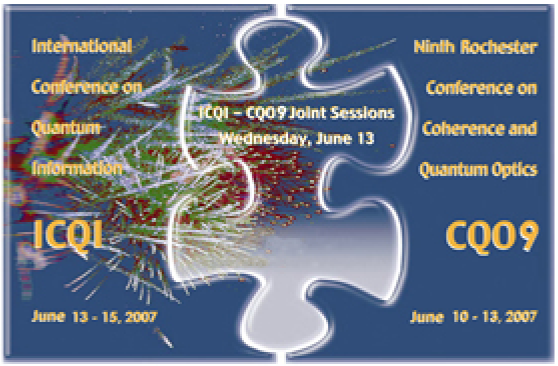
The Ninth Rochester Conference on Coherence and Quantum Optics (CQO9)

Collocated with
The International Conference on Quantum Information (ICQI)



June 10–13, 2007
University of Rochester Campus
Rochester, New York, USA

Housing Reservations (Deadline: May 24, 2007)
Pre-Registration (Deadline: May 17, 2007)

The Ninth Rochester Conference on Coherence and Quantum Optics (CQO9) is the latest in a historic series of conferences that began in 1960. The conferences have been held on the campus of the University of Rochester every six years. They provide a perspective on the developments in the field for the past few years and highlight the latest developments in a series of tutorials, historical reviews, invited papers and poster sessions. The tutorials and historical reviews, along with the university setting with reasonably priced dormitory housing and food, make this conference especially attractive for students and young researchers.

Ninth Rochester Conference on Coherence and Quantum Optics (CQO9)

Organizing Committee

Girish Agarwal, *Oklahoma State Univ., USA*
Nicholas Bigelow, *Univ. of Rochester, USA*
Joseph H. Eberly, *Univ. of Rochester, USA*
Serge Haroche, *Ecole Normale Supérieure, France*
H. Jeffrey Kimble, *California Inst. of Technology, USA*
Sir Peter Knight, *Imperial College, UK*
Mikhail Lukin, *Harvard Univ., USA*
Pierre Meystre, *Univ. of Arizona, USA*
Kazimierz Rzazewski, *Polish Academy of Sciences, Poland*
Stig Stenholm, *Royal Swedish Technical Univ., Sweden*
Carlos R. Stroud, Jr., *Univ. of Rochester, USA*
Han Woerdman, *Univ. Leiden, Netherlands*

Joint Secretaries

Nicholas Bigelow, *Univ. of Rochester, USA*
Joseph H. Eberly, *Univ. of Rochester, USA*
Carlos R. Stroud, Jr., *Univ. of Rochester, USA*

International Conference on Quantum Information (ICQI)

Organizing Committee

Robert W. Boyd, *Univ. of Rochester, USA,* ***Co-Chair***
Bahaa Saleh, *Boston Univ., USA,* ***Co-Chair***

Charles H. Bennett, *IBM T. J. Watson Res. Ctr., USA*
James Franson, *Univ. of Maryland, Baltimore County, USA*
Barry C. Sanders, *Univ. of Calgary, Canada*
Ian Walmsley, *Univ. of Oxford, UK*
Harald Weinfurter, *Technische Univ. München, Germany*
Andrew G. White, *Univ. of Queensland, Australia*

Topics to Be Considered

Topics of interest will include all aspects of experimental and theoretical coherence and quantum optics.

There will be a special extended symposium on Singular Optics and Quantum Optics in Mesoscopic Solids.

Other topics include the following:

- Entanglement dynamics
- Bose and Fermi coherences
- Cavity QED in atomic and condensed matter contexts
- Quantum non-demolition and quantum control processes
- Vortex and singular linear optics and nonlinear optics
- Collective coherence effects
- EPR and Schrödinger Cat scenarios in the laboratory
- Photon orbital angular momentum
- New tests of quantum mechanics
- Measures of multi-partite entanglement
- Creation of high-order entanglement
- Transverse effects and Schmidt modes
- Cluster states, multi-partite decoherence and entanglement

