Roger O'Brient
Research Physicist

CONTACT INFORMATION

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RESEARCH INTERESTS

experimental cosmology, cosmic microwave background polarimetry, submillimeter astrophysics, epoch of reionization, detector design for cosmological and astrophysical observation, superconducting circuits

EDUCATION

University of California at Berkeley, Berkeley, California USA

Ph.D., Physics, August 2010

M.A., Physics, May 2004

California Institute of Technology, Pasadena, California USA

B.S., Physics, June 2001 (GPA: 3.6)

DOCTORAL THESIS

Title: "A Log-periodic focal-plane architecture for Cosmic Microwave Background Polarimetry"
Advisor: Professor Adrian Lee

RESEARCH EXPERIENCE

2015-present: Microdevices Engineer at NASA JPL/ Visiting Caltech faculty

I currently develop superconducting circuits and sensors for applications in astrophysics, planetary science, and earth observing. This includes Kinetic Inductance Detectors (KIDs), microresonator bolometers (aka TKIDs), and traveling-wave parametric amplifiers to build low noise radiometers for spectroscopy and spatial interferometry. I am also a collaborator in the BICEP/Keck CMB program, where I supervise fabrication and integration efforts and am leading a team to develop our next generation readout and detectors for future BICEP Array cameras.

2010-2015: NASA JPL/ California Institute of Technology *NPP Postdoctoral Fellow*, Advisor: Professor James Bock

I worked on BICEP-2, Keck Array, and BICEP-3, supervising graduate students on testing and simulation of the detectors. I deployed with the BICEP/Keck team to the South Pole Station to upgrade our cameras with improved detectors and to deploy BICEP3. I have worked along side our fabrication engineers in the MDL cleanroom while trouble-shooting and optimizing processes. I also worked on TIME, an instrument that will tomographically map CII emissions during the epoch of reionization, helping design both TES and KID versions of our spectrometers.

2003-2009: University of California at Berkeley *Graduate Research Assistant*, Advisor: Professor Adrian Lee.

I worked with the Polarbear team to help vet a prototype antenna-coupled TES bolometer for the Polarbear Experiment. I then designed a new dual-polarized antenna-coupled TES bolometer with two octaves of bandwidth (using a sinuous antenna) and a back end channelizer to partition that bandwidth into narrow frequency channels. My responsibilities involved simulating proposed designs in commercially available and home-written software, fabricating prototype pixels in the Berkeley Microlab, designing and machining components for an optical test cryostat, and characterizing the devices' optical and thermal properties. I have also worked on anti-reflection coating techniques, specifically for our detectors' contacting lenslettes.

Awards

- NASA Postdoctoral Fellow- JPL, 2011-2014
- Graduated with Honors from California Institute of Technology, 2001

Grants and Funding

Total competitive amount to date: $7,952,000

1) Spontaneous Research and Development Fund (RTD, JPL internal): "Submillimeter Resonator Test-Chips to Screen the Integrity of Superconducting Thin Films." (R.17400.057) **PI: Roger O'Brient**, Co-I: Alexis Weber. 5/17-9/17. $30,000

2) Strategic Research and Development Fund (SRTD, JPL internal): "A flexible radio-frequency readout for multiplexed submillimeter-wave detectors." (R.17.223.057) **PI: Roger O'Brient**, Co-Is: Darren Dowell, Peter Day, Pierre Echternach. 11/16-11/17. $155,000

3) Strategic Research and Development Fund (SRTD, JPL internal): "Resonator Bolometers for photometric millimeter wave polarimetry" (R.17.223.058) **PI: Roger O'Brient**, Co-Is: James Bock, Hien Ngyen, Bryan Steinbach, Anthony Turner 11/16-11/17. $155,000

4) Topical Research and Developement Fund (TRTD, JPL internal): "Submillimeter Kinteic Inductance Detectors for Measurement of Insterstellar Magnetic Fields and the first Starbursts" (R.16.164.017). **PI: Roger O'Brient**, Co-Is: Darren Dowell, Matthew Hollister, Henry LeDuc, Jonas Zmuidzinas. 11/15-11/16. $350,000

5) Office of Naval Research: "Superconducting Detector Arrays for Passive Millimeter-Wave Terrestrial Imaging" (106014.1.1), PI Peter Day, Co-Is: Bradley Johnson, Rick LeDuc, Phil Mouskopf, **Roger O'Brient** 12/15-12/17. $900,000

6) NASA Strategic Astrophysics Technology (SAT). "Superconducting Antenna-Coupled Detectors and Readouts for Space-Borne CMB ." (NNH14ZDA001N-SAT) PI: Bock, J., Co-Is: Filippini, J., Moncelsi, L., **O'Brient, R.**, Staniszewski, Z., Turner, A., Weber, A. 11/16-1/18. $1,750,000

7) NASA Strategic Astrophysics Technology (SAT). "Antenna coupled Superconducting Detectors for Microwave Background Polarimetry." (12-SAT12-0031) PI: Bock, J. Co-Is: Filippini, J., Kuo, C., Lueker, M., **O'Brient, R.**, Staniszewski, Z., Turner, A., Weber, A. 4/2014-3/2016. $1,663,000.

