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Education:

- Ph.D.** Physics, University of California, Berkeley, 1995.
Advisor: Professor Joseph Silk.
- M.A.** Physics, University of California, Berkeley, 1993.
- A.B.** Physics, Princeton University, 1989 (magna cum laude).

Professional Experience:

- **University of Richmond**, Physics Department Chair (2010-11, 2015 - present).
- **University of Richmond**, Physics Department. Professor. (2018 - present)
- **University of Richmond**, Physics Department. Associate Professor. (2008 - 2018)
- **University of Richmond**, Physics Department. Assistant Professor. (2002-2008)
- **Brown University**, Physics Department. Visiting Scientist. (Research leave appointment, 2006.)
- **Massachusetts Institute of Technology**, Physics Department and Kavli Center for Space Research. Visiting Assistant Professor. (Research leave appointment, 2006.)
- **St. Cloud State University**, Physics and Astronomy Department. Assistant Professor. (1999-2002)
- **Bates College**, Physics and Astronomy Department. Assistant Professor. (1996-1999)
- **U.C. Berkeley**. Postdoctoral Researcher. (1995–1996)
- **San Francisco Conservatory of Music**. Part-Time Collegiate Professor. (Spring 1996)
- **U.C. Berkeley**, Physics Department. Lecturer. (Fall 1995)
- **U.C. Berkeley**, Astronomy Department. Acting Instructor. (Fall 1991)
- **Moses Brown School**. High School Physics Teacher. (1989–1990)

Courses Taught:

- **University of Richmond:** Calculus-based introductory physics I and II, modern physics, general astronomy with lab, junior seminar, senior seminar, relativity and cosmology, mathematical methods in physics, quantum mechanics II, statistical mechanics, electricity and magnetism I and II, first-year seminar, cosmology, astrophysics.
- **St. Cloud State University:** Algebra-based introductory physics I and II, modern physics, general astronomy, extragalactic astronomy and cosmology, applied theoretical physics (i.e., mathematical and computational methods).
- **Bates College:** Introduction to stellar & galactic astronomy, introduction to cosmology, calculus-based introductory physics I and II, quantum mechanics II, thermodynamics, electromagnetic theory, mathematical methods, astrophysics (for physics majors), engineering physics.
- **San Francisco Conservatory of Music:** Conceptual Physics.
- **U.C. Berkeley:** Calculus-based introductory physics, introduction to ancient & modern cosmology. (These are courses for which I was primary instructor; teaching assistantships are not listed.)

Publications in Refereed Journals:

Number of refereed publications: 53.

- E.S. Battistelli et al., “QUBIC: The Q & U Bolometric Interferometer for Cosmology,” accepted for publication in the *Journal of Low Temperature Physics* (2020).
- M.M. Gamboa Lerena et al., “Angular resolution at map level in the QUBIC instrument,” *Boletín de la Asociación Argentina de Astronomía*, 61B, 155 (2020).
- S. Marnieros et al., “TES bolometer arrays for the QUBIC B-mode CMB experiment,” *Journal of Low Temperature Physics* 199, 955 (2020).
- M. Ghrear*, E.F. Bunn, D. Contreras, and D. Scott, “Testing for directionality in the Planck polarization and lensing data,” *Monthly Notices of the Royal Astronomical Society*, 490, 3404 (2019).
- D.L. Jow*, D. Contreras, D. Scott, and E.F. Bunn, “Taller in the saddle: constraining CMB physics using saddle points,” *Journal of Cosmology and Astroparticle Physics*, 3, 31 (2019).
- J. Singal et al., “The Radio Synchrotron Background: Conference summary and report,” *Publications of the Astronomical Society of the Pacific*, 130, 036001 (2018).
- T. Louis, E.F. Bunn, B. Wandelt, and J. Silk, “Measuring polarized emission in clusters in the CMB S4 era,” *Physical Review D*, 96, 123509 (2017).

- E.F. Bunn and B. Wandelt, “Pure E and B polarization maps via Wiener filtering,” *Physical Review D*, 96, 043523 (2017).
- E.F. Bunn, Q. Xue*, and H. Zheng*, “Testing cosmological models with large-scale power modulation using microwave background polarization observations,” *Physical Review D*, 94, 10352 (2016).
- A. Tartari et al., “QUBIC: A Fizeau interferometer targeting primordial B-modes,” *Journal of Low Temperature Physics*, 184, 739 (2016).
- H. Liu* and E.F. Bunn, “Fisher matrix optimization of cosmic microwave background interferometers,” *Physical Review D*, 93, 023512 (2016).
- L. Zhang et al., “Bayesian semi-blind component separation for foreground removal in interferometric 21-cm observations,” *Astrophysical Journal Supplement*, 222, 3 (2016).
- A. Ghribi et al., “Latest progress on the QUBIC instrument,” *Journal of Low Temperature Physics*, 176, 698 (2014).
- P.M. Sutter et al., “Probabilistic image reconstruction for radio interferometers,” *Monthly Notices of the Royal Astronomical Society*, 438, 768 (2014).
- A. Karakci et al., “Systematic effects in interferometric observations of the CMB polarization,” *Astrophysical Journal Supplement*, 207, 14 (2013).
- L. Zhang et al., “Maximum likelihood analysis of systematic errors in interferometric observations of the cosmic microwave background,” *Astrophysical Journal Supplement*, 206, 24 (2013).
- A. Karakci et al., “Bayesian inference of polarized cosmic microwave background power spectra from interferometric data,” *Astrophysical Journal Supplement*, 204,10 (2013).
- M. Piat et al., “QUBIC: the Q and U Bolometric Interferometer for Cosmology,” *Journal of Low Temperature Physics*, 167, 872 (2012).
- E.F. Bunn, “Efficient decomposition of cosmic microwave background polarization maps into pure E, pure B, and ambiguous components,” *Physical Review D*, 83, 083003 (2011).
- E. Battistelli et al., “QUBIC: The QU bolometric interferometer for cosmology,” *As-troparticle Physics*, 34, 705 (2011).
- H. Zheng* and E.F. Bunn, “Cosmic microwave background constraints on cosmological models with large-scale isotropy breaking,” *Physical Review D* 82, 063533 (2010).
- R. Charlassier, E.F. Bunn, J.-Ch. Hamilton, J. Kaplan, and S. Malu, “Bandwidth in bolometric interferometry,” *Astronomy & Astrophysics* 514, A37 (2010).
- E.F. Bunn, “Evolution and the second law of thermodynamics,” *American Journal of Physics*, 77, 922 (2009).

