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Colin Bischoff

Education and Employment

2022–present	Associate professor, University of Cincinnati Department of Physics
2016–2022	Assistant professor, University of Cincinnati Department of Physics
2013–2016	Research associate, Harvard-Smithsonian Center for Astrophysics, Supervisor: John Kovac
2010–2013	Postdoctoral fellow, Harvard-Smithsonian Center for Astrophysics, Supervisor: John Kovac
2002–2010	University of Chicago, Ph.D. in physics. Thesis title: *Observing the Cosmic Microwave Background Polarization Anisotropy at 40 GHz with QUIET*, Advisor: Bruce Winstein
1998–2002	Stanford University, B.S. in physics with honors. Thesis title: *Synchrotron X-Ray Scattering Study of Structural Distortions in the Double-Layer Manganite* $La_{1.2}Sr_{1.8}Mn_2O_7$, Thesis advisor: Martin Greven

Awards

2020	University of Cincinnati Innovative Use of Technology in Teaching Award
2012	Antarctic Service Medal for deployment to the South Pole

Teaching

Fall 2023	Instructor for PHYS 1020, The Solar System; 52 students
Spring 2023	Instructor for PHYS 3041, Instrumentation and Methods in Astronomy; 29 students
Fall 2022	Instructor for PHYS 1020, The Solar System; 51 students
Spring 2022	Instructor for PHYS 1021, Stars and Galaxies; 41 students
Fall 2021	Instructor for PHYS 1020, The Solar System; 79 students
Spring 2021	Instructor for PHYS 3041, Instrumentation and Methods in Astronomy; 44 students
Fall 2020	Instructor for PHYS 1020, The Solar System; 34 students
Fall 2019	Instructor for PHYS 4025/8025, Introduction to Astrophysics; 25 students (21 undergrad, 4 grad)
Spring 2019	Instructor for PHYS 4026/8026, Cosmology; 11 students (9 undergrad, 2 grad)
Fall 2018	Instructor for PHYS 4025/8025, Introduction to Astrophysics; 20 students (12 undergrad, 8 grad)

Teaching (continued)

Fall 2017	Instructor for PHYS 4025/8025, Introduction to Astrophysics; 22 students (17 undergrad, 5 grad)
Fall 2016	Instructor for PHYS 4025/8025, Introduction to Astrophysics; 26 students (14 undergrad, 12 grad)
Fall 2013	Teaching fellow for Harvard University Computer Science 109/Statistics 121/Applied Computation 209: Data Science including development of lab assignments, Profs. Hanspeter Pfister (Computer Science) and Joe Blitzstein (Statistics)

Advising and Mentoring

Ph.D. Students

2023–present	Margaret Lautzenhiser (University of Cincinnati physics), anticipated graduation 2028.
2021–present	Michael Zito (University of Cincinnati physics), anticipated graduation 2026.
2020–present	Christos Giannakopoulos (University of Cincinnati physics), anticipated graduation 2025.
2018–2023	Emma Hand (University of Cincinnati physics). Thesis title: *ILC Analysis of BICEP2 and Keck Array CMB Polarization Data through the 2015 Observing Season.*
2017–2021	Steven Palladino (University of Cincinnati physics). Thesis title: *Constraining Primordial Gravitational Waves with BICEP/Keck Array Telescopes and Developing the BICEP Array Housekeeping System.* Received Dean's Dissertation Completion Fellowship for 2020–2021 academic year.

Masters Students

2021–2022	Kyle Weeks (University of Cincinnati physics). Thesis title: *The BICEP Array Housekeeping System and the Calibration of the Daughter Cards.*
2018–2019	Hunter Fryman-Sinkhorn (University of Cincinnati physics). Thesis title: *Sidelobe Analysis of BICEP3 Calibration Data.*
2016–2017	Jessica Kerby (University of Cincinnati physics).