8) President's and Director's Fund (NASA-JPL). "Probing Inflationary CMB Polarization at 95GHz with BICEP-3'.' PIs: J. Bock and O Dore. Co-Is: Hristov, V., Hui, H., Crill, B., Hildebrandt, S., **O'Brient, R.**, Pullen, A., Weber, A.. 1/2013-1/2015. $1,095,000

9) NASA Directors Research and Development Fund (DRDF). "Exploring the Epoch of Reionization with [CII] Line Tomography." PI: Bock, J., Co-Is: Bradford, M., LeDuc, H., **O'Brient, R.**, Cooray, A., Zemcov, M. 4/2012-3/2014. $200,000

10) NASA Strategic Astrophysics Technology (SAT). "Antenna coupled Superconducting Detectors for Microwave Background Polarimetry." (10-SAT10-0017) PI: Bock, J. Bonetti, CoIs: J., Day, P., Holmes, W., LeDuc, H., Nguyen, H., Turner, A., Golwala, S., Jones, W., Kuo, C, **O'Brient, R.** 4/2012-3/2014. $1,654,000

Invited Talks

1) "Constraining GUT-level physics with the BICEP Telescopes." *Lawrence Berkeley National Laboratory Physics Division Seminar*, Berkley, CA, March 21, 2017

2) "One Photon, two photon, red(shifted) photon, blue photon: superconducting devices for astrophysics" *McGill Space-sciences Institute Seminar: McGill University*, Montreal, November 3, 2015.

3) "BICEP2's detection of degree-scale B-mode polarization" *Physics Colloquium: University of Houston*, Houston, TX February 19, 2015.

4) "BICEP2's detection of degree-scale B-mode polarization" *Physics Colloquium: Washington University at St Louis*, St. Louis, MO February 4, 2015.

5) "BICEP2's detection of degree-scale B-mode polarization" *Physics Colloquium: Syracuse University*, Syracuse, NY September 11, 2014.

6) "A Detection of Degree-scale B-mode polarization with BICEP2" *ICHEP, plenary speaker*, Valencia, Spain July 8, 2014.

7) "B-mode Cosmology with BICEP1 & BICEP2" *Joint Institute for Astronomy Colloquium: University of Maryland-College Park/NASA Goddard Space Flight Center*, College Park, MD May 5, 2014.

8) "B-mode cosmology with BICEP1 and BICEP2" . *Institute for Astronomy Colloquium, University of Hawai'i*, Manoa, HI April 23, 2014.

9) "TIME to learn about reionization: the Tomographic Ionized carbon Mapping Experiment' . *Institute for Astronomy Tech Talk, University of Hawai'i*, Hilo, HI April 22, 2014.

10) "B-mode cosmology with BICEP1 and BICEP2" . *Astrophysics Colloquium, UCLA*, Los Angeles, CA April 16, 2014.

11) "Superconducting Millimeter-wave Circuits and Antennas" (Session tutorial & Overview). *15th Low Temperature Detectors Workshop*, Caltech, Pasadena, CA June 26, 2013.

12) "Phased-antenna-array coupled detectors for Cosmology and astrophysics". *5th European Conference on Antennas and Propagation*, Rome, Italy April 13, 2011.

Professional Presentations

1) "Keck Array's 230GHz on-sky performance" *16th Low Temperature Detectors Workshop*, Grenoble, Fr July 23, 2015.

2) "One photon, two photon, red photon, blue photon: parametric amplifiers for the millimeter band" *16th Low Temperature Detectors Workshop*, Grenoble, Fr July 21, 2015.

3) "Polarized Galactic Dust Polarimetry with the Keck Array 230GHz cameras" *16th Low Temperature Detectors Workshop*, Grenoble, Fr July 23, 2015.

4) "Moore's Law and detectors for Cosmology" *Center for Detectors Seminar: Rochester Institute of Technology*, Rochester, NY February 13, 2015.

5) "Moore's Law and detectors for Cosmology" *Physics Seminar: Washington University at St Louis*, St. Louis, MO February 5, 2015.