*Asterisks indicate undergraduate collaborators

*Asterisks indicate undergraduate collaborators.

- E.F. Bunn and D.W. Hogg, “The kinematic origin of the cosmological redshift,” *American Journal of Physics*, 77, 688 (2009).
- P. Hyland, B. Follin*, and E.F. Bunn, “Phase shift sequences for an adding interferometer,” *Monthly Notices of the Royal Astronomical Society*, 393, 531 (2009).
- E.F. Bunn and A. Bourdon*, “Contamination cannot explain the lack of large-scale power in the cosmic microwave background radiation,” *Physical Review D*, 78, 123509 (2008).
- T. Faulkner, M. Tegmark, E.F. Bunn, Y. Mao, “Constraining $f(R)$ gravity as a scalar tensor theory,” *Physical Review D*, 76, 063505 (2007).
- D. Hanson*, D. Scott, and E.F. Bunn, “Directionality in the WMAP polarization data,” *Monthly Notices of the Royal Astronomical Society*, 381, 2 (2007).
- E.F. Bunn, “Systematic errors in cosmic microwave background interferometry,” *Physical Review D*, 75, 083517 (2007).
- E.F. Bunn and M. White, “Mosaicking with cosmic microwave background interferometers,” *Astrophysical Journal* 655, 21 (2007).
- E.F. Bunn, “Probing the Universe on gigaparsec scales with remote cosmic microwave background quadrupole measurements,” *Physical Review D*, 73, 123517 (2006).
- J.C. Baez and E.F. Bunn, “The meaning of Einstein’s equation,” *American Journal of Physics*, 73, 653 (2005).
- E.F. Bunn, M. Zaldarriaga, M. Tegmark, and A. de Oliveira-Costa, “E/B decomposition of finite pixelized CMB maps,” *Physical Review D*, 67, 023501 (2003).
- M.E. Abroe, A. Balbi, J. Borrill, E.F. Bunn, S. Hanany, A.H. Jaffe, A.T. Lee, K.A. Olive, B. Rabii, P.L. Richards, G.F. Smoot, R. Stompor, C.D. Winant, and J.H.P. Wu, “Frequentist estimation of cosmological parameters from the MAXIMA-1 cosmic microwave background anisotropy data,” *Monthly Notices of the Royal Astronomical Society*, 334, 11 (2002).
- E.F. Bunn, “Detectability of microwave background polarization,” *Physical Review D*, 65, 043003 (2002). See also erratum at *Physical Review D*, 66, 069902 (2002).
- E.F. Bunn and Matthew J. McIrvin, “Answer to Question #67: How does the electric field get out of a black hole?” *American Journal of Physics*, 69, 245 (2001). (This is a short pedagogical note.)
- E.F. Bunn and D. Scott, “A preferred-direction statistic for sky maps,” *Monthly Notices of the Royal Astronomical Society*, 313, 331 (2000).
- D.J. Eisenstein and E.F. Bunn, “Comment on the appropriate null hypothesis for cosmological birefringence,” *Physical Review Letters*, 79, 1957 (1997).
- J.J. Levin, J.D. Barrow, E.F. Bunn, and J. Silk, “Flat spots: topological signatures of open universes in COBE sky maps,” *Physical Review Letters*, 79, 974 (1997).

*Asterisks indicate undergraduate collaborators.