Undergraduate Student Research

2022–present	Lauren Bell (University of Cincinnati physics); Capstone: *Foreground Scaling in the BICEP/Keck 2018 Likelihood.*
2021–present	Aedhan Scott (University of Cincinnati physics). Convolutional neural networks applied to CMB maps; polarized optical systematics.
2021–2023	Eli Meisel (University of Cincinnati physics), graduated 2023; Capstone: *Higher Order Temperature to Polarization Leakage Analysis of BICEP3 Beam Maps Using Shapelets with Applications to CMB-S4.*
2023	Varrick Bippus (University of Cincinnati physics), graduated 2023; Capstone: *Researching Variable Stars and the Difficulties of Finding Them.*

Advising and Mentoring (continued)

2022–2023	Ben Ellis (University of Cincinnati physics), graduated 2023; Capstone: *Cosmic Microwave Background Polarization: How Foreground Dust Correlates across Frequency.*
2021–2023	Jeremy Webb (University of Cincinnati physics), graduated 2023; Capstone: *CMB-S4 Data Visualization.*
2020–2021	Francesca Gear (University of Cincinnati astrophysics), graduated 2021; Capstone: *Separating the Cosmic Microwave Background from Galactic Foregrounds Using Generalized Morphological Component Analysis.*
2020–2021	Charles Skerbec (University of Cincinnati astrophysics), graduated 2021; Capstone: *Pure B Filtering with a Convolutional Neural Network.*
2020	Ranjit Sapkota (University of Cincinnati physics), graduated 2020; Capstone: *Decorrelation of the CMB Foreground due to spatially varying spectral index.*
2018–2020	Michael Ray (University of Cincinnati physics), graduated 2021. Developing pure-B estimators using messenger method.
2018–2019	Evan Powers (University of Cincinnati physics), graduated 2021. Likelihood analysis of B-mode power spectra.
2018–2019	Chancelor Roberts (University of Cincinnati physics), graduated 2021. Likelihood analysis of B-mode power spectra.
2018	Anthony Crawford (University of Cincinnati physics); MUSE summer project: *Separating Cosmic Microwave Background Radiation from Foreground Contamination.*
2018	Rajpreet Kaur (University of Cincinnati physics); Women in Science and Engineering (WISE) summer project: *Identifying and separating foreground contaminations from CMB signal.*
2017–2018	Josh Roberson (University of Cincinnati astrophysics), graduated 2018; Capstone: *Comparison of Likelihood Approximations for CMB Power Spectra.*
2017–2018	Sushmita Walve (University of Cincinnati physics), graduated 2018; Capstone: *Characterization of Dust Polarization in Planck 353 GHz Maps.*
2017	Doris Dolezal (University of Cincinnati physics/astrophysics), graduated 2017; Capstone: *CMB Polarization Maps and Pure B-mode Filtering: A Study of the Messenger Method.*
2017	Adam Heinemann (University of Cincinnati physics/astrophysics), graduated 2017; Capstone: *Blind Separation of CMB from Foregrounds.*

Funding

- "Research in Particle and Cosmology Theory and Experiment at the University of Cincinnati (Task C)," Department of Energy Office of Science award number DE-SC0011784. Award amount $330,000. Awarded April 1 2023.
- "Collaborative Research: Imaging the Beginning of Time from the South Pole: Completing the BICEP Array Survey," National Science Foundation award number 2220447. Award amount $800,366. Awarded September 1 2022.

Funding (continued)

- "Research in Particle and Cosmology Theory and Experiment at the University of Cincinnati (Task C)," Department of Energy Office of Science award number DE-SC0011784. Award amount $300,000. Awarded April 1 2020.
- "Understanding instrumental systematics for the CMB-S4 ultra-deep survey," National Science Foundation award number 2009469. Award amount $237,741. Awarded June 26 2020.
- "Collaborative Research: Elements: Software: NCSI: HDR: Building An HPC/HTC Infrastructure For The Synthesis And Analysis Of Current And Future Cosmic Microwave Background Datasets," National Science Foundation award number 1835536. Award amount $39,005. Awarded August 14 2018.
- "MSIP: Innovation to Achieve the Full Science Reach of the BICEP Array Stage 3 CMB Polarization Experiment," National Science Foundation award number 1836010. PI Chao-Lin Kuo (Stanford). Cincinnati sub-award amount $80,125. Awarded August 7 2018. Supplemental funding of $138,038 awarded in 2021.

