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13. ABSTRACT (Maximum 200 words) In the Center for Opto-Electronic Systems Research at the University of Rochester, the primary goal of the faculty is to contribute fundamental scientific knowledge in the critical technology areas of lasers, modulation, optical system design, propagation and coherence, detection theory, signal and image processing, switching, neural networks, and displays. This research impacts on the following topics enumerated in the DoD critical technologies list: Photonics; Signal Processing; Passive Sensors; Software Producibility; and, to a lesser extent, Signature Control; Sensitive Radars; and Machine Intelligence or Robotics. Under the URI program, block funding will also permit us to educate a large number of superior doctoral scholars in a unique environment.				
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**ARO-URI CENTER FOR
OPTO-ELECTRONIC SYSTEMS RESEARCH**

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SECTION 1: ABSTRACT AND PRODUCTIVITY CHART

**ARO-URI CENTER FOR
OPTO-ELECTRONIC SYSTEMS RESEARCH**

**OPTOELECTRONIC
MATERIALS
DEVICES
SYSTEMS
RESEARCH**

ABSTRACT

In the Center for Opto-Electronic Systems Research at the University of Rochester, the primary goal of the faculty is to contribute fundamental scientific knowledge in the critical technology areas of lasers, modulation, optical system design, propagation and coherence, detection theory, signal and image processing, switching, neural networks, and displays. This research impacts on the following topics enumerated in the DoD critical technologies list: Photonics; Signal Processing; Passive Sensors; Software Producibility; and, to a lesser extent, Signature Control; Sensitive Radars; and Machine Intelligence or Robotics. Research in optics and photonics is inherently broad and encompassing, and significant positive influence can be anticipated across a major sector of our economy, as follows: (a) defense systems, (b) factory and office automation, and (c) communications. In addition to the normal emphasis on refereed publications in the open literature, the nine (9) faculty principals also plan to continue an extensive, successful, innovative program of technology transfer with the appropriate Army laboratories, including seminars, workshops, joint research, and long-term working visits. Furthermore, under the URI program, block funding has enabled us to educate a large number of superior doctoral scholars in a unique environment. This environment includes an eminent, cross-disciplinary faculty, an unexcelled capital facility in electrooptics, and industrial interactions with two major local corporations (Xerox and Eastman Kodak) as well as 25 U.S. corporations who are actively engaged in all aspects of photonics. This program of research is also provided at a reasonable cost to ARO due to substantial cost-sharing and careful management by the University of Rochester.

PRODUCTIVITY CHART[†]



CATEGORY \ YEAR	92-93	93-94	94-95	95-96	96-97	97-98	TOTAL
FACULTY (SEC. 2-1 TO 2-3)	10	10	9	9	9	9	
PUBLICATIONS (CUM: SEC. 3-1 TO 3-16) (BY PI: SEC. 4-1 TO 4.23)	27	40	54	46	33	21	221
PH.D. FELLOWS (19 FROM 86-91) (SEC. 5)	12	6	5	5	7	4 (6)	58

[†]PAGE REFERENCES ARE INDICATED IN THE ABOVE TABLE.

SECTION 2: SCIENTIFIC PERSONNEL AND PHONE LIST

ARO-URI CENTER FOR
OPTO-ELECTRONIC SYSTEMS RESEARCH

SCIENTIFIC PERSONNEL

Nicholas George Director, ARO-URI Center for Opto-Electronic Systems Research; Wilson Professor of Electronic Imaging; and Professor of Optics and Professor of Electrical Engineering (Ph.D. Electrical Engineering and Physics, California Institute of Technology; M.S. University of Maryland; B.S. University of California, Berkeley)

Novel electronic imaging systems for automatic pattern recognition, imaging through turbulence, fog and smoke, and true-height contour holograms; sub-resolution in color scanning and printing, include dithering and compression

Robert W. Boyd Associate Director, ARO-URI Center for Opto-Electronic Systems Research and Professor of Optics (Ph.D. Physics, University of California, Berkeley; B.S. Physics, Massachusetts Institute of Technology)

Development of nonlinear optical materials, especially composite materials; applications of nonlinear optics, including optical power limiters, phase conjugate mirrors, optical fiber devices, frequency conversion devices, and optical amplifiers

Govind P. Agrawal Professor of Optics (Ph.D. and M.S., Indian Institute of Technology, New Delhi, India)

Femtosecond dynamics of semiconductor lasers; feedback induced enhancement of laser noise; soliton amplification and generation in doped fibers; spatio-temporal coupling in nonlinear media and its role in mode locking Ti:sapphire lasers

Dennis G. Hall Director of The Institute of Optics and William F. May Professor of Optics (Ph.D. Physics, University of Tennessee; B.S. Physics, University of Illinois, Urbana-Champaign)

Semiconductor opto-electronics; broad area, surface-emitting semiconductor lasers

SCIENTIFIC PERSONNEL (CONTINUED)

Susan Houde-Walter Professor of Optics
(Ph.D. and M.S. Optics, University of Rochester; B.A., Sarah Lawrence College)

Optoelectronic materials and design: III-V semiconductors, optical glass, design methods for monolithic integration of optoelectronics

Stephen D. Jacobs Associate Professor of Optics and Senior Scientist at the Laboratory for Laser Energetics
(Ph.D. Optics, University of Rochester)

Polymer liquid crystal flake inks for applications, including reflective paints and pigments, friend/foe discrimination

G. Michael Morris Professor of Optics
(Ph.D. and M.S. Electrical Engineering, California Institute of Technology; B.S. Engineering Physics, University of Oklahoma)

Diffraction optics technology, including optical system design, manufacture of diffractive structures, and subwavelength structured surfaces