- E.F. Bunn and M. White, “The four-year COBE normalization and large-scale structure,” *Astrophysical Journal*, 480, 6 (1997).
- E.F. Bunn, A.R. Liddle, and M. White, “Four-year COBE normalization of inflationary cosmologies,” *Physical Review D*, 54, R5917 (1996).
- E.F. Bunn, P.G. Ferreira, and J. Silk, “How anisotropic is our Universe?” *Physical Review Letters*, 77, 2883 (1996).
- K. Yamamoto and E.F. Bunn, “Observational tests of one-bubble open inflationary cosmological models,” *Astrophysical Journal*, 464, 8 (1996).
- E.F. Bunn, Y. Hoffman, and J. Silk, “The Wiener-filtered COBE DMR data and predictions for the Tenerife experiment,” *Astrophysical Journal*, 464, 1 (1996).
- M. Tegmark and E.F. Bunn, “A brute-force analysis of the COBE DMR data,” *Astrophysical Journal*, 455, 1 (1995).
- M. White and E.F. Bunn, “The COBE normalization of CMB anisotropies,” *Astrophysical Journal*, 450, 477 (1995).
- W. Hu, E.F. Bunn, and N. Sugiyama, “COBE constraints on baryon isocurvature models,” *Astrophysical Journal Letters*, 447, 59 (1995).
- E.F. Bunn and N. Sugiyama, “Cosmological-constant cold dark matter models and the COBE two-year sky maps,” *Astrophysical Journal*, 446, 49 (1995).
- M. White and E.F. Bunn, “A first map of the CMB at 0°5 resolution,” *Astrophysical Journal Letters*, 443, 53 (1995).
- E.F. Bunn, D. Scott, and M. White, “The COBE normalization for standard cold dark matter,” *Astrophysical Journal Letters*, 441, 9 (1995).
- M. Tegmark, E.F. Bunn, and W. Hu, “Power spectrum independent constraints on cosmological models,” *Astrophysical Journal*, 434, 1 (1994).
- E.F. Bunn, K.B. Fisher, Y. Hoffman, O. Lahav, J. Silk, and S. Zaroubi, “Wiener filtering of the COBE DMR data,” *Astrophysical Journal Letters*, 432, 75 (1994).
- E.F. Bunn, M. White, M. Srednicki, and D. Scott, “Are SP 91 and COBE inconsistent with cold dark matter?” *Astrophysical Journal*, 429, 1 (1994).
- E.F. Bunn, Y. Hoffman, and J. Silk, “The effects of incomplete sky coverage on the analysis of large angular scale microwave background anisotropy,” *Astrophysical Journal*, 425, 359 (1994).
- M. Srednicki, M. White, D. Scott, and E.F. Bunn, “Implications of the Millimeter-wave Anisotropy Experiment for cold dark matter models,” *Physical Review Letters*, 71, 3747 (1993).

Fellowships, Awards and Funding:

(Numerous Summer Fellowships and Travel Grants to students from the School of Arts and Sciences are not listed.)

- Royal Society (U.K.) International Exchange, “Analysis of weak lensing and CMB polarization data,” with A. Jaffe (Imperial College, London), 2018 (£3000 awarded).
- Visitor funding, Institut Lagrange (Paris), 2016 (€9000 awarded).
- Sole P.I. on NSF grant proposal “RUI: Cosmic microwave background polarization analysis with undergraduates,” 2014-2017, extended to 2018 (\$122,500 awarded).
- Sole P.I. on NSF grant proposal “RUI: Preparing for the era of cosmic microwave background polarimetry.” Original request was for \$115,000 over the three-year period from 2009-2012. NSF increased the award to \$187,000 over a five-year period.
- P.I. on NSF grant proposal “MRI: Acquisition of a computing cluster for astrophysics and nuclear physics research at the University of Richmond,” 2009-2012, \$161,912 awarded.
- Co-P.I. on NSF grant proposal “Collaborative research: Simulation of systematic effects in interferometry for studies of the cosmic microwave background, 2009-2012, \$800,000 awarded (total); University of Richmond request: \$30,000.
- Sole P.I. on NSF grant proposal “RUI: Cosmic microwave background analysis in the post-WMAP era,” 2005-2008 (\$109,000 awarded).
- Co-I. on NASA grant “Mission Concept Study for the Einstein Polarization Interferometer for Cosmology,” 2003-2005 (\$200,000 awarded).
- Funding from NASA to support work on data analysis issues for the upcoming Planck satellite mission, 2001-2005 (approx. \$10,000/year awarded).
- Sole P.I. on NSF grant AST-0098048, “RUI: Cosmic microwave background data analysis,” 2001-2004 (\$112,000 awarded).
- Sole P.I. on Research Corporation Cottrell Award CC5341, “Statistical characterization of foregrounds for microwave background observations,” 2002-2005 (\$34,000 awarded).
- I.T.P. Scholar, Institute for Theoretical Physics, University of California at Santa Barbara, 1998-2001.
- Funding from Howard Hughes institute to support an undergraduate research assistant, 1998 (\$4000 awarded).
- National Science Foundation Graduate Fellowship, 1990–1993.
- Kusaka Award for Physics, Princeton University, 1989.

Conference Proceedings:

- L. Mele et al., “The QUBIC instrument for CMB polarization measurements,” *Journal of Physics: Conference Series*, 1548, 012016 (2020).
- M. Piat et al., “QUBIC: using NbSi TESs with a bolometric interferometer to characterize the polarisation of the CMB,” submitted to the *Journal of Low Temperature Physics* for LTD18.
- A. Mennella et al., “QUBIC: Exploring the primordial Universe with the Q & U Bolometric Interferometer,” *Universe*, 5, 42 (2019).
- M. Salatino et al., “Performance of NbSi transition-edge sensors readout with a 128 MUX factor for the QUBIC experiment,” *Proceedings of the SPIE*, 10708, 1070845 (2018).
- A.J. May et al., “Thermal architecture for the QUBIC cryogenic receiver,” *Proceedings of the SPIE*, 10708, 107083V (2018).
- C. O’Sullivan et al., “Simulations and performance of the QUBIC optical beam combiner,” *Proceedings of the SPIE*, 10708, 107082I (2018).
- C. O’Sullivan et al., “QUBIC: the Q and U bolometric interferometer for cosmology,” *Proceedings of the SPIE*, 10708, 107082B (2018).
- P. de Bernardis et al., “QUBIC: Measuring CMB polarization from Argentina,” *Boletín de la Asociación Argentina de Astronomía*, 60, 107 (2018).
- Burke et al., “Optical modelling and analysis of the Q and U bolometric interferometer for cosmology,” *Proceedings of the SPIE*, 10531, 105310G (2018).
- A. Mennella et al., “QUBIC - The Q & U Bolometric Interferometer for Cosmology — A novel way to look at the polarized cosmic microwave background,” *Proceedings of the European Physical Society Conference on High Energy Physics*, <https://pos.sissa.it/cgi-bin/reader/conf.cgi?confid=314,id.44> (2017).
- S. Scully et al., “Optical design and modelling of the QUBIC instrument, a next-generation quasi-optical bolometric interferometer for cosmology,” *Proceedings of SPIE*, 9914,99142S (2016).
- E.F. Bunn et al., “Simulation of the analysis of interferometric microwave background polarization data,” *proceedings of IAU Symposium 306: Statistical Challenges in 21st-Century Cosmology* (2014).
- E.F. Bunn, “Large-angle anomalies in the microwave background,” *proceedings of the 2010 Rencontres de Moriond (La Thuile, Italy)*.
- E.F. Bunn, “E/B mode mixing,” *proceedings of the Workshop on Mitigating Systematic Errors in Space-Based CMB Polarization Measurements for the CMBPol Mission Concept Study, Annapolis, MD, July 2008*.
- G.S. Tucker, A.L. Korotkov, A.C. Gault, P.O. Hyland, S. Malu, P. Timbie, E.F. Bunn, B.G. Keating, E. Bierman, C. O’Sullivan, P.A.R. Ade, and L. Piccirillo, “The millimeter-wave bolometric interferometer (MBI)”, *Proceedings of SPIE*, 7020,70201M (2008).

- P.T. Timbie, G.S. Tucker, P.A.R. Ade, S. Ali, E. Bierman, E.F. Bunn, C. Calderon, A.C. Gault, P.O. Hyland, B.G. Keating, J. Kim, A. Korotkov, S.S. Malu, P. Mauskopf, J.A. Murphy, C. O’Sullivan, L. Piccirillo, and B.D. Wandelt, “The Einstein Polarization Interferometer for Cosmology (EPIC) and the Millimeter-wave Bolometric Interferometer (MBI),” *New Astronomy Reviews*, 50, 999 (2006).
- A.L. Korotkov, J. Kim, G.S. Tucker, A. Gault, P. Hyland, S. Malu, P.T. Timbie, E.F. Bunn, E. Bierman, B. Keating, A. Murphy, C. O’Sullivan, P.A.R. Ade, C. Calderon, and L. Piccirillo, “The Millimeter-wave Bolometric Interferometer,” *Millimeter and Submillimeter Detectors and Instrumentation for Astronomy III* (J. Zmuidzinas et al., eds.), *Proceedings of SPIE*, 6272, 62750X (2006).
- E.F. Bunn, “Separating E from B,” *New Astronomy Reviews*, 47, 987 (2003).
- E.F. Bunn, “Detectability of E- and B-mode CMB polarization,” in *Frontiers of the Universe*, proceedings of the XIIIth Rencontres de Blois, June 17-23, 2001 (J. Tran Thanh Van et al., eds., Editions Frontières, France).
- E.F. Bunn, “Calculating cosmic background anisotropies and implications” (four invited lectures), in *The Cosmic Background Radiation*, NATO ASI Series C, vol. 502, edited by C.H. Lineweaver et al., p. 135 (1997).

Invited Talks:

- “Listening to the Big Bang: Testing theories of the early Universe with the cosmic microwave background radiation,” *Physics Colloquium*, Bates College, March 2019.
- “Pure E and B polarization maps via Wiener filtering,” *Cosmology seminar*, Imperial College (London), April 2018.
- “Pure E and B polarization maps via Wiener filtering,” *Cosmology seminar*, University of British Columbia, February 2018.
- “What we talk about when we talk about curved spacetime,” *Physics and Astronomy Colloquium*, University of British Columbia, February 2018.
- “Remote quadrupole measurements with CMB S4,” *seminar*, Institut d’Astrophysique, Paris, November 2016.
- “The Open Journal of Astrophysics,” *Astroparticle and Cosmology seminar*, University of Paris 7, October 2016.
- “Pure E and B polarization maps via Wiener filtering,” *Astroparticle and Cosmology seminar*, University of Paris 7, October 2016.
- “Polarization predictions for cosmological models with large-scale power modulation,” *seminar*, Institut d’Astrophysique, Paris, September 2016.
- “Large-scale anomalies in the cosmic microwave background: should you care?,” *Physics Colloquium*, James Madison University, October 2015.

