

## Eric R. Switzer

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### Employment and education

Astrophysicist, NASA GSFC, Observational Cosmology Laboratory, 2013-

Senior Research Associate, CITA, University of Toronto, 2011-2013.

Postdoctoral Fellow, Kavli Institute for Cosmological Physics, University of Chicago, 2008-2011.

Ph.D. Physics, Princeton University, 2008.

B.A. Physics (with honors), University of Chicago, 2003.

US citizen.

Past and present research areas: instrumentation and data analysis for cosmic microwave background (CMB) experiments, cosmological helium recombination and reionization, mapping diffuse 21 cm emission at  $z \sim 1$ . Dissertation adviser: Lyman Page. Title: *Small-scale anisotropies of the cosmic microwave background: Experimental and theoretical perspectives*.

### Honors and awards

APS, 32 most influential papers in General Relativity: ACT detection of lensing of the CMB.

CITA Senior Research Associate, 2011-2013.

Compton Lecture Series, "The Physics of Energy Devices," University of Chicago, fall 2009. →

KICP Postdoctoral Fellowship, University of Chicago, 2008-2011.

Centennial Fellowship, Princeton University Graduate School, 2003-2008.

Joseph Henry Merit Prize, Princeton University Graduate School, 2003.

Member of Phi Beta Kappa, University of Chicago.

DESY-Zeuthen Summer Student Research Fellowship, 2002.

### Professional Activities and Collaborations

2015 Science Lead, Legacy Archive for Microwave Background Data (LAMBDA)

2013- Primordial Inflation Polarization Explorer (PIPER)

2011- Green Bank Telescope 21 cm Intensity Mapping

2011- Atacama Cosmology Telescope (ACTPol)

2008-2011 South Pole Telescope (SPT, Temperature)

2005-2011 Atacama Cosmology Telescope (ACT, Temperature)

### Refereed Publications

1. **E. R. Switzer**, D. J. Watts, "Robust Likelihoods for Inflationary Gravitational Waves from Maps of Cosmic Microwave Background Polarization", PRD **94** 063526 (2016). →
2. N. J. Miller, D. T. Chuss, T. A. Marriage, E. J. Wollack, J. W. Appel, C. L. Bennett, J. Eimer, T. Essinger-Hileman, D. J. Fixsen, K. Harrington, S. H. Moseley, K. Rostem, **E. R. Switzer**, D. J. Watts, "Recovery of Large Angular Scale CMB Polarization for Instruments Employing Variable-delay Polarization Modulators", *ApJ* **818**(2) (2016). →
3. **E. R. Switzer**, T.-C. Chang, K. W. Masui, U.-L. Pen, T. C. Voytek, "Interpreting the unresolved intensity of cosmologically redshifted line radiation", *ApJ* **815**(1), (2015). →