6) "The BICEP-3: a BICEP camera on steroids!" *SPIE: Millimeter and Submillimeter Detectors and Instrumentation for Astronomy VI*, Montreal, Canada June 25 2014.

7) "It's TIME to learn about reionization: lithographed spectrometers for a reionization experiment" *SPIE: Millimeter and Submillimeter Detectors and Instrumentation for Astronomy VI*, Montreal, Canada June 25 2014.

8) "A detection of degree scale B-modes with BICEP-2" *Caltech Astrophysics Tea Talk*, Pasadena, CA March 17, 2014.

9) "A glimpse of our universe's origins through superconducting detectors." *CASS Seminar*, La Jolla, CA February 19, 2014.

10) "Planar Antenna-Coupled Superconducting Detectors for CMB Polarimetry" *Annual NASA Long-Wavelength PIs Program Review*, Washington, DC December 12, 2013.

11) "Monolithic Microwave Integrated Circuits for Cosmology and Astrophysics." *Special Cosmology Seminar at KICP, University of Chicago*, Chicago, IL March 14, 2013.

12) "Antenna-coupled TES bolometers in BICEP-2, Keck Array, Spider, and Polar-1" *SPIE: Millimeter and Submillimeter Detectors and Instrumentation for Astronomy V*, Amsterdam, The Netherlands June 28, 2012.

13) "Tapered Antenna-array coupled TES bolometers for CMB Polarimetry." *14th International Workshop on Low Temperature Detectors*, Heidelberg, Germany August 3, 2011.

14) "A Dual-polarized multi-chroic antenna-coupled TES-bolometer with a cochlea-inspired channelizer circuit." *Applied Superconductivity Conference*, Washington, DC August 2, 2010.

15) "A dual-polarized multichroic antenna-coupled TES bolometer for terrestrial CMB Polarimetry." *SPIE: Millimeter and Submillimeter Detectors and Instrumentation for Astronomy V*, San Diego, California July 1, 2010.

16) "Sinuous Antennas for CMB Polarimetry." *Observational Cosmology Seminar at Stanford*, Palo Alto, CA September 26, 2009.

17) "Sinuous Antennas for CMB Polarimetry." *OBSCOS Seminar at Caltech*, Pasadena, CA September 4, 2009.

18) "Sinuous Antennas for CMB Polarimetry." *Seminar at UCSD*, La Jolla, CA August 29, 2008.

19) "Sinuous Antennas for CMB Polarimetry." *SPIE: Millimeter and Submillimeter Detectors and Instrumentation for Astronomy IV*, Marseilles, France June 28, 2008.

20) "A Multi-Band Dual-Polarized Antenna-Coupled TES Bolometer." *12th International Workshop on Low Temperature Detectors*, Paris, France July 24, 2007.

Teaching Experience

Fall 2003-Spring 2006

Physics Instructor for Princeton Review MCAT Preparation Course.

Fall 2001-Fall 2002

Teaching Assistant, Physics 7C- Optics and Modern Physics (Profs Wohl, Shen, Packard). University of California at Berkeley.

Spring 2001

Teaching Assistant, Applied Physics - Statistical Mechanics (Prof John Crocker). California Institute of Technology.

Fall 1999 and 2000

Teaching Assistant, Applied Physics 23- Demonstration Lectures in Optics (Prof Michael Shumate). California Institute of Technology.

Winter 2000 and 2001

Teaching Assistant, Applied Physics 24- Modern Optics Laboratory (Prof Michael Shumate). California Institute of Technology.

Outreach

Science Fair Judge

I have judged the Los Angeles County Science Fair and California State Science Fair from 2011-2016.

Deployment Blog and Elementary School Discussions

I maintained a blog describing my deployment with Keck Array to the South Pole in 2012-13 and 2014-15(http://solitudefortressof.blogspot.com). Elementary school students at Del Mar Hills Academy of Arts and Sciences followed along and I called up to California from the Pole for Q&A.

Presentation to middle-school students at Turning Point School in Culver City, CA about Antarctica and research there, Jan 28 2015.

Los Angeles Astronomical Society

Assist with weekly telescope-building classes free to the general public (Garvey Ranch, Monterey Park)

Assist with monthly public star-gazing parties (Griffith Park Observatory, Los Angeles)

Berkeley Science Review

Assisted in editorial review of the Berkeley Science Review (Scientific American style magazine about research at Cal.) 2004-2006, and penned two articles:

Dark Side of the Universe
Tuxedo Park (book review)

Public Outreach for the BICEP2 result

Interview with Radio Times with Marty Moss-Crane, WHYY Philadelphia, March 25, 2014

Interview with Tabula Magazine,Tbilisi Georgia, March 31, 2014

Public Lecture at Los Angeles Griffith Park Observatory, June 9, 2014

Talk to Santa Monica Amateur Astronomy Club, New Roads School. June 13 2014.

