

## **Mark Beck**

Department of Physics  
Whitman College  
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### **Education**

Ph.D. in Optics, The Institute of Optics, University of Rochester, 1992; Thesis advisor: Prof. Ian Walmsley

One year of graduate study, Department of Applied Physics, Stanford University, 1986.

B.S. in Optics, The Institute of Optics, University of Rochester, 1985.

### **Positions Held**

August 2011 – Present  
Benjamin H. Brown Professor of Physics, Whitman College, Walla Walla, Washington.

August 2010 – Present  
Professor of Physics, Whitman College, Walla Walla, Washington.

September 2015 – December 2015  
Visiting Professor of Physics, University of Oxford, Oxford, United Kingdom.

July 2012 – June 2015  
Chair, Division of Mathematics and Natural Sciences, Whitman College, Walla Walla, Washington.

August 2002 – July 2010  
Associate Professor of Physics, Whitman College, Walla Walla, Washington.

July 2002 - June 2005  
Chair, Dept. of Physics, Whitman College, Walla Walla, Washington.

August 1996 - July 2002  
Assistant Professor of Physics, Whitman College, Walla Walla, Washington.

November 2000 – December 2000  
Visiting Assistant Professor of Optics, The Institute of Optics, University of Rochester, Rochester, New York.

August 1994 - July 1996  
Visiting Assistant Professor of Physics, Reed College, Portland, Oregon.

May 1992 - July 1994  
Post-doctoral assistant to Prof. Michael Raymer, Department of Physics, University of Oregon, Eugene, Oregon

July 1986 - April 1992  
Research Assistant, The Institute of Optics, University of Rochester, Rochester, New York.

September 1986 - May 1987  
Teaching Assistant, The Institute of Optics, University of Rochester, Rochester, New York.

## **Honors and Awards**

Garrett Fellow of Whitman College, 2007 - 2010

A.E. Lange Award for Distinguished Science Teaching, Whitman College, 2004

Phi Beta Kappa

Tau Beta Pi

University Research Initiative Fellowship, US Army Research Office, 1988 - 1992

Sproull Fellowship of the University of Rochester, 1986 - 1988

Polster Prize of The Institute of Optics, 1985

SPIE Scholarship in Optical Engineering, 1984

## **Other Professional Activities**

Distinguished Traveling Lecturer (DTL) Committee Member. This committee serves the Division of Laser Sciences of the American Physical Society; we organize the DTL program in which distinguished scientists visit colleges and universities. (2002-present)

Chair, Local Organizing Committee, Annual Meeting of the Northwest Section of the American Physical Society, Walla Walla, WA, Oct. 2010.

Member-at-Large of the Executive Board of the Northwest Section of the American Physical Society. (2005-2009)

Program Committee, Annual Meeting of the Northwest Section of the American Physical Society, Seattle, WA, 2001

Program Committee, SPIE Symposium on "Generation, Amplification and Measurement of Ultrashort Laser Pulses III", San Jose, CA, 1996

Member, Optical Society of America

Member, American Physical Society

Member, Advanced Labs Physics Association

Member, American Association of Physics Teachers

## **External Research Grants Received**

Principle Investigator on: "Photon Based Undergraduate Quantum Mechanics Curriculum," National Science Foundation (DUE-0340917), 2004-2007, \$43,425.

Principle Investigator on: "RUI: Amplitude Squeezing of Pulsed, Vertical-Cavity, Surface Emitting Lasers," National Science Foundation (PHY-0098398), 2001-2005, \$129,921.

Principle Investigator on: "Photon Statistics of Pulsed, Vertical-Cavity, Surface Emitting Lasers," National Science Foundation (PHY-9732453), 1998-2001, \$120,000.

Principle Investigator on: "Photon Statistics of Pulsed, Vertical-Cavity, Surface Emitting Lasers," Research Corporation, 1998-2000, \$30,700.

Co-Investigator on: "Innovative Experimental Stations for the Second Year Physics Laboratory", National Science Foundation (DUE-9851056), 1998-2000, \$37,200.

