Howard Hui, Ph.D.

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California Institute of Technology
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Positions

California Institute of Technology

Research Scientist *2021 – present*

SPHEREx Calibration Scientist *2020 – present*

Keck Institute for Space Studies Postdoctoral Scholar *2019 – 2021*

NASA Jet Propulsion Laboratory

Research Affiliate *2021 – present*

NASA Postdoctoral Scholar *2018 – 2019*

Education

California Institute of Technology

Ph.D. in Physics *2018*

Measuring the Polarization of the Cosmic Microwave Background with BICEP3
Advisor: Jamie Bock

Oregon State University

B.S. in Physics and B.S. in Mathematics, Cum Laude *2011*

Research Interests

Observational cosmology, cosmic microwave background, line-intensity mapping, galaxy formation

Millimeter-wave transition-edge sensors and kinetic inductance detectors

Infrared HgCdTe (H2RG) detectors

Research

Collaborations: SPHEREx, BICEP/Keck Array, CMB Stage-4

SPHEREx: All-Sky Near-IR Spectral Survey, Calibration Scientist 2019 – present

Payload, telescope optics/detector integration and calibration

Mission operations, in-orbit commissioning

Instrument systematics and calibration lead for extragalactic background light science: point spread function, airglow, and zodiacal light

Developing a new zodiacal light model from the SPHEREx all-sky spectral survey

First SPHEREx observations of atmospheric helium and oxygen airglow

Superconducting detector development 2025 – present

AlMn TES arrays for CMB-S4 prototype focal planes

Thermal kinetic inductance detectors (TKIDs)

Far-IR bolometers and readout development 2018 – 2019

Characterized TES for an 87–230 μm spectrometer, NEP $< 2 \times 10^{-19}$ W/Hz$^{1/2}$

Integrated frequency-division multiplexing readout system to the test chamber

BICEP/Keck Array: Cosmic Microwave Background (CMB) polarimeters

Caltech Instrument Team manager *2025 – present*

BICEP3 analysis lead for the BK18 inflation constraints (PRL 2021) *2016 – 2021*

BICEP3 lead graduate student: 95 GHz cryogenic focal plane and detector readout *2011 – 2018*

South Pole Deployment *2012–13, 2014–15, 2015–16, 2016–17*

Millimeter-wave detector development for cosmology and earth science 2007 – 2010

40 GHz feedhorn and TES detector development for CMB experiments (NASA Goddard)

Variable-delay Polarization Modulator development (NASA Goddard)

Anti-reflection coating for the Airborne Scanning Microwave Limb Sounder (JPL/A-SMLS)

Grants and Funding

Line Intensity Mapping 2026 Conference, Organizer — funding from the Keck Institute for Space Studies 2026

President's and Director's Fund, NASA-JPL — "Probing Inflationary CMB Polarization at 95GHz with BICEP-3", Co-I (PIs: J. Bock, O. Doré), $1,095,000 2013 – 2015

Supervised Students and Postdocs

All students and postdocs are co-advised with Jamie Bock unless otherwise noted.

Sarah Gates, Graduate Student	2025 – present
Anns Greathouse, Research Assistant	2025 – present
Ryan Wills, Graduate Student (RIT, with M. Zemcov)	2025 – present
Kazuma Noda, Graduate Student (RIT, with M. Zemcov)	2025 – present
Anika Patel, Graduate Student	2023 – present
Abby Williams, Research Assistant (with Y.T. Cheng)	2022 – 2024
Sam Condon, Research Assistant (with S. Padin)	2021 – 2023
Chi Nguyen, Postdoctoral Scholar	2020 – present
Cheng Zhang, Graduate Student	2018 – 2022
Katherine Hughes, Undergraduate Intern	2018
Raj Katti, Research Assistant	2014 – 2016