CQO9 Invited Speakers

Janos Bergou, *Hunter College, USA*
Sir Michael Berry, *Bristol Univ., UK*
Immanuel Bloch, *Univ. Mainz, Germany*
Michel Brune, *ENS Paris, France*
Howard Carmichael, *Univ. Auckland, New Zealand*
Jean Dalibard, *ENS Paris, France* (presented by Peter Kruger)
Luiz Davidovich, *Univ. Federal do Rio de Janeiro, Brazil*
Peter Drummond, *Univ.Queensland, Australia*
James Franson, *Univ. of Maryland, Baltimore Co., USA*
Akira Furusawa, *Univ. of Tokyo, Japan*
Alex Gaeta, *Cornell Univ., USA*
Hyatt Gibbs, *Univ. of Arizona, USA*
James P. Gordon, *Retired*
Lois Gresh, *Univ. of Rochester, USA*
Steven Harris, *Stanford Univ., USA*
Serge Haroche, *Ecole Normal Paris, France*
Randy Hulet, *Rice Univ., USA*
Robert Jones, *Univ. of Virginia, USA*
Henry Kapteyn, *Univ. of Colorado, USA*
Prem Kumar, *Northwestern Univ., USA*
Gershon Kurizki, *Weizmann Inst., Israel*
Alex Kuzmich, *Georgia Tech, USA*
Ulf Leonhardt, *Univ. of St. Andrews, UK*
Paul Lett, *NIST, USA*
Maciej Lewenstein, *ICFO, Spain*
Margaret Murnane, *Univ. of Colorado, USA*
Miles Padgett, *Univ. of Glasgow, UK*
Sir John Pendry, *Imperial College, UK*
Michael Raymer, *Univ. of Oregon, USA*
Monika Ritsch-Marte, *Innsbruck Medical Univ., Austria*
Wolfgang Schleich, *Univ. Ulm, Germany*
R. J. Schoelkopf, *Yale Univ., USA*
Keith Schwab, *Cornell Univ., USA*
Marlan O. Scully, *Texas A&M Univ., USA*
Marat Soskin, *Natl. Acad. of Sciences, Ukraine*
Juan P. Torres, *ICFO, Spain*
Kerry Valhala, *Caltech, USA*
Taco Visser, *Vrei Univ., Netherlands*
Werner Vogel, *Univ. Rostock, Germany*
Ian Walmsley, *Oxford Univ., UK*
Franco Wong, *MIT, USA*
Anton Zeillinger, *Univ. Vienna, Austria*
Peter Zoller, *Univ. Innsbruck, Austria*

CQO9 Special Events

There will be a variety of tutorials and reviews, and in addition a session of historical overviews that will include:

- Serge Haroche describing the history of cavity QED
- Marlan O. Scully describing the history of laser theory
- James P. Gordon describing the history of quantum optics at Bell Labs.

There will be three extended symposia:

- Singular Optics
- Quantum Optics in Mesoscopic Solids
- Quantum Entanglement

On the lighter side, the banquet will include a lecture by bestselling author Lois Gresh on The Superphysics of Superheroes.

Agenda of Sessions

Sunday, June 10, 2007		
7:00 p.m.–10:30 p.m.	CSuA • CQO9 Poster Session I and IOP Reception	Wilson Commons
Monday, June 11, 2007		
8:15 a.m.–8:30 a.m.	CMA • CQO9 Introduction	Hubbell Auditorium
8:30 a.m.–10:00 a.m.	CMB • CQO9 Plenary Session I	Hubbell Auditorium
10:00 a.m.–10:30 a.m.	Coffee Break	
10:30 a.m.–12:00 p.m.	CMC • CQO9 Oral Session I	Landers Auditorium
10:30 a.m.–12:00 p.m.	CMD • CQO9 Oral Session II	Sloan Auditorium
12:00 p.m.–1:30 p.m.	Lunch Break	
1:30 p.m.–3:30 p.m.	CME • CQO9 Oral Session III	Landers Auditorium
1:30 p.m.–3:30 p.m.	CMF • CQO9 Oral Session IV	Sloan Auditorium
3:30 p.m.–4:00 p.m.	Coffee Break	
4:00 p.m.–5:30 p.m.	CMG • CQO9 Oral Session V	Landers Auditorium
4:00 p.m.–5:30 p.m.	CMH • CQO9 Oral Session VI	Sloan Auditorium
7:30 p.m.–10:30 p.m.	CMI • CQO9 Poster Session II and JMO Reception	Wilson Commons
Tuesday, June 12, 2007		
8:30 a.m.–10:00 a.m.	CTuA • CQO9 Plenary Session II	Hubbell Auditorium
10:00 a.m.–10:30 a.m.	Coffee Break	
10:30 a.m.–12:00 p.m.	CTuB • CQO9 Oral Session VII	Landers Auditorium
10:30 a.m.–12:00 p.m.	CTuC • CQO9 Oral Session VIII	Sloan Auditorium
12:00 p.m.–1:30 p.m.	Lunch Break	
1:30 p.m.–3:30 p.m.	CTuD • CQO9 Oral Session IX	Landers Auditorium
1:30 p.m.–3:00 p.m.	CTuE • CQO9 Oral Session X	Sloan Auditorium
3:30 p.m.–4:00 p.m.	Coffee Break	
4:00 p.m.–6:15 p.m.	CTuF • CQO9 Plenary Session III	Hubbell Auditorium
7:00 p.m.–10:00 p.m.	Banquet with speaker Lois Gresh	Douglass Dining Center
Wednesday, June 13, 2007		
8:15 a.m.–8:30 a.m.	IWA • ICQI Introduction	Hubbell Auditorium
8:30 a.m.–10:00 a.m.	JWA • Joint CQO9/ICQI Plenary Session I	Hubbell Auditorium
10:00 a.m.–10:30 a.m.	Coffee Break	
10:30 a.m.–12:00 p.m.	CWA • CQO9 Oral Session XI	Sloan Auditorium
10:30 a.m.–12:00 p.m.	IWB • ICQI Oral Session I	Landers Auditorium
12:00 p.m.–1:30 p.m.	Lunch Break	
1:30 p.m.–2:15 p.m.	JWB • Joint CQO9/ICQI Plenary Session II	Hubbell Auditorium
2:30 p.m.–4:30 p.m.	CWB • CQO9 Oral Session XII	Sloan Auditorium
2:30 p.m.–4:30 p.m.	IWC • ICQI Oral Session II	Landers Auditorium
4:30 p.m.–6:30 p.m.	JWC • Joint CQO9/ICQI Poster Session and APS Reception	Wilson Commons
Thursday, June 14, 2007		
8:30 a.m.–10:00 a.m.	IThA • ICQI Plenary Session I	Hubbell Auditorium
10:00 a.m.–10:30 a.m.	Coffee Break	
10:30 a.m.–12:00 p.m.	IThB • ICQI Oral Session III	Hubbell Auditorium
10:30 a.m.–12:00 p.m.	IThC • ICQI Oral Session IV	Landers Auditorium
12:00 p.m.–1:30 p.m.	Lunch Break	
1:30 p.m.–2:30 p.m.	IThD • ICQI Plenary Session II	Hubbell Auditorium
2:45 p.m.–3:30 p.m.	IThE • ICQI Oral Session V	Hubbell Auditorium
2:30 p.m.–3:15 p.m.	IThF • ICQI Oral Session VI	Landers Auditorium
3:30 p.m.–4:00 p.m.	Coffee Break	
4:00 p.m.–6:30 p.m.	IThG • ICQI Oral Session VII	Hubbell Auditorium
4:00 p.m.–6:30 p.m.	IThH • ICQI Oral Session VIII	Landers Auditorium
7:00 p.m.–10:00 p.m.	Banquet	Douglass Dining Center