## **Books**

M. Beck, [\*Quantum Mechanics: Theory and Experiment\*](#) (Oxford University Press, Oxford, 2012).

## **Refereed Publications** (underlines indicate undergraduate co-authors)

Marisol N. Beck and M. Beck, "[Witnessing entanglement in an undergraduate laboratory](#)", Am. J. Phys. **84**, 87 (2016).

E.T. Burch, C. Henel Smith, W. Larson, and M. Beck, "[Quantum-state tomography of single-photon entangled states](#)," Phys. Rev. A **92**, 032328 (2015).

E. Dederick and M. Beck, "[Exploring entanglement with the help of quantum state measurement](#)," Am. J. Phys. **82**, 962-971 (2014).

D. Branning, S. Khanal, Y.H. Shin, B. Clary, and M. Beck, "[Scalable multi-photon coincidence counting electronics](#)," Rev. Sci. Instr. **82**, 016102 (2011).

D. Branning, S. Bhandari, and M. Beck, "[Low-cost coincidence-counting electronics for undergraduate quantum optics](#)," Am. J. Phys. **77**, 667-670 (2009).

M. Beck, "[Comparing measurements of  \$g^{\(2\)}\(0\)\$  performed with different coincidence detection techniques](#)," J. Opt. Soc. Am. B **24**, 2972 – 2978 (2007).

J. A. Carlson, M. D. Olmstead, and M. Beck, "[Quantum mysteries tested: an experiment implementing Hardy's test of local realism](#)," Am. J. Phys. **74**, 180-186 (2006). [Also included in the online compilation: Virtual Journal of Quantum Information <<http://www.vjquantuminfo.org>>, Vol. **6**, Iss. 3]

A. Gogo, W. D. Snyder, and M. Beck, "[Comparing quantum and classical correlations in a quantum eraser](#)," Phys. Rev. A **71**, 052103 (2005). [Also included in the online compilation: Virtual Journal of Quantum Information <<http://www.vjquantuminfo.org>>, Vol. **5**, Iss. 6]

J. J. Thorn, M. S. Neel, V. W. Donato, G. S. Bergreen, R. E. Davies, and M. Beck, "[Observing the quantum behavior of light in an undergraduate laboratory](#)", Am. J. Phys. **72**, 1210-1219 (2004).

A.M. Dawes, M. Beck and K. Banaszek, "[Mode optimization for quantum state tomography with array detectors](#)," Phys. Rev. A. **67**, 032102 (2003).

M. Beck, C. Dorrer, and I.A. Walmsley, "[Joint quantum measurement using unbalanced array detection](#)," Phys. Rev. Lett. **87**, 253601 (2001).

A.M. Dawes and M. Beck, "[Simultaneous quantum state measurements using array detection](#)," Phys. Rev. A. **63**, 040101 (R), (2001).

D.R. Shelly, T.W.S Garrison, M. Beck, and D.H. Christensen, "Polarization correlations in pulsed, vertical-cavity, surface-emitting lasers," Opt. Express **7**, 249 (2000).

M. Beck, "[Quantum state tomography with array detectors](#)," Phys. Rev. Lett. **84**, 5748 (2000).

T.W.S Garrison, M. Beck, and D.H. Christensen, "[Noise behavior of pulsed, vertical-cavity, surface-emitting lasers](#)", J. Opt. Soc. Am B **16**, 2124 (1999).

A.C. Funk and M. Beck, "Sub-Poissonian photocurrent statistics: Theory and undergraduate experiment", Am. J. Phys. **65**, 492 (1997).

M.G. Raymer, J. Cooper, H.J. Carmichael, M. Beck, and D.T. Smithey, "Ultrafast measurement of optical-field statistics by dc-balanced homodyne detection", *J. Opt. Soc. Am B* **12**, 1801, (1995).

M.J. Werner, M.G. Raymer, M.Beck, P.D. Drummond, "Ultrashort pulsed squeezing by optical parametric amplification", *Phys. Rev. A* **52**, 4202 (1995).

