Shaul Hanany
Professor of Physics; University of Minnesota/Twin Cities
115 Union St. S.E., Minneapolis, MN 55455; hanany@umn.edu; (612) 626 8929

Major Employment and Appointments

2008 – present	Professor, University of Minnesota/Twin Cities
2011 – 2012	Visiting Professor, Technion - Israel Institute of Technology, Israel
2002 – 2008	Associate Professor, University of Minnesota/Twin Cities
2004 – 2006	Associate Professor, Weizmann Institute of Science, Israel
1999 – 2002	Assistant Professor, University of Minnesota/Twin Cities
1996 – 1998	Research Physicist, University of California, Berkeley
1993 – 1996	Center Research Fellow, The Center for Particle Astrophysics, University of California, Berkeley

Education

1993	Ph.D., Physics, Columbia University "On Photoemission with Polarized X-rays" (Advisor: Prof. R. Novick)
1992	M.Phil., Physics, Columbia University
1989	M.Sc., Physics, Rensselaer Polytechnic Institute "Monte Carlo Simulations of the Dynamics of Dust Grains in Homogeneous Static Gas" (Advisor: Prof. W. Roberge)
1987	B.Sc. Physics, Tel Aviv University, Israel

Honors and Awards (abridged)

2016	George W. Taylor/CSE Alumni Society Award for Distinguished Teaching, College of Science and Engineering, University of Minnesota
2012	Fellow, American Physics Society
2003 & 2010	'Best Professor in Physics', Institute of Technology Student Board, University of Minnesota
2001 – 2003	McKnight-Land Distinguished Professor, University of Minnesota/Twin Cities
2000	Results published by Hanany et al (2000) were cited as "One of the 10 most important breakthroughs in science for the year 2000" by *Science* magazine (*Science*, **290**, 2221)

Membership

American Physical Society (fellow); Division of Astrophysics
American Astronomical Society

Scientific Projects (abridged)

CORE: Lead US Investigator	A proposed European CMB polarization satellite
EPIC-IM: Co-I	A NASA mission concept for a CMB polarization satellite
EBEX: PI	A long duration balloon experiment to measure the CMB polarization
Magnetic Bearing: PI	Development of bearings based on high Tc superconducting materials
MAXIPOL: PI	A North American balloon experiment to measure the CMB polarization
Archeops: Co-I	A European balloon borne CMB temperature and polarization experiment
MAXIMA: Co-I	A North American balloon experiment to measure the CMB

Recent Relevant Invited Talks (partial list)

2016	"The US CMB Balloon Program", American Physical Society Meeting, Salt Lake City, Utah, April 2016
2015	"The EBEX HWP", B-mode from Space Workshop, Tokyo, Japan, December 2015
2015	"The US Balloon Program and Lessons for LiteBIRD", B-mode from Space Workshop, Tokyo, Japan, December 2015

2015 "Potential US Participation in the CoRE+ Space Mission",
CoRE+ Collaboration Meeting, Paris, France, October 2015
2015 "The US Balloon Program",
European CMB Coordination Workshop, Florence, Italy, August 2015
2015 "The Legacy of Planck: CMB Measurements after 2020 ",
International Astronomical Union, Hawaii, August 2015 (declined)
2015 "CMB Measurements with EBEX and Future Space Missions ",
Marcel Grossman Conference 14, Rome, July 2015 (declined)
2014 "The Polarization of the CMB ",
Israeli Physical Society Plenary Session, Beer Sheva, Israel, Decmeber 2014

Relevant Community Service (partial list)

- Committee Member, Balloon Working Group, NASA's Balloon Program Office, 2011 - present
- Editor, Journal of Cosmology and Astro-Particle Physics, 2000 – present
- Co-Organizer, "Cosmology with the CMB and its polarization", January 2015, Minneapolis, MN
- Committee Member, European Space Agency's Planck satellite Mid-Term Review Board, 2011 - 2014
- Lead Coordinator, Inflation Probe Science Interest Group,
  a subgroup of the Physics of The Cosmos Program Analysis Group, 2011 - present
- Executive Committee Member, Physics of The Cosmos Program Analysis Group for
  NASA's Astrophysic Subcommittee, 2010 - present
- Member, Astrophysics Subcommittee to NASA's Science Advisory Committee, 2008 - 2012
- Co-Organizer, CMBPol Technology Workshop, Boulder, CO, August 2008
- Chair, Primordial Polarization Program Definition Team, A NASA appointed committee
  to coordinate activities toward a future CMB polarization satellite, 2007 – 2010

Recent Significant Relevant Publications (underlines denote Hanany group members)

- *'The EBEX Balloon Borne Experiment - Optics, Receiver, and Polarimetry'* The EBEX Collaboration: A. Aboobaker,...F. Aubin,...C. Bao,... S. Hanany,...J. Klein,...K. Raach,...I. Sagiv,... K. Young, K. Zilic, 2016, ApJSupp, in print.
- *'Millimeter-Wave Broadband Anti-Reflection Coatings Using Laser Ablation of Sub-Wavelength Structures'* T. Matsumura, K. Young, Q. Wen, S. Hanany, ... 2016, Applied Optics, Vol. 55, #13, pg. 3502
- *'Maximum Likelihood Foreground Cleaning for Cosmic Microwave Background Polarimeters in the Presence of Systematic Effects'* C. Bao,...B. Gold, S. Hanany,... 2016, ApJ, Vol. 819, pg. 12
- *'CMB Telescopes and Optical Systems'*, S. Hanany, M Niemack, and L. Page; to appear in 'Planets, Stars and Stellar Systems - Volume 1: Telescopes and Instrumentation' . Ian Maclean Ed., Springer 2012.
- *'The performance of the bolometer array and readout system during the 2012/2013 flight of the E and B experiment (EBEX)*, K. Macdermid, ..., ...A. Aboobaker,... S. Hanany, ... J. Klein, ...M. Milligan, ...K. Raach,... I. Sagiv, ... K. Zilic, 2008, Appl. Opt., Vol. 47, Pgs. 103 – 109
- *'MAXIPOL: Cosmic Microwave Background Polarimetry Using a Rotating Half Wave Plate'*, B. R. Johnson, ..., M. E. Abroe, ..., S. Hanany, ..., T. Jones, ..., T. Matsumura, ..., T. Renbarger, ..., 2007, ApJ, Vol. 665, Pg. 42, astro-ph/0611394,
- *'Temperature and polarization angular power spectra of Galactic dust radiation at 353 GHz as measured by Archeops,* N. Ponthieu, ..., S. Hanany, ..., 2005, A&A, Vol. 444, Pg. 327, astro-ph/0501427
- *'Millimeter-Wave Achromatic Half Wave Plate* S. Hanany, J. Hubmayr, B. R. Johnson, T. Matsumura, P. Oxley, M. Thibodeau, Applied Optics, 2005, Vol. 44, Pgs. 4666-4670, physics/0503122
- *'First Detection of Polarization of the Submillimetre Galactic Dust Emission by Archeops'* A. Benoit, ..., S. Hanany, ..., D. P. Marrone, ... 2004, Astronomy and Astrophysics, Vol. 424, Pg. 571, astro-ph/0306222
- *'MAXIMA-1: A Measurement of the Cosmic Microwave Background Anisotropy on Angular Scale of 10 arcminutes to 5 degrees'* S. Hanany, ..., 2000, ApJ, Vol. 545L, pg. 5, astro-ph/0005123