Awards

NASA Excellence in Group Achievement Award for SPHEREx	2026
JPL STAR Award for SPHEREx Focal Plane Development	2023
Keck Institute for Space Studies Affiliate	2020
California Institute of Technology Leadership Award	2018
Antarctic Service Medal	2014
NASA Graduate Research Fellowship	2013
NSF Graduate Research Fellowship, Honorable Mention	2011
Oregon State University Waldo-Cummings Award (Institute Highest Honor)	2009, Finalist: 2010
NASA Oregon Space Grant Scholarship	2008, 2009, 2010
NASA John Mather Nobel Scholar Award	2008
Oregon State University Excellence in Physics Scholarship	2008, 2009, 2010

Media Features

Building SPHEREx, Caltech News	2025
Interview with Unrealscience	2025
Faces of NASA	2022
NASA FIR Detectors Development, NASA Science	2020

Invited Talks

University of Oslo Astronomy Seminar	2026
University of Washington Astronomy Colloquium	2026
Korea Advanced Institute of Science and Technology (KAIST) Physics Seminar	2025
Chinese University of Hong Kong Physics Colloquium	2025
Cornell University Astrophysics Colloquium	2025
NASA PhysPAG EC Report	2025
Caltech Aerospace Department Guest Lecture	2025
NASA Jet Propulsion Laboratory Astrophysics Colloquium	2025
Fermilab CPC Seminar	2024
Johns Hopkins University Astrophysics Seminar	2024
Villanova University Astrophysics Colloquium	2024
University of Pennsylvania Astrophysics Seminar	2024
University of British Columbia Physics Colloquium	2022
Villanova University Astrophysics Colloquium	2022
NASA Jet Propulsion Laboratory Astrophysics Seminar	2021
Argonne National Laboratory HEP Seminar	2019
Johns Hopkins University Astrophysics Seminar	2018
UCLA HEAP Seminar	2018

Conference Presentations

SCAR Astronomy and Astrophysics from Antarctica, Phuket, Thailand	2025
Line-Intensity Mapping, Annecy, France	2025
SPIE Astronomical Instrumentation, Yokohama, Japan	2024
Line-Intensity Mapping, Urbana-Champaign, IL (Session Chair)	2024
Diffuse Cosmic Backgrounds and the Low Surface Brightness Universe, Aspen, CO	2024
Windows on the Universe, ICISE, Vietnam (Session Chair)	2023
Line-Intensity Mapping, Garching, Germany	2023
SPIE Astronomical Instrumentation, Montreal, Canada	2022
APS April Meeting, New York, NY	2022
18th Low Temperature Detectors Workshop, Milan, Italy	2019
SPIE Astronomical Instrumentation, Austin, TX	2018
CMB-S4 Collaboration Meeting, Boston, MA	2017
17th Low Temperature Detectors Workshop, Kurume, Japan	2017
SPIE Astronomical Instrumentation, Edinburgh, United Kingdom	2016

Professional Service

Line Intensity Mapping 2026 Conference, Organizer	2026
Line-Intensity Mapping Conference, Scientific Organizing Committee	2023 – present
NASA Astrophysics Review Panel	2024
CMB-S4 Publication Board	2022 – 2024
NSF Review Panel	2020 – 2024
NASA Academy Soffen Scholarship Board	2019 – 2024

Outreach

Pasadena City College Astronomy and Physics Club Guest Lecture	2019
PCC-Caltech Connection	2018 – 2020
COSPAR 2018 Assembly Outreach Volunteer, Pasadena	2018
Caltech Y Organizing Committee	2016 – 2018
Caltech Y RISE Tutor	2015 – 2017
Science Fair Judge, Pasadena	2015 – 2016
UCLA Exploring Your Universe Volunteer	2014 – 2016
NASA Student Ambassador	2010 – 2018