D.F. McAlister, M. Beck, L. Clarke, A. Mayer, and M.G. Raymer, "Optical phase retrieval by phase-space tomography and fractional-order Fourier transforms", *Opt. Lett.* **20**, 1181 (1995).

M.E. Anderson, M. Beck, M.G. Raymer, and J.D. Bierlein, "Quadrature squeezing with ultrashort pulses in nonlinear-optical waveguides", *Opt. Lett.* **20**, 620 (1995).

M.G. Raymer, D.T. Smithey, M. Beck, and J. Cooper, "Quantum states and number-phase uncertainty relations measured by optical homodyne tomography," *Acta Phys. Pol. A* **86**, 71, (1994).

M.G. Raymer, M. Beck, and D.F. McAlister, "Complex wave-field reconstruction using phase-space tomography", *Phys. Rev. Lett.* **72**, 1137 (1994).

M.G. Raymer, J. Cooper, and M. Beck, "Many-port homodyne detection of an optical phase," *Phys. Rev. A* **48**, 4617 (1993).

M. Beck, M.G. Raymer, I.A. Walmsley, and V. Wong, "Chronocyclic tomography for measuring amplitude and phase structure of optical pulses," *Opt. Lett.* **18**, 2041 (1993).

D.T. Smithey, M. Beck, J. Cooper, M.G. Raymer, and A. Faridani, "Complete experimental determination of the state of a light mode via the Wigner function and the density matrix: application to quantum phase distributions of vacuum and squeezed-vacuum states" *Physica Scripta* **T48**, 35 (1993).

D.T. Smithey, M. Beck, J. Cooper, and M.G. Raymer, "Measurement of number-phase uncertainty relations of optical fields," *Phys. Rev. A* **48**, 3159 (1993).

M. Beck, D.T. Smithey, J. Cooper, and M.G. Raymer, "Experimental determination of number-phase uncertainty relations," *Opt. Lett.* **18**, 1259, (1993).

M. Beck, D.T. Smithey, and M.G. Raymer, "Experimental determination of quantum-phase distributions using optical homodyne tomography," *Phys. Rev. A* **48**, R890, (1993).

D.T. Smithey, M. Beck, M.G. Raymer, and A. Faridani, "Measurement of the Wigner distribution and the density matrix of a light mode using optical homodyne tomography: application to squeezed states and the vacuum," *Phys. Rev. Lett.* **70**, 1244, (1993).

D.T. Smithey, M. Beck, M. Belsley, and M.G. Raymer, "Sub-shot-noise correlation of total photon number using macroscopic twin pulses of light," *Phys. Rev. Lett.* **69**, 2650, (1992).

M. Beck and I.A. Walmsley, "The role of amplitude and phase shaping in the dispersive-pulse regime of a passively mode-locked dye laser," *IEEE J. of Quantum Electron.* **QE-28**, 2274, (1992).

M. Beck, I.A. Walmsley, and J.D. Kafka, "Group delay measurements of optical components near 800 nm," *IEEE J. of Quantum Electron.* **QE-27**, 2074, (1991).

M. Beck and I.A. Walmsley, "Measurement of group delay with high temporal and spectral resolution," *Opt. Lett.* **15**, 492, (1990).

M. Beck, I. McMackin and M.G. Raymer, "Transition from quantum-noise-driven dynamics to deterministic dynamics in a multimode laser," *Phys. Rev. A* **40**, 2410, (1989).

I. McMackin, C. Radzewicz, M. Beck, and M.G. Raymer, “Instabilities and chaos in a multimode, standing-wave, cw dye laser,” *Phys. Rev. A* **38**, 820, (1988).

M.G. Raymer, Z. Deng, and M. Beck, “Strong-field dynamics of a multimode, standing-wave dye laser,” *J. Opt. Soc. Am. B* **5**, 1588, (1988).

### **Other Publications** (underlines indicate undergraduate co-authors)

Marisol N. Beck and M. Beck, Witnessing Entanglement, 2015 BFY Proceedings [College Park, MD, July 22-24, 2015], edited by M. Eblen-Zayas, E. Behringer, and J. Kozminski, doi:[10.1119/bfy.2015.pr.003](https://doi.org/10.1119/bfy.2015.pr.003).

