and Hibernia S. Tyrrell Fellowship** Awarded to an outstanding student pursuing a Ph.D. in Physics.
2014	**Chapin-Herron Scholarship** Merit-based scholarship awarded to an undergraduate student at the University of California, Berkeley.
2014	**Estha M. Rodkey Scholarship** Merit- and need-based scholarship awarded to a UC Berkeley undergraduate.
2014	**Jean C. Witter Jr. Liberty Scholarship** Merit-based scholarship awarded to a UC Berkeley undergraduate.
2013	**Jesse Koshland Scholarship** Merit-based scholarship awarded to a UC Berkeley undergraduate.
2013	**Phoebe A. Hearst Scholarship** Merit- and need-based scholarship awarded to a UC Berkeley undergraduate.

PRESENTATIONS, PUBLICATIONS & WORKSHOPS

Presentations & Talks

June 2024	*The Simons Observatory: Deployment and Current Configuration of the Observatory Control System for SAT-MF1 and Data Access Software Systems.* Poster presented at SPIE Astronomical Telescopes + Instrumentation, Yokohama, Japan.
January 2019	*Thermometry Integration and Calibration for the Simons Observatory.* Poster presented at the 234th Meeting of the American Astronomical Society, Seattle Convention Center.
October 2018	*Thermometry Construction and Validation Process for the Simons Observatory.* Poster presented at the Wright Laboratory High Energy Physics Instrumentation Seminar, Yale University.
2019	*Cosmology - The Evolution of the Universe.* Public talk presented to the local Ismaili Muslim Connecticut community on cosmology, life as an experimental cosmologist, and being a woman in STEM.
August 2017	*Stellar Rotation Periods from the Kepler Space Mission.* Poster presented at the UC Berkeley Astrophysical Symposium, Berkeley, CA.
August 2017	*HYPERION: Characterizing Absorbers at Low Radio Frequencies.* Poster presented at the UC Berkeley Astrophysical Symposium, Berkeley, CA.

Publications with Significant Contributions

2025	Howard, C., Bhimani, S., Datta, R., Thomas, A., et al. *CCAT Collaboration: Dual-band optics optimized for the 350 GHz and 405 GHz atmospheric window.* In preparation.

2024 Bhimani, S., et al. *The Simons Observatory: Site Deployment of the Observatory Control System and Data Access Software (SAT-MF1).* Proc. SPIE 13102, *Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy XIV.*

2024 Koopman, B.J., Bhimani, S., Galitzki, N., Hasselfield, M., et al. *The Simons Observatory: Deployment of the Observatory Control System and Supporting Infrastructure.* Proc. SPIE 13102.

2024 Nguyen, H., Bhimani, S., Galitzki, N., Koopman, B.J., et al. *The Simons Observatory: Alarms and Detector Quality Monitoring.* Proc. SPIE 13102.

2020 Koopman, B.J., Lashner, J., Saunders, L.J., Hasselfield, M., Bhandardkar, T., Bhimani, S. et al. *The Simons Observatory: Overview of Data Acquisition, Control, Monitoring, and Computer Infrastructure.* Proc. SPIE 11452, *Software & Cyberinfrastructure for Astronomy VI.*

Other Publications

2025 Polzin *et al.*, *Astronomy as a Field: A Guide for Aspiring Astrophysicists.*

2024 Mangu *et al.*, *The Simons Observatory: Design, Integration, and Current Status of Small Aperture Telescopes.*

2024 Galitzki *et al.*, *The Simons Observatory: Design, Integration, and Testing of the Small Aperture Telescopes.*

2024 Errard *et al.*, *A Brief Overview of the Simons Observatory.* mmUniverse Proceedings.

2022 Bhandarkar *et al.*, *The Simons Observatory: Development and Validation of the Large Aperture Telescope Receiver.* Proc. SPIE 12190.

2022 CMB-S4 Collaboration, *Snowmass 2021 CMB-S4 White Paper.*

2021 Zhu *et al.*, *The Simons Observatory Large Aperture Telescope Receiver. The Astrophysical Journal Supplemental Series 256*, 23.

2019 CMB-S4 Collaboration, *CMB-S4 Science Case, Reference Design, and Project Plan.* FNAL Technical Report.

2019 Simons Observatory Collaboration, *The Simons Observatory: Astro2020 Decadal Project White Paper.* NASA Technical Report.