Interview with Spanish press corps and Nature News at ICHEP in Valencia. July 8, 2014.

East Bay "Nerd-Nite" Talk- New Parkway Theater, Oakland, CA. August 25 2014.

South Pole Sunday Science Lecture. Jan 4, 2014.

Science in Antarctica, Turning Point School, Jr High School, Culver City, CA. Jan 29, 2015.

Science in Antarctica, Awty International School, High School. Houston, Tx. Feb 20, 2015.

References

1) **Adrian Lee**, Professor of Physics, University of California, Berkeley. Phone: (510) 643-4606. Email:atl@physics.berkeley.edu

2) **James Bock**, Professor of Physics, California Institute of Technology and Senior Scientist, NASA-JPL. Phone: (818)-354-0715. Email: jjb@astro.caltech.edu

3) **Jonas Zmuidzinas**, Professor of Physics, California Institute of Technology; Chief Technologist, Jet Propulsion Laboratory. Phone: (626) 395-6229. Email: jonas@caltech.edu

4) **Gabriel Rebeiz**, Professor of Electrical Engineering, University of California at San Diego. Phone: (858)-534-8001. Email: grebeiz@ucsd.edu

5) **Eric Shirokoff**, Assistant Professor of Astronomy, University of Chicago. Phone: (773)-834-5399. Email: shiro@uchicago.edu

6) **Chao-lin Kuo**, Professor of Physics, Stanford University. Phone: (650)-736-7880. Email: clkuo@stanford.edu

7) **Bill Holzapfel**, Professor of Physics, University of California, Berkeley. Phone: (510) 642-5036 Email: swlh@cosmology.berkeley.edu

8) **Paul Richards**, Professor Emeritus, University of California, Berkeley. Phone: (510) 642-3027. Email: richards@cosmology.berkeley.edu

9) **Jeff McMahon**, Associate Professor, University of Michigan. Phone: (734) 615-2553. Email: jeffmcm@umich.edu

Selected publications

A more complete publication list can be found on my webpage http://www.astro.caltech.edu/∼ rogero/cv.html. Below are selected publications:

1) BICEP2/Keck Collaboration: Ade, P., Aiken, R,..., **O'Brient, R.**, ... Yoon, K.W. *Measurement of Gravitational Lensing from Large-scale B-mode Polarization* ApJ 833, 228 (2016)

2) BICEP2/Keck Collaboration: Ade, P.; Ahmed, Z.; ... **O'Brient, R.**; ... Yoon, K.W. *BICEP2/ Keck Array VI: Improved Constraints On Cosmology and Foregrounds When Adding 95 GHz Data From Keck Array* Phys. Rev. Lett. 116, 031302 (2016).

3) Hailey-Dunsheath, S.; ... **O'Brient, R.**;... Zmuidzinas, J. *Low Noise Titanium Nitrdide KIDs for SuperSpec: A Millimeter-Wave On-Chip Spectrometer* JLTP Vol 184,1. pp180-187. (2016)

4) BICEP2/Keck/ SPIDER Collaborations: Ade, P.; Aiken, R.; ... **O'Brient, R.**; ... Yoon, K.W. *Antenna-coupled TES bolometers for degree-scale polarimeters used in BICEP2, Keck Array, and SPIDER*, accepted by ApJ for publication ApJ 812, 176 (2015). **Corresponding author**

5) BICEP2 Collaboration: Ade, P.; Aiken, R; ... **O'Brient, R.**; ... Yoon, K.W. *Detection of B-mode polarization at degree angular scales.*, PRL 112, 241101 (2014).

6) **O'Brient, R.**; et al. *A Dual-polarized Broadband Planar Antenna and Channelizing Filter Bank for Millimeter Wavelengths*, Appl. Phys. Lett.102, 063506 (2013)

7) Edwards, J.; **O'Brient, R**; Lee, A.T.; Rebeiz; A.T., *Dual-Polarized Sinuous Antennas on Extended Hemispherical Silicon Lenses*, IEEE Trans. Antenna Propag., Vol 60, Issue 9, 4082-4091 (2012).

8) **O'Brient, R.**; et al. *A log-periodic channelizer for multichroic antenna-coupled TES-bolometers*, IEEE Trans. on Superconductivity, vol. 21, issue 3, pp.180-183 (2011).

9) Myers, M.; ... **O'Brient, R.**; ... Tran, H.*An antenna-coupled bolometer with an integrated microstrip bandpass filter* Appl. Phys. Lett. 86 114103 (2005).