Education Proposals

- "Computing for the Astrophysics Classroom," Ohio Supercomputer Center grant PES0799. Awarded 10000 Resource Units (equivalent to 100,000 computing hours). Awarded August 26 2019.
- "Analysis and Computing for the Cosmology Classroom," Ohio Supercomputer Center grant PES0780. Awarded 5000 Resource Units (equivalent to 50,000 computing hours). Awarded January 22 2019.
- "Data Analysis for the Astrophysics Classroom," Ohio Supercomputer Center grant PES0743. Awarded 5000 Resource Units (equivalent to 50,000 computing hours). Awarded August 28 2018.
- "Data Analysis for the Astrophysics Classroom," Ohio Supercomputer Center grant PES0743. Awarded 5000 Resource Units (equivalent to 50,000 computing hours). Awarded August 25 2017.

Publications

37. S. Belkner, J. Carron, L. Legrand, C. Umiltà, C. Pryke, and C. Bischoff 2023, *CMB-S4: Iterative internal delensing and r constraints*, submitted to Astrophys. J., arXiv:2310.06729
36. The BICEP/Keck Collaboration 2022, *BICEP/Keck XVII: Line of Sight Distortion Analysis: Estimates of Gravitational Lensing, Anisotropic Cosmic Birefringence, Patchy Reionization, and Systematic Errors*, ApJ 949, 2, 43
35. The BICEP/Keck Collaboration 2023, *BICEP/Keck XVI: Characterizing Dust Polarization Through Correlations with Neutral Hydrogen*, ApJ 945, 1, 72
34. The BICEP/Keck Collaboration 2022, *BICEP/Keck XV: The BICEP3 CMB Polarimeter and the First Three Year Data Set*, ApJ 927, 1, 77
33. CMB-S4 Collaboration 2022, *CMB-S4: Forecasting Constraints on Primordial Gravitational Waves*, ApJ 926, 1, 54
32. The BICEP/Keck Collaboration 2022, *BICEP/Keck XIV: Improved constraints on axion-like polarization oscillations in the cosmic microwave background*, Phys. Rev. D 105, 022006

Publications (continued)

31. The BICEP/Keck Collaboration 2021, *BICEP/Keck XIII: Improved Constraints on Primordial Gravitational Waves using Planck, WMAP, and BICEP/Keck Observations through the 2018 Observing Season*, Phys. Rev. Lett. 127, 151301

30. The BICEP/Keck Collaboration 2021, *BICEP/Keck XII: Constraints on axion-like polarization oscillations in the cosmic microwave background*, Phys. Rev. D 103, 042002

29. The BICEP/Keck and SPTpol Collaborations 2021, *A demonstration of improved constraints on primordial gravitational waves with delensing*, Phys. Rev. D 103, 022004

28. Keck Array and BICEP2 Collaborations 2019, *BICEP2/Keck Array XI: Beam Characterization and Temperature-to-Polarization Leakage in the BK15 Dataset*, ApJ 844, 2, 114

27. Keck Array and BICEP2 Collaborations 2018, *BICEP2/Keck Array X: Constraints on Primoridal Gravitational Waves Using Planck, WMAP, and New BICEP2/Keck Observations through the 2015 Season*, Phys. Rev. Lett. 121, 221301

26. Keck Array and BICEP2 Collaborations 2017, *BICEP2/Keck Array IX: New Bounds on Anisotropies of CMB Polarization Rotation and Implications for Axion-Like Particles and Primordial Magnetic Fields*, Phys. Rev. D 96, 102003

25. Keck Array and BICEP2 Collaborations 2016, *BICEP2/Keck Array VIII: Measurement of Gravitational Lensing from Large-scale B-mode Polarization*, ApJ 833, 2, 228

24. Keck Array and BICEP2 Collaborations 2016, *BICEP2/Keck Array VII: Matrix Based E/B Separation Applied to BICEP2 and the Keck Array*, ApJ 825, 1, 66

23. Keck Array and BICEP2 Collaborations 2016, *BICEP2/Keck Array VI: Improved Constraints On Cosmology and Foregrounds When Adding 95 GHz Data From Keck Array*, Phys. Rev. Lett. 116, 031302