M. Beck and E. J. Galvez, “Quantum optics in the undergraduate teaching laboratory,” in *Coherence and Quantum Optics IX*, edited by N. P. Bigelow, J. H. Eberly, and C. R. Stroud, (Optical Society of America, Washington DC, 2008) p. 308.

S. Bhandari, D. Branning, and M. Beck, “Low-cost coincidence counting electronics for quantum optics,” in *Coherence and Quantum Optics IX*, edited by N. P. Bigelow, J. H. Eberly, and C. R. Stroud, (Optical Society of America, Washington DC, 2008) p. 330.

M. G. Raymer and M. Beck, "Experimental quantum state tomography of optical fields and ultrafast statistical sampling," in *Quantum State Estimation*, ed. by M. G. A. Paris and J. Rehacek (Springer-Verlag, Berlin, 2004), p. 235-295. [Invited Review Article]

M. Beck, C. Dorrer, and I.A. Walmsley, “Joint quantum measurement using unbalanced array detection,” in *Coherence and Quantum Optics VIII*, edited by N. P. Bigelow, J. H. Eberly, C. R. Stroud, and I. A. Walmsley, (Kluwer Academic/Plenum, New York, 2003) p.455.

A.M. Dawes and M. Beck, “Simultaneous quantum state measurements using array detection,” in *Coherence and Quantum Optics VIII*, edited by N. P. Bigelow, J. H. Eberly, C. R. Stroud, and I. A. Walmsley, (Kluwer Academic/Plenum, New York, 2003) p. 301.

M. Beck, “Time-frequency spectrograms of optical pulses”, in *Generation, Amplification, and Measurement of Ultrashort Laser Pulses II*, F.W. Wise, C.P.J. Barty, Eds., *Proc. SPIE* **2377**, 63, (1995).

M. Beck, M. Anderson and M.G. Raymer, “Imaging through scattering media using pulsed homodyne detection,” *OSA Proceedings on Advances in Optical Imaging and Photon Migration*, Vol. **21**, R. Alfano ed., (1994), p. 257.

M.G. Raymer, M. Beck, and D.F. McAlister, “Spatial and temporal optical field reconstruction using phase-space tomography”, *Quantum Optics VI*, D.F. Walls and J.D. Harvey eds., (Springer-Verlag, Berlin, 1994), p. 245.

M. Beck, D.T. Smithey, and M.G. Raymer, “Number-phase uncertainty relations,” *Optics and Photonics News* Vol. **4**, No. 12, p. 40 (December, 1993).

### **Workshops Given**

“Single Photon Experiments in More Depth,” Advanced Laboratory Physics Association (ALPhA) Immersion, Whitman College, 2014.

“Quantum Mechanics Experiments with Individual Photons,” Advanced Laboratory Physics Association (ALPhA) Immersion, Whitman College, 2012.

“Photon Quantum Mechanics Labs,” Summer Meeting of the American Association of Physics Teachers, Edmonton, Alberta, 2008. Given in collaboration with Enrique Galvez.

“Photon Quantum Mechanics,” Summer Meeting of the American Association of Physics Teachers, Syracuse, New York, 2006. Given in collaboration with Enrique Galvez and Charles Holbrow.

### **Invited Presentations**

"Exploring Fundamentals of Quantum Mechanics in the Undergraduate Laboratory," University of Oregon, Eugene, Oregon, 2014.

"Exploring Fundamentals of Quantum Mechanics in the Undergraduate Laboratory," Portland State University, Portland, Oregon, 2014.

“Quantum Optics Laboratories for Undergraduates,” Education and Training in Optics and Photonics 2013, Porto, Portugal, 2013.

“Integrating the Quantum Mechanics Classroom and Laboratory,” Conference on Laboratory Instruction Beyond the First Year of College, Philadelphia, Pennsylvania, 2012.

"Exploring Fundamentals of Quantum Mechanics in the Undergraduate Laboratory," Simon Fraser University, Vancouver, British Columbia, 2012.

"Testing Local Realism," Reed College, Portland, Oregon, 2011.