Friday, June 15, 2007		
8:30 a.m.–10:00 a.m.	IFA • ICQI Plenary Session III	Hubbell Auditorium
10:00 a.m.–10:30 a.m.	Coffee Break	
10:30 a.m.–12:00 p.m.	IFB • ICQI Oral Session IX	Hubbell Auditorium
10:30 a.m.–12:00 p.m.	IFC • ICQI Oral Session X	Landers Auditorium
12:00 p.m.–1:30 p.m.	Lunch Break	
1:30 p.m.–2:30 p.m.	IFD • ICQI Plenary Session IV	Hubbell Auditorium
2:30 p.m.–3:30 p.m.	IFE • ICQI Oral Session XI	Hubbell Auditorium
2:30 p.m.–3:30 p.m.	IFF • ICQI Oral Session XII	Landers Auditorium
3:30 p.m.–4:00 p.m.	Coffee Break	
4:00 p.m.–6:00 p.m.	IFG • ICQI Oral Session XIII	Hubbell Auditorium
4:00 p.m.–6:00 p.m.	IFH • ICQI Oral Session XIV	Landers Auditorium

NOTES

Abstracts

● Sunday, June 10, 2007 ●

CSuA • CQO9 Poster Session I and IOP Reception

Wilson Commons
7:00 p.m.–10:30 p.m.
CSuA • CQO9 Poster Session I and IOP Reception

CSuA1 • 7:00 p.m.
Photon Number-Resolved Detectors, *Aleksandr Verevkin, Matt Bell, Andrei Antipov; Univ. at Buffalo, USA.* Quantum informations and imaging would require Photon Number-Resolved (PNR) detectors. We demonstrate how the visible-to-near IR Silicon-based and near-to-mid IR superconducting-based PNR detectors can be build.

CSuA2 • 7:00 p.m.
Transverse Structures in Spontaneous Parametric Down-Conversion with Orbital Angular Momentum, *Geraldo A. Barbosa, Prem Kumar; Northwestern Univ., USA.* Coincidence structures carrying orbital angular momentum in Type-II spontaneous-parametric-down-conversion are obtained theoretically. Azimuthal symmetry breaking around the pump beam direction is reflected on these structures.

CSuA3 • 7:00 p.m.
Spinor Condensates at Finite Temperatures, *Kazimierz M. Rzazewski[1], Mariusz Gajda[2], Miroslaw Brewczyk[3]; [1]Ctr. for Theoretical Physics, Poland, [2]Inst. of Physics, Poland, [3]Univ. of Bialystok, Poland.* We consider a spinor condensate of ^{87}Rb atoms in its F = 1 hyperfine state at finite temperatures. Spin textures, breaking of chiral symmetry and coherence is than studied.

CSuA4 • 7:00 p.m.
Quantum Optics in the Undergraduate Teaching Laboratory, *Mark Beck[1], Enrique Galvez[2]; [1]Whitman College, USA, [2]Colgate Univ., USA.* We describe several experiments which use individual photons and entangled photon pairs to explore fundamental aspects of quantum mechanics in an undergraduate teaching laboratory. These experiments include single photon interference and tests of local realism.