Charles L. Bennett

Professional Preparation:

Massachussets Institute of Technology	Physics	Ph.D. 1978-1984
Univ. of Maryland, *cum laude*, High Honors in Astronomy	Physics	B.S. 1974-1978

Appointments:

2005 - Present	Professor of Physics & Astronomy, Johns Hopkins Univ, Baltimore, MD
1984 - 2005	Senior Scientist for Experimental Cosmology, Infrared Astrophysics Branch Head, Astrophysics Staff Scientist, NASA-GSFC, Greenbelt, MD

Experience and Awards:

Observational/experimental cosmology. CLASS PI. WMAP PI. COBE-DMR Deputy PI. COSPAR Space Science Award Shaw Prize in Astronomy. Gruber Cosmology Prize (once for COBE, once for WMAP). Caterina Tomassoni and Felice Pietro Chisesi Prize. Comstock Prize in Physics. Harvey Prize. Henry Draper Medal. John C. Lindsay Award. NASA Exceptional Scientific Achievement (once for COBE, once for WMAP). NASA Outstanding Leadership Medal for WMAP. National Academy of Sciences. American Academy of Arts and Sciences. Fellow of American Assn for the Advancement of Science. Fellow of the American Physical Society.

Select Publications:

1. Watts, D. J., Larson, D., Marriage, T. A., Abitbol, M. H., Appel, J. W., **Bennett, C. L.**, Chuss, D. T., Eimer, J. R., Essinger-Hileman, T., Miller, N. J., Rostem, K., Wollack, E. J., "Measuring the Largest Angular Scale CMB B-mode Polarization with Galactic Foregrounds on a Cut Sky," ApJ, 814, Issue 2, article id. 103, 2015.
2. Essinger-Hileman, T. et al., "CLASS: The Cosmology Large Angular Scale Surveyor," arXiv:1408.4788, Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series, Volume 9153, 2014.
3. **Bennett, C. L.**; Larson, D.; Weiland, J. L.; Jarosik, N.; Hinshaw, G.; Odegard, N.; Smith, K. M.; Hill, R. S.; Gold, B.; Halpern, M.; Komatsu, E.; Nolta, M. R.; Page, L.; Spergel, D. N.; Wollack, E.; Dunkley, J.; Kogut, A.; Limon, M.; Meyer, S. S.; Tucker, G. S.; Wright, E. L., "Nine-year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Final Maps and Results," ApJ Supp, 208, id 20, 2013.
4. **Bennett, C.L.**, Bay, M., Halpern, M., Hinshaw, G., Jackson, C., Jarosik, N., Kogut, A., Limon, M., Meyer, S.S., Page, L., Spergel, D.N., Tucker, G.S., Wilkinson, D.T., Wollack, E., Wright, E.L., "The Microwave Anisotropy Probe (MAP) Mission," ApJ, 583, 1, 2002.
5. **Bennett, C.L.**, Halpern, M., Hinshaw, G., Jarosik, N., Kogut, A., Limon, M., Meyer, S.S., Page, L., Spergel, D.N., Tucker, G.S., Wollack, E., Wright, E.L., Barnes, C., Greason, M.R., Hill, R.S., Komatsu, E., Nolta, M.R., Odegard, N., Peiris, H.V., Verde, L., Weiland, J.L., "First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Preliminary Maps and Basic Results," ApJ Supp, 148, 1, 2003.
6. **Bennett, C.L.**, Hill, R.S., Hinshaw, G., Nolta, M.R., Odegard, N., Page, L., Spergel, D.N., Weiland, J.L., Wright, E.L., Halpern, M., Jarosik, N., Kogut, A., Limon, M., Meyer, S.S., Tucker, G.S., Wollack, E., "First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Foreground Emission," ApJ Supp, 148, 97, 2003.
7. Spergel, D.N., Verde, L., Peiris, V., Komatsu, E., Nolta, M.R., **Bennett, C.L.**, Halpern, M., Hinshaw, G., Jarosik, N., Kogut, A., Limon, M., Meyer, S.S., Page, L., Tucker, G.S., Weiland, J.L., Wollack, E., Wright, E.L., "First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Determination of Cosmological Parameters," ApJ Supp, 148, 175, 2003.