References

Professor Jamie Bock, jjb@astro.caltech.edu

Dr. C. Matt Bradford, charles.m.bradford@jpl.nasa.gov

Professor Steve Padin, spadin@caltech.edu

Professor John Kovac, jmkovac@cfa.harvard.edu

Selected Publications

1. M. Ashby, B. Crill, **H. Hui** et al. "Absolute Flux Calibration of the Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer (SPHEREx) Mission", submitted to ApJS (2026)
2. **H. Hui** et al. "Observations of Atmospheric Helium and Oxygen with SPHEREx", accepted to J. Geophys. Res. Atmos. (2026)
3. **H. Hui** et al. "Spectral response of SPHEREx", ApJS 284, 10 (2026)
4. C. Lisse et al. "SPHEREx Pre-Perihelion Mapping of H_2O, CO_2, and CO in Interstellar Object 3I/ATLAS", ApJL 1000, L52 (2026)
5. J. Bock et al. "The SPHEREx Satellite Mission", ApJ 999, 139 (2026)
6. C. Nguyen et al. "Improving H2RG Performance in SPHEREx Brassboard Model", ApJS 276, 43 (2025)
7. S. Condon et al. "Cryogenic Focus Measurement System for a Wide-Field Infrared Space Telescope", Appl. Opt. 63, 3453 (2024)
8. BICEP/Keck Collaboration (**Corr. Author**). "BK-XV: The BICEP3 CMB Polarimeter and the First Three Year Data Set", ApJ 927, 77 (2022)
9. BICEP/Keck Collaboration. "BK-XIII: Improved Constraints on Primordial Gravitational Waves using Planck, WMAP, and BICEP/Keck Observations through the 2018 Observing Season", PRL 127, 151301 (2021)
10. BICEP2, Keck Array, and SPIDER Collaborations. "Antenna-coupled TES Bolometers used in BICEP2, Keck Array, and SPIDER", ApJ 812, 176 (2015)
11. D. Chuss et al. "Properties of a Variable-delay Polarization Modulator", Appl. Opt. 51, 197 (2012)

Peer-Reviewed Publications

1. P. Korngut et al. "The SPHEREx Instrument: Calibration, testing and performance measurements of the NIR spectroscopic surveyor from the laboratory to in-orbit commissioning", submitted to ApJS (2026)