22. BICEP2 Collaboration 2015, *BICEP2 III: Instrumental Systematics*, ApJ 814, 2, 110

21. BICEP2/Keck and Planck Collaborations 2015, *A Joint Analysis of BICEP2/Keck Array and Planck Data*, Phys. Rev. Lett. 114, 101301

20. BICEP2, Keck Array, and SPIDER Collaborations 2015, *Antenna-coupled TES bolometers used in BICEP2, Keck Array, and SPIDER*, ApJ 812, 2, 176

19. BICEP2 and Keck Array Collaborations 2015, *BICEP2/Keck Array V: Measurements of B-mode Polarization at Degree Angular Scales and 150 GHz by the Keck Array*, ApJ 811, 2, 126

18. T. Ruud et al. 2015, *The Q/U Imaging ExperimenT: Polarization Measurements of the Galactic Plane at 43 and 95 GHz*, ApJ 811, 2, 89

17. BICEP2 and Keck Array Collaborations 2015, *BICEP2/Keck Array. IV. Optical Characterization and Performance of the BICEP2 and Keck Array Experiments*, ApJ 806, 2, 206

16. Abazajian et al. 2015, *Inflation physics from the cosmic microwave background and large scale structure*, Astropart. Phys. 63, 55, Snowmass white paper

15. Abazajian et al. 2015, *Neutrino physics from the cosmic microwave background and large scale structure*, Astropart. Phys. 63, 66, Snowmass white paper

14. Huffenberger et al. 2014, *The Q/U Imaging ExperimenT: Polarization Measurements of Radio Sources at 43 and 95 GHz*, ApJ 806, 1, 112

13. BICEP2 Collaboration 2014, *BICEP2 II: Experiment and Three-Year Data Set*, ApJ 792, 1, 62

Publications (continued)

12. BICEP2 Collaboration 2014, *BICEP2 I: Detection of B-Mode Polarization at Degree Angular Scales*, Phys. Rev. Lett. 112, 241101

11. J. Kaufman et al. 2014, *Self-Calibration of BICEP1 Three-Year Data and Constraints on Astrophysical Polarization Rotation*, Phys. Rev. D 89, 062006

10. D. Barkats et al. 2014, *Degree-Scale CMB Polarization Measurements from Three Years of BICEP1 Data*, ApJ 783, 2, 67

9. QUIET Collaboration 2013, *The Q/U Imaging ExperimenT Instrument*, ApJ 768, 1, 9

8. S. Moyerman et al. 2013, *Scientific Verification of Faraday Rotation Modulators: Detection of Diffuse Polarized Galactic Emission*, ApJ 765, 1, 64

7. QUIET Collaboration 2012, *Second Season QUIET Observations: Measurements of the CMB Polarization Power Spectrum at 95 GHz*, ApJ 760, 2, 145

6. O. Tajima, H. Nguyen, C. Bischoff, A. Brizius, I. Buder, and A. Kusaka 2012, *Novel calibration system with sparse wires for CMB polarization receivers*, J. Low Temp. Phys. 167, 936

5. Z. Staniszewski et al. 2012, *The Keck Array: A Multi Camera CMB Polarimeter at the South Pole*, J Low Temp. Phys. 167, 827

4. QUIET Collaboration 2011, *First Season QUIET Observations: Measurements of Cosmic Microwave Background Polarization Power Spectra at 43 GHz in the Multipole Range* $25 \leq \ell \leq 475$, ApJ 741, 2, 111

3. C. Bischoff et al. 2008, *New Measurements of Fine-Scale CMB Polarization Power Spectra from CAPMAP at Both 40 and 90 GHz*, ApJ 684, 2, 771

2. D. Barkats et al. 2005, *CMB Polarimetry using Correlation Receivers with the PIQUE and CAPMAP Experiments*, ApJS 159, 1, 1

1. D. Barkats et al. 2005, *First Measurements of the Polarization of the Cosmic Microwave Background Radiation at Small Angular Scales from CAPMAP*, ApJ 619, 2, L127

