

# Raphael Pooser

Wigner Fellow, Computational Sciences and Engineering Division, Oak Ridge National Laboratory,  
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## Research Interests and areas of expertise:

**Quantum Optics, Quantum Information with continuous variables, nonlinear optics**

## Education:

- **University of Virginia**; PhD, Engineering Physics; research in Quantum Optics and Quantum Information; enrolled September 2001 - May 2007.
- **New York University**; BS, Physics, Cum Laude (cum. GPA 3.8, Dean's list); enrolled September 1998 - May 2001.

## Research Experience:

- **Oak Ridge National Lab: Wigner Fellow**, September 2009 - present.
  - Research Scientist in the Center for Quantum Information Science and Technology
- **National Institute of Standards and Technology: Intelligence Community Postdoctoral Fellow**, June 2007- June 2009
  - Performed research in quantum imaging, quantum optics, and quantum information with nonlinear optics
  - Designed and built high-power solid state lasers for use in study of nonlinear optical processes
  - Published scientific articles in *Science*, *Nature*, and *Physical Review Letters*
- **University of Virginia: Graduate Physics Research Assistant**, August 2001 - May 2007
  - Performed nonlinear optics experiments using both pulsed and continuous wattage lasers
  - Designed and tested new types of nonlinear optical crystals for use in quantum information experiments
  - Performed supporting theoretical calculations in both nonlinear and quantum optics
  - Published papers on theoretical and experimental quantum optics in *Optics Letters* and *Physical Review A*
- **Lehigh University: Undergraduate Research Assistant**, June 2000 - August 2000
  - Performed theoretical calculations to compute the deuteron form factors in nuclear physics.
- **Indiana University Cyclotron Facility: Undergraduate Research Assistant**, June 1999 - August 1999
  - Performed experimental research measuring cosmic ray muon decay in lead glass photon detectors

## Teaching Experience:

- **National Institute of Standards and Technology**, June 2007 - August 2007
  - Taught a quantum optics course to senior level undergraduates
- **University of Virginia: Teaching Assistant**, January 2006 - May 2006
  - Held study sessions, tutored students, and graded papers for an advanced Photonics course.
- **New York University: Teaching Assistant**, September 2000 - May 2001
  - Answered questions online and graded assignments for C-programming class.

## Skills:

- Fluent in C programming language. Have working knowledge in C++ and Fortran.
- Fluent speaker of the French language
- Experienced with building fast RF electronics; soldering surface mounted electronics
- High level of practical knowledge and familiarity with the following computer software programs via usage on a routine basis:
  - Mathematica, Gnuplot, Igor Pro, Labview, LaTeX

### Recent Honors and Awards:

- Received Wigner Fellowship at Oak Ridge National Lab, September, 2009.
- First place in Sigma Xi annual poster competition at National Institute of Standards and Technology, Feb., 2009.
- Awarded Intelligence Community Postdoctoral fellowship at National Institute of Standards and Technology, June, 2007-2009.
- First place in the Department of Physics annual research poster competition at UVA, April 2005.
- Upper Class NSF SELIM fellow at UVA, September 2004 - May 2005.
- Awarded Distinction title for high Statistical and Classical Mechanics PhD qualifying exam scores, April 2003.
- Awarded NSF IGERT Fellowship within SELIM program at UVA, October 2001-May 2003.
- Received Dean's fellowship from Engineering school at UVA, August 2001-May 2004.
- Inducted to Sigma Pi Sigma, physics honor society, May 2001.
- Awarded George Granger Brown scholarship from NYU for academic merit in physics, January 2001.
- Awarded \$5000 scholarship from Varsity-Books.com based on academic merit, August 2000.
- Received College of Arts and Sciences Grant and Scholarships from NYU, 1998-2001.
- Received \$1000 Talbots Scholarship from Talbots corporation, August 1999.
- Received full Scholarship to attend Webb School of Knoxville, August 1996-May 1998.

### Publications:

- R. C. Pooser, A. M. Marino, V. Boyer, P. D. Lett, *Quantum correlated light beams from non-degenerate four-wave mixing in an atomic vapor: the D1 and D2 lines of 85Rb and 87Rb*, Optics Express, **17**, 16722 (2009).
- R. C. Pooser, K. M. Jones, A. M. Marino, V. Boyer, P. D. Lett, *Low-Noise Amplification of a Continuous Variable Quantum State*, Phys. Rev. Lett. **103**, 010501 (2009).
- A. M. Marino, R. C. Pooser, V. Boyer, P. D. Lett, *Tunable delay of EPR correlations*, Nature **457**, 859-862 (12 February 2009). Featured in *News and Views in Nature* **457**, 798-799 (12 February 2009).
- V. Boyer, A. M. Marino, R. C. Pooser, and P. D. Lett, *Entangling light in its spatial degrees of freedom with four-wave mixing in an atomic vapor*, ChemPhysChem, DOI: 10.1002/cphc.200800734, US: <http://dx.doi.org/10.1002/cphc.200800734>
- R. C. Pooser, V. Boyer, A. M. Marino, P. D. Lett, *Squeezed Light and Entangled Images from Four-Wave-Mixing in Hot Rubidium Vapor*, in Quantum Communications and Quantum Imaging VI, edited by Ronald Meyers, Yanhua Shih, Keith Deacon, Proceedings of SPIE Vol. **7092** (SPIE, Bellingham, WA, 2008) 70920G-1
- A. M. Marino, V. Boyer, R. C. Pooser, P. D. Lett, K. Lemons, and K. M. Jones, *Delocalized Correlations in Twin Light Beams with Orbital Angular Momentum*, Phys. Rev. Lett. **101**, 093602 (2008).
- V. Boyer, A. M. Marino, R. C. Pooser, and P. D. Lett., *Entangled Images From Four-Wave Mixing*, Science 25 July 2008 **321**: 544-547; published online 12 June 2008 in Science Express Reports, DOI: 10.1126/science.1158275. Work was featured in Physics Today vol. **61** August 2008 issue, pp 16-18. Also featured in Science *Perspective* article "Let Quantum Mechanics Improve Your Images" by Robert Boyd.
- A.S. Bradley, M.K. Olsen, O. Pfister, and R.C. Pooser, *Bright tripartite entanglement in triply concurrent parametric down conversion*, Physical Review A **72**, 053805 (2005).
- R.C. Pooser and O. Pfister, *Observation of triply coincident nonlinearities in periodically poled KTiOPO4*, Optics Letters **30**, 2635 (2005). Work featured in the November 2005 issue of the Materials Research Society Bulletin. Also Featured in Virtual Journal of Ultrafast Science, November 2005.
- O. Pfister, S. Feng, G. Jennings, R. Pooser, and D. Xie, *Multipartite continuous-variable entanglement from concurrent nonlinearities*, Physical Review A **70**, 020302(R) (2004).
- R.C. Pooser and O. Pfister, *Particle-number scaling of the phase sensitivity in realistic Bayesian twin-mode Heisenberg-limited interferometry*, Physical Review A **69**, 043616 (2004).
- R.C. Pooser and O. Pfister, *Efficient generation of non-Gaussian Quantum light via a resonant nonlinear cascade*, submitted for publication.