2. Z. Rustamkulov et al. "SPHEREx 0.75 to 5 μm Spectra for a Sequence of Nearby Brown Dwarfs", submitted to ApJ (2026)
3. A. Cukierman et al. "Spectral Map Making with SPHEREx", submitted to ApJS (2026)
4. G. Murgia et al. "SPHEREx Mapping of Galactic Diffuse Emission Reveals PAH Depletion in H II Regions", ApJ 1004, 176 (2026)
5. R. Akeson et al. "The SPHEREx image and spectrophotometry processing pipeline", ApJS 285, 67 (2026)
6. S. Bryan et al. "Optimized Satellite Operations in Low-Earth Orbit with the SPHEREx Survey Planning Software", JATIS 12(2), 027001 (2026)
7. BICEP/Keck Collaboration. "BK-XXI: Constraints on Early-Universe Parity Violation from Multipole-Dependent Birefringence", PRD 113, 123536 (2026)
8. BICEP/Keck Collaboration. "BK-XX: Component-separated maps of polarized CMB and thermal dust emission using Planck and BICEP/Keck Observations through the 2018 Observing Season", ApJ 999, 89 (2026)
9. G. Melnick et al. "The SPHEREx Ices Investigation: An Overview", ApJ 1002, 33 (2026)
10. J. Hora et al. "SPHEREx Wide-Field Infrared Spectral Mapping of Interstellar Ices and Polycyclic Aromatic Hydrocarbons", ApJ 1001, 165 (2026)
11. C. Lisse et al. "SPHEREx Reobservation of Interstellar Object 3I/ATLAS in December 2025: Detection of Increased Post-Perihelion Activity, Refractory Coma Dust, and New Coma Gas Species", Res. Notes AAS 10, 26 (2026)
12. BICEP/Keck Collaboration. "BK-XIX: Extremely Thin Composite Polymer Vacuum Windows for BICEP and Other High Throughput Millimeter Wave Telescopes", ApJ 1000, 238 (2026)
13. B. Crill et al. "The SPHEREx Sky Simulator: Science Data Modeling for the First All-Sky Near-Infrared Spectral Survey", ApJS 281, 10 (2025)
14. C. Fazar et al. "Image persistence flagging for SPHEREx", JATIS 11(1), 011208 (2025)
15. BICEP/Keck Collaboration. "BK-XVIII: Measurement of BICEP3 polarization angles and consequences for constraining cosmic birefringence and inflation", PRD 111, 063505 (2025)
16. L. Foote et al. "High-sensitivity transition-edge-sensed bolometers: improved speed and characterization with AC and DC bias", J. Appl. Phys. 134, 094503 (2023)
17. G. Heaton et al. "Noise Reduction Methods for Large-scale Intensity-mapping Measurements with Infrared Detector Arrays", ApJS 268, 44 (2023)
18. BICEP/Keck Collaboration. "BK-XVII: Line of Sight Distortion Analysis: Estimates of Gravitational Lensing, Anisotropic Cosmic Birefringence, Patchy Reionization, and Systematic Errors", ApJ 949, 43 (2023)
19. BICEP/Keck Collaboration. "BK-XVI: Characterizing Dust Polarization Through Correlations with Neutral Hydrogen", ApJ 945, 72 (2023)
20. The CMB-S4 Collaboration. "CMB-S4: Forecasting Constraints on Primordial Gravitational Waves", ApJ 926, 54 (2022)
21. BICEP/Keck Collaboration. "BK-XIV: Improved constraints on axion-like polarization oscillations in the cosmic microwave background", PRD 105, 022006, (2022)
22. BICEP/Keck and SPTPol Collaborations. "A Demonstration of Improved Constraints on Primordial Gravitational Waves with Delensing", PRD 103, 022004 (2021)
23. BICEP/Keck Collaboration. "BK-XII: Constraints on axion-like polarization oscillations in the cosmic microwave background", PRD 103, 042002 (2021)
24. Keck Array and BICEP2 Collaboration. "BK-XI: Beam Characterization and Temperature-to-Polarization Leakage in the BK15 Dataset", ApJ 884, 114 (2019)
25. Keck Array and BICEP2 Collaboration. "BK-X: Constraints on Primordial Gravitational Waves Using Planck, WMAP, and New BICEP2/Keck Observations through the 2015 Season", PRL 121, 221301 (2018)

26. Keck Array and BICEP2 Collaboration. "BK-IX: New Bounds on Anisotropies of CMB Polarization Rotation and Implications for Axion-Like Particles and Primordial Magnetic Fields", PRD 96, 102003 (2017)
27. Keck Array and BICEP2 Collaboration. "BK-VIII: Measurement of Gravitational Lensing from Large-scale B-mode Polarization", ApJ 833, 228 (2016)
28. Keck Array and BICEP2 Collaboration. "BK-VII: Matrix Based E/B Separation Applied to BICEP2 and the Keck Array", ApJ 825, 66 (2016)
29. Keck Array and BICEP2 Collaboration. "BK-VI: Improved Constraints On Cosmology and Foregrounds When Adding 95 GHz Data From Keck Array", PRL 116, 031302 (2016)
30. Keck Array and BICEP2 Collaboration. "BK-V: Measurements of B-mode Polarization at Degree Angular Scales and 150 GHz by Keck Array", ApJ 811, 126 (2015)
31. BICEP/Keck and Planck Collaborations. "A Joint Analysis of BICEP2/Keck Array and Planck Data", PRL 114, 101301 (2015)
32. Keck Array and BICEP2 Collaboration. "BK-IV: Optical Characterization and Performance of the BICEP2 and Keck Array Experiments", ApJ 806, 206 (2015)
33. M. Krejny et al. "The Hertz/VPM polarimeter: Design and first light observations", Appl. Opt. 47, 4429 (2008)
34. J. Danielson et al. "Intense narrow band terahertz generation via type-II difference-frequency generation in ZnTe using chirped optical pulses", J. Appl. Phys. 104, 033111 (2008)