White Papers

4. Carlstrom et al. 2019, *CMB-S4*, arXiv:1908.01062

3. Abazajian et al. 2019, *CMB-S4 Science Case, Reference Design, and Project Plan*, arXiv:1907.04473

2. Abitbol et al. 2017, *CMB-S4 Technology Book, First Edition*, arXiv:1706.02464

1. Abazajian et al. 2016, *CMB-S4 Science Book, First Edition*, arXiv:1610.02743

Conference Proceedings

2. C. Bischoff for the BICEP/Keck Collaboration 2016, *Measurements of Degree-Scale B-mode Polarization with BICEP2, Keck Array, and BICEP3*, in: Proc. Moriond Cosmology 2016, E. Augé, J. Dumarchez, & J. T. T. Vân (eds.), 19

Publications (continued)

1. C. Bischoff for the BICEP Collaboration 2013, *A CMB B-mode Search with Three Years of BICEP Observations*, in: Proc. IAU Symposium No. 288, Astrophysics from Antarctica, M. G. Burton, X. Cui, & N. F. H. Tothill (eds.), 61

Collaborations

- BICEP/Keck Collaboration and South Pole Observatory: Senior Member.
- CMB-S4 Collaboration: Senior Member. Science Council co-chair. Level-3 lead for Data Reduction. Previously served as co-chair for Low-ℓ BB Analysis Working Group and chair of the Education and Public Outreach committee.

Talks

- *Observing the Origin of the Universe from the South Pole*; 2nd US Antarctic Science Meeting, June 21 2023
- *Searching for B Modes with BICEP3 and BICEP Array*; University of Illinois Astronomy Colloquium, February 28 2023
- *New B-mode Results from BICEP3 and Keck Array*; University of Oslo Cosmoglobe workshop, May 6 2022
- *Constraints on Primordial Gravitational Waves from the BICEP/Keck Telescopes*; Purdue Astronomy seminar, April 25 2022
- *BICEP/Keck Overview*; University of Oslo Cosmoglobe workshop, June 9 2021
- *Systematics control and mitigation for BICEP/Keck deep polarization maps*; Kavli IPMU CMB systematics and calibration workshop (invited talk), November 30 2020
- *The Search for Primordial Gravitational Waves with CMB Polarization*; 223rd Meeting of the American Astronomical Society, January 7 2019
- *New Results from BICEP/Keck*; University of Chicago Astronomy Seminar, December 5 2018
- *Constraining Cosmological Inflation with the BICEP/Keck Telescopes*; Wright State University Physics Seminar, March 21 2017
- *Status of BICEP3 and Keck Array*; University of Illinois Urbana-Champaign Astronomy Seminar, July 14 2017
- *Polarized Foregrounds for CMB Observations*; NRAO Futures II (invited talk), August 3 2016
- *Constraining Cosmological Inflation with BICEP2, Keck Array, and BICEP3*; Argonne National Laboratory Physics Seminar, April 20 2016
- *Measurements of Degree-Scale B-mode Polarization with BICEP2, Keck Array, and BICEP3*; Rencontres de Moriond Cosmology (invited talk), March 20 2016
- *Constraining Cosmological Inflation with BICEP2, Keck Array, and BICEP3*; University of Cincinnati Physics Colloquium, February 25 2016

Talks (continued)