Curriculum Vitae for Julian Borrill

Contact Information

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email: jdborrill@lbl.gov
web: http;//crd.lbl.gov/borrill

Space Sciences Laboratory
University of California at Berkeley
Berkeley, CA 94720

Education

1984: MA in Maths & Political Science, Trinity College Cambridge
1990: MSc in Information Technology, Queen Mary College London
1990: MSc in Astrophysics, Queen Mary College London
1993: DPhil in Theoretical Physics, University of Sussex

Employment

1993 - 95: Postdoctoral Researcher, Theoretical Physics Group, Imperial College London
1995 - 97: Postdoctoral Researcher, Department of Physics & Astronomy, Dartmouth College
1997 - 99: Postdoctoral Researcher, NERSC Center, Berkeley Lab
1999 - 2010: Staff Scientist, Computational Research Division, Berkeley Lab
& Research Physicist, Space Sciences Laboratory, UC Berkeley
2010 - present: Senior Scientist, Computational Research Division, Berkeley Lab
& Senior Research Physicist, Space Sciences Laboratory, UC Berkeley

Awards

Berkeley Lab Outstanding Perfromance Award (2003)
NASA Public Service Award (2010, 2010, 2014)
NASA Group Achievement Award (2011, 2013)
NERSC Achievement Award for High Impact Science (2014)
NASA Exceptional Public Achievement Medal (2016)

Synergistic Activities

Chair, NASA 2006 Mission Operations & Data Analysis Senior Review
Member, NASA 2004 Mission Operations & Data Analysis Senior Review
Member, NASA Science Archive Working Group (2003 - 05)
Member, NASA Universe Working Group (2006 - 07)
Member, NASA Primordial Polarization Program Definition Team (2008 - 10)
Member, NERSC User Group Executive Committee (2008 - 2014)
Invited Participant, DOE ASCR/HEP Requirements Review (2009, 2012, 2015)
Reviewer, NASA AISR Program (2005, 2007)
Reviewer, NASA New Technology Refresh (2007)
Reviewer, DOE/NSF Dark Energy Survey (2007 - 2014)
Reviewer, NSF Laser Interferometer Gravitational Wave Observatory (2009, 2012)
Reviewer, NSF Blue Waters Graduate Student Fellowships (2014)
Reviewer, NSF KICP Site Visit (2014, 2016)
Reviewer, DOE INCITE Program (2014)
Reviewer, DOE NERSC-8 Design Review (2014)

Supervision

Computer systems engineers: R. Baird, C. Cantalupo, A. Collier, R. Keskitalo & T. Kisner
Postdoctoral researchers: J. Errard, S. Ricciardi, F. Stivoli, R. Stompor & R. Sudarsan
Summer Students: G. de Gasperis, L. Griffiths, M. Krumholz & J. Urrestilla

Brendan Crill — CV

Education:

Brown University, Physics, B.Sc. 1995 (magna cum laude; honors)
California Institute of Technology, Physics, Ph.D. 2001

Appointments:

2008 – present	Staff Scientist, Jet Propulsion Laboratory
2007 – 2008	Visiting Professor, Astronomy Department, U Toronto
2004 – 2007	Staff Scientist, Infrared Processing and Analysis Center, Caltech
2002 – 2004	Assistant Professor, Physics, California State University Dominguez HIlls

Awards:

2014 NASA exceptional service medal
2013 JPL Mariner award
2011 JPL Ranger award
2004 NASA Faculty Fellowship
1999 Everhart Lectureship, Caltech
1995 R. Bruce Lindsay Prize, Brown University
1991 National Scholarship, Brown University

Selected Publications:

1. "BICEP2 / Keck Array VI: Improved Constraints on Cosmology and Foregrounds from BICEP2 and Keck Array Cosmic Microwave Background Data with Inclusion of 95 GHz Band", Keck Array and BICEP2 Collaborations: P. A. R. Ade et al., Phys. Rev. Lett. 116, 031302 (2016). (astro-ph/1510.09217)

2. "A Joint Analysis of BICEP2/Keck Array and Planck Data", BICEP2/Keck and Planck Collaborations: P. A. R. Ade plus 250 alphabetical authors, Phys. Rev. Lett. 114, 101301 (2015). (astro-ph/1502.00612)

3. "*Planck* 2015 results: I. Overview of Planck Products and Scientific Results", Planck collaboration, A&Ap accepted (2015). (astro-ph/1502.01582)

4. "*Planck* 2013 results: I. Overview of Planck Products and Scientific Results", Planck collaboration, A&Ap 571, A1 (2014).

5. "BOOMERANG: A Balloon-borne Millimeter-Wave Telescope and Total Power Receiver for Mapping Anisotropy in the Cosmic Microwave Background", Crill, B. P. et al.

6. "MASTER of the Cosmic Microwave Background Anisotropy Power Spectrum: A Fast Method for Statistical Analysis of Large and Complex Cosmic Microwave Background Data Sets," Hivon, E. and Gorski, K. M. and Netterfield, C. B. and Crill, B. P. and Prunet, S. and Hansen, F., ApJ 567, 2 (2002)

7. "A flat Universe from high-resolution maps of the cosmic microwave background radiation," de Bernardis, P. et al. Nature 404, 955 (2000).

Biographical Sketch of Mark J. Devlin
June 2016

Department of Physics and Astronomy
University of Pennsylvania
Philadelphia, Pennsylvania 19104
http://www.devlinlab.info

Office: (215) 573-7521
Lab: (215) 573-7558
Fax: (215) 573-3826
email: devlin@physics.upenn.edu

Research Interests: Experimental Cosmology, Millimeter and Sub-millimeter Instrumentation

Professional Preparation:

1988	B.S.	Physics/Math	University of Wisconsin
1993	M.A.	Physics	University of California at Berkeley
1993	Ph.D.	Physics	University of California at Berkeley

Professional Appointments:

2006-	Reese W. Flower Professor of Astronomy and Astrophysics, University of Pennsylvania
2003-2006	Class of 1965 Term Chair, University of Pennsylvania
2000-2003	Associate Professor, University of Pennsylvania
1996-2000	Assistant Professor, University of Pennsylvania
1995-1996	Research Associate, Princeton University
1994-1995	Postdoctoral Researcher, Princeton University
1993-1994	Postdoctoral Researcher, University of California at Berkeley

Honors and Awards:

2015	University of Pennsylvania School of Arts and Sciences Ira H. Abrams Memorial Award for Distinguished Teaching
2015	University of Wisconsin Physics Department Distinguished Alumni Award
2011	American Physical Society Fellow
2010	University of Pennsylvania School of Arts and Sciences Dean's award for Undergraduate Research Mentoring
2008	Kavli Fellow, NAS
2000	Alfred P. Sloan Fellow
1998-2003	NSF Career Award

Experience:

2016 -	Spokesperson for the Simons Observatory
2005 -	PI of the MUSTANG project (90 GHz camera for the Green Bank Telescope)
2003 -	Co-I of the Atacama Cosmology Telescope (co-Director starting 2014)
2001 -	PI of the Balloon-borne Large Aperture Telescope - BLAST

Scott Dodelson

(a) Professional Preparation

Undergraduate: Columbia College and School of Engineering, Joint BA/BS Applied Physics 1983.
Graduate: Columbia University, Physics, PhD, 1988.
Postdoctoral: Harvard University, 1988–1991.
Postdoctoral: Fermi National Accelerator Laboratory, Theoretical Astrophysics, 1991–1994.