Carlos R. Stroud Professor of Optics
(Ph.D. Physics, Washington University; A.B. Physics and Mathematics, Centre College)

Quantum electronics with ultrashort laser pulses, remote sensing with modulated laser fields

Emil Wolf Wilson Professor of Optical Physics, Professor of Physics and Professor of Optics
(Ph.D., Bristol; D.Sc. Edinburgh)

Structure of the focal region; inverse problems, especially diffraction tomography and super-resolution; theory of partial coherence, with applications to radiometry and spectroscopy

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SECTION 3: CUMULATIVE LISTING OF PUBLICATIONS

**ARO-URI Center for
OPTO-ELECTRONIC SYSTEMS RESEARCH**

Cumulative Publication Listing

June 1992 to September 1998

1. "Liquid crystals for laser applications," S. D. Jacobs, K. L. Marshall, and A. Schmid, *The Handbook of Laser Science and Technology*, CRC. **1995**, 509-577 (1995).
2. "Propagation of Gaussian Schell-model beams in dispersive and absorbing media," W. Wang and E. Wolf, *J. Mod. Opt.* **39**, 2007-2021 (1992).
3. "Improvement of the photorefractive efficiency of BaTiO₃ by γ irradiation," T. R. Moore and R. W. Boyd, *Appl. Phys. Lett.* **61**, 2015-2017 (1992).
4. "Influence of refractive index nonlinearities on modulation and noise properties of semiconductor lasers," G. P. Agrawal, G. H. Duan and P. Gallion, *Elect. Lett.* **28**, 1773-1774 (1992).
5. "Neural networks applied to diffraction-pattern sampling," N. George and S. Wang, *Appl. Opt.* **33**, 3127-3134 (1994).
6. "Optical-feedback-induced chaos and its control in semiconductor lasers," G. R. Gray, A. T. Ryan, G. P. Agrawal, and E. C. Gage, *SPIE*. **2039**, 45-57 (1993).
7. "Effect of two-photon absorption on the amplification of ultrashort optical pulses," G. P. Agrawal, *Phys. Rev. E*. **48**, 2316-2318 (1993).
8. "Concept of linewidth enhancement factor in semiconductor lasers: its usefulness and limitations," G. P. Agrawal and C. M. Bowden, *IEEE Photo. Tech. Lett.* **5**, 640-642 (1993).
9. "Optical-feedback-induced chaos and its control in multimode semiconductor lasers," G. R. Gray, A. T. Ryan, G. P. Agrawal, and E. C. Gage, *IEEE J. Quant. Elect.* **30**, 668-679 (1994).
10. "Simultaneous amplification and compression of picosecond optical pulses during Raman amplification in optical fibers," C. Headley III and G. P. Agrawal, *J. Opt. Soc. Am. B*. **10**, #12, 2383-2389 (1993).
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13. "Photomixing of achromatically frequency-modulated incoherent light," N. George and S. Radic, *Opt. Lett.* **18**, 1038-1040 (1993).
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19. "Dynamic and noise properties of tunable multielectrode semiconductor lasers including spatial hole burning and nonlinear gain," G. Duan, P. Gallion, and G. P. Agrawal, *IEEE J. Quan. Elect.* **29**, 844-855 (1993).
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21. "Laser instabilities and chaos in inhomogenously broadened dense media," C. M. Bowden, S. Singh, and G. P. Agrawal, *J. Mod. Opt.* **42**, 101-107 (1995).
22. "Steering of optical beams in nonlinear Kerr media by spatial phase modulation," A. T. Ryan and G. P. Agrawal, *Opt. Lett.* **18**, 1795-1797 (1993).
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25. "A case study: dual-use technologies and university research initiatives," N. George, B. D. Guenther, and V. Piarulli, *Army RD&A Bull.* **PB 70-93-6**, 19-23 (1993).
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58. "Nonlinear optical susceptibilities of layered composite materials," R. W. Boyd and J. E. Sipe, J. Opt. Soc. Am. B. **11**, 297-303 (1994).
59. "A new method for determining the angular separation of double stars," D. F. V. James, H. C. Kandpal and E. Wolf, Astrophys. J. **445**, 406-410 (1995).
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78. "Reflection and transmission properties of holographic mirrors and holographic Fabry-Perot filters. III. holographic Fabry-Perot filters," W. Wang, (E. Wolf, faculty investigator), *Appl. Opt.* **33**, 7883-7894 (1994).
79. "Semiclassical theory of Rydberg wave packet interferometry," M. Mallalieu and C.R. Stroud, Jr., *Phys. Rev. A.* **51**, 1827-1835 (1995).
80. "Analysis of nonuniform nonlinear distributed feedback structures: generalized transfer matrix method," S. Radic, N. George, and G. P. Agrawal, *IEEE J. Quant. Elect.* **31**, 1326-1336 (1995).
81. "The classical limit of an atom," M. Nauenberg, C. Stroud and J. Yeazell, *Sci. Am.* **270**, 44-49 (1994).
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87. "Photoelectron statistics of solitons corrupted by amplified spontaneous emission," T. Yoshino and G. P. Agrawal, Phys. Rev. A. **51**, 1662-1668 (1995).
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89. "Radiation in spherically symmetric structures. I. the coupled-amplitude equations for vector spherical waves," K. G. Sullivan and D. G. Hall, Phys. Rev. A. **50**, 2701-2707 (1994).
90. "Radiation in spherically symmetric structures. II. enhancement and inhibition of dipole radiation in a spherical Bragg cavity," K. G. Sullivan and D. G. Hall, Phys. Rev. A. **50**, 2708-2718 (1994).
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93. "Noise properties of a beam propagating through an atomic vapor," V. V. Iruvanti and R. W. Boyd, submitted to Opt. Comm. (1995).
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96. "Structure of focused fields in systems with large Fresnel numbers," W. Wang, A. T. Friberg, and E. Wolf, J. Opt. Soc. Am. A. **12**, 1947-1953 (1995).