- *Measurements of Degree-Scale B-mode Polarization with BICEP2, Keck Array, and BICEP3*; Marcel Grossmann 14, July 14 2015
- *Joint Analysis of BICEP2, Keck Array, and Planck*; Boston University Astronomy Colloquium, March 2 2015
- *Joint Analysis of BICEP2, Keck Array, and Planck*; Kavli Institute for Cosmological Physics Friday Seminar, February 13 2015
- *Beam Mapping for BICEP2 and Keck Array*; UC San Diego CMB group meeting, May 20 2014
- *Detection of B-Mode Polarization at Degree Scales Using BICEP2*; UC Davis Physics Colloquium, April 21 2014
- *Detection of B-Mode Polarization at Degree Scales Using BICEP2*; Boston University High Energy Experimental Physics Seminar, April 17 2014
- *Detection of B-Mode Polarization at Degree Scales Using BICEP2*; NRC Herzberg Institute for Astrophysics and University of Victoria Physics Colloquium, April 8 2014
- *Detection of B-Mode Polarization at Degree Scales Using BICEP2*; Harvard-Smithsonian Institute for Theory and Computation, April 3 2014
- *Final Results from Three Years of Observations with the BICEP Telescope*; Kavli Institute for Cosmological Physics Friday Seminar, May 17 2013
- *Final Results from Three Years of Observations with the BICEP Telescope*; American Physical Society April Meeting, April 13 2013
- *Final Results from Three Years of Observations with the BICEP Telescope (almost)*; International Astronomical Union XXVIII General Assembly, August 21 2012
- *Final Results from Three Years of Observations with the BICEP Telescope (almost)*; Scientific Committee for Antarctic Research XXXII Open Science Conference, July 18 2012
- *Current Status of QUIET*; American Physical Society April Meeting, February 13 2010
- *Measuring CMB Polarization with QUIET*; Lawrence Berkeley National Lab Research Progress Meeting, November 24 2009
- *Current Status of QUIET*; Santa Fe '09 Cosmology Summer Workshop, July 9 2009
- *Measuring CMB Polarization from the Garden State with CAPMAP*; The Path to CMBPol – Upcoming Measurements of CMB Polarization, July 1 2009
- *The QUIET Polarimeter Array*; URSI National Radio Science Meeting, January 4 2007

Education Talks

- *Teaching Data Analysis with Jupyter Notebooks*, University of Cincinnati Center for Enhancement of Teaching & Learning workshop, April 12 2021

Public Outreach

- *How to study the origin of our universe*; virtual presentation to Mason High School Science National Honor Society, Mason OH, November 15 2021.
- *Skype a Scientist*; video chat with 5th grade science classes from Albright Middle School, Villa Park IL, June 3 2021.
- *CMB-S4 Saturday Science Series*; virtual lecture on CMB science to high school students, April 17 2021.
- *Skype a Scientist*; video chat with 6th grade science classes from Jack M Barrack Hebrew Academy, Bryn Mawr PA, March 18 2021.
- *Ask a Scientist*; video chat with 6th grade science class from Bellevue-Santa Fe Charter School, San Luis Obispo CA, December 19 2019.
- *Sharing Science Workshop*; Cincinnati Museum Center, March 27 2019.
- *Ask a Scientist*; video chat with 6th grade science class from Bellevue-Santa Fe Charter School, San Luis Obispo CA, November 9 2017.
- *Astronomy from the Bottom of the World*; keynote address for Cincinnati Observatory ScopeOut, September 23 2017.
- *Cosmology from Antarctica*; University of Cincinnati AstroDay, October 15 2016.
- *Observing the Origin of the Universe from Antarctica*; Keene Public Library Astronomy Lecture Series, February 29 2016.
- *Observing the Origin of the Universe from the South Pole*; Smithsonian's Stars Lecture, Smithsonian National Air and Space Museum, January 24 2015.
- *Observing the Origin of the Universe from the South Pole*; Presentation to the Cape Cod Astronomical Society in Yarmouth, MA, September 9 2014.
- *South Pole Astronomy*; exhibit for DiscoverSTEM 2013 at Acton-Boxborough Regional High School, November 4 2013.
- *Observing the Origin of the Universe from the South Pole*; Presentation to the Cape Cod Astronomical Society in Yarmouth, MA, August 1 2013.
- *Observing the Universe from Antarctica*; Teen program at the Malden Public Library in Malden, MA, July 29 2011.
- *Cosmology at the South Pole*; Lecture at the Gleason Public Library in Carlisle, MA, March 16 2011.
- *Bang! The Origin of the Universe*; Teen program at the Homewood Public Library in Homewood, IL, 2007.

Professional Service

- Member of American Physical Society, American Astronomical Society, and International Astronomical Union.
- Reviewer for Astrophysical Journal, Journal of Astronomical Instrumentation.
- Panel and ad-hoc reviewer for National Science Foundation. Panel reviewer for Department of Energy Office of Science. Ad-hoc reviewer for Centre National de la Recherche Scientifique (CNRS).