(b) Appointments

2011–present, Scientist III, Fermilab
2004–2011, Scientist II, Fermilab
2006–2008, Acting Director, Fermi Center for Particle Astrophysics
2004–2005, Visiting Professor, Northwestern University
2001–2006, Head, Theoretical Astrophysics Group, Fermilab
1999–2004, Scientist I, Fermilab
1994–1999, Associate Scientist, Fermilab
2004–present, Professor, Part Time, Department of Astronomy and Astrophysics, The University of Chicago
1999–2004, Associate Professor, Part Time, Department of Astronomy and Astrophysics, The University of Chicago

(c) Recent Relevant Publications (from 190 total)

1. A. Kovcs *et al.* [DES Collaboration], "Imprint of DES super-structures on the Cosmic Microwave Background," Submitted to: Mon.Not.Roy.Astron.Soc.

2. E. J. Baxter, R. Keiser, S. Dodelson, *et al.*, "A Measurement of Gravitational Lensing of the Cosmic Microwave Background by Galaxy Clusters Using Data from the South Pole Telescope," Astrophys. J. **806**, no. 2, 247 (2015).

3. J. Zuntz, M. Paterno, E. Jennings, D. Rudd, A. Manzotti, S. Dodelson, S. Bridle, S. Sehrish, and J. Kowalkowski, "CosmoSIS: Modular Cosmological Parameter Estimation ," **Astronomy and Computing** 12, 45 (2015).

(d) Relevant Service and Awards

2016-present: Co-Chair, Science Committee, Dark Energy Survey 2015-present: Chair, DOE Cosmic Visions: Dark Energy 2012-present: Co-convener, Computing and Infrastructure Working Group, LSST Dark Energy Science Collaboration
2011-16: Co-convener, Theory and Combined Probes Working Group, Dark Energy Survey

THESIS ADVISOR FOR:
Graduate: Kim Coble (1999), Ryan Scranton (2002), Eduardo Rozo (2006), Fabian Schmidt (2009), Melanie Simet (2012), Eric Baxter (2014), Youngsoo Park (2015), Alessandro Manzotti (current), Sam Passaglia (current). Total Number of Graduate Students Advised is 9.
Undergraduate: Sara Burtwell (2002), Matt Billmire (2003), Brian Klein (2007), Vikram Upadyay (2014), Nianyi Change (2015-present)

POSTDOCS ADVISED SINCE 2005:
Over my career, I have sponsored more than 35 postdoctoral scholars.

Raphael Flauger

EDUCATION

2009 Ph.D. (Physics) – The University of Texas at Austin.
Thesis Advisor: Steven Weinberg.
2003 M.Sc. (Theoretical Physics) – Imperial College London.
2002 M.A. (Physics) – The University of Texas at Austin.
2000 Vordiplom (Physics) – Universität Würzburg.

EMPLOYMENT

2016– Assistant Professor, University of California, San Diego.
2015–2016 Assistant Professor, The University of Texas at Austin.
2014–2015 Assistant Professor, Carnegie Mellon University.
2011–2014 Member, Institute for Advanced Study, Princeton.
2011–2014 Postdoctoral Fellow, New York University.
2009–2011 Postdoctoral Associate, Yale University.

HONORS AND AWARDS

2016 National Academy of Sciences Kavli Fellow.
2016 Recipient of New Horizons in Physics Prize.
2015– Alfred P. Sloan Foundation Research Fellow.
2014 James Arthur Fellow.
2011-2014 Supported by Raymond and Beverly Sackler Foundation.
2008 Graduate Fellow, Kavli Institute for Theoretical Physics.

SELECTED PUBLICATIONS

1. K. Clough, E. A. Lim, B. S. DiNunno, W. Fischler, R. Flauger and S. Paban.
"Robustness of Inflation to Inhomogeneous Initial Conditions"
arXiv:1608.04408 [hep-th]
2. R. Flauger, M. Mirbabayi, L. Senatore and E. Silverstein.
"Productive Interactions: heavy particles and non-Gaussianity"
arXiv:1606.00513 [hep-th]
3. D. N. Spergel, R. Flauger and R. Hložek.
"Planck Data Reconsidered"
Phys. Rev. D **91**, no. 2, 023518 (2015)
4. R. Flauger, J. C. Hill and D. N. Spergel.
"Toward an Understanding of Foreground Emission in the BICEP2 Region"
JCAP **1408**, 039 (2014)
5. R. Flauger, L. McAllister, E. Pajer, A. Westphal and G. Xu.
"Oscillations in the CMB from Axion Monodromy Inflation"
JCAP **1006**, 009 (2010)

CURRICULUM VITÆ

Krzysztof Marian Górski

Academic Degrees:

Professor of Physical Sciences		Poland	2003
Doctor Habilitatus	Physics	Warsaw University	1997
Ph.D.	Physics	Warsaw University	1987
M.Sc.	Astronomy	Nicolaus Copernicus University	1980

Employment:

California Institute of Technology Jet Propulsion Laboratory, Pasadena, CA
Senior Research Scientist, January 2003—Present
European Southern Observatory, Garching bei München, Germany
Associate Astronomer, August 1999—December 2002
Teoretisk Astrofysik Center, Kobenhavn, Denmark
Associate Professor, June 1996—August 1999
NASA/Goddard Space Flight Center, Raytheon STX, Greenbelt, MD
Chief Scientist, August 1995—July 1996
NASA/Goddard Space Flight Center, Universities Space Research Association
Senior Research Scientist, February 1993—August 1995
Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto, Japan
Visiting Research Scholar, October 1992—January 1993
Institut d'Astrophysique de Paris, CNRS, Paris, France
Visiting Fellow—Poste Rouge, March 1992—October 1992
University of Chicago, Department of Astronomy and Astrophysics, Chicago, IL
Visiting Scholar, October 1991—February 1992
NASA/Goddard Space Flight Center, Universities Space Research Association
Consultant with the *COBE* Science Team, March 1991—January 1993
Princeton University, Department of Astrophysical Sciences, and
Institute for Advanced Study, School of Natural Science, Princeton, NJ
Visiting Research Fellow, March 1991—October 1991
Los Alamos National Laboratory, Theoretical Astrophysics, Los Alamos, NM
Director's Postdoctoral Fellow, February 1989—April 1991
University of California at Berkeley, Astronomy Department, Berkeley, CA
Postdoctoral Fellow, June 1986—February 1989
Copernicus Astronomical Center, Polish Academy of Sciences, Warsaw, Poland
Research Assistant, 1984—1986, Research Associate, 1986