2019 CMB-S4 Collaboration, *CMB-S4 Decadal Survey APC White Paper.* NASA Technical Report.

Workshops Attended

March 2019 Advanced ACTPol CMB Data Analysis Winter School, Princeton University.

TEACHING & MENTORING EXPERIENCE

Independent Research Mentor *Mentor & Research Supervisor*

2020 – Present

- Mentored ∼90 high school students through physics and astrophysics research projects—ranging from the physics of sailing and rocket propulsion to the Standard Model and CMB cosmology—via Lumiere, Polygence, Indigo Research, Scholar Launch, and Horizon Academics.
- Guide students through ideation, literature review, methodology, data collection, analysis, and writing to produce publishable or showcase-ready manuscripts.
- Provide one-on-one feedback, structured milestones, and accountability to keep multi-month research processes on track.
- Help students submit papers to conferences, journals, or academic showcases, and coached presentations and research talks.
- Customize mentoring to each students background/goals, with flexible scaffolding for novices and advanced learners.

Physics Department, Yale University *Teaching Fellow*

2019 – 2024

- Taught undergraduate laboratory and discussion sections across courses including Modern Physical Measurement Lab, Advanced Physics Lab, Advanced Classical Physics, Electromagnetism, and Being Human in STEM.
- Guided students through experimental design, data collection, and quantitative analysis, emphasizing connections between theoretical concepts and practical measurement.
- Presented weekly lab introductions to contextualize experiments and strengthen conceptual understanding.
- Provided feedback on lab reports, led office hours, and facilitated review sessions for classes ranging from 5-150 students.

University of Central Asia, Khorog, Tajikistan *Astronomy Program Developer & Instructor*

2019 – 2021

- Developed and taught a summer programming course enabling undergraduates to analyze exoplanet rotation periods using Python and astronomical datasets.
- Designed lectures, assignments, and class activities connecting physics concepts with data analysis techniques.

Bay Area Academic Coaching Program (Online) *High School Physics Tutor*

2020 – 2021

- Tutored high-school physics students in California through the Aga Khan Development Network initiative for Afghan refugee students.
- Designed individualized problem sets and conceptual reviews to strengthen quantitative reasoning.

Yale Pathways to Science / Girls Science Investigation *Activity Leader & Panelist*

2019 – 2021

- Led hands-on physics demonstrations and discussions for middle-school students to promote early engagement in STEM.
- Collaborated with faculty and volunteers to design accessible laboratory activities.

SERVICE & LEADERSHIP

Simons Observatory (SO)

2024 – Present **SO Mentorship Program Mentor**

- Provided research and career guidance to early-career graduate student in the Simons Observatory through SOs formal mentorship initiative
- Supported mentee in project planning, technical skill development, networking, and progress across observational and instrumentation work

2020 – Present **Equity, Diversity, and Inclusion (EDI) Lead**

- Led collaboration-wide EDI initiatives including organizing town halls and analyzing the 2020 climate survey.
- Partnered with social scientists to develop a robust follow-up survey assessing collaboration climate and inclusivity.

2020 – 2022 **Ambassador to APS-IDEA Initiative**

- Served on the SO committee for the American Physical Society Inclusion, Diversity, and Equity Alliance.
- Helped design inclusive collaboration practices and climate assessments for the SO community.

2020 – 2022 **SO-NSBP Scholars Program Committee Member**

- Organized mentormentee matching for the inaugural SONSBP program and spoke on PhD experience panels.
- Provided individualized feedback on graduate school personal statements and developed CMB programming workshops.

Yale University

2022 **Panelist & Volunteer, Girls Advancing in STEM (GAINS)**

- Led demonstrations of lab work to high school students at Yales Wright Laboratory; spoke about experimental cosmology.

2019 – 2021 **Volunteer & Panelist, Yale Pathways to Science**

- Served as activity leader and science panelist for Girls Science Investigation, empowering middle school girls in STEM through hands-on labs.

2020 **Panelist, Yale Peer Pathways & CuWiP at Yale**

- Spoke on graduate school experiences, research paths, and being a woman in physics.

2019 – 2021 **Graduate Student Advisory Committee (GSAC) Representative**

- Represented early-year graduate students and served as liaison between the Director of Graduate Studies and the department.

Other Initiatives

2017 **Mentor, Bay Area Scientists in Schools (BAS)**

- Guided 7th- and 8th-grade science projects at Willard Middle School in Berkeley, CA.