4. A. Engelen, B. D. Sherwin, N. Sehgal, ACTPol Collaboration, "The Atacama Cosmology Telescope: Lensing of CMB Temperature and Polarization Derived from Cosmic Infrared Background Cross-correlation", *ApJ* **808**(1) (2015). →
5. N. Hand, A. Leauthaud, S. Das, B. D. Sherwin, ACT Collaboration, "First Measurement of the Cross-Correlation of CMB Lensing and Galaxy Lensing", *PRD* **91**(6) 062001 (2015). →
6. **E. R. Switzer**, A. Liu, "Erasing the variable: Empirical foreground discovery for global 21 cm spectrum experiments", *ApJ* **793**(2) 102 (2014). →
7. M. B. Gralla, D. Crichton, T. A. Marriage, W. Mo, ACT Collaboration, "A Measurement of the Millimeter Emission and the Sunyaev-Zel'dovich Effect Associated with Low-Frequency Radio Sources", *MNRAS* **445**(1) 460 (2014). →
8. S. Naess, M. Hasselfield, J. McMahon, M. Niemack, ACTPol Collaboration, "The Atacama Cosmology Telescope: CMB Polarization at  $200 < \ell < 9000$ ", *JCAP* **10**(007) (2014). →
9. E. Calabrese, R. Hlozek, N. Battaglia, J. R. Bond, F. de Bernardis, M. J. Devlin, A. Hajian, S. Henderson, J. C. Hill, A. Kosowsky, T. Louis, J. McMahon, K. Moodley, L. Newburgh, M. D. Niemack, L. A. Page, B. Partridge, N. Sehgal, J. L. Sievers, D. N. Spergel, S. T. Staggs, **E. R. Switzer**, H. Trac, E. J. Wollack, "Precision Epoch of Reionization studies with next-generation CMB experiments", *JCAP* **08**(010) (2014). →
10. D. T. Chuss, J. R. Eimer, D. J. Fixsen, J. Hinderks, A. J. Kogut, J. Lazear, P. Mirel, **E. R. Switzer**, G. M. Voellmer, E. J. Wollack, "Variable-delay Polarization Modulators for Cryogenic Millimeter-wave Applications", *Rev. Sci. Inst.* **85**(6) (2014). →
11. S. Das, T. Louis, M. R. Nolte, ACT Collaboration, "The Atacama Cosmology Telescope: Temperature and Gravitational Lensing Power Spectrum Measurements from Three Seasons of Data," *JCAP* **4** 14, (2014). →
12. D. Marsden, M. Gralla, T. A. Marriage, **E. R. Switzer**, B. Partridge, M. Massardi, G. Morales, ACT Collaboration, "The Atacama Cosmology Telescope: Dusty Star-Forming Galaxies and Active Galactic Nuclei in the Southern Survey," *MNRAS* **439**(2) 1556 (2014). →
13. L. M. Mocanu, T. M. Crawford, J. D. Vieira, SPT Collaboration, "Extragalactic millimeter-wave point source catalog, number counts and statistics from 771 square degrees of the SPT-SZ Survey," *ApJ* **779**(1) 61 (2013). →
14. J. L. Sievers, R. A. Hlozek, M. R. Nolte, ACT Collaboration, "The Atacama Cosmology Telescope: cosmological parameters from three seasons of data," *JCAP* **10**(60), (2013). →
15. M. Hasselfield, K. Moodley, ACT Collaboration, "The Atacama Cosmology Telescope: Beam Measurements and the Microwave Brightness Temperatures of Uranus and Saturn," *ApJS* **209**(1) 17 (2013). →
16. M. Hasselfield, M. Hilton, T. A. Marriage, ACT Collaboration, "The Atacama Cosmology Telescope: Sunyaev-Zel'dovich selected galaxy clusters at 148 GHz from three seasons of data," *JCAP* **7**(8), (2013). →
17. J. Dunkley, E. Calabrese, J. Sievers, ACT Collaboration, "The Atacama Cosmology Telescope: likelihood for small-scale CMB data," *JCAP* **7**(25), (2013). →
18. **E. R. Switzer**, K. W. Masui, K. Bandura, L.-M. Calin, T.-C. Chang, X.-L. Chen, Y.-C. Li, Y.-W. Liao, A. Natarajan, U.-L. Pen, J. B. Peterson, J. R. Shaw, T. C. Voytek, "Determination of  $z \sim 0.8$  neutral hydrogen fluctuations using the 21 cm intensity mapping auto-correlation," *MNRAS* **10.1093/mt074** (2013). →