- “Listening to the Big Bang,” public talk, James Madison University, October 2015.
- “Listening to the Big Bang: Progress and puzzles from observations of the cosmic microwave background radiation,” Keynote talk, Southeastern Section American Physical Society meeting, Columbia, SC, November 2014.
- “Listening to the Big Bang,” Science and Spirituality Lecture Series, Emmanuel Episcopal Church, Boston, January 2014.
- “Remote CMB quadrupole measurements,” Low- l CMB Workshop, Case Western Reserve University, September 2014.
- “Interferometers for cosmic microwave background polarization measurements,” Particle Astrophysics Seminar, Fermilab, October 2013.
- “The cosmic microwave background radiation,” review talk at the Virginia Academy of Sciences, May 2011.
- “The meaning of Einstein’s equation,” the Virginia Academy of Sciences, May 2011.
- “Cosmology from future cosmic microwave background polarization experiments,” Astrophysics Division Colloquium, NASA Goddard Space Flight Center, May 2010.
- “Listening to the Big Bang,” Physics Colloquium, Western Washington University, April 2010
- “Large-angle anomalies in the microwave background,” Rencontres de Moriond, La Thuile, Italy, March 2010.
- “The future of large-angle CMB anomalies,” Workshop on Low- l / Large-Angle Cosmology, Case Western Reserve University, February 2010.
- “How should we describe the cosmological redshift?” Cosmology Seminar, Université Paris VII, December 2009 and Cosmology Seminar, University of Wisconsin, February 2010.
- “Large-angle anomalies in the microwave background: Are they significant? What do they mean?” Colloquium, Astroparticle Physics and Cosmology, Université Paris VII, October 2009, and Cosmology Colloquium, University of Wisconsin, February 2010.
- “E/B mode mixing,” Workshop on Mitigating Systematic Errors in Space-Based CMB Polarization Measurements for the CMBPol Mission Concept Study, Annapolis, MD, July 2008.
- “Interferometry on the spherical sky,” Workshop on Bolometric Interferometry for the B-mode Search, Université Paris Diderot, Paris, France, June 2008.
- “Systematic errors in CMB interferometric polarimetry,” Workshop on Bolometric Interferometry for the B-mode Search, Université Paris Diderot, Paris, France, June 2008.
- “Analysis and systematics summary,” Workshop on Bolometric Interferometry for the B-mode Search, Université Paris Diderot, Paris, France, June 2008.

- “Listening to the Big Bang,” Astronomy Day, Science Museum of Virginia, May 10, 2008.
- “Listening to the Big Bang,” Roanoke Valley Astronomical Society, June 2007.
- “Non-Gaussian statistics of Galactic dust,” Workshop on Non-Gaussianity in Cosmology, Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, July 2006.
- “Can we beat cosmic variance?,” Astrophysics Seminar, Brown University, June 2006.
- “Listening to the Big Bang,” Physics Department Seminar, Davidson College, February 3, 2005.
- “Probing inflation with cosmic microwave background polarization,” Astronomy Department Colloquium, University of Virginia, September 20, 2004.
- “The cosmic microwave background after WMAP,” Physics Colloquium, North Carolina State University, February 9, 2004.
- “Listening to the Big Bang,” Physics Colloquium, Amherst College, September 11, 2003.
- “The cosmic microwave background and dark energy,” Southeastern Sectional American Physical Society meeting, Wilmington, N.C., November 7, 2003.
- “Separating E from B,” Workshop on the Cosmic Microwave Background and its Polarization, University of Minnesota, March 2003.
- “Calculating cosmic background anisotropies and implications,” four lectures at the NATO Advanced Study Institute on the Cosmic Background Radiation, Strasbourg, France, July 1996.
- E.F. Bunn, “COBE DMR data analysis” (panel discussion), Conference on Microwave Background Fluctuations, Institute for Theoretical Physics, Santa Barbara, California, February 1995.
- E.F. Bunn, “Constraining the cosmological constant,” Berkeley CMB Workshop, August 1994.
- E.F. Bunn, “Cold dark matter and degree-scale CMB anisotropy,” Value of Omega Conference, Warsaw, Poland, and Summer School in Astrophysics, Budapest, Hungary, July 1993.

Contributed Conference Presentations:

- C. Painter* and E.F. Bunn, “Cosmological Inflation in N-Dimensional Gaussian Random Fields with Algorithmic Data Compression,” American Astronomical Society Meeting, January 2020.

- D. Falcone* and E.F. Bunn, “Correlations in the orientations of galaxies from the Sloan Digital Sky Survey,” American Astronomical Society Meeting, January 2020.
- C. Mooney*, E.F. Bunn, and S. Quinn*, “Polychromatic map reconstruction from time-ordered data of telescopes with asymmetric and wavelength-dependent antenna patterns,” American Astronomical Society meeting, January 2019.
- E. Goetz* and E.F. Bunn, “Using 3-dimensional fast Fourier transforms to simulate microwave background maps on a spherical cap,” American Astronomical Society meeting, January 2019.
- S. Karki* and E.F. Bunn, “Analysis of polarized CMB power spectra using Gibbs sampling,” American Astronomical Society Meeting, January 2018.
- S. Quinn* and E.F. Bunn, “Polychromatic map-making from imaging telescopes with asymmetric beams,” American Astronomical Society Meeting, January 2018.
- E. Goetz* and E.F. Bunn, “Simulating CMB maps on a spherical cap with FFTs,” American Astronomical Society Meeting, January 2018.
- A. Adil* and E.F. Bunn, “Working around cosmic variance: Remote quadrupole measurements of the CMB,” American Astronomical Society Meeting, January 2018.
- E.F. Bunn and Q. Xue*, “Polarization predictions for cosmological models with broken statistical isotropy,” Statistical Challenges in 21st-Century Cosmology, Chania, Greece, May 2016.
- E.F. Bunn and Q. Xue*, “Polarization predictions for cosmological models with large-scale power modulation,” American Astronomical Society Meeting, January 2016.
- H. Liu* and E.F. Bunn, “Fisher matrix optimization of cosmic microwave background interferometry,” American Astronomical Society Meeting, January 2016.
- L. Zhang et al., “Bayesian semi-blind component separation for foreground removal in interferometric 21 cm observations,” American Physical Society Meeting, April 2015.
- E.F. Bunn et al., “Simulation of interferometric observations of cosmic microwave background polarization,” American Astronomical Society Winter Meeting, Washington, DC, January 2014.
- A. Karakci et al., “Bayesian analysis of systematic effects in interferometric observations of the cosmic microwave background polarization,” American Astronomical Society Summer Meeting, Indianapolis, IN, June 2013.
- Q. Xue* and E.F. Bunn, “Polarization predictions for cosmological models with broken isotropy,” American Astronomical Society Summer Meeting, Anchorage, AK, June 2012.
- R. Lee* and E.F. Bunn, “Simulation of cosmic microwave background map reconstruction with large asymmetric beams,” American Astronomical Society Summer Meeting, Anchorage, AK, June 2012.