CSuA5 • 7:00 p.m.
Study of Stochastic Resonance in a Three-Level Atomic Optical Bistability System, *Amitabh Joshi, Haibin Wu, Min Xiao; Univ. of Arkansas, USA.* Stochastic-resonance is experimentally demonstrated in optical bistability from an optical ring cavity containing three-level (L-type) rubidium atoms. The results obtained match well qualitatively with the theoretical predictions of the generic model for the SR phenomenon.

CSuA6 • 7:00 p.m.
Transverse Properties of Entangled Two-Photon States Generated in Nonlinear Photonic-Band-Gap Structures, *Jan Peřina[1], Marco Centini[2], Concita Sibilia[2], Mario Bertolotti[2], Michael Scalora[3]; [1]Joint Lab of Optics of Palacky Univ. and Inst. of Physics of Acad. of Sciences of the Czech Republic, Czech Republic, [2]Univ. la Sapienza, Italy, [3]Charles M. Bowden Res. Ctr., USA.* Transverse characteristics (intensity profiles, correlation area) of the spontaneously generated down-converted fields have been studied for structures composed of up to several tens of thin GaN/AlN layers using a vectorial quantum model.

CSuA7 • 7:00 p.m.
Role of Raman Scattering on Correlated Photon Pairs Generated through Four-Wave Mixing, *Qiang Lin[1], Govind Agrawal[2]; [1]Caltech, USA, [2]Univ. of Rochester, USA.* We discuss photon-pair correlation under the combined effects of four-wave mixing and Raman scattering inside optical fibers and silicon waveguides. Our theory is vectorial in nature and includes all polarization effects.

CSuA8 • 7:00 p.m.
Modulation of the Spatial Coherence of Light by Surface Plasmons, *Greg Gbur[1], Choon How Gan[1], Taco D. Visser[2]; [1]Univ. of North Carolina at Charlotte, USA, [2]Free Univ., Netherlands.* It is demonstrated that the spatial coherence of light transmitted through a Young's double slit interferometer can be significantly increased or decreased by the action of surface plasmons propagating between the apertures.

CSuA9 • 7:00 p.m.
Two-Photon Spatial Coherences in Strongly Driven Multiparticle Structures, *Mihai Macovei, Joerg Evers, Christoph H. Keitel; Max-Planck Inst. for Nuclear Physics, Germany.* The quantum properties of the electromagnetic field scattered by a regular structure of strongly driven two-state particles are investigated. The scattered light separates into distinct spectral bands exhibiting interesting two-photon interference effects.

CSuA10 • 7:00 p.m.
Sub-to-Super-Luminal Group Velocity in Atomic Medium with Squeezed Baths, *K. I. Osman[1], S. S. Hassan[2], Amitabh Joshi[3]; [1]Dept. of Mathematics, Al-Azhar Univ., Egypt, [2]College of Science, Univ. of Bahrain, Bahrain, [3]Univ. of Arkansas, USA.* Two conditions are formulated that shows a Lambda-type three-level atomic system in squeezed baths along with quantum interference between decay channels becomes dispersionless or absorptionless. Relative phase of external fields controls the group velocity.

CSuA11 • 7:00 p.m.
Prospects of Creating Qubit with Ultracold RbCs Molecules in Lowest Quantum States, *He Wang, G. Iyanu; Aerospace Corp., USA.* We report observation of ultracold ground-state RbCs molecules in a dual MOT and present a photoassociation and optical pumping scheme for efficient generation of ultracold ground-state RbCs in lowest rovibrational states for creation of qubits.

CSuA12 • 7:00 p.m.
Polarization Entanglement Converted from Spatially Correlated Photon Pairs, *Ryosuke Shimizu[1], Takashi Yamaguchi[2], Yasuyoshi Mitsumori[1,2], Hideo Kosaka[1,2], Keiichi Edamatsu[1,2]; [1]Japan Science and Technology Agency, Japan, [2]Tohoku Univ., Japan.* We propose and demonstrate a novel scheme for the generation of polarization entanglement from spatially correlated photon pairs generated by parametric down-conversion. Using the state, we also demonstrate the violation of Bell's inequality.

CSuA13 • 7:00 p.m.
Cancellation of the Collisional Frequency Shift in Caesium Fountain Clocks, *Krzysztof Szymaniec[1], Witold Chalupczak[1], Eite Tiesinga[2], Carl J. Williams[2], Stefan Weyers[3], Robert Wynands[3]; [1]Natl. Physical Lab, UK, [2]Joint Quantum Inst. and Atomic Physic Div., Natl. Inst. of Standards and Technology, USA, [3]Physikalisch-Technische Bundesanstalt, Germany.* We have observed the cancellation of the collisional frequency shift in primary caesium fountain clocks. We present systematic experimental study of the effect and a theoretical model explaining our observations.