19. E. Calabrese, R. Hlozek, ACT Collaboration, "Cosmological parameters from pre-Planck cosmic microwave background measurements", *PRD* **87**(10), 103012 (2013). →
20. J. Chluba, **E. R. Switzer**, D. Nagai, K. Nelson, "Sunyaev-Zeldovich signal processing and temperature-velocity moment method for individual clusters," *MNRAS* **430**(4) 3054 (2013). →
21. N. Sehgal, ACT Collaboration, "The Atacama Cosmology Telescope: Relation between Galaxy Cluster Optical Richness and Sunyaev-Zel'dovich Effect," *ApJ* **767**(1) 38 (2013). →
22. F. Menanteau, C. Sifón, ACT Collaboration, "The Atacama Cosmology Telescope: Physical Properties of Sunyaev-Zel'dovich Effect Clusters on the Celestial Equator," *ApJ* **765**(1) 67, (2013). →
23. M. Farhang, J. R. Bond, J. Chluba, **E. R. Switzer**, "Constraints on Perturbations to the Recombination History from Measurements of the Cosmic Microwave Background Damping Tail," *ApJ* **764**(2) 137 (2013). →
24. K. W. Masui, **E. R. Switzer**, N. Banavar, K. Bandura, C. Blake, L.-M. Calin, T.-C. Chang, X. Chen, Y.-C. Li, Y.-W. Liao, A. Natarajan, U.-L. Pen, J. B. Peterson, J. R. Shaw, T. C. Voytek, "Measurement of 21 cm brightness fluctuations at  $z \sim 0.8$  in cross-correlation," *ApJL* **763**(1) L20 (2013). →
25. R. Dünner, M. Hasselfield, T. A. Marriage, J. Sievers, ACT Collaboration, "The Atacama Cosmology Telescope: Data Characterization and Mapmaking," *ApJ* **762**(1) 10 (2013). →
26. M. J. Wilson, B. D. Sherwin, J. C. Hill, ACT Collaboration, "Atacama Cosmology Telescope: A measurement of the thermal Sunyaev-Zel'dovich effect using the skewness of the CMB temperature distribution," *PRD* **86**(12) 122005 (2012). →
27. B. D. Sherwin, S. Das, A. Hajian, ACT Collaboration, "The Atacama Cosmology Telescope: Cross-Correlation of CMB Lensing and Quasars," *PRD* **86**(8) 083006 (2012). →
28. N. Hand, ACT Collaboration, "Detection of Galaxy Cluster Motions with the Kinematic Sunyaev-Zel'dovich Effect," *PRL* **109**(4) 041101 (2012). →
29. J. Chluba, J. Fung, **E. R. Switzer**, "Radiative transfer effects during primordial helium recombination," *MNRAS* **423**(4) 3227 (2012). →
30. E. D. Reese, T. Mroczkowski, F. Menanteau, M. Hilton, J. Sievers, ACT Collaboration, "The Atacama Cosmology Telescope: High-Resolution Sunyaev-Zel'dovich Array Observations of ACT SZE-selected Clusters from the Equatorial Strip" *ApJ* **751**(1) 12 (2012). →
31. R. Hlozek, J. Dunkley, ACT Collaboration, "The Atacama Cosmology Telescope: a measurement of the primordial power spectrum," *ApJ* **749**(1) 90 (2012). →
32. A. Hajian, M. P. Viero, ACT Collaboration, "Correlations in the (Sub)millimeter background from ACTxBLAST," *ApJ* **744**(1) 40 (2012). →
33. A. Hajian, ACT Collaboration, "The Atacama Cosmology Telescope: Calibration with WMAP Using Cross-Correlations," *ApJ* **740** 86 (2011). →
34. J. Dunkley, R. Hlozek, J. Sievers, ACT Collaboration, "The Atacama Cosmology Telescope: Cosmological Parameters from the 2008 Power Spectrum," *ApJ* **739**(1) 52 (2011). →
35. T. A. Marriage, ACT Collaboration, "The Atacama Cosmology Telescope: Sunyaev-Zel'dovich-Selected Galaxy Clusters at 148 GHz in the 2008 Survey," *ApJ* **737**(2) 61 (2011). →
36. B. Sherwin, J. Dunkley, S. Das, ACT Collaboration, "Evidence for Dark Energy from the Cosmic Microwave Background Alone Using the Atacama Cosmology Telescope Lensing Measurements," *PRL* **107**(2) 021302 (2011). →