Awards:

2012 NASA Exceptional Achievement Medal — Planck

Selected Publications:

Planck 2016 intermediate results. XLVI. Reduction of large-scale systematic effects in HFI polarization maps and estimation of the reionization optical depth, Planck Collaboration 2016, *A&A*, accepted

Planck 2015 results. I. Overview of products and scientific results, Planck Collaboration 2016, *A&A*, **594**, A1

Planck 2015 results. XVI. Isotropy and statistics of the CMB, Planck Collaboration 2016, *A&A*, **594**, A16

Planck 2013 results. I. Overview of products and scientific results, Planck Collaboration 2014, *A&A*, **571**, A1

Planck 2013 results. XXXI. Consistency of the Planck data, Planck Collaboration 2014, *A&A*, **571**, A31

MASTER of the Cosmic Microwave Background Anisotropy Power Spectrum: A Fast Method for Statistical Analysis of Large and Complex CMB Data Sets, Hivon, E., Górski, K.M., et al., 2002, *ApJ*, **567**, p.2

HEALPix: A Framework for High-Resolution Discretization and Fast Analysis of Data Distributed on the Sphere, Górski, K.M., et al., 2005, *ApJ*, **622**, p.759

Power Spectrum of Primordial Inhomogeneity Determined from the Four-Year COBE DMR Sky Maps Górski, K.M., et al., 1996, *ApJ*, **464**, p.L11

William C. Jones

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Department of Physics
Joseph Henry Laboratories
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Education and Honors

David and Lucile Packard Fellowship	2010
Alfred P. Sloan Research Fellowship	2009
Ph.D., Physics, June 2005	California Institute of Technology
– *Milton and Francis Clauser Doctoral Thesis Prize*	June 2005
– *Kingsley Foundation Fellowship*	July 2000
– *NASA Graduate Student Research Fellowship*	2000 – 2003
B.A., Physics, *magna cum laude*, June 1998	Princeton University
– *Certificate in Applied and Computational Mathematics*	June 1998
– *Allen G. Shenstone Prize for Experimental Physics*	June 1998
– *Sigma Xi*	June 1998
– *National Merit Scholarship*	1994 – 1998

Employment

• Associate Professor of Physics, Princeton University	July 2016 – present
• Assistant Professor of Physics, Princeton University	September 2008 – 2016
• Scientist – *Director's Fellow*, Jet Propulsion Laboratory	August 2006 – August 2008
• Adjunct Assistant Professor of Physics, Harvey Mudd College	July 2006 – January 2007
• Postdoctoral Scholar, Dept. of Physics, Caltech	April 2005 – August 2006
• Resident Associate, Avery House, Caltech	June 2002 – June 2008
• Research Assistant, Caltech	September 1998 – April 2005
• Teaching Assistant, Caltech	January 1999 – June 2000

Primary Research

My research is focused on the measurement of anisotropies in the temperature and polarization of the Cosmic Microwave Background Radiation (CMB), with an emphasis on large scale polarization as an observational probe of models of the early Universe. Our group is currently leading the analysis of the SPIDER 2015 dataset. Recent advances in mid-latitude scientific ballooning open the door for opportunities in the near-UV and visible wavelengths. My group is presently exploring the cosmological potential of persistent, sub-arcsecond imaging of galaxy clusters and quasars. Together with our collaborators we flew SuperBIT on a test flight in 2016. I am the PI of SPIDER, the PI of SUPERBIT, a *Planck* Scientist and member of the HFI Core Team.

October 27, 2016

LLOYD E. KNOX

PROFESSIONAL PREPARATION

University of Chicago, Ph.D. 1995 (Physics)
University of Virgina, B.S. summa cum laude, 1990 (Physics)

APPOINTMENTS

2006– Professor of Physics, University of California at Davis
2002–2006 Associate Professor of Physics, University of California at Davis
2000–2002 Assistant Professor of Physics, University of California at Davis
1998–2000 Edwin P. Hubble Scientist, U. Chicago
1995–1998 Junior Research Associate, Canadian Institute for Theoretical Astrophysics
1995–1995 Research Associate, U. Chicago

SELECTED PUBLICATIONS

1. B. Follin, L. Knox, M. Millea & Z. Pan,"First Detection of the Acoustic Oscillation Phase Shift Expected from the Cosmic Neutrino Background", *Phys. Rev. Lett.* **115**, 091301 (2015).

2. Planck Collaboration, "Planck 2015 results. XIII. Cosmological parameters", *Astronomy & Astrophysics* **594**, 13 (2016).

3. Hou et al., "Constraints on Cosmology from the Cosmic Microwave Background Power Spectrum of the 2500 deg^2 SPT-SZ Survey", *Astrophys. J.* **782**, 74 (2014).

4. Z. Hou, R. Keisler, L. Knox, M. Millea & C. Reichardt,"How Massless Neutrinos Affect the Cosmic Microwave Background Damping Tail", (2013) Phys. Rev. D **87**, 083008 (2013).

5. M. Millea, O. Doré, J. Dudley, G. Holder, L. Knox, L. Shaw, Y.-S. Song, O. Zahn, "Modeling Extragalactic Foregrounds and Secondaries for Unbiased Estimation of Cosmological Parameters From Primary CMB Anisotropy", *Astrophys. J.* **746**, 4 (2012).

6. L. Knox & Y.S. Song, "Limit on the Detectability of the Energy Scale of Inflation", *Phys Rev. Lett.* **89**, 11303 (2002).