*Asterisks indicate undergraduate collaborators.

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- E.F. Bunn, “An efficient algorithm for separating cosmic microwave background polarization maps into E, B, and ambiguous components,” American Astronomical Society Summer Meeting, Anchorage, AK, June 2012.
- A.C. Gault, P.A.R. Ade, E. Bierman, E.F. Bunn, P.O. Hyland, B.G. Keating, A.L. Korotkov, S.S. Malu, C. O’Sullivan, L. Piccirillo, P.T. Timbie, and G.S. Tucker, “The Millimeter-wave Bolometric Interferometer (MBI),” American Astronomical Society Meeting, January 2009.
- B. Rybolt*, S. Guest*, G. Larson*, and E.F. Bunn, “Using wavelet transforms to detect dust in cosmic microwave background maps,” American Astronomical Society Meeting, St. Louis, MO, May 2008.
- A. Bourdon* and E.F. Bunn, “An ellipsoidal universe cannot explain the lack of large-scale power in the microwave background,” American Astronomical Society Meeting, St. Louis, MO, May 2008.
- B. Follin* and E.F. Bunn, “Optimal phase shift sequences for a bolometric interferometer for microwave background polarimetry,” American Astronomical Society Meeting, St. Louis, MO, May 2008.
- E.F. Bunn and M. White, “Microwave background interferometry on the spherical sky,” American Astronomical Society Meeting, St. Louis, MO, May 2008.
- E.F. Bunn, C.W. Beausang, M. Fetea, G. Gilfoyle, O. Lipan, H. Nebel, M. Trawick, J. Mable, and J. Wimbush, “The Richmond Physics Olympics,” American Association of Physics Teachers meeting, Greensboro, NC, August 2007.
- E.F. Bunn, “Measurement of gigaparsec-scale perturbation modes with remote quadrupole observations,” American Astronomical Society meeting, Seattle, WA, January 2007.
- A. Korotkov, P.A. Ade, S. Ali, E. Bierman, E.F. Bunn, C. Calderon, A.C. Gault, P.O. Hyland, B.G. Keating, J. Kim, S.S. Malu, P.D. Mausekopf, J.A. Murphy, C. O’Sullivan, L. Piccirillo, P.T. Timbie, G.S. Tucker, and B.D. Wandelt, “The Millimeter-Wave Bolometric Interferometer,” American Astronomical Society meeting, Seattle, WA, January 2007.
- E.F. Bunn, J. Baez, “Einstein’s equation without tensors,” American Astronomical Society meeting, Washington, DC, January 2006.
- G. Larson*, E.F. Bunn, V. Kasliwal*, M. McCann*, “Filtering dust contamination from CMB data with wavelets and radon transforms,” American Astronomical Society meeting, Washington, DC, January 2006.
- E.F. Bunn, “Observing strategies for B-mode CMB polarization experiments,” American Astronomical Society meeting, Denver, CO, June 2, 2004.
- M. McCann*, E.F. Bunn, R. Chan*, V. Kasliwal*, “The three-point correlation function of Galactic dust: implications for microwave background non-Gaussianity,” American Astronomical Society meeting, Denver, CO, June 2, 2004.

*Asterisks indicate undergraduate collaborators.

- V. Kasliwal*, E.F. Bunn, R. Chan*, M. McCann*, “The bispectrum of Galactic dust: implications for microwave background non-Gaussianity,” American Astronomical Society meeting, Denver, CO, June 2, 2004.
- M. McCann*, E.F. Bunn, R. Chan*, and V. Kasliwal*, “The cosmic microwave background and the three-point function,” Southeastern Sectional American Physical Society meeting, Wilmington, N.C., November 6, 2003. **Co-winner: Marsh White Award for best undergraduate paper.**
- V. Kasliwal* , E.F. Bunn, R. Chan*, and M. McCann*, “Identifying dust in the microwave background radiation Using the bispectrum,” Southeastern Sectional American Physical Society meeting, Wilmington, N.C., November 6, 2003. **Co-winner: Marsh White Award for best undergraduate paper.**
- E.F. Bunn, R. Chan*, V. Kasliwal*, M. McCann*, P.-C. Yap*, “Non-Gaussian Galactic dust in the cosmic microwave background,” contributed talk at workshop on Theorists at Undergraduate Institutions, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, July 21, 2003.
- M. Kohring* and E.F. Bunn, “Gaussian and non-Gaussian temperature fluctuations in the microwave background,” Fall 1998 New England Section American Physical Society meeting.
- E.F. Bunn, “The effects of incomplete sky coverage on the analysis of the COBE data,” Center for Particle Astrophysics Microwave Background Workshop, December 1992.