97. "Phase-conjugate optical feedback in semiconductor lasers," G. R. Gray, D. H. DeTienne, and G. P. Agrawal, SPIE Proceedings, Physics and Simulation of Optoelectronic Devices III, **2399**, 713-722 (1995).
98. "Blending polysiloxane glass resins to produce optical films with a specific refractive index," E. M. Korenic and K. L. Marshall, (S. Jacobs, faculty investigator), Opt. and Photo. News. **6**, (1995).
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SUSAN N. HOUDE-WALTER

"Mechanisms for n-type impurity-induced disordering of AlGaAs/GaAs superlattices," B. L. Olmsted, S. N. Houde-Walter, and R. E. Viturro, *Mat. Res. Soc. Symp. Proc.* **262**, 867-872 (1992). (11)*

"Tilted superlattice composition profile determined by photoluminescence and thermal disordering," F. G. Johnson, B. L. Olmsted, S. Chen, and G. W. Wicks, (S. N. Houde-Walter, faculty investigator), *J. Elect. Mat.* **22**, 331-334 (1993). (12)

"Vacancy-mediated disordering of AlGaAs-GaAs superlattices by group IV or VI impurity in-diffusion," B. L. Olmsted and S. N. Houde-Walter, *Appl. Phys. Lett.* **62**, 1516-1518 (1993). (14)

"Tilted superlattice composition profile measure by photoluminescence and Raman," F. G. Johnson, B. L. Olmsted, S. Chen, and G. W. Wicks, (S. N. Houde-Walter, faculty investigator), *J. Crys. Grth.* **127**, 812-815 (1993). (16)

"Energetics of impurity-free vacancy-mediated disordering of AlGaAs/GaAs superlattices," B. L. Olmsted and S. N. Houde-Walter, (*III-V Electronic and Photonic Device Fabrication and Performance*, ed. K.S. Jones, S. J. Pearton, and H. Kanber) *Mat. Res. Soc. Sym. Proc.* **300**, 391-396 (1993). (27)

"Si-induced AlGaAs/GaAs superlattice disordering using a grown-in impurity source and the effects of annealing ambient," B. L. Olmsted and S. N. Houde-Walter, (*III-V Electronic and Photonic Device Fabrication and Performance*, ed. K. S. Jones, S. J. Pearton, and H. Kanber) *Mat. Res. Soc. Sym. Proc.* **300**, 415-520 (1993). (28)

"Al-Ga interdiffusion through group III-vacancy second nearest-neighbor hopping," B. L. Olmsted and S. N. Houde-Walter, *Appl. Phys. Lett.* **63**, 530-532 (1993). (29)

"Disordering and compensation in Si-doped AlGaAs/GaAs superlattices using Ga- and As- rich annealing ambients," B. L. Olmsted and S. N. Houde-Walter, *Appl. Phys. Lett.* **63**, 1131-1133 (1993). (30)

"The migration of bound and leaky solutions to the waveguide dispersion relation," R. E. Smith and S. N. Houde-Walter, *J. Lightwave Tech.* **11**, 1760-1768 (1993). (31)

"Failure of the leaky-mode representation near the waveguide mode cutoff," R. E. Smith and S. N. Houde-Walter, *Opt. Lett.* **10**, 1-3 (1995). (112)*

SUSAN N. HOUDE-WALTER (continued)

"Leaky guiding in nontransparent waveguides," R. E. Smith and S. N. Houde-Walter, J. Opt. Soc. Am. A. **12**, 715-724 (1995). **(113)**

"Modeling ion-exchanged glass photonics: the modified quasi-chemical diffusion coefficient," J. M. Inman, J. L. Bently, and S. N. Houde-Walter, submitted to The Journal of Non-Crystalline Solids. (1995). **(114)**

"Chemical structure and the mixed mobile ion effect in silver-for- sodium ion exchange in silicate glasses," J.M. Inman, S.N. Houde-Walter, B.L. McIntyre, Z.M. Liao, R.S. Parker, and V. Simmons, J. of Non-Crystalline Solids **194**, 85-92 (1996) **(187)**.

"Temperature Dependence of Silver-Sodium Interdiffusion in Micro-optic Glasses," B. Messerschmidt, B.L. McIntyre, S.N. Houde-Walter, R.R. Andre, and C.H. Hsieh, Optical Materials. **7**, 165-171 (1997) **(188)**.

"Desired concentration-dependent ion exchange for micro-optic lenses," B. Messerschmidt, B.L. McIntyre, and S.N. Houde-Walter, Applied Optics **35**, 5670-5676 (1996) **(189)**.

"Ionic mobility in an ion exchanged silver-sodium boroaluminosilicate glass for micro-optics applications," B.Messerschmidt, C.H. Hsieh, B.L. McIntyre, and S.N. Houde-Walter, submitted to J. Non-Cryst. Sol. (1997) **(193)**.