7. Z. Hou, R. Keisler, L. Knox, M. Millea & C. Reichardt,"How Massless Neutrinos Affect the Cosmic Microwave Background Damping Tail", *Phys. Rev. D* **87**, 083008 (2013).

8. A. Albrecht et al., "Report of the Dark Energy Task Force", arXiv:astro-ph/0609591 (2006).

PERFORMANCE ON RELEVANT PRIOR RESEARCH PROJECTS: Lloyd Knox is a fellow of the American Physical Society elected in 2013 with the citation, "For motivating major observations (WMAP and Planck), developing widely-using data analysis tools, providing insightful interpretations of data, and calculating the impact of astrophysical processes on the microwave sky. He currently leads the US Planck team estimating cosmological parameters, and works with the South Pole Telescope team measuring signals he predicted over the past 15 years." He had lead responsibility for the Inflation chapter of the recently completed CMB-S4 Science Book and is currently coordinating the data analysis challenges in support of further development of the S4 concept.

Alan Kogut

NASA Goddard Space Flight Center **Co-Investigator**

Eucation

1989	Ph.D., Physics	University of California at Berkeley
1983	A.B., Physics	Princeton University

Professional History

Dr. Kogut joined NASA Goddard Space Flight Center in 1989 as a member of the Cosmic Background Explorer (COBE) team. Since joining NASA Goddard Space Flight Center he has amassed over 25 years of experience building precision instruments to measure the CMB spectrum, anisotropy, and polarization from ground-based, balloon-borne, and satellite platforms, including COBE-DMR, WMAP, ARCADE, and PIPER. He is Principal Investigator of the ARCADE balloon project to measure the CMB spectrum, the PIPER balloon instrument to measure CMB polarization, and the PIXIE mission concept.

Selected Professional Positions and Experience

1998 -- Present	Astrophysicist, NASA Goddard Space Flight Center
1993 -- 1998	Chief Scientist, Hughes STX
1991 -- 1993	Research Scientist, Universities Space Research Association
1989 -- 1991	Research Associate, National Research Council

Selected Publications

"Foreground Bias From Parametric Models of Far-IR Dust Emission", A. Kogut and D.J. Fixsen, The Astrophysical Journal, 826, 101 (2016)

"Spectral Confusion for Cosmological Surveys of Redshifted CII Emission ", A. Kogut, E. Dwek, and S.H. Moseley, The Astrophysical Journal, 806, 234 (2015)

"Systematic Effects in Polarizing Fourier Transform Spectrometers for Cosmic Microwave Background Observations", P.C. Nagler, D.J. Fixsen, A. Kogut, and G.S. Tucker, The Astrophysical Journal Supplement Series, 221, 21 (2015)

"Polarization Properties of A Multi-Moded Concentrator", A. Kogut, D.J. Fixsen, and Robert S. Hill, Journal of the Optical Society of America A, 32, 1040 (2015)

"Synchrotron Spectral Curvature from 22 MHz to 23 GHz", A. Kogut, The Astrophysical Journal,753, 110 (2012)

"The Primordial Inflation Explorer (PIXIE): A Nulling Polarimeter for Cosmic Microwave Background Observations", A. Kogut, D. J. Fixsen, D. T. Chuss, J. Dotson, E. Dwek, M. Halpern, G. F. Hinshaw, S. M. Meyer, S. H. Moseley, M.D. Seiffert, D. N. Spergel, and E. J. Wollack, Journal of Cosmology and Astrophysics, 7, 025 (2011)

"ARCADE 2 Observations of Galactic Radio Emission", A. Kogut, D. J. Fixsen, S. M. Levin, M. Limon, P. M. Lubin, P. Mirel, M. Seiffert, J. Singal, T. Villela, E. Wollack, and C. A. Wuensche, The Astrophysical Journal, 734, 4 (2011)

"Three-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Foreground Polarization", A. Kogut, J. Dunkley, C. L. Bennett, O. Dore, B. Gold, M. Halpern, G. Hinshaw, N. Jarosik, E. Komatsu, M. R. Nolta, N. Odegard, L. Page, D. N. Spergel, G. S. Tucker, J. L. Weiland, E. Wollack, and E. L. Wright, The Astrophysical Journal, 665, 355 (2007)

CHARLES R. LAWRENCE

EDUCATION

1983	Ph. D. in Physics, Massachusetts Institute of Technology.
1970	B. S. with Distinction, Honors in Physics, University of Michigan, Ann Arbor.

EMPLOYMENT

2013–	Fellow, JPL
2012–	Senior Research Scientist, JPL
2000–	Principal Scientist, Astrophysics, JPL
1993–2000	Research Scientist, Astrophysics, JPL
1993–1994	Visiting Associate, California Institute of Technology
1991–1993	Senior Research Associate, California Institute of Technology
1986–1991	Senior Research Fellow, California Institute of Technology
1983–1986	Research Fellow, California Institute of Technology
1970–1977	Physics Teacher, Baltimore County Public Schools, MD

PROFESSIONAL ACTIVITIES

2014–	Chief Scientist, Astronomy, Physics, and Space Technology Directorate, JPL
2010–	Co-Chair, Planck Editorial Board
1998–	Deputy Project Scientist for SIRTF/Spitzer
1998–	Survey Scientist for Low Frequency Instrument on Planck; member of Planck Science Team
1997–	Project Scientist, US Planck Project, and PI, US Low Frequency Instrument team

AWARDS

2014	NASA Exceptional Achievement Medal — Planck
2010	NASA Outstanding Leadership Medal — Planck
2004	NASA Outstanding Leadership Medal — Spitzer
1999	NASA Exceptional Achievement Medal — Cryogenic HEMT Optimization Program

SELECTED PUBLICATIONS

Planck intermediate results. XLVI. Reduction of large-scale systematic effects in HFI polarization maps and estimation of the reionization optical depth, Planck Collaboration 2016, *A&A*, accepted

Planck 2015 results. I. Overview of products and scientific results, Planck Collaboration 2016, *A&A*, **594**, A1

Planck 2013 results. XXXI. Consistency of the Planck data, Planck Collaboration 2014, *A&A*, **571**, 31

Planck 2013 results. I. Overview of products and scientific results, Planck Collaboration 2014, *A&A*, **571**, 1

Planck early results. II. The thermal performance of Planck, Planck Collaboration 2011, *A&A*, **536**, A2

Planck Pre-Launch Status: Design and Description of the Low Frequency Instrument, M. Bersanelli et al. 2010, *A&A*, **520**, A4

The Infrared Spectrograph on the Spitzer Space Telescope, J. R. Houck et al. 2004, *Ap. J. Suppl.*, **154**, 18

The Spitzer Space Telescope Mission, M. W. Werner et al. 2004, *Ap. J. Suppl.*, **154**, 1

Separation of Foreground Radiation from Cosmic Microwave Background Anisotropy Using Multifrequency Measurements, W. N. Brandt, C. R. Lawrence, A. C. S. Readhead, J. Pakianathan, and T. Fiola 1994, *Ap. J.*, **424**, 1.