CSuA14 • 7:00 p.m.
Correlation Functions and Multipartite Entanglement in Cavity QED, *Perry Rice[1], James P. Clemens[1], Luis Orozco[2], Rebecca Olson[2], David Norris[2], Jietai Jing[2]; [1]Miami Univ., USA, [2]Univ. of Maryland, USA.* Entanglement between an atom and a field mode can be characterized by correlations between transmitted and fluorescent light. Here we examine multipartite entanglement using a multi-level atom, and two orthogonal polarization modes of the cavity.

CSuA15 • 7:00 p.m.
Mode Counting in High-Dimensional Orbital Angular Momentum Entanglement, *Martin P. van Exter, Wouter H. Peeters, Han P. Woerdman; Leiden Univ., Netherlands.* We demonstrate experimentally how the orbital-angular-momentum entanglement within a photon pair can be fully characterized with a two-photon interferometer that contains an image rotator. The Schmidt number of the entanglement can be tuned from 1-8.

CSuA16 • 7:00 p.m.
Low-Cost Coincidence-Counting Electronics for Quantum Optics, *Sagar Bhandari[1], David Branning[1], Mark Beck[2]; [1]Trinity College, USA, [2]Whitman College, USA.* We have built and tested a multi-order coincidence-counting circuit that has higher count rates and lower cost than widely-used time-to-amplitude-converters. This is attractive for experimenters, especially in places where cost is a serious issue.

CSuA17 • 7:00 p.m.
Cavity QED with Ultracold Gases: Probing and Manipulating Quantum States of Atoms in Optical Lattices by Light Scattering, *Igor B. Mekhov[1,2], Christoph Maschler[1], Helmut Ritsch[1]; [1]Inst. for Theoretical Physics, Univ. of Innsbruck, Austria, [2]V. A. Fock Inst. of Physics, St. Petersburg State Univ., Russian Federation.* Quantum phases of atoms in optical lattices can be distinguished by light scattering. Atom number distribution functions can be mapped on transmission spectra of a high-Q cavity, allowing QND measurements of atomic variables observing light.

CSuA18 • 7:00 p.m.
Conditioned Homodyne Measurements and Entanglement for a Two-Level Atom in an OPO, *Perry Rice, Jeffrey Hyde; Miami Univ., USA.* We consider entanglement between a two-level atom and a cavity mode inside an OPO, and find that a measure of entanglement is a homodyne measurement of the field conditioned on detection of a fluorescent photon.

CSuA19 • 7:00 p.m.
Ultralow Threshold Behavior of a Quantum-Dot Whispering-Gallery Microlaser, *Siyka I. Shopova, Albert T. Rosenberger; Oklahoma State Univ., USA.* The behavior of a laser consisting of HgTe quantum dots on a silica microsphere's surface is compared to a thresholdless laser model. We find that approximately 25% of the spontaneous emission couples into lasing modes.

CSuA20 • 7:00 p.m.
Cascade Atom in High-Q Cavity: The Spectrum for Non-Markovian Decay, *Bryan J. Dalton[1], Barry M. Garraway[2]; [1]Swinburne Univ. of Technology, Australia, [2]Univ. of Sussex, UK.* Spontaneous emission spectra for an excited three level cascade atom in an empty damped high-Q cavity are determined from the atom-cavity mode zero temperature master equation and the quantum regression theorem. Interference effects are shown.

CSuA21 • 7:00 p.m.
Slowing and Cooling Atoms in a Bistable Optical Cavity, *Ilya Sh. Averbukh, Mark Y. Vilensky, Yehiam Prior; Dept. of Chemical Physics, Weizmann Inst. of Science, Israel.* We propose a generic approach for nonresonant laser cooling of atoms/molecules based on their interaction with a bistable optical cavity. The cooling mechanism is of Sisyphus type due to hysteretic character of the cavity field.

CSuA22 • 7:00 p.m.
Light Transmittance of Nematic Liquid Crystal Cells: Singularities in Polarization Resolved Angular Patterns, *Alexei D. Kiselev, Marat S. Soskin, Igor A. Buinyi, Roman G. Vovk; Inst. of Physics of Natl. Acad. of Science of Ukraine, Ukraine.* The polarization of light transmitted through a nematic liquid crystal cell is studied in relation to the incidence angles. The polarization resolved angular patterns are measured experimentally and interpreted theoretically.

CSuA23 • Paper withdrawn.

CSuA24 • 7:00 p.m.
Cross Polarization of Maxwell-Gaussian Laser Beams with Orbital and Spin Angular Momentum, *Reeta Vyas, Surendra Singh; Univ. of Arkansas, USA.* Effects of orbital and spin angular momentum of light beam on cross polarization and focusing properties of Maxwell-Gaussian beams are studied in terms of the solutions of paraxial wave equation.

CSuA25 • 7:00 p.m.
Effect of Probe-Conjugate Delay on the Spectrum of Squeezed Light, *Alberto M. Marino, Vincent Boyer, Colin F. McCormick, Paul D. Lett; NIST, USA.* We use a four-wave mixing process to generate relative-intensity squeezing. We are able to significantly modify the squeezing spectrum by controlling the relative delay between the probe and conjugate beams.