**ARO-URI Center for
OPTO-ELECTRONIC SYSTEMS RESEARCH**

STEPHEN D. JACOBS

"Liquid crystals for laser applications," S. D. Jacobs, K. L. Marshall, and A. Schmid, The handbook of Laser Science and Technology, CRC. **1995**, 509-577 (1995). **(1)***

"Ferroelectrics push liquid crystals into new markets," S. Jacobs and K. L. Marshall, R&D Magazine. **November**, 20-22 (1993). **(49)**

"Mid-infrared modulation using field-induced scattering in ferroelectric liquid crystals," K. L. Marshall, S. D. Jacobs, and J. E. Miller, Appl. Opt. **34**, 6704-6713 (1995). **(64)**

"Some dynamic features of the preparation of liquid crystalline elastomers," C. J. Twomey, T. N. Blanton, K. L. Marshall, S. H. Chen, and S. D. Jacobs, Liquid Crystals. **19**, 339-344 (1995). **(84)**

"Blending polysiloxane glass resins to produce optical films with a specific refractive index," E. M. Korenic and K. L. Marshall, (S. D. Jacobs, faculty investigator), Opt. and Photo. News. **6**, (1995). **(98)**

"Cholesteric liquid crystal inks and paints," E. M. Korenic, S. D. Jacobs, S. M. Faris, and L. Li, submitted to Research Highlights of the Army Research Office - Physics Division. (1994). **(104)**

"Colorimetry of fractured cholesteric liquid crystal polymers," E. M. Korenic, S. D. Jacobs, S. M. Faris, and L. Li, The third IS&T/SID Color Imaging Conference, (IS&T, Springfield, VA) 60-62 (1995). **(108)**

"Colorimetry of cholesteric liquid crystals," E. M. Korenic, S. D. Jacobs, S. M. Li, submitted to Proceedings of "Optics and Imaging in the Information Age" - OSA/IS&T Annual Meeting, Rochester, NY (1996). **(176)**

"Color gamut of cholesteric liquid crystal films and flakes by standard colorimetry," E. M. Korenic, S. D. Jacobs, S. M. Faris and L. Li, submitted to Color research and application (1997). **(195)**

**ARO-URI Center for
OPTO-ELECTRONIC SYSTEMS RESEARCH**

G. MICHAEL MORRIS

"Antireflection structured surfaces for the infrared spectral region," D. H. Raguin and G. M. Morris, Appl. Opt. **32**, 1154-1167 (1993). **(32)***

"Analysis of antireflection-structured surfaces with continuous one-dimensional surface profiles," D. H. Raguin and G. M. Morris, Appl. Opt. **32**, 2582-2598 (1993). **(33)**

"Effective medium theory approach to guided-mode resonances," S. M. Norton, D. H. Raguin, and G. M. Morris, OSA Topical meeting on optical design for photonics, Palm Springs, CA, paper OWA8, March 22-24 (1993). **(34)**

"Coherence properties of synchrotron radiation in the space-frequency domain," D. Faklis and G. M. Morris, submitted to the J. Mod. Opt. (1993). **(35)**

"Subwavelength structured surfaces and their applications," D. H. Raguin, G. M. Morris, and S. Norton, SPIE Crit. Rev. of Opt. Sci. and Tech. **CR49**, 234-261 (1993). **(36)**

"Photon-limited image classification with a feedback neural network," G. M. Morris, L. A. Saaf, Appl. Opt. **34**, 3963-3970 (1995). **(92)**

"Efficient and stable implement of rigorous couple-wave analysis for surface-relief gratings, S. Peng and G. M. Morris, SPIE Annual Meeting, SPIE Proc. **2532**, San Diego, CA, Conference on: Application and theory of Periodic Structures, (1995). **(152)**

"Resonant scattering from two-dimensional gratings," Song Peng and G. Michael Morris, J. Opt. Soc. Am. A. **13**, 993-1005 (1996). **(153)**

"Experimental demonstration of resonant anomalies in diffraction from two-dimensional gratings," Song Peng and G. Michael Morris, Opt. Lett. **21**, 549-551 (1996). **(154)**

"Experimental study of resonant grating filters based on two-dimensional gratings," S. Peng and G. M. Morris, SPIE Photonics West, SPIE Proc. **2689**, Diffractive and Holographic Optics, Technology III, San Jose, CA, Jan-Feb (1996). **(155)**

"Highly improved convergence of the coupled-wave method for TM polarization," Philippe Lalanne and G. Michael Morris, Opt. Soc. Am. **13**, 779-784 (1996). **(156)***

"Diffractive optics applied to eyepiece design," M. D. Missig and G. M. Morris, Appl. Opt. **34**, 2452-2461 (1995). **(157)**

G. MICHAEL MORRIS (continued)

"Efficient implement of rigorous coupled-wave analysis for surface relief gratings," S. Peng and G. M. Morris, J. Opt. Soc. Am. A. **12**, 1087-1096 (1995). **(158)**

"Imaging thermal objects with photon-counting detectors," E. A. Watson and G. M. Morris, Appl. Opt. **31**, 4751-4757 (1992). **(159)**

"Coupled-mode theory of resonant-grating filters," Scott M. Norton, Turan Erdogan, and G. Michael Morris, submitted to J. Opt. Soc. Amer. A (1997). **(171)**

**ARO-URI Center for
OPTO-ELECTRONIC SYSTEMS RESEARCH**

CARLOS R. STROUD, JR.

"Semiclassical dynamics of circular-orbit Rydberg wave packets," M. Mallalieu and C. R. Stroud Jr., Phys. Rev. A. **49**, 2329-2339 (1994). **(43)***

"Excitation of the classical-limit state of an atom," Z. D. Gaeta, M. W. Noel, and C. R. Stroud, Jr., Phys. Rev. Lett. **73**, 636-639 (1994). **(45)**

"Autler-Townes effect for an atom in a bichromatic laser field: I. a dressed-atom approach," M. F. Van Leeuwen, S. Papademetriou, and C. R. Stroud, Jr., submitted to Phys. Rev. A. (1994). **(63)**

"Coherence and control of atomic electrons," C. R. Stroud, Jr., Proceedings of the Fourteenth International Conference on Atomic Physics, Boulder CO, American Institute of Physics, New York. (1994). **(71)**