"Testing Local Realism," Pacific University, Forest Grove, Oregon, 2011.

“Fundamentals of Quantum Mechanics in the Undergraduate Classroom and Laboratory,” Gordon Research Conference on Physics Research and Education, Holyoke, Massachusetts, 2010.

“Exploring Fundamentals of Quantum Mechanics in an Undergraduate Laboratory,” Annual Meeting of the American Association of Physics Teachers, WA Section, Richland, Washington, 2007.

“Exploring Fundamentals of Quantum Mechanics in an Undergraduate Laboratory,” Frontiers in Optics, Rochester, New York, 2006.

"Interference, Complementarity, Entanglement and all that Jazz," Harvey Mudd College and Pomona College, Claremont, California, 2005.

"Interference, Complementarity, Entanglement and all that Jazz," Washington State University, Pullman, Washington, 2005.

"Interference, Complementarity, Entanglement and all that Jazz," Lewis and Clark College, Portland, Oregon, 2005.

"Interference, Complementarity, Entanglement and all that Jazz," Reed College, Portland, Oregon, 2005.

"Interference, Complementarity, Entanglement and all that Jazz," University of Oregon, Eugene, Oregon, 2005.

"Interference, Complementarity, Entanglement and all that Jazz," Oregon State University, Corvallis, Oregon, 2005.

"Interference, Complementarity, Entanglement and all that Jazz," Walla Walla College, College Place, Washington, 2004.

"Interference, Complementarity, Entanglement and all that Jazz," Amherst College, Amherst, Massachusetts, 2004.

"Experiments with Individual Photons," Annual Meeting of the Northwest Section of the American Physical Society, Moscow, Idaho, 2004.

"Experiments with Single Photons: Existence Proof and Interference," 128<sup>th</sup> American Association of Physics Teachers National Meeting, Miami Beach, Florida, 2004.

"Light, What is it?" Reed College, Portland, Oregon, 2003.

"Noise behavior of pulsed, vertical-cavity, surface-emitting lasers," University of Oregon, Eugene, Oregon, 1999.

"State measurement of optical fields," Univ. of Toronto, Toronto, Ontario, 1996.

"State measurement of optical fields," Whitman College, Walla Walla, WA, 1996.

"State measurement of optical fields," Franklin and Marshal College, Lancaster, Pennsylvania, 1996.

"State measurement of optical fields," Annual Meeting of the Optical Society of America, Portland, Oregon, 1995.

"Time-frequency spectrograms of optical pulses," Generation, Amplification, and Measurement of Ultrashort Laser Pulses II, San Jose, California, 1995.

"Measuring the wavefunction of light," Lewis and Clark College, Portland, Oregon, 1994.

"Measuring the wavefunction of light," Reed College, Portland, Oregon, 1994.

"Measuring the wavefunction of light," Oregon State University, Corvallis, Oregon, 1993.

"Measuring the wavefunction of light," Chemical Physics Institute Retreat, University of Oregon, Charleston, Oregon, 1993.

"Why you have to be careful when you use the Kramers-Kronig relations," University of Oregon, Eugene, Oregon, 1991.

"What do your CPM pulses really look like?" University of California, San Diego, California, 1991.

### **Other Presentations**

"Witnessing Entanglement," Conference on Laboratory Instruction Beyond the First Year of College, College Park, Maryland, 2015.

"Quantum Mysteries," Whitman College Alumni Presentation, New York, New York, 2013.

"Junior/Senior quantum mechanics with lab," Annual Meeting of the Northwest Section of the American Physical Society, Portland, Oregon, 2008.

"Quantum optics in the undergraduate teaching laboratory", Coherence and Quantum Optics 9, Rochester, New York, 2007.

"Quantum Mysteries," Faculty Forum, Whitman College, Walla Walla, Washington, 2006.

"Implementing Hardy's test of local realism," Annual Meeting of the Northwest Section of the American Physical Society, Tacoma, Washington, 2006.

“Quantum Mysteries,” Family Weekend Presentation, Whitman College, Walla Walla, Washington, 2004.