CSuA26 • 7:00 p.m.
Global Coherence and Its Variation on Propagation in Coherent Mode Representation, *Kisik Kim, Dae-Yoon Park; Inha Univ., Republic of Korea.* We analyzed the variation of global coherence of the field with the entropic measure in the framework of coherent mode representation and discovered the circumstance under which global coherence is enhanced as the field propagates.

CSuA27 • 7:00 p.m.
Tunable Control of the Bandwidth and Frequency Correlations of Entangled Photons, *Martin Hendrych, Juan P. Torres; ICFO-Inst. of Photonic Sciences, Spain.* We demonstrate experimentally a new technique to control the bandwidth and the type of frequency correlations of entangled photons. The method is based on the tunable control of the dispersive properties of all interacting waves.

CSuA28 • 7:00 p.m.
Electromagnetic Coherence and Pancharatnam–Berry Phase in Young's Interference Experiment, *Ari T. Friberg[1], Jani Tervo[2], Tero Setälä[3]; [1]Royal Inst. of Technology, Sweden, [2]Univ. of Joensuu, Finland, [3]Helsinki Univ. of Technology, Finland.* The spectral interference law is used to derive the electromagnetic degree of coherence and the Pancharatnam–Berry phase in Young's two-pinhole setup. The phase has a straightforward connection to the Stokes parameters at the openings.

CSuA29 • 7:00 p.m.
Observation of EIT in Rubidium Vapor Using the Hanle Effect, *Iris Zhang, Sam G. Bish, Benjamin Agyare, Samir Bali; Miami Univ., USA.* We have observed Electromagnetically Induced Transparency (EIT) in Rubidium vapor using a single linearly polarized incident laser beam and an external magnetic field. Progress toward a detailed understanding of the observed subnatural resonances is reported.

CSuA30 • 7:00 p.m.
Selective Alignment of Molecular Spin Isomers, *Sharly Fleischer, Ilya Sh. Averbukh, Yehiam Prior; Dept. of Chemical Physics, Weizmann Inst. of Science, Israel.* Double pulse excitation of fractional revivals of rotational wavepackets is demonstrated as an effective tool for spin-selective alignment in a multi-component mixture of molecular spin isomers.

CSuA31 • 7:00 p.m.
The Structure of Twisted Cavity Modes, *Gerard Nienhuis, Steven J. M. Habraken; Univ. Leiden, Netherlands.* We present an algebraic method that allows for obtaining explicit expressions of the modes of a twisted optical cavity. We apply it to study the orbital angular momentum that is associated with the twist.

CSuA32 • 7:00 p.m.
Adjunct Spectral Entanglement in Entanglement Swapping and Type-I Fusion, *Travis S. Humble, Warren P. Grice; Oak Ridge Natl. Lab, USA.* We show how adjunct spectral entanglement affects polarization-based entanglement swapping and type-I fusion gates and we explain why the concurrences of the subsequently entangled states are distinctively dependent on the initial joint spectral amplitudes.

CSuA33 • 7:00 p.m.
Experimental Observation of Spontaneous Two-Photon Emission from Semiconductors, *Alex Hayat, Meir Orenstein; Dept. of Electrical Engineering, Technion, Israel.* We report experimental observations of spontaneous two-photon emission from semiconductors. The wide-band two-photon emission intensity was 4 orders of magnitude lower than the fundamental emission and blue-shifted due to significant k-dependence of the matrix element.

CSuA34 • 7:00 p.m.
Observation of Two-Photon Stimulated Emission and Three-Photon Interference, *Fang-Wen Sun[1], Bi-Heng Liu[1], Y. X. Gong[1], Yun-Feng Huang[1], Guang-Can Guo[1], Zhe-Yu J. Ou[1,2]; [1]Univ. of Science and Technology of China, China, [2]Indiana Univ.-Purdue Univ. Indianapolis, USA.* By injecting a weak coherent state into a parametric amplifier and making the appropriate projection measurement, we observe the stimulated emission of two photons. This phenomenon can be interpreted as a three-photon interference effect.

CSuA35 • 7:00 p.m.
Spin Squeezing and Entanglement, *Bariş Öztop, Alexander Klyachko, Alexander S. Shumovsky; Bilkent Univ., Turkey.* We reformulate definition of spin squeezing and spin coherence in terms of the total variance in spin operators. We propose a new measure of spin squeezing. We show equivalence of spin squeezing and spin entanglement.

CSuA36 • 7:00 p.m.
Optical Interferometry with Pulsed Fields, *Robert W. Schoonover[1], Brynmor J. Davis[1], Randy A. Bartels[2], P. Scott Carney[1]; [1]Univ. of Illinois Urbana Champaign, USA, [2]Dept. of Physics and JILA, Univ. of Colorado and NIST, USA.* An analysis of coherence properties of pulsed fields in interferometric experiments is presented. The results bear on means to recover certain statistical properties of the source in a two-slit experiment.