"Semiclassical theory of Rydberg wave packet interferometry," M. Mallalieu and C.R. Stroud, Jr., Phys. Rev. A. **51**, 1827-1835 (1995). **(79)**

"The classical limit of an atom," M. Nauenberg, C. R. Stroud, Jr., and J. Yeazell, Sci. Am. **270**, 44-49 (1994). **(81)**

"Autler-Townes effect for an atom in 100% amplitude-modulated laser field. I. A dressed-atom approach," M. F. Van Leeuwen, S. Papademetriou and C. R. Stroud, Jr., Phys. Rev. A. **53**, 990-996 (1996). **(162)**

"Autler-Townes effect for an atom in 100% amplitude-modulated laser field. II. Experimental results," M. F. Van Leeuwen, S. Papademetriou and C. R. Stroud, Jr., Phys. Rev. A. **53**, 997-1003 (1996). **(163)**

"Excitation of an atomic electron to a coherent superposition of macroscopically distinct states," M. W. Noel and C. R. Stroud, Jr., Phys. Rev. Lett. **77**, 1913-1916 (1996). **(166)**

"Fractional wavefunction revivals in the infinite square well," D.L. Aronstein and C.R. Stroud, Jr., Phys. Rev. A **55**, 4526-4537 (1997). **(170)**

"Young's double-slit interferometry within an atom," Michael W. Noel and C. R. Stroud, Jr., Phys. Rev. Lett. **75**, 1252-1255 (1995). **(173)**

"Spatio-temporal shaping of terahertz pulses," Jake Bromage, Stojan Radic, G. P. Agrawal, C. R. Stroud, Jr., P. M. Fauchet, and Roman Sobolewski, Opt. Lett. **22**, 627-629 (1997). **(174)***

"Optical mixing of Rydberg angular momenta," John D. Corless and C. R. Stroud, Jr., Phys. Rev. Lett. **79**, 637-640 (1997). **(175)**

CARLOS R. STROUD, JR. (continued)

"Pulsed single-mode dye laser for coherent control experiments," J.D. Corless, J.A. West, J. Bromage, and C.R. Stroud, Jr., J. of Scientific Instruments **68**, 2259-2264 (1997). **(186)**.

"Visualization of the core-scattering dynamics of Rydberg wave pockets," J.A. West and C.R. Stroud, Jr. Opt. Exp. **1**, 31-38 (1997) **(194)**.

**ARO-URI Center for
OPTO-ELECTRONIC SYSTEMS RESEARCH**

EMIL WOLF

"Propagation of Gaussian Schell-model beams in dispersive and absorbing media," W. Wang and E. Wolf, J. Mod. Opt. **39**, 2007-2021 (1992). **(2)***

"Higher-order coherence functions in the space-frequency domain," G. S. Agarwal and E. Wolf, J. Mod. Opt. **40**, 1489-1496 (1993). **(39)**

"Inverse problems with quasi-homogeneous random media," D. G. Fischer and E. Wolf, J. Opt. Soc. Am. A **11**, 1128-1135 (1994). **(40)**

"A new method for determining the angular separation of double stars," D. F. V. James, H. C. Kandpal, and E. Wolf, Astrophys. J. **445**, 406-410 (1995). **(59)**

"Partially coherent sources which generate far fields with the same spatial coherence properties," H. C. Kandpal and E. Wolf, Opt. Comm. **110**, 255-258 (1994). **(62)**

"A generalized radon transform for tomographic measurement of ultra-short optical pulses," D. F. V. James and G. S. Agarwal, (E. Wolf, faculty investigator), J. Opt. Soc. Am. B. **12**, 704-708 (1995). **(67)**

"Change of polarization of light beams on propagation in free space," D. F. V. James, (E. Wolf, faculty investigator), J. Opt. Soc. Am. A. **11**, 1641-1643 (1994) **(72)**

"Inverse problems with quasihomogeneous random media utilizing scattered pulses," D. G. Fisher and B. Cairns, (E. Wolf, faculty investigator), J. Mod. Opt. **42**, 655-666 (1995). **(73)**

"On the fundamental theorem of diffraction tomography," E. Wolf, SPIE. **1983**, 618-619 (1993). **(74)**

"Spectral changes in the Mach-Zehnder interferometer," G. S. Agarwal and D. F. V. James, (E. Wolf, faculty investigator), J. Mod. Opt. **40**, 1431-1436 (1993). **(75)**

"Comment on 'Radiometric measurements and correlation-induced spectral changes,' by K. A. Nugent and J. L. Gardner," E. Wolf, Metrologia. **31**, 311-313 (1994). **(77)**

"Reflection and transmission properties of holographic mirrors and holographic Fabry-Perot filters, part III: holographic Fabry-Perot filters," W. Wang, (E. Wolf, faculty investigator), Appl. Opt. **33**, 7883-7894 (1994). **(78)***

"Far-zone behavior of focused fields in systems with different Fresnel numbers," W. Wang and E. Wolf, Opt. Comm. **119**, 453-459 (1995). **(82)**

EMIL WOLF (continued)

"Generalized Fresnel transforms in optics," D. F. V. James and G. S. Agarwal, (E. Wolf, faculty investigator), in press, J. Mod. Opt. (1994). **(83)**

"Spectral invariance and non-invariance of light generated by partially coherent sources," E. Wolf, J. Appl. Phys. B. **60**, 303-308 (1995). **(95)**

"Structure of focused fields in systems with large Fresnel numbers," W. Wang, A. T. Friberg, and E. Wolf, J. Opt. Soc. Am. A. **12**, 1947-1953 (1995). **(96)**

"Principles and development of diffraction tomography," E. Wolf, Trends in Optics, ed. by A. Consortini (Academic Press, San Diego, CA), 83-110. (1996). **(109)**