### **Conference Talks:**

- R. C. Pooser, A. M. Marino, V. Boyer, K. M. Jones, and P. D. Lett, *Low Noise Amplification of a Continuous Variable Quantum State*, SPIE 2010 Defense, Security, and Sensing meeting, April 8-9, 2010, Quantum Information and Computation VIII session, Orlando, FL.
- R. C. Pooser, A. M. Marino, V. Boyer, K. M. Jones, and P. D. Lett, *Partial Cloning of a Continuous Variable Quantum State*, Conference on Lasers and Electro-optics / International Quantum Electronics Conference, June, 2009, Quantum Imaging and Spatial Entanglement session, Baltimore, MD.
- A. M. Marino, R. C. Pooser, V. Boyer, and P. D. Lett, *Tunable Delay of Entangled Images*, Conference on Lasers and Electro-optics / International Quantum Electronics Conference, June, 2009, Quantum Imaging and Spatial Entanglement session, Baltimore, MD.
- R. C. Pooser, V. Boyer, A. M. Marino, P. D. Lett, *Squeezed Light and Entangled Images from Four-Wave-Mixing in Hot Rubidium Vapor*, SPIE 2008 Optics and Photonics meeting, August, 2008, Quantum Communications and Quantum Imaging VI session, San Diego, CA.
- R. C. Pooser, A. M. Marino, V. Boyer, and P. D. Lett, *Compact Source of Entangled Images and Squeezed Light Using Four-Wave Mixing in Rubidium Vapor*, American Physical Society meeting of the Division of Atomic Molecular and Optical Physics, May, 2008, Entanglement session, State College, PA.
- R.C. Pooser and O. Pfister, *Generating scalable multipartite entanglement and non-Gaussian states of light using nonlinear concurrences and cascades*, OSA Annual Meeting, October, 2006; Division of Laser Science, Quantum Optics session, Rochester, NY.
- O. Pfister, R.C. Pooser, A.S. Bradley, and M.K. Olsen, *Multimode Squeezing and Entanglement with Concurrent Nonlinearities*, Laser Science XXI Meeting of the American Physical Society. Tucson, AZ, October 17–19, 2005.
- O. Pfister, S. Feng, G. Jennings, R. Pooser, D. Xie, *Multipartite continuous-variable entanglement from concurrent nonlinearities*, Laser Science XX Meeting of the American Physical Society. Rochester, New York. October 10-14, 2004.
- R. C. Pooser, *Quantum Optics and Quantum Information*, presented at the SELIM / IGERT symposium, Charlottesville, VA, August, 2004.
- R. C. Pooser, *Simulating Bayesian Measurements for Heisenberg Limited Interferometry*, presented at the 10<sup>th</sup> Laser Processing Consortium at Jefferson lab, June, 2003.

### **Departmental Seminars and Poster Sessions:**

- R. C. Pooser and O. Pfister, *Generating Schrödinger Cats with Light: Novel Sources of Multipartite Continuous-Variable Entanglement*, departmental poster competition, April, 2005.
- R. C. Pooser, *Multipartite Continuous Variable Entanglement Using Concurrent Nonlinearities*, departmental seminar, University of Virginia Department of Physics, February, 2005.
- R. C. Pooser, *Simulating Bayesian Measurements for Heisenberg Limited Interferometry*, departmental seminar, University of Virginia Department of Physics, December, 2003.

### **Public Speaking Experience:**

- April 2010 – served as alumnus speaker for the Gift of Hope annual Luncheon for the Boys and Girls Club of the Tennessee Valley, Knoxville, TN.
- April 2010 – served as alumnus speaker for the community service awards dinner for the Boys and Girls Clubs of the Tennessee Valley, Lake City, TN.
- August 2002 – December 2004: served as spokesperson for the Boys and Girls Clubs of America; traveled to various first and third party conferences to deliver speeches; audience size ranged from 50 to 1,500.
- One time spokesperson for the United Way, Knoxville, TN in annual fund raising campaign, September 2003.