CSuA37 • 7:00 p.m.
All-Optical Switching at Ultra-Low Light Levels, *Jiepeng Zhang, Gessler Hernandez, Yifu Zhu; Florida Intl. Univ., USA.* We report an experimental demonstration of all-optical switching with signal and control light pulses containing about 20 photons each, corresponding to a control energy density of ~10^{-5} photons per atomic cross section.

CSuA38 • 7:00 p.m.
Correlation Between Intensity Fluctuations in a Stochastic Electromagnetic Beam and the Degree of Cross-Polarization, *Daniel F. V. James[1], Tomohiro Shirai[2], S. N. Volkov[3], Emil Wolf[3,4]; [1]Univ. of Toronto, Canada, [2]Natl. Inst. of Advanced Industrial Science and Technology (AIST), Japan, [3]Univ. of Rochester, USA, [4]College of Optics and Photonics, CREOL, Univ. of Central Florida, USA.* It is shown that the knowledge of the degree of coherence and polarization is not adequate to determine correlations measured in the Hanbury Brown-Twiss experiment. A new statistical parameter, which we introduce, is also needed.

CSuA39 • 7:00 p.m.
Dispersion-Cancellation in a Classical Interferometer, *Kevin J. Resch[1], Prabak Puvanathasan[2], Jeff S. Lundeen[3], Morgan W. Mitchell[4], Kostadinka Bizheva[2]; [1]Inst. for Quantum Computing, Univ. of Waterloo, Canada, [2]Dept. of Physics, Univ. of Waterloo, Canada, [3]Clarendon Lab, Univ. of Oxford, UK, [4]Inst. de Ciences Fotoniques, Spain.* Even-order dispersion cancellation — an effect previously identified with entanglement — is demonstrated using a spectrally-resolved white-light Mach-Zehnder interferometer. This simplifies an important interferometric measurement technique and clarifies the role of entanglement in quantum metrology.

CSuA40 • 7:00 p.m.
Phase Vortices from the Interference of Three Spherical Waves, *Gary Ruben, David M. Paganin; Monash Univ., Australia.* We study the phase vortices arising from the interference of three complex spherical waves. Expressions are developed for vortex positions in the far field, as a function of source arrangement.

CSuA41 • 7:00 p.m.
Scattering Matrix Theory for Stochastic Fields, *Olga Korotkova, Emil Wolf; Dept. of Physics and Astronomy, Univ. of Rochester, USA.* Scattering of scalar stochastic fields on deterministic and on random media is discussed by means of a new generalized scattering matrix. Discussion of effects of coherence on the scattered field is also considered.

CSuA42 • 7:00 p.m.
Superradiance Steering and Pinning in a Two-Dimensional Resonance Photonic Crystal, *Igor V. Mel'nikov[1,2], Joseph W. Haus[3], Anton N. Knigavko[2,4]; [1]Optolink Ltd., Russian Federation, [2]High Q Labs, Inc., Canada, [3]Univ. of Dayton, USA, [4]Brock Univ., Canada.* The phase synchronization across a 2-D resonance photonic crystal with lateral confinement of the radiation is predicted. This builds up a superradiance anisotropy and excitation transfer along the Bragg planes along with pronounced excitation localization.

CSuA43 • 7:00 p.m.
"Backwards" Pulse Propagation in Erbium Doped Fiber, *George M. Gehring, Aaron Schweinsberg, Heedeuk Shin, Robert W. Boyd; Inst. of Optics, Univ. of Rochester, USA.* We experimentally investigate and explain the "backwards propagation" effect that occurs in a negative group velocity medium, such as Er^{3+}-doped fiber. A novel method for distortion compensation in such a system is presented.

CSuA44 • 7:00 p.m.
Enhancing the Performance of Spectroscopic Interferometers Using Slow-Light Media, *Zhimin Shi, Robert W. Boyd; Inst. of Optics, Univ. of Rochester, USA.* We show both theoretically and experimentally that by introducing a slow-light medium into an interferometer, its spectral sensitivity/resolution can be enhanced by a factor equal to the group index of the material.

CSuA45 • 7:00 p.m.
Integral Equations Approach to Wave Propagation in Left Handed Materials, *Jan Mostowski; Inst. of Physics, Polish Acad. of Sciences, Poland.* Wave propagation in left handed materials is studied with the help of integral equations. New interpretation of several results is given for contiuous media, coherence and localization of waves in random media is discussed.

CSuA46 • 7:00 p.m.
Propagation of Partially Coherent, Partially Polarized Fields via a Wigner Representation in Direction and Angular Momentum, *Miguel A. Alonso, Jonathan C. Petruccelli; Univ. of Rochester, USA.* Electromagnetic fields of any level of coherence, polarization, or directional spread are described exactly by Wigner-like representations in direction and angular momentum, leading to an efficient scheme for propagating coherence and polarization through optical systems.