37. S. Das, B. Sherwin, ACT Collaboration, "Detection of the Power Spectrum of Cosmic Microwave Background Lensing by the Atacama Cosmology Telescope," *PRL* **107**(2) 021301 (2011). →
38. N. Hand, ACT Collaboration, "The Atacama Cosmology Telescope: Detection of Sunyaev-Zel'Dovich Decrement in Groups and Clusters Associated with Luminous Red Galaxies," *ApJ* **736**(1) 39 (2011). →
39. D. S. Abbot, **E. R. Switzer**, "The Steppenwolf: A Proposal for a Habitable Planet in Interstellar Space," *ApJL* **735**(2) L27 (2011). →
40. D. S. Swetz, ACT Collaboration, "Overview of the Atacama Cosmology Telescope: Receiver, Instrumentation, and Telescope Systems," *ApJS* **194**(2) 41 (2011). →
41. N. Sehgal, H. Trac, ACT Collaboration, "The Atacama Cosmology Telescope: Cosmology from Galaxy Clusters Detected via the Sunyaev-Zel'dovich Effect," *ApJ* **732**(1) 44 (2011). →
42. T. A. Marriage, J. B. Juin, Y.-T. Lin, D. Marsden, M. R. Nolte, B. Partridge, ACT Collaboration, "Atacama Cosmology Telescope: Extragalactic Sources at 148 GHz in the 2008 Survey," *ApJ* **731**(2) 100 (2011). →
43. S. Das, T. A. Marriage, ACT Collaboration, "The Atacama Cosmology Telescope: A Measurement of the Cosmic Microwave Background Power Spectrum at 148 and 218 GHz from the 2008 Southern Survey," *ApJ* **729**(1) 62-78 (2011). →
44. A. D. Hincks, ACT Collaboration, "The Atacama Cosmology Telescope (ACT): Beam Profiles and First SZ Cluster Maps," *ApJS* **191**(2) 423-438 (2010). →
45. F. Menanteau, J. Gonzalez, J. B. Juin, T. A. Marriage, E. D. Reese, ACT Collaboration, "The Atacama Cosmology Telescope: Physical Properties and Purity of a Galaxy Cluster Sample Selected via the Sunyaev-Zel'dovich Effect," *ApJ* **723**(2) 1523-1541 (2010). →
46. M. McQuinn, **E. R. Switzer**, "The He I 584 Å Forest as a Diagnostic of Helium Reionization," *MNRAS* **408**(3) 1945-1955 (2010). →
47. J. W. Fowler, ACT Collaboration, "The Atacama Cosmology Telescope: A Measurement of the  $600 < \ell < 8000$  Cosmic Microwave Background Power Spectrum at 148 GHz," *ApJ* **722**(2) 1148-1161 (2010). →
48. N. R. Hall, R. Keisler, L. Knox, C. L. Reichardt, SPT Collaboration, "Angular Power Spectra of the Millimeter Wavelength Background Light from Dusty Star-forming Galaxies with the South Pole Telescope," *ApJ* **718**(2) 632-646 (2010). →
49. T. M. Crawford, **E. R. Switzer**, W. L. Holzapfel, C. L. Reichardt, D. P. Marrone, J. D. Vieira, "A Method for Individual Source Brightness Estimation in Single- and Multi-band Data," *ApJ* **718**(1) 513-521 (2010). →
50. J. D. Vieira, T. M. Crawford, **E. R. Switzer**, SPT Collaboration, "Extragalactic Millimeter-wave Sources in South Pole Telescope Survey Data: Source Counts, Catalog, and Statistics for an 87 Square-degree Field," *ApJ* **719**(1) 763-783 (2010). →
51. M. McQuinn, **E. R. Switzer**, "Redshifted intergalactic  $^3\text{He}$  8.7 GHz hyperfine absorption," *PRD* **80**(6) 063010 (2009). →
52. **E. R. Switzer**, "Small-scale anisotropies of the cosmic microwave background: Experimental and theoretical perspectives," *Princeton Ph.D. Thesis* (2008). →