Conference Proceedings

1. **H. Hui** et al. "In-orbit checkout of SPHEREx and the characterization of low-Earth-orbit foregrounds", Proceedings of the SPIE (2026)
2. C. Nguyen et al. "Tracing the boundary of the South Atlantic Anomaly region with SPHEREx transient flagging rates", Proceedings of the SPIE (2026)
3. C. Fazar et al. "A bestiary of low-level electrical artifacts in SPHEREx flight data", Proceedings of the SPIE (2026)
4. A. Steiger et al. "Status of BICEP Array and integration of the 220/270GHz receiver", Proceedings of the SPIE (2026)
5. M. Petroff et al. "Overview and status of BICEP Array's BA4-90/150 CMB polarimeter", Proceedings of the SPIE (2026)
6. B. Elwood et al. "Beam systematics and residual TP leakage in the BICEP/Keck telescopes", Proceedings of the SPIE (2026)
7. B. Cantrall et al. "Advanced time-division multiplexed readout chain for the BICEP Array 90/150 GHz receiver", Proceedings of the SPIE (2026)
8. M. Izquierdo Poza et al. "Optical characterization of the BICEP Array 150 and 220/270GHz CMB polarimeters in the 2026 season", Proceedings of the SPIE (2026)
9. A. Patel et al. "Engineering of titanium transition edge sensor wafers for the BA4-90/150 receiver of BICEP Array", Proceedings of the SPIE (2026)
10. S. Fatigoni et al. "Aliased noise characterization and mitigation in BICEP Array 150, 220 and 270GHz time-division multiplexed detectors", Proceedings of the SPIE (2026)
11. A. Polish et al. "Optics and broadband antireflection coatings for the BA4-90/150 receiver", Proceedings of the SPIE (2026)
12. C. Vergès et al. "Controlling instrumental systematics for the BICEP inflation survey", Moriond (2026)
13. S. Zhang et al. "Performance and Sensitivity of the BICEP Array 150 GHz Receiver", IEEE TAS (2026)