"Experiments with individual photons in an undergraduate lab," Laser Science XX, Rochester, NY, 2004.

“Mode optimization for quantum state tomography with array detectors,” Annual Meeting of the Optical Society of America, Orlando, Florida, 2002.

“Light, What is it?” Faculty Forum, Whitman College, Walla Walla, Washington, 2001.

“Joint quantum measurement using unbalanced array detection,” Coherence and Quantum Optics 8, Rochester, NY, June 2001.

“Noise behavior of pulsed vertical-cavity, surface-emitting lasers”, Quantum Optoelectronics, Snowmass, Colorado, 1999.

“Complex wave-field reconstruction using phase-space tomography,” QELS’94, Anaheim, California, 1994.

“Chronocyclic tomography for measuring the amplitude and phase structure of optical pulses,” CLEO’94, Anaheim, California, 1994.

“Imaging Through Scattering Media Using Pulsed Homodyne Detection,” Advances in Optical Imaging and Photon Migration, Orlando, Florida, 1994.

“Experimental determination of number-phase uncertainty relations,” Annual Meeting of the Optical Society of America, Toronto, Ontario, 1993.

“Experimental determination of quantum phase distributions using optical homodyne tomography,” QELS ‘93, Baltimore, Maryland, 1993.

“Pulse shaping in colliding-pulse mode-locked dye lasers,” CLEO’92, Anaheim, California, 1992.

“Experimental characterization of the intensity and phase of asymmetric 60 fs pulses from a CPM dye laser,” Annual Meeting of the Optical Society of America, San Jose, California, 1991.

“Linear causal filters that do not satisfy the Kramers-Kronig relation,” QELS ‘91, Baltimore, Maryland, 1991.

“Measurement of group delay with high temporal and spectral resolution,” CLEO ‘90, Anaheim, California”, 1990.

“Mode switching and quantum fluctuations in multimode dye lasers,” Annual Meeting of the Optical Society of America, Santa Clara, California, 1988.

“Numerical modeling of a multimode, standing-wave, cw dye laser,” Annual Meeting of the Optical Society of America, Rochester, New York, 1987.

### **Consulting/External Reviews**

External Review, Physics Department, Seattle University, Seattle, WA, 2014.

External Review, Physics Department, Rhodes College, Memphis, TN, 2012.

Consultant to faculty search committee, Physics Department, Willamette University, Salem, OR, 2009.

Consultant on installing quantum mechanics laboratories, Physics Department, Dickenson College, Carlisle, Pennsylvania, 2008.



## **Book Reviews**

*Introductory Quantum Optics*, by Christopher C. Gerry and Peter L. Knight; reviewed in Am. J. Phys. **73**, 1197 (2005).

*Advanced LabVIEW Labs*, by John Essick; reviewed in LabVIEW Technical Resource vol. **7**, number 3, pg. 23, (2000).

*Measuring the Quantum State of Light*, by Ulf Leonhardt; reviewed in Am. J. Phys. **66**, 550, (1998).

## **Courses Taught**

Energy and the Environment (Physics 105)

General Physics I & II (Lecture and Lab; Physics 155 & 156)

Twentieth Century Physics (Physics 245 & 246)

Electricity and Magnetism I & II (Physics 325 & 326)

Advanced Lab (Physics 339)

Optics (Physics 348)

Quantum Mechanics I & II (Lecture and Lab; Physics 385 & 386)

Lasers (Physics 451)

Quantum Fields and Information (Physics 452)

## **Selected Whitman College Committee Service**

2014-2015, Co-Chair of the Science Working Group

2012-2015, Committee of Division Chairs

2012-2015, Budget Advisory Committee

2013-2014, Co-Chair of the Science Exploratory Committee

2012-2014, Curriculum Committee

2011-2012, Tuition Exchange Working Group

2007-2009, Faculty Personnel Committee

2004-2007, Faculty Fringe Benefits Committee (Chair 2006-2007)

2006, Search Committee for Provost and Dean of the Faculty

1998-2000, Whitman Undergraduate Conference Organizing Committee

1997-2000, Admissions and Financial Aid Committee