53. **E. R. Switzer**, C. M. Hirata, "Primordial helium recombination III: Thomson scattering, isotope shifts, and cumulative results," *PRD* **77**(8) 083008 (2008). →
54. C. M. Hirata, **E. R. Switzer**, "Primordial helium recombination II: two-photon processes," *PRD* **77**(8) 083007 (2008). →
55. **E. R. Switzer**, C. M. Hirata, "Primordial helium recombination I: feedback, line transfer, and continuum opacity," *PRD* **77**(8) 083006 (2008). →
56. J. W. Fowler, M. D. Niemack, S. R. Dicker, ACT Collaboration, "Optical design of the Atacama Cosmology Telescope and the Millimeter Bolometric Array Camera," *Applied Optics* **46**(17) 3444-3454 (2007). →
57. **E. R. Switzer**, C. M. Hirata, "Ionizing radiation from hydrogen recombination strongly suppresses the lithium scattering signature in the CMB," *PRD* **72**(8) 083002 (2005). →
58. K. Abazajian, **E. R. Switzer**, S. Dodelson, K. Heitmann, S. Habib, "Nonlinear cosmological matter power spectrum with massive neutrinos: The halo model," *PRD* **71**(4) 043507 (2005). →
59. J. A. Switzer, C.-J. Hung, L.-Y. Huang, **E. R. Switzer**, T. D. Golden, and E. W. Bohannon, "Electrochemical Self-Assembly of Copper/Cuprous Oxide Layered Nanostructures," *J. Am. Chem. Soc.* **120** 3530-3531 (1998). →

### Submitted Publications

1. L. Wolz, C. Blake, F. B. Abdalla, C. M. Anderson, T.-C. Chang, Y.-C. Li, K. W. Masui, **E. R. Switzer**, U.-L. Pen, T. C. Voytek, J. Yadav, "Erasing the Milky Way: new cleaning technique applied to GBT intensity mapping data", 1510.05453 (2015). →

### Proceedings, Reports

1. N. Gandilo, PIPER Collaboration, "The Primordial Inflation Polarization Explorer (PIPER)", *Proc. SPIE* **9914** (2016). →
2. J. Lazear, PIPER Collaboration, "The Primordial Inflation Polarization Explorer (PIPER)", *Proc. SPIE* **9153** (2014). →
3. E. R. Switzer, T. M. Crawford, C. L. Reichardt, "Bayesian flux reconstruction in one and two bands," Statistical Challenges in Modern Astronomy V, Feigelson and Babu (Eds.), Springer 2012. →
4. E. S. Battistelli, ACT collaboration, "Automated SQUID tuning procedure for kilo-pixel arrays of TES bolometers on the Atacama Cosmology Telescope," *Proc. SPIE*, **7020** 702028-702028-12 (2008). →
5. A. D. Hincks, ACT collaboration, "The effects of the mechanical performance and alignment of the Atacama Cosmology Telescope on the sensitivity of microwave observations," *Proc. SPIE*, **7020** 70201P-70201P-10 (2008). →
6. D. S. Swetz, ACT collaboration, "Instrument design and characterization of the Millimeter Bolometer Array Camera on the Atacama Cosmology Telescope," *Proc. SPIE*, **7020** 702008-702008-12 (2008). →
7. **E. R. Switzer**, ACT collaboration, "Systems and control software for the Atacama Cosmology Telescope," *Proc. SPIE*, **7019** 70192L-70192L-12 (2008). →

8. R. J. Thornton, ACT collaboration, "Opto-mechanical design and performance of a compact three-frequency camera for the MBAC receiver on the Atacama Cosmology Telescope," *Proc. SPIE*, **7020** 70201R-70201R-10 (2008). →
9. Y. Zhao, ACT collaboration, "Characterization of Transition Edge Sensors for the Millimeter Bolometer Array Camera on the Atacama Cosmology Telescope," *Proc. SPIE*, **7020**, 70200O-70200O-11 (2008). →
10. M. Niemack, ACT collaboration, "A kilopixel array of TES bolometers for ACT: development, testing, and first light," *J. Low Temp. Phys.*, **151**(3-4) 690-696 (2008). →
11. E. R. Switzer, "Physics AI Guide: Princeton University," *Guide for graduate assistant instructorships*, Sept. 2006.
12. E. R. Switzer, "Graduate Student Life – Home on the Range," *Princeton physics departmental newsletter*, Sept. 2006.
13. A. Kosowsky, the ACT collaboration, "The Atacama Cosmology Telescope: A progress report," *New Astronomy Reviews* **50**(11-12) 969-976 (2006); Switzer: *preliminary beam maps appearing therein*. →
14. M. Niemack, the ACT collaboration, "Measuring two-millimeter radiation with a prototype multiplexed TES receiver for ACT," *Proc. SPIE* **6275** 62750C (2006).
15. "Numerical radiative transport for recombination physics," *Princeton advanced project under C. M. Hirata*, Apr. 2005.
16. "Variance estimates in the SDSS spectrographic data," *Sloan Digital Sky Survey internal report*, Sep. 2004.
17. **E. R. Switzer**, K. Abazajian, S. Dodelson, S. Habib, and K. Heitmann, "Massive neutrinos and the halo model of large scale structure," *Nuc. Phys. B, Proceedings from Neutrino 2004* **143**, 571 (2005). →
18. E. R. Switzer, "OPAL/LEP II measurements of  $\tau$  polarization at  $\approx 206$  GeV," *Undergraduate thesis under Mark Oreglia, University of Chicago* (2003).
19. E. R. Switzer, "Measurements of electron energy deposition in the HERMES silicon recoil detector," *DESY HERMES Recoil Group internal report*, Aug. 2002.

## Teaching, Service and Outreach

Fall 2014	Advising: OSSI, Undergraduate (PIPER)
Summer 2014	Advising: USNA-GSFC Exchange, Undergraduate (analysis)
Summer 2013	Advising: 2 CITA Undergraduates
2012–2013	Advising: 1 Undergraduate (academic year, research course)
2011–2012	Advising: 1 Masters
May 2012	Organizer: “21 cm intensity mapping analysis” workshop, CITA.
Mar. 2011	Interviews in popular press for “The Steppenwolf: A proposal for a habitable planet in interstellar space.”
Mar. 2010	Early-stage textbook review, Cambridge University Press.
2009–2010 year	KICP Friday seminar committee.
Oct. 2009 – Dec. 2009	“The Physics of Energy Devices,” Compton Lecture Series, University of Chicago (10 public lectures).
May 2009 issue	Interview: George Musser, “Spectral Sensation,” <i>Scientific American</i> .
2008–2010	Founder and organizer of the energy technology student group within the University of Chicago physics department.
2007–	Referee: <i>The Astrophysical Journal</i> , MNRAS, JOAA, Class. Quantum Grav.
May 2006 – Sep. 2006	Developed physics teaching guide for the McGraw Center for Teaching and Learning at Princeton.
Sep. 2005 – Dec. 2005	Introductory Integrated Engineering/Math/Physics, Problem session (Teaching Assistantship), Princeton.
Feb. 2005 – May 2005	Introductory Engineering Physics, Supplemental problem sessions (Teaching Assistantship), Princeton.
Sep. 2004 – May 2005	Introductory General Physics, Labs (Teaching Assistantship), Princeton.

### Invited Talks

1. “The Primordial Inflation Explorer (PIXIE),” *CMB spectral distortions from cosmic baryon evolution*, Raman Research Institute, July 2016.
2. “Global foregrounds and intensity mapping,” *CMB spectral distortions from cosmic baryon evolution*, Raman Research Institute, July 2016.
3. “Cosmic tomography with the Green Bank Telescope,” *Opportunities and Challenges in Intensity Mapping*, SLAC Workshop, Mar. 2016.
4. “PIPER’s Continuous Adiabatic Demagnetization Refrigerator,” *B-modes from Space*, IMPU Workshop, Dec. 2015.
5. “Cosmic tomography with the GBT and status of the Primordial Inflation Polarization Explorer (PIPER),” *JHU seminar*, Nov. 2015.
6. “Seeking signs of cosmological inflation in the CMB polarization: BICEP2 and efforts at GSFC,” *GWU DC/MD/VA Astrophysics Summer 2014 meeting*, July 2014.
7. “Measuring mm/sub-mm curls and circles across the sky with the Primordial Inflation Polarization Explorer (PIPER),” *Science and Exploration Directorate Director’s Seminar (GSFC)*, Nov. 2013.
8. “Results from the Green Bank Telescope 21 cm intensity survey,” *Observations and Theoretical Challenges in Primordial Cosmology (KITP)*, Apr. 2013.
9. “Results from the Green Bank Telescope 21 cm intensity survey: Methods,” *Innovative Techniques in 21 cm Analysis (Ohio)*, Apr. 2013.
10. “A history of the universe through its atoms,” *NASA GSFC, cosmology division seminar*, Jan. 2013.

11. "A history of the universe through its atoms," *CMU, physics colloquium*, Jan. 2013.
12. "21 cm Intensity Mapping with the Green Bank Telescope," *UPenn, astrophysics seminar*, Dec. 2012.
13. "21 cm Intensity Mapping with the Green Bank Telescope," *University of Waterloo, astrophysics seminar*, Jan. 2012.
14. "Bayesian flux reconstruction in one and two bands," *Statistical Challenges in Modern Astronomy V (Penn State University)*, June 2011. →
15. "Removing foregrounds and characterizing residuals in  $z \sim 1$  21 cm surveys," *21-cm Cosmology: Advanced data analysis (CITA)*, June 2011.
16. "Some Aspects of Cosmological Helium," *CITA, astrophysics seminar*, Jan. 2011. →
17. "Some Aspects of Cosmological Helium," *Fermilab Center for Particle Astrophysics, seminar*, Dec. 2010. →
18. "Statistics of the source population observed at millimeter wavelengths by the South Pole Telescope," *Berkeley, astrophysics seminar*, Mar. 2010. →
19. "A physicist's outlook on energy," *Environmental Protection Agency Region 5 office, seminar*, Feb. 2010. →
20. "The Physics of Energy Devices," Compton Lectures, University of Chicago, Fall 2009: →
  - Lecture 1: Introduction and motors
  - Lecture 2: Motors and generators
  - Lecture 3: Power transmission
  - Lecture 4: Power from the wind
  - Lecture 5: Basic thermodynamics
  - Lecture 6: Heat engines and transportation
  - Lecture 7: Nuclear fission
  - Lecture 8: Solar energy
  - Lecture 9: Special guest lecture – Dorian Abbot
  - Lecture 10: Summary; future
21. "Wandering in the hyperfine forest," *KICP seminar, University of Chicago*, Apr. 2009.
22. "Prospects for observing the spectral distortion from recombination," *The Physics of Cosmological Recombination (MPA)*, July 2008.
23. "Cosmological helium recombination," *The Physics of Cosmological Recombination (MPA)*, July 2008.
24. "Small-scale CMB Anisotropies and the Atacama Cosmology Telescope: Perspectives and Progress," *Berkeley, cosmology group seminar*, Oct. 2007.
25. "Small-scale CMB Anisotropies and the Atacama Cosmology Telescope: Perspectives and Progress," *KICP, seminar*, Oct. 2007.

## Talks, Posters

1. "BICEP2: detection of B-mode polarization at degree angular scales", *presentation for GSFC Fermi group*, Mar. 2014.



2. "The Primordial Inflation Polarization ExploreR: Science from Circular Polarization Measurements", *AAS 223*, Jan. 2014.
3. "21 cm Intensity Mapping with the Green Bank Telescope," *Workshop on Recent Developments in Astronuclear and Astroparticle Physics (ICTP)*, Nov. 2012.
4. "21 cm Intensity Mapping with the Green Bank Telescope," *Cosmology on the Beach, Cancun*, Jan. 2012.
5. "21 cm Intensity Mapping with the Green Bank Telescope," *G2000, University of Toronto*, Nov. 2011.
6. "Prospects for cosmology at  $z \sim 1$  with 21 cm radiation," *KICP Postdoctoral Symposium*, Mar. 2011.
7. "Statistics of the source population observed at millimeter wavelengths by the South Pole Telescope," *KICP Postdoctoral Symposium*, Feb. 2010.
8. "Radiative transport through the hyperfine transitions," *KICP, theory group talk*, Dec. 2009. →
9. Several informal presentations for the energy technology study group, University of Chicago, 2009. →
10. "Small-Scale Anisotropies of the CMB: Experimental and Theoretical Perspectives," *Ph.D. Final Public Oral, Princeton*, Oct. 2008.
11. "Millimeter-wave emission of the planets," *Princeton Gravity Group*, Feb., 2008.
12. "Cosmological helium recombination," *Princeton Gravity Group*, Feb., 2007.
13. "Corrections to cosmological recombination," *Princeton Gravity Group*, Apr. 2006.
14. "Weren't we done with recombination?" *Princeton Gravity Group*, Mar. 2005.