

# Rebecca M. Holmes

Los Alamos National Laboratory  
P.O. Box 1663, MS D466  
Los Alamos, NM 87544 U.S.A.

Personal URL: <http://rebeccaolmes.net>

## Education

2017 **PhD, Physics**, University of Illinois at Urbana-Champaign  
2011 **BS, Physics**, University of North Carolina at Chapel Hill

## Experience

2017 - 2018 **Postdoctoral research associate**, ISR-1 (Space Science & Applications), LANL

- Chick Keller Postdoctoral Fellow in Space and Earth Sciences
- Analysis of single-photon camera data with machine learning techniques, data collection, and optical modeling.
- Experimental demonstration of hyperspectral intensity correlation interferometry (LDRD 20180658ER): Implementing data collection and analysis with a single-photon avalanche photodiode (SPAD) array.
- ELROI, a satellite “license plate” based on single-photon detection: Optical characterization of prototypes, environmental testing of prototypes, data analysis and software development for simulations and flight tests, link budget and ground station modeling.
- ISR Early Career Pitch Day award: Deep space CubeSat mission concept development and orbital modeling.

2011 - 2017 **Graduate research assistant**, University of Illinois at Urbana-Champaign

- National Science Foundation Graduate Research Fellow
- Dissertation: Testing the limits of human vision with quantum states of light (Research advisor: Paul Kwiat)
- Designed and built the first single-photon source optimized for human vision research, developed experimental control software in LabVIEW, supervised experimental trials with human subjects, integrated EEG hardware to measure brain activity, developed data analysis tools in Python and MATLAB to study temporal integration and other aspects of human visual performance at extremely low light levels (NSF grant PHY 519407).
- Graduate mentor for CAPSat, a University of Illinois undergraduate CubeSat mission supported by the NASA Undergraduate Student Instrument Project initiative. Supervised undergraduate work on flight-ready optics and electronics to test annealing techniques for repairing radiation damage to single-photon detectors in space.
- Teaching assistant for Physics 403, Modern Experimental Physics.

Summer 2010 **Undergraduate research assistant**, P-23 (Neutron Science & Technology) at LANL

- MAJORANA collaboration (with Steve Elliott): Built an acoustic testing chamber and quantified effects of microphonic noise on energy resolution in high-purity germanium detectors.

2007 - 2011 **Undergraduate research assistant**, University of North Carolina at Chapel Hill

- UNC Experimental Nuclear and Particle Astrophysics Group (with Reyco Henning and John Wilkerson): Collected and assayed samples to measure gamma rays from fission products in the atmosphere after the 2011 Fukushima reactor accident.
- PROMPT/SkyNet robotic telescope network (with Dan Reichart): Rapid-response photometry of gamma-ray burst afterglows with data from robotic telescopes.

2007 - 2011 **Educator**, Morehead Planetarium & Science Center, Chapel Hill, NC

- Presented hundreds of live science demo shows and programs on current issues in science for K-12 school groups and the public, taught summer science camps for children, and wrote a camp curriculum.

## Awards

- 2018 ISR Early Career Pitch Day award (\$5k)
- 2018 Science in “3” Outstanding Presentation Award
- 2018 Chick Keller Postdoctoral Fellowship in Space and Earth Sciences
- 2018 LANL Spot Award for service as co-chair of the ISR-1 Seminar Series
- 2018 LANL Spot Award for work on customer project
- 2015 Optical Society of America Emil Wolf Outstanding Student Paper Prize
- 2012 National Science Foundation Graduate Research Fellowship

## Outreach

- 2018 “Science on Tap: Honey, have you seen my CubeSat?” - Bradbury Science Museum
- 2017 “Local Realism Is Dead, Long Live Local Realism?” - published in *Physics World* (June 2017)
- 2016 “Seeing Single Photons” - published in *Physics World* (December 2016)
- 2015 “How does an optical fingerprint sensor work?” - Winning video in the Optical Society of America “Enabled by Optics” public outreach competition:  
<https://youtu.be/CLdrbn8XYIw>
- 2015-2017 Mentored two undergraduate physics majors and a first-year graduate student in the Illinois GPS peer mentoring program.
- 2011-2017 Answered over 60 physics questions from the public for the University of Illinois “Ask the Physics Van” website:  
<http://rebeccaHolmes.net/askthevan/>

## Press

- 2018 “The human eye could help test quantum mechanics” - quoted in *Scientific American*
- 2018 “How quantum mechanics lets us see, smell, and touch” - quoted in *Discover Magazine*
- 2015 “Quantum technology probes ultimate limits of vision” - quoted in *Nature News*
- 2015 “Squinting to See a Single Photon” - quoted in *APS News*

## Professional skills

- Scientific programming: Python, MATLAB, IDL, LabVIEW
- Web development: HTML, CSS/Sass, Ruby on Rails and SQL for dynamic web applications, Jekyll for static web applications
- Technical and popular writing and editing