14. A. Patel et al. "First Integration and Testing of the Medium-Frequency Small Aperture Telescope Detector Module for CMB-S4," IEEE TAS (2026)
15. A. Steiger et al. "Design and Performance of 220 and 270 GHz Bandpass Filters for BICEP Array", IEEE TAS (2025)
16. A. Polish et al. "Improved Absolute Polarization Calibrator for BICEP CMB Polarimeters", mmUniverse (2025)
17. S. Susca et al. "Payload system design, integration, and verification challenges for an academically centered flight instrument development", IEEE (2024)
18. **H. Hui** et al. "Spectral response of the SPHEREx telescope", Proceedings of the SPIE (2024)
19. P. Korngut et al. "SPHEREx Instrument optical integration and testing campaign overview", Proceedings of the SPIE (2024)
20. C. Nguyen et al. "How to tame your dragon's breath: edge design to minimize scattered light from sources outside of SPHEREx field of view", Proceedings of the SPIE (2024)
21. C. Giannakopoulos et al. "Calibration Measurements of the BICEP3 and BICEP Array CMB Polarimeters from 2017 to 2024", Proceedings of the SPIE (2024)
22. Y. Nakato et al. "Development of the 220/270 GHz BICEP Array CMB receiver", Proceedings of the SPIE (2024)
23. S. Fatigoni et al. "Results and Limits of Time Division Multiplexing for the BICEP Array High Frequency Receivers", JLTP (2024)
24. A. Schillaci et al. "BICEP Array: 150 GHz detector module development", JLTP (2024)
25. M. Dierickx et al. "Plastic Laminate Antireflective Coatings for Millimeter-wave Optics in BICEP Array", JLTP (2024)
26. S. Condon et al. "SPHERExLabTools: A Python Data Acquisition System for SPHEREx Characterization and Calibration", Proceedings of the SPIE (2022)
27. D. Goldfinger et al. "Thermal testing for cryogenic CMB instrument design", Proceedings of the SPIE (2022)
28. S. Zhang et al. "BICEP Array 150 GHz design development and progress", Proceedings of the SPIE (2022)
29. L. Moncelsi et al. "Receiver development for BICEP Array, a next-generation CMB polarimeter at the South Pole", Proceedings of the SPIE (2020)
30. T. St. Germaine et al. "Analysis of Temperature-to-Polarization Leakage in BICEP3 and Keck CMB Data from 2016 to 2018", Proceedings of the SPIE (2020)
31. J. Cornelison et al. "Polarization Calibration of the BICEP3 CMB polarimeter at the South Pole", Proceedings of the SPIE (2020)
32. J. H. Kang et al. "Observing low elevation sky and the CMB Cold Spot with BICEP3 at the South Pole", Proceedings of the SPIE (2020)
33. A. Schillaci et al. "Design and performance of the first BICEP Array receiver", JLTP (2019)
34. C. Zhang et al. "Characterizing the Sensitivity of 40 GHz TES Bolometers for BICEP Array", JLTP (2019)
35. T. St. Germaine et al. "Optical characterization of the Keck Array and BICEP3 CMB Polarimeters from 2016 to 2019", JLTP (2019)
36. A. Cukierman et al. "Microwave multiplexing on the Keck Array", JLTP (2019)
37. A. Soliman et al. "Design and Characterization of Antenna-Coupled 30/40 GHz Detectors and Modules for the BICEP Array Experiment", JLTP (2019)
38. J. H. Kang et al. "2017 upgrade and performance of BICEP3: a 95GHz refracting telescope for degree-scale CMB polarization", Proceedings of the SPIE (2018)
39. M. Crumrine et al. "BICEP Array cryostat and mount design", Proceedings of the SPIE (2018)
40. **H. Hui** et al. "BICEP Array: a multi-frequency degree-scale CMB polarimeter", Proceedings of the SPIE (2018)

41. D. Barkats et al. "Ultra-Thin Large-Aperture Vacuum Windows for Millimeter Wavelengths Receivers", Proceedings of the SPIE (2018)
42. A. Soliman et al. "Design and performance of wide-band corrugated walls for the BICEP Array detector modules at 30/40 GHz", Proceedings of the SPIE (2018)
43. B. Racine et al. "Measurements of Degree-Scale B-mode Polarization with the BICEP/Keck Experiments at South Pole", Moriond (2018)
44. J. Grayson et al. "BICEP3 performance overview and planned Keck Array upgrade", Proceedings of the SPIE (2016)
45. K. Karkare et al. "Optical Characterization of the BICEP3 CMB Polarimeter at the South Pole", Proceedings of the SPIE (2016)
46. **H. Hui** et al. "BICEP3 focal plane design and detector performance", Proceedings of the SPIE (2016)
47. W. L. K. Wu et al. "Initial Performance of BICEP3: A Degree Angular Scale 95 GHz Band Polarimeter", JLTP (2016)
48. Z. Ahmed et al. "BICEP3: a 95GHz refracting telescope for degree-scale CMB polarization", Proceedings of the SPIE (2014)
49. I. Buder et al. "BICEP2 and Keck array: upgrades and improved beam characterization", Proceedings of the SPIE (2014)
50. K. S. Karkare et al. "Keck array and BICEP3: spectral characterization of 5000+ detectors", Proceedings of the SPIE (2014)
51. R. O'Brient et al. "Antenna-coupled TES bolometers for the Keck array, Spider, and Polar-1", Proceedings of the SPIE (2012)
52. R. W. Ogburn et al. "BICEP2 and Keck array operational overview and status of observations", Proceedings of the SPIE (2012)
53. G. Voellmer et al. "A large free-standing wire grid for microwave variable-delay polarization modulation", Proceedings of the SPIE (2008)