"Homogeneous and evanescent contributions in scalar near-field diffraction," M. Kowarz, (E. Wolf, faculty investigator), Appl. Opt. **34**, 3055-3063 (1995). **(139)**

"Bessel-beam representation for partially coherent fields," M. W. Kowarz and G. S. Agarwal, (E. Wolf, faculty investigator), J. Opt. Soc. Am. A. **12**, 1324-1330 (1995). **(140)**

"Transmission properties of holographic Fabry-Perot filters," W. Wang, (E. Wolf, faculty investigator), Proceedings of Conference on Applications and Theory of Periodic Structures, part of SPIE's 1995 International Symposium on Optical Science, Engineering and Instrumentation, San Diego, CA, July (1995). **(141)**

"Focusing of partially coherent light in systems of large Fresnel numbers," W. Wang, A. T. Friberg, and E. Wolf, J. Opt. Soc. Am. A. **14**, 491- 496 (1997). **(142)**

"Correlation-induced spectral changes," E. Wolf and D. F. V. James, Reports on Progress in Physics (IOP Publishing, Bristol and London), **59**, 771-818 (1996). **(146)**

"Cross-spectrally pure light and the spectral modulation law," D. F. V. James and E. Wolf, Opt. Comm. **138**, 257-261 (1997). **(167)**

"Theory of diffraction tomography for quasi-homogeneous random objects," D. G. Fischer and E. Wolf, Opt. Comm. **133**, 17-21 (1997). **(218)**

"Sources of arbitrary state of coherence which generate completely coherent fields outside the source," G. Gbur and E. Wolf, Opt. Lett. **22**, 943-945 (1997). **(219)**

"Scattering in the presence of field discontinuities at boundaries," T. Visser and E. Wolf, Phys. Lett. A, in press. **(220)**

"Remarks on boundary conditions for scalar scattering," T. D. Visser, P. S. Carney, and E. Wolf, submitted to Physics Letters A. **(221)**

ARO-URI Ph.D. FELLOWS

The ARO-URI Center for Opto-Electronic Systems Research was established to contribute fundamental knowledge in the key technology areas of signal processing and image understanding, sources and sensors, and optical system design. A primary goal of the Center has been the education of outstanding Ph.D. graduate students through its affiliation with The Institute of Optics. To date, sixty Ph.D. Fellows have been supported since the beginning of the ARO-URI Center Program (1988). Of those, fifty have completed their theses and ten are in the process of finishing. This section contains a listing of the Ph.D. Fellows. Their thesis title is given along with their advisor and the year the thesis was completed or is expected. For those Fellows who have graduated, we also include their current location.

**ARO-URI CENTER FOR
OPTO-ELECTRONIC SYSTEMS RESEARCH**

LISTING OF PH.D. FELLOWS

TITLE / FELLOWS / ADVISOR	YEAR	CURRENT ADDRESS
"Contributions to the theory of the electronic and optical properties of $\text{Si-Ge}_x\text{-Si}_{1-x}$ semiconductor superlattices" Carel Martijn de Sterke Dennis G. Hall, Advisor	1987	University of Sydney Theoretical Physics Department Sydney, Australia NSW 2006
"Diffraction theory for polygonal apertures" R. Edward English, Jr. Nicholas George, Advisor	1988	Lawrence Livermore National Laboratory P. O. Box L-462 Livermore, CA 94550 (510) 422-3602
"Two-beam coupling and phase conjugation by resonant nonlinear optical interactions" Mark Tyree Gruneisen Robert W. Boyd, Advisor	1988	U.S.A.F. Phillips Laboratory PL/LITN Kirtland Air Force Base 3550 Aberdeen Avenue, SE Albuquerque, NM 87117-6008 (505) 846-4730
"Image recovery from partial Fresnel zone information" Robert J. Rolleston Nicholas George, Advisor	1988	Xerox Corporation Webster Research Center 800 Phillips Road, 0128-27E Webster, NY 14580 (716) 422-3138

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Laser speckle from thin and cascaded diffusers" Lyle Gordon Shirley Nicholas George, Advisor	1988	MIT Lincoln Laboratory P. O. Box 73-KB370 Lexington, MA 02173 (617) 981-0774
"Optical phase conjugation enhanced by the Brillouin interaction" Mark Daniel Skeldon Robert W. Boyd, Advisor	1988	Laboratory for Laser Energetics University of Rochester Rochester, NY 14627 (716) 275-4781
"Sol-gel method for making radial gradient-index glass" J. Brian Caldwell Duncan T. Moore, Advisor	1989	Enichem American, Inc. 2000 Princeton Park Monmouth Junction, NJ 08852 (908) 422-0400
"Instabilities and chaos of laser beams propagating through nonlinear optical medium" Daniel Joseph Gauthier Robert W. Boyd, Advisor	1989	Duke University Department of Physics Durham, NC 27706
"Quantum-limited image recognition" Thomas Arthur Isberg G. Michael Morris, Advisor	1989	3M Company 3M Center Bldg. 201-3E-03 St. Paul, MN 55144-1000 (612) 733-1110

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Dynamics and instabilities in homogeneously broadened lasers" Karl William Koch, III Carlos R. Stroud, Jr., Advisor	1989	U.S.A.F. Phillips Laboratory PL/LIDN Kirtland Air Force Base 3550 Aberdeen Avenue, SE Albuquerque, NM 87117-6008 (505) 846-4750
"Interaction of atomic hydrogen with pico- and femtosecond laser pulses" Jonathan S. Parker Carlos R. Stroud, Jr., Advisor	1989	University of Maryland NIST College Park, MD (301) 405-1000
"Classification techniques for quantum-limited and classical-intensity images" Miles N. Wernick G. Michael Morris, Advisor	1989	Illinois Institute of Technology Electrical Engineering Department 3301 South Dearborn Chicago, IL 60616
"Serrated circular apertures: optical fourier transforms and fractal analysis" Madeleine Marie Beal Nicholas George, Advisor	1990	3M Company 3M Center Bldg. 260-5A-11 St. Paul, MN 55144-1000 (612) 736-9287
"Optical emission from single-crystal silicon" Phillip Laurence Bradfield Dennis G. Hall, Advisor	1990	Consultant