## Publications & talks

### JOURNAL ARTICLES

- 2018 R.M. Holmes and D.M. Palmer, “Extreme background-rejection techniques for ELROI optical satellite license plate,” *Applied Optics*, 2018 (in press).  
<https://arxiv.org/abs/1810.01438>
- 2018 D.M. Palmer and R.M. Holmes, “Extremely Low Resource Optical Identifier: A license plate for your satellite,” *Journal of Spacecraft and Rockets*, vol. 55, no. 4, 2018, pp. 1014-1023. <https://doi.org/10.2514/1.A34106>
- 2017 R.M. Holmes, M. Victora, R.F. Wang, and P.G. Kwiat, “Measuring temporal summation in visual detection with a single-photon source,” *Vision Research*, vol. 140, 2017, pp. 33-43. <https://doi.org/10.1016/j.visres.2017.06.011>
- 2011 S. MacMullin, G.K. Giovanetti, M.P. Green, R. Henning, R.M. Holmes, K. Vorren, and J.F. Wilkerson, “Measurement of airborne fission products in Chapel Hill, NC, USA from the Fukushima Dai-ichi reactor accident,” *Journal of Environmental Radioactivity*, vol. 112, 2012, pp. 165-70. <https://doi.org/10.1016/j.jenvrad.2012.01.026>

### INVITED TALKS

- 2019 R.M. Holmes, C.T. Weaver, and D.M. Palmer, “ELROI satellite license plate demonstration on a CubeSat,” Proc. SPIE, Advanced Photon Counting Techniques XIII (April 2019) (upcoming)
- 2018 R.M. Holmes, M. Victora, R.F. Wang, P.G. Kwiat, “Testing the limits of human vision with quantum states of light: past, present, and future experiments,” Proc. SPIE 10659, Advanced Photon Counting Techniques XII, 1065903 (14 May 2018)

### OTHER PRESENTATIONS

- 2018 LANL P/T Colloquium: “Space traffic management and why satellites need license plates” (December 6, 2018)
- 2018 DoD Space Experiments Review Board briefing - Chantilly, VA (November 7, 2018)
- 2018 Air Force Space Experiments Review Board briefing - Albuquerque, NM (August 22, 2018)
- 2018 R.M. Holmes, C.T. Weaver, D.M. Palmer, “ELROI: A satellite license plate to simplify space object identification,” Proceedings of the Advanced Maui Optical and Space Surveillance (AMOS) Technologies Conference 2018. (paper/poster)
- 2018 R.M. Holmes, C.T. Weaver, D.M. Palmer, “ELROI: A license plate for satellites that anyone can read,” Proceedings of the AIAA/USU Conference on Small Satellites, Assuring the

Space Ecosystem I, SSC18-XI-01. (paper/talk)

- 2018 R.M. Holmes, S. Gill, J.Z. Harris, J.S. Lansford, R. Myers, C.T. Weaver, A.P. Zucherman, A.M. Jorgensen, D.M. Palmer, “Progress on ELROI satellite license plate flight prototypes,” Proc. SPIE 10659, Advanced Photon Counting Techniques XII, 106590M (14 May 2018) (paper/talk)
- 2017 R.M. Holmes, et al., “Measuring temporal integration in visual detection using a single-photon source,” 2017 Annual Meeting of the Psychonomic Society (poster)
- 2016 2016 International Conference on Quantum Communication, Measurement and Computing (poster)
- 2015 R.M. Holmes, et al. “Testing the limits of human vision with single photons,” in Frontiers in Optics 2015, OSA Technical Digest (online) (Optical Society of America, 2015), paper FTu5B.5. (talk)
- 2015 R.M. Holmes, et al. “Studying the lower limit of human vision with a single-photon source,” at the 46th Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics, vol. 60, no. 7, 2015. (talk)
- 2014 Visual Cognition and Human Performance lunch series at the University of Illinois Psychology Department in Champaign, IL (talk)
- 2014 R.M. Holmes, et al. “Determining the lower limit of human vision using a single-photon source,” in Research in Optical Sciences, OSA Technical Digest (online) (Optical Society of America, 2014), paper QTu2A.2. (talk)
- 2013 R.M. Holmes, et al. “Determining the lower limit of human vision using a single-photon source,” in The Rochester Conferences on Coherence and Quantum Optics and the Quantum Information and Measurement meeting, OSA Technical Digest (online) (Optical Society of America, 2013), paper W6.06. (poster)
- 2012 2012 Midwest Cold Atom Workshop in Urbana, IL (talk)
- 2012 R.M. Holmes, et al. “Determining the lower limit of human vision using a single-photon source,” in Conference on Lasers and Electro-Optics 2012, OSA Technical Digest (Optical Society of America, 2012), paper QTu1E.8. (talk)
- 2010 R.M. Holmes, “Microphonics in germanium detectors for MAJORANA,” 2010 Fall Meeting of the APS Division of Nuclear Physics (poster)