Presentations at the University of Richmond:

- C. Mooney* and E.F. Bunn, “Polychromatic map reconstruction using telescopes with asymmetric antenna patterns,” University of Richmond Student Symposium, 2019.
- E. Goetz* and E.F. Bunn, “Using three-dimensional fast Fourier transforms to simulate cosmic microwave background maps on a spherical cap,” University of Richmond Student Symposium, 2019.
- S. Karki* and E.F. Bunn, “Analysis of polarized CMB power spectra using Gibbs sampling,” University of Richmond Student Symposium, 2018.
- S. Quinn* and E.F. Bunn, “Polychromatic map-making from imaging telescopes with asymmetric beams,” University of Richmond Student Symposium, 2018.
- A. Adil* and E.F. Bunn, “Working around cosmic variance: Remote quadrupole measurements of the cosmic microwave background,” University of Richmond Student Symposium, 2018.
- E. Goetz* and E.F. Bunn, “Simulating CMB maps on a spherical cap with FFTs,” University of Richmond Student Symposium, 2018.

*Asterisks indicate undergraduate collaborators.

- A. Adil* and E.F. Bunn, “Working around cosmic variance: Remote quadrupole measurements of the cosmic microwave background radiation,” University of Richmond Student Symposium, 2017.
- E. Herman*, E.F. Bunn, and A. Kosowsky, “Suppression in the CMB at large angular scales,” University of Richmond Student Symposium, 2016.
- Amalia Gjerloev* and E.F. Bunn, “Making the world a safer place for Helmholtz’s Theorem: Removing ambiguity from vector field decompositions,” University of Richmond Student Symposium, 2016.
- Jeremy Strockoz* and E.F. Bunn, “Cosmic microwave background simulations on a spherical cap,” University of Richmond Student Symposium, 2016.
- D. Ricculi* and E.F. Bunn, “Identifying unusual patterns in CMB fluctuations using polarized light from remote quadrupoles,” HHMI Fall Symposium, 2014.
- E. Herman* and E.F. Bunn, “Design optimization for future interferometric cosmic microwave background experiments,” Arts and Sciences Student Symposium, Spring 2014.
- H. Liu* and E.F. Bunn, “Fisher matrix optimization of cosmic microwave background interferometers,” Arts and Sciences Student Symposium, Spring 2014.
- Q Xue* and E.F. Bunn, “Polarization predictions for cosmological models with broken isotropy,” Arts and Sciences Student Symposium, Spring 2012.
- H. Bonner* and E.F. Bunn, “A search for non-random distribution of galaxy orientations in the Galaxy Zoo catalog,” HHMI student symposium, fall 2011.
- N. Annichiarico* and E.F. Bunn, “Studying large-scale patterns of anisotropy in elliptical galaxies,” Arts and Sciences Student Symposium, April 2011.
- A. Bourdon* and E.F. Bunn, “Examination of proposed explanations for large-scale microwave background anomalies,” Arts and Sciences Student Symposium, April 2009.
- B. Follin* and E.F. Bunn, “Measuring the B-mode polarization of the cosmic microwave background,” Arts and Sciences Student Symposium, April 2009.
- B. Rybolt* and E.F. Bunn, “Searching for non-Gaussianity of the cosmic microwave background radiation,” Arts and Sciences Student Symposium, April 2009.
- H. Zheng* and E.F. Bunn, “Physical properties of dark energy,” Arts and Sciences Student Symposium, April 2009.
- B. Rybolt* and E.F. Bunn, “Galactic spring cleaning,” Arts and Sciences Student Symposium, April 2008.
- S. Guest* and E.F. Bunn, “Galactic spring cleaning,” Arts and Sciences Student Symposium, April 2008.

*Asterisks indicate undergraduate collaborators.

- A. Bourdon* and E.F. Bunn, “Discrepancies between large-scale microwave background fluctuations and theoretical predictions,” Arts and Sciences Student Symposium, April 2008.
- B. Follin* and E.F. Bunn, “Manipulation of phase shifts in Big-Bang interferometry,” Arts and Sciences Student Symposium, April 2007.
- W. Brooks* and E.F. Bunn, “Detecting Galactic dust with the radon transformation,” Arts and Sciences Student Symposium, April 2007.
- B. Rybolt* and E.F. Bunn, “Galactic spring cleaning: searching for dust contamination of CMB maps using wavelet transformations,” Arts and Sciences Student Symposium, April 2007.
- M. McCann* and E.F. Bunn, “Identifying dust in the microwave background,” Arts and Sciences Student Symposium, April 2005.
- E.F. Bunn, “Listening to the Big Bang,” University of Richmond Lunchtime Forum, November 3, 2004.
- V. Kasliwal*, G. Larson*, M. McCann*, and E.F. Bunn, “Non-Gaussian statistics of dust in the microwave background,” talk presented by students to U.R. student and faculty researchers in physics, mathematics, and computer science, summer 2004.
- V. Kasliwal* and E.F. Bunn, “The bispectrum as an indicator of Gaussianity in the cosmic microwave background,” Arts and Sciences Student Symposium, April 16, 2004.
- E.F. Bunn, “How to make a baseball as big as the Sun,” presentation in the Mathematics Department’s “Cool Math” seminar series, April 14, 2004.
- R. Chan*, V. Kasliwal*, M. McCann*, and E.F. Bunn, “Identifying dust in the microwave background,” talk presented by students to U.R. student and faculty researchers in physics, mathematics, and computer science, summer 2003.
- E.F. Bunn, “The cosmic microwave background radiation,” Physics Department Seminar, University of Richmond, September 16, 2002.