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Nonlinear optical systems interacting with amplitude-modulated optical fields" Stephen H. Chakmakjian Carlos R. Stroud, Jr., Advisor	1990	U.S.A.F. Phillips Laboratory Nonlinear Optics Branch Kirtland Air Force Base Albuquerque, NM 87117-6008 (505) 822-7000
"Effects and control of the correlation properties of light sources" Dean Faklis G. Michael Morris, Advisor	1990	Rochester Photonics Corporation 330 Clay Road Rochester, NY 14623 (716) 272-3010
"Stochastic and deterministic fluctuations in stimulated brillouin scattering" Alexander L. Gaeta Robert W. Boyd, Advisor	1990	Cornell University Applied & Engineering Physics Ithaca, NY 14853 (607) 255-9983
"Fabrication and testing of index gradients in fluoride materials" Michael T. Houk Duncan T. Moore, Advisor	1990	Burleigh Instruments, Inc. Burleigh Park Fishers, NY 14453 (716) 924-9355
"Radial gradient lenses for single-mode optical systems" John P. Bowen Duncan T. Moore, Advisor	1991	Rochester Photonics 330 Clay Road Rochester, NY 14623 (716) 272-3010

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Pulse shaping in colliding-pulse, mode-locked dye lasers" Mark K. Beck Ian A. Walmsley, Advisor	1992	University of Oregon Department of Physics Eugene, OR 97403 (503) 346-4751
"Single point diamond turning of glass" Christian Gary Blough Duncan T. Moore, Advisor Erwin G. Loewen, Advisor	1992	Rochester Photonics 330 Clay Road Rochester, NY 14623 (716) 272-3010
"Recovery of particle size distributions from the far field scattering pattern" Scott D. Coston Nicholas George, Advisor	1992	Bio-Derm, Inc. Clearwater, FL
"Wave guiding and grating coupling phenomena in silicon based integrated optics" Robert Milton Emmons Dennis G. Hall, Advisor	1992	NiOptics Corp 1801 Maple Avenue Evanston, IL 60201 (708) 491-3196
"Propagation, loss and free-carrier effects in silicon waveguide structures" Alan Frank Evans Dennis G. Hall, Advisor	1992	Corning Inc. Sullivan Park, SP-FR-01-7 Corning, NY 14831 (607) 974-3947

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Global optimization in lens design" Andrew E. W. Jones Gregory W. Forbes, Advisor	1992	Sinclair Optics Inc. 6780 Pittsford-Palmyra Road Fairport, NY 14450 (716) 425-4380
"An investigation of distributed coupling in a nonlinear semiconductor waveguide" David Floyd Prelewitz Thomas G. Brown, Advisor	1992	University of Rochester Electronic Imaging Systems Rochester, NY 14627 (716) 275-0547
"Feedforward neural networks" Lennart A. Saaf G. Michael Morris, Advisor	1992	IBM East Fishkill Facility Fishkill, NY 12524 (914) 894-8554
"Hamilton's methods applied to the design of asymmetric optical systems" Bryan D. Stone Gregory W. Forbes, Advisor	1992	University of Rochester The Institute of Optics Rochester, NY 14627 (716) 275-6205
"Design methods for gradient-index optical systems" David Yih-Hsing Wang Duncan T. Moore, Advisor	1992	Co. Breault Research 7820 East Broadway, Suite 207 Tucson, AZ 85710 (602) 721-0500

LISTING OF Ph.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Nonlinear optical modification to the polarization and noise properties of a laser beam after propagating through atomic-potassium vapor" William V. Davis Robert W. Boyd and Leonard Mandel, Advisors	1993	Eastman Kodak Company 3/81/RL MC02017 Rochester, NY 14650 (716) 588-6318
"Group III-vacancy mediated disordering of intrinsic and n-type AlGaAs/GaAs" Brian L. Olmsted Susan N. Houde-Walter, Advisor	1993	University of Georgia Dept. Physics & Astronomy Athens, GA 30602 (706) 542-2485
"Subwavelength structured surfaces: theory and experiments" Daniel Henri Raguin G. Michael Morris, Advisor	1993	Rochester Photonics Corporation 330 Clay Road Rochester, NY 14623 (716) 272-3010
"Wavelength and roughness dependence of backscattering" Donald John Schertler Nicholas George, Advisor	1993	University of Rochester The Institute of Optics Rochester, NY 14627 (716) 275-5805
"Optical absorption, emission, and modulation in III-V semi-conductor quantum well structures" Steven Marc Shank Gary W. Wicks, Advisor	1993	Galileo Electro-Optics Ithaca, NY