Jeffrey J. McMahon

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Ann Arbor, Michigan 48109

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Primary Research Interests: Cosmology, CMB Instrumentation, Metamaterial Optical Elements, Millimeter Wave Polarization Sensitive Detectors

Professional Preparation:

2006	Ph.D.	Physics	Princeton University	
1999	B.A.	Physics	U. C. Berkeley	High Honors
1999	B.A.	Applied Math	U. C. Berkeley	High Honors

Professional Appointments:

2015—	Associate Professor, The University of Michigan department of Physics
2009-2015	Assistant Professor, The University of Michigan department of Physics
2006-2009	Enrico Fermi *and* KICP postdoctoral fellow, University of Chicago
1999-2000	Assistant Engineer, C. H.Townes group, Space Sciences Lab, UC Berkeley

Professional Honors:

2006	Enrico Fermi Postdoctoral Fellowship, University of Chicago
2006	KICP Postdoctoral Fellowship, University of Chicago
2001	Joseph Henry Prize, Princeton University

Relevant Expertise: McMahon is an expert in millimeter wave detectors and optical systems. McMahon is lead the development of horn coupled multichroic detectors for measurement of the cosmic microwave background. We successfully deployed the first two multichroic polarimeter arrays on a CMB instrument (ACTPOL). These dicrhoic arrays are sensitive to the 90/150 and 150/230 GHz CMB bands and pave the way for widespread use of this technology. McMahon also led the effort to develop antireflection coated silicon lenses for the ACTPol project including the design and fabrication of the Michigan metamaterial AR coating machine. Using this machine our group produced 3:1 bandwidth metamaterial AR coated lenses which are now fielded on the ACTPol experiment and prototypes at frequencies up to 1 THz. McMahoh has 16 years of experience developing and fielding CMB instruments and in his current rols as the technical chair on the Simons Observatory is at the forefront of CMB technology.

Selected Publications:

1. "Design and Deployment of a Multichroic Polarimeter Array on the Atacama Cosmology Telescope",R. Datta et al, Journal of Low Temperature Physics (2015)

2. "Large-aperture wide-bandwidth anti-reflection-coated silicon lenses for millimeter wavelengths",R. Datta (my student) et al, (Submitted) Applied Optics. 2013

3. "The Atacama Cosmology Telescope: CMB Polarization at $200 < \ell < 9000$",S. Naess et al, Astrophysics Journal (2014)

LYMAN ALEXANDER PAGE JR, November, 2016

Department of Physics, Princeton University
Princeton, New Jersey 08544-0708
Phone: (609) 258-5578, Email: Page@Princeton.edu

Education

Massachusetts Institute of Technology, Cambridge, MA	Ph.D. 1989 (Physics)
Thesis Advisor: Stephan S. Meyer	
Bowdoin College, Brunswick, ME	B.A. 1978 (Physics)

Employment and Research History

James S. McDonnell Distinguished University of Physics at Princeton	July 2015 - Present
Professor of Physics at Princeton	July 1998 - Present
Associate Professor of Physics at Princeton	July 1995 - June 1998
Assistant Professor of Physics at Princeton	July 1991 - June 1995
Instructor of Physics at Princeton	July 1990 - July 1991
Postdoctoral Research Fellow at MIT	October 1989 - July 1990
Graduate Student at MIT	September 1983 - September 1989
Self employed as a painter, rigger, & carpenter	February 1980 - September 1983
Research Technician, Bartol Research Foundation, Newark, DE, McMurdo Antarctica, and South Pole, Antarctica.	September 1978 - January 1980

Page's primary research is on measurements of the cosmic microwave background (CMB) from ground-based, balloon-borne, and satellite platforms with HEMT amplifiers, SIS mixers, and bolometers. Page is one of the original co-investigators on the *WMAP* satellite and the founding director of the ACT project.

Honors and Awards

Gruber Prize	August 2015
APS Fellow	December 2013
Gruber Prize with WMAP team	August 2012
Kavli AAS Lecture	January 2012
Shaw Prize	September 2010
Phi Beta Kappa teaching award and induction	June 2010
Welch Lectures	April 2010
Chandrasekhar Lectures (ICTS)	April 2010
Member of the National Academy of Sciences	2006
Philips Lectureship	2006
Fellow of the American Academy of Arts & Sciences	2004
Marc Aaronson Lectureship & Prize	November 2003
Primakoff Lectureship	March 2003
David and Lucile Packard Fellowship	September 1994
Princeton Engineering Council Teaching Award	May 1994 & 1992
Research Corporation Cottrell Scholar	May 1994
National Science Foundation NYI Award	August 1993
NASA Graduate Student Researchers Program Fellowship	1987-1989

Biographical Sketch — Clem Pryke

Professional Preparation:

University of Leeds (UK), Physics, B.Sc. 1992 (First Class Honours)
University of Leeds (UK), Physics, Ph.D. 1996
University of Chicago, McCormick Postdoctoral Fellow, 1996-9

Appointments:

10/15 – 5/16	Visiting Scholar, Harvard/CfA
7/10 – present	Associate Professor, Physics, U. Minnesota
6/02 – 6/10	Assistant Professor, Astronomy and Astrophysics, U. Chicago
1/01 – 6/02	Senior Research Associate, Astronomy and Astrophysics, U. Chicago
4/99 – 1/01	Research Scientist, Enrico Fermi Institute, U. Chicago

Most Related Recent Publications:

1. "BICEP2 / Keck Array VI: Improved Constraints on Cosmology and Foregrounds from BICEP2 and Keck Array Cosmic Microwave Background Data with Inclusion of 95 GHz Band", Keck Array and BICEP2 Collaborations: P. A. R. Ade plus 59 alphabetical authors, Phys. Rev. Lett. 116, 031302 (2016). (astro-ph/1510.09217)

2. "A Joint Analysis of BICEP2/Keck Array and Planck Data", BICEP2/Keck and Planck Collaborations: P. A. R. Ade plus 250 alphabetical authors, Phys. Rev. Lett. 114, 101301 (2015). (astro-ph/1502.00612)

3. "BICEP2 III: Instrumental Systematics", BICEP2 Collaboration: P. A. R. Ade plus 43 alphabetical authors, ApJ, 814, 110 (2015)

4. "BICEP2 II: Experiment and Three-Year Data Set", BICEP2 Collaboration: P. A. R Ade plus 50 alphabetical authors, ApJ, 792, 62 (2014)

5. "BICEP2 I: Detection Of B-mode Polarization at Degree Angular Scales", BICEP2 Collaboration: P. A. R Ade plus 46 alphabetical authors, Phys. Rev. Lett. 112, 241101 (2014). (astro-ph/1403.3985)

Most Related Experience:

Extensive experience of CMB polarization data analysis. Lead analysis of QUaD experiment data. Lead analysis team of BICEP2/Keck experiments. co-PI on multi NSF grants for these experiments.

Synergistic Activities:

- Organized two major community wide workshops on CMB (Chicago 2009 and Minneapolis 2015).
- Designed new graduate level class on practical data analysis integrating real research data.
- Proposal and paper reviews.
- Outreach activities including major public lectures and TV/radio appearances.

Curriculum Vitae — Graça Rocha

Name: **Graça Maria Moreira de Sousa Teixeira da Rocha.**

Education

1997	PhD in Physics, University of Cambridge, UK.
1992	MSc in Mathematics, QMW, University of London, UK.
1991	Licenciatura in Physics and Applied Mathematics, Astronomy, University of Porto, Portugal.
1987	Licenciatura in Mathematics, branch of Pure Mathematics, University of Porto, Portugal.

Employment

2009 –	Staff Research Scientist at JPL
2011 – 2012	Group Supervisor of the 'Evolution of Galaxies' group at JPL
2006 – 2009	Staff Scientist at IPAC, Caltech
2006 –	Visitor at Caltech, Physics, Math & Astronomy Department, Observational Cosmology group
2001 – 2005	Leverhulme Postdoctoral Fellow at the University of Cambridge, UK
2004 – 2005	Lecturer of a graduate course on 'Theoretical Cosmology' at the University of Cambridge
2005	Postdoctoral Scholar in Physics, Observational Cosmology Group, Caltech
2000 – 2001	Visitor at the University of Oxford
2001 –	Collaborator at CAUP, Portugal, & Academic Visitor at the University of Oxford
1998 – 2001	Postdoctoral Fellow at CAUP, & Invited Lecturer at the University of Porto
1997	Postdoctoral Fellow in the Department of Physics, KSA, USA

Recent Honors and Awards: NASA and JPL Awards

2014 –	NASA Exceptional Achievement Medal for the work on Planck Data Analysis
2011 –	NASA Group Achievement Award: Early Release Compact Source Catalogue Team
2011 –	NASA Group Achievement Award: Planck Data Analysis and Operations Support Team
2011 –	NASA Group Achievement Award: Herschel & Planck Projects Teams
2009 –	NASA Group Achievement Award: BICEP Experiment Team
2009 –	NASA Group Achievement Award: Planck Data Analysis Pipeline Development Team
2009 –	NASA Group Achievement Award: Planck Data Analysis Team
2013 –	JPL Mariner Award - Award for leading a team to calculate cosmological parameters from CMB
2012 –	JPL Mariner Award - Award for essential contributions to the Planck data analysis
2011 –	JPL Team Bonus Award: Planck Effective Beamshape Team
2010 –	Certificate of Recognition for 5 years of service to JPL

Areas of Expertise: My Area of expertise is Cosmology, more specifically constraining models of structure formation and fundamental physics with the study of the Cosmic Microwave Background Radiation, CMB. I am member of the ESA-NASA Planck mission, as Planck Scientist and as member of both the LFI and HFI instruments. I coordinated several Planck working groups: the 'Compact Source Investigation', CSI, collaboration; the 'Power Spectrum and Likelihood' WG at JPL; the 'Fundamental Physics' WG (I am the corresponding author of the resulting Planck Intermediate Paper). I was the spokesperson for Planck team at the Planck plenary session at ESLAB, Nordwijk, Netherlands in April 2013.

Selected Publications

Planck 2015 results. XVI. Cosmological parameters, Planck Collaboration 2016, A&A 594, A13

Planck 2015 results. IX. Diffuse component separation: CMB maps, Planck Collaboration 2016, A&A 594, A9

Planck 2015 results. XI. CMB power spectra, likelihoods, and robustness of parameters, Planck Collaboration 2016, A&A 594, A11

Planck intermediate results. XXIV. Constraints on variations in fundamental constants, Planck Collaboration 2016, A&A 580, A22.

PowellSnakes II: a fast Bayesian approach to discrete object detection in multi-frequency astronomical data sets, Carvalho, P., Rocha, G., Hobson, M. P., Lasenby, A. 2012, MNRAS 427, 1384-1400.

Fast Pixel Space Convolution for Cosmic Microwave Background Surveys with Asymmetric Beams and Complex Scan Strategies: FEBeCoP', Mitra, S.; Rocha, G.; Gorski, K. M.; Huffenberger, K. M.; Eriksen, H. K.; Ashdown, M. A. J.; Lawrence, C. R. 2011, ApJS 193 5M.

Measuring α in the early Universe: cosmic microwave background polarization, re-ionization and the Fisher matrix analysis, Rocha, G.; Trotta, R.; Martins, C. J. A. P.; Melchiorri, A.; Avelino, P. P.; Bean, R.; Viana, P. T. P. 2004, MNRAS 352, 20R.

Constraints on cosmological parameters from recent measurements of cosmic microwave background anisotropy, Hancock, S., Rocha, G., Lasenby, A. N., Gutierrez, C. M. 1998, MNRAS 294, L1-L6.