CSuA47 • 7:00 p.m.
A Proposal for Generating and Detecting Two Excitations on a Coherent State, *Christopher C. Gerry[1], Demetrios Kalamidas[2], Adil Benmoussa[1]; [1]Lehman College, USA, [2]City College of New York, USA.* We present a proposal for the simultaneous generation of two-photon excitations on a coherent state using down-conversion with a coherent state (laser field) in the signal mode.

CSuA48 • 7:00 p.m.
Fully Tunable Photonic Structures in Homogeneous Absorbing Media, *Maurizio Artoni[1,2], G. C. La Rocca[3]; [1]European Lab for Nonlinear Spectroscopy, Italy, [2]Dept. of Chemistry and Physics of Materials, Univ. of Brescia, Italy, [3]Scuola Normale Superiore, Italy.* Resonant media supporting electromagnetically induced transparency may give rise to periodic patterns where a light probe is found to experience a fully developed photonic band-gap whose control could be accomplished with remarkable experimental simplicity.

CSuA49 • 7:00 p.m.
Control of Single-Photon Emission from a Two-Level Single-Molecule Source: A Quantum Trajectory Analysis, *Yongqiang Xue, William W. Kennerly; College of Nanoscale Science and Engineering, Univ. at Albany-SUNY, USA.* We demonstrate using quantum jump simulation that the pulse area provides a good indicator for predicting the probability of generating single-photon on demand from a two-level single-molecule source excited by laser pulses of different shape.

CSuA50 • 7:00 p.m.
Absolute Calibration of Photo-Detectors in the Analog Regime by Using Parametric Down-Conversion, *Giorgio Brida, Marco Genovese, Ivano Ruo-Berchera; Inst. Nazionale di Ricerca Metrologica (INRIM), Italy.* We study new techniques for absolute calibration of analog photo-detectors based on the highly correlated beams produced by parametric down-conversion.

CSuA51 • 7:00 p.m.
Qubit Entanglement in Coherent Field Environments, *Muhammed Yönaç; Dept. of Physics and Astronomy, Univ. of Rochester, USA.* We examine theoretically the entanglement between a pair of two-level atoms which are exposed to an exactly resonant coherent state. We report features like entanglement creation, entanglement sudden death (ESD) and periodic revival of entanglement.

• Monday, June 11, 2007 •

CMA • CQO9 Introduction

Hubbell Auditorium
8:15 a.m.–8:30 a.m.
CMA • CQO9 Introduction

CMB • CQO9 Plenary Session I

Hubbell Auditorium
8:30 a.m.–10:00 a.m.
CMB • CQO9 Plenary Session I
J. P. (Han) Woerdman; Univ. Leiden, Netherlands, Presider

CMB1 • 8:30 a.m. **•Plenary•**
Optical Vorticulture: Some Recent Insights, *Michael Berry; Bristol Univ., UK.* Energy spirals slowly around optical vortices, in orbits that get more circular closer to the singularity. Interferometers are threaded by vortices, whose number increases discontinuously by unity as the phase difference increases continuously by 2Pi.

CMB2 • 9:15 a.m. **•Plenary•**
Metamaterials and the Control of Electromagnetic Fields, *John Pendry; Imperial College London, UK.* A new class of materials, metamaterials, whose properties are engineered by controlling their nanostructure, open new vistas in optics and offer the possibility of lenses that can resolve details finer than the wavelength of light.

10:00 a.m.–10:30 a.m.
Coffee Break

CMC • CQO9 Oral Session I

Landers Auditorium
10:30 a.m.–12:00 p.m.
CMC • CQO9 Oral Session I
J. P. (Han) Woerdman; Univ. Leiden, Netherlands, Presider

CMC1 • 10:30 a.m. **•Invited•**
Title to Be Announced, *Robert J. Schoelkopf; Yale Univ., USA.* No abstract available.

CMC2 • 11:00 a.m. **•Invited•**
Singular Photons: Control and Use of the Quantum Orbital Angular Momentum of Light, *Juan P. Torres; ICFO-Inst. de Ciencies Fotoniques, Spain.* We show how to control the orbital angular momentum of entangled photons generated in parametric downconversion and electromagnetically induced transparency schemes. We discuss its use in different quantum optics and quantum information applications.

CMC3 • 11:30 a.m. **•Invited•**
A Cascade of Singularities in Young's Interference Experiment, *Taco D. Visser; Free Univ., Netherlands.* We describe how to produce correlation singularities in Young's double-slit experiment. By changing the coherence they evolve in a non-trivial way into phase singularities, which in turn can unfold into triplets of polarization singularities.

CMD • CQO9 Oral Session II

Sloan Auditorium
10:30 a.m.–12:00 p.m.
CMD • CQO9 Oral Session II
Wayne H. Knox; Inst. of Optics, Univ. of Rochester, USA, Presider

CMD1 • 10:30 a.m. **•Invited•**
Title