LISTING OF Ph.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Experimental determination of the dynamics of a molecular nuclear wave packet via the spectra of a spontaneous emission" Thomas J. Dunn Ian A. Walmsley, Advisor	1994	Anvik Corporation 250 Clearbrooke Road Elmsford, NY 10523 (914) 345-2442
Spatial optical transforms with applications" Keith Bryan Farr Nicholas George, Advisor	1994	Advanced Optical Systems, Inc. 3330 L&N Drive, Suite A Huntsville, AL 35801 (205) 650-5960
"Semiclassical dynamics of Rydberg electron wave packets" Mark R. Mallalieu Carlos R Stroud, Jr., Advisor	1994	University of Kansas Department of Chemistry Lawrence, KS 66044
"Resonant interactions of atoms with modulated optical fields" Stephanos Papademetriou Carlos R. Stroud, Jr., Advisor	1994	Indigo Medical Incorporated 2309 Renard Place, S.E. Suite 104 Albuquerque, NM 87106 (505) 765-0488
"Modal expansions in transparent and nontransparent planar waveguides" Robert Edward Smith Susan N. Houde-Walter, Advisor	1994	Sandia National Laboratory Albuquerque, NM
"Image processing, coding, and compression with multiple-point impulse response functions" Bryan Joseph Stossel Nicholas George, Advisor	1994	Eastman Kodak Company Research Laboratories Rochester, NY (716) 726-3412

LISTING OF Ph.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Ultrafast stimulated Raman scattering in optical fibers" Clifford Headley Govind P. Agrawal, Advisor	1995	AT&T Bell Laboratories Murray Hill, NJ 07974
"Diffraction effects in the near field" Marek Kowarz Emil Wolf, Advisor	1995	Eastman Kodak Company Optical Storage Technology R&D 460 Buffalo Road Rochester, NY 14652-3815 (716) 588-4160
"Periodic structures in multiwavelength optical systems" Stojan Radic Nicholas George, Advisor	1995	University of Rochester The Institute of Optics Rochester, NY 14627 (716) 275-7834
"Aspects of the generation and propagation of solitons in optical fibers" Andrew Stentz Robert W. Boyd, Advisor	1995	AT&T Bell Laboratories Murray Hill, NJ
"Novel asymptotic methods for wave-propagation" Miguel Angel Alonso Gregory W. Forbes, Advisor	1996	Macquarie University School of MPCE North Ryde, 2109 Sydney, Australia

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR

YEAR

CURRENT ADDRESS

"Methods of inverse scattering for random media"

David Gerard Fischer

Emil Wolf, Advisor

1996

Johns Hopkins University
Applied Physics Laboratory
Johns Hopkins Road, Rm. 1E-147
Laurel, MD 20723
(410) 792-5000, x4860

"Ion exchange and chemical structure in glass"

Jill Marie Inman

Susan N. Houde-Walter, Advisor

1996

Pacific-Sierra Research Corp.
L.M.D.C.
12300 Sunrise Valley Drive
Reston, VA 22091
(703) 453-3515

"Temporal, spectral, and noise characteristics of erbium-doped fiber amplifiers and lasers"

Lisa Liou

Govind P. Agrawal, Advisor

1996

Corning, Inc.
Corning, NY

"Atomic electron wave packet interference and control"

Michael Noel

Carlos R. Stroud, Jr., Advisor

1996

University of Virginia
Department of Physics
Charlottesville, VA 22901

"Polarization-control components and narrow-band filters based on subwavelength grating structures"

Song Peng

G. Michael Morris, Advisor

1996

IBM
Essex, VT

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Investigation of the third-order nonlinear optical response of composite materials" Russell Jeffrey Gehr Robert W. Boyd, Advisor	1997	Sandia National Laboratory Lasers, Optics & Remote Sensing Department Albuquerque, NM 87185 (505) 844-0854
"Ultrafast spatiotemporal coupling in nonlinear dispersive media" Andrew T. Ryan Govind P. Agrawal, Advisor	1997	Decan Research 2440 Embarcadero Street Palo Alto, CA 94303 (415) 493-6100
"Resonant grating structures: theory, design, and applications" Scott Norton G. Michael Morris, Advisor	1997	Seagate, Inc. California
"Angularly localized wave packets in one- and two-electron atoms" James West Carlos R. Stroud, Jr., Advisor	1997	Corning, Inc. Corning, NY
"On the resolution enhancement of optical beams with extreme focal depth" Ronald L. Gordon Gregory Forbes, Advisor	1997	Finle Technologies Austin, TX 78746 512-327-3781

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Phase-only superresolution elements" Tasso R. Sales G. Michael Morris, Advisor	1997	Rochester Photonics Corporation 330 Clay Road Rochester, NY 14623 716-272-3010
"Static, dynamic, and noise characteristics of vertical-cavity surface-emitting lasers" Joanne Y. Law Govind A. Agrawal, Advisor	1997	Therma-Wave, Inc. 1250 Reliance Way Fremont, CA
"Classical limit state of an atom" Michael Van Leeuwen Carlos R. Stroud, Jr., Advisor	1998	University of Maryland Bethesda, MD

LISTING OF PH.D. FELLOWS (CONTINUED)

TITLE / FELLOW / ADVISOR	YEAR	CURRENT ADDRESS
"Concentric-circle-grating lasers" Pamela Greene Dennis G. Hall, Advisor	(1999)	University of Rochester The Institute of Optics Rochester, NY 14627
"Automatic pattern recognition using an all digital ring-wedge detector" David M. Berfanger Nicholas George, Advisor	(1999)	University of Rochester The Institute of Optics Rochester, NY 14627
Diffraction optics for imaging spectrometers" David J. Fischer Duncan T. Moore, Advisor	(1999)	University of Rochester The Institute of Optics Rochester, NY 14627
"Terahertz pulses" Jake Bromage Carlos R. Stroud, Advisor	(1999)	University of Rochester The Institute of Optics Rochester, NY 14627
"Optical gain in rare-earth doped glasses" Gina Jones Susan Houde-Walter, Advisor	(2001)	University of Rochester The Institute of Optics Rochester, NY 14627
"Quantum computing" Ashok Muthukrishnan Carlos R. Stroud, Advisor	(2001)	University of Rochester Institute of Optics Rochester, NY 14627