Pedagogical Writings:

- E.F. Bunn, M. Dias, M. Fetea, G.P. Gilfoyle, C. Helms, O. Lipan, H. Nebel, J. Singal, M. Trawick, P. Rubin, and M. Vineyard, Laboratory Manual for Physics 131-132, revised yearly.
- Laboratory Manual for Physics 121 (Astrophysics), written 2005, revised 2006, 2012, 2015, 2018, 2019.

*Asterisks indicate undergraduate collaborators.

- J.C. Baez and E.F. Bunn, “The meaning of Einstein’s equation,” <http://math.ucr.edu/home/baez/einstein/> . (This web site is a revised and significantly extended version of the work described in our publication of the same name.)
- “Does a ray of light have mass?” in “Ask the Wizard,” *Discover Magazine*, December 2000
- “Frequently Asked Questions About Black Holes” (available from <http://cosmology.berkeley.edu/Education/BHfaq.html> and various mirror sites).

Research Students Mentored:

- | | |
|---------------------------------|------------------------------|
| • Rom Chan (2003-2004) | • J.P. Wheeler (2012) |
| • Vishal Kasliwal (2003-2005) | • Ellis Herman (2013-2016) |
| • Molly McCann (2003-2006) | • Haonan Liu (2013-2015) |
| • Gary Larson (2004-2007) | • James Moshos (2013-2014) |
| • Whitney Brooks (2007) | • David Ricculli (2014) |
| • Spencer Guest (2007-2008) | • Amalia Gjerloev (2015) |
| • Austin Bourdon (2007-2008) | • Jeremy Strockoz (2015) |
| • Brent Follin (2007-2009) | • Arsalan Adil (2016-2018) |
| • Ben Rybolt (2008) | • Solomon Quinn (2017-2018) |
| • Jeff Zheng (2008-2010) | • Eric Goetz (2017-2019) |
| • Nick Annichiarico (2009-2011) | • Saket Karki (2017-2019) |
| • Josh Carbonneau (2010-2011) | • Connor Mooney (2018-2019) |
| • Haisten Bonner (2010-2011) | • Dario Falcone (2019-2020) |
| • Robert Lee (2011-2012) | • Connor Painter (2019-2020) |
| • Jocelyn Xue (2011-2012) | • Nicolas Ferree (2020) |

Professional Membership and Activities:

- Associate Editor, *Open Journal of Astrophysics*.
- Member of Science Advisory Board, Science Museum of Virginia (2015-2017).
- Member of the American Physical Society, American Astronomical Society, American Association of Physics Teachers.
- Referee for *Physical Review D*, *Physical Review Letters*, *Astrophysical Journal*, *Astrophysical Journal Letters*, *American Journal of Physics*, *Physica Scripta*, and *Monthly Notices of the Royal Astronomical Society*.

- Frequent reviewer of grant proposals for the National Science Foundation.
- Department of Energy program review panel member for SPT-3G, an experiment at Argonne National Laboratory.

Service Activities at the University of Richmond:

- Physics Department chair (2010-2011, 2015 - present).
- Member, A& S Faculty Steering Committee (2019 - present).
- A& S Faculty Parliamentarian (2019 - present).
- Richmond Scholars Steering Committee (2013 - 2016, 2018 - present).
- Member, Merit Review Committee (2018 - 2019).
- Chair, Physics Department Search Committee (2018 - 2019).
- Member, Dean's Advisory Council (2015 - 2018).
- First-year Seminar Committee, 2012 - 2015.
- Science Scholars selection committee, 2007-2008, 2011 - 2014.
- Member of Writing and Speech Center Advisory Board, 2010-2015.
- Diversity Advocate, Physics Department faculty search committee, 2012-2013.
- Member of task force on streamlining external grant administration (2010-2011).
- Development of the Martha Carpenter Observatory and acquisition of the Martha Carpenter Computing Cluster.
- Member of committee developing HHMI-funded interdisciplinary introductory science course (2008 - 2009).
- Member of task force on assessment of Natural Sciences Field of Study courses (2008 - 2009).
- Advisor to undeclared students (2003 - 2009) and physics majors (2010 - present).
- Member of Undergraduate Research Committee (2006 - 2009).
- Faculty advisor to Goldwater Scholarship applicants (2005 - 2009).
- Member of Physics Department Unit Conversion Committee (2006 - 2008).
- Member of Boatwright Scholars Committee (2006-2007).
- Instructor for physics portion of MCAT review course (2005, 2007, 2008).
- Member of Undergraduate Admissions Committee (2004-2005).

- Member of University Scholars Committee (2003-2005).
- Faculty mentor (2004-2005).
- Member of Bioinformatics search committee (2004-2005).
- Member of Computer Science search committees (2002-2003 and 2003-2004).
- Member of Physics search committees for fixed-term faculty, tenure-track faculty, and lab director (2002-2004, 2012-2013).
- Miscellaneous service activities within the physics department, including the following:
 - Mentor to visiting fellow Johan Hansson (2008).
 - Assessing junior and senior seminar participants.
 - Supervising independent studies.
 - Revising introductory lab manuals.
 - Acting as department liaison during the Gottwald Science Center renovation.
 - Preparing students for the Physics GRE.
 - Helping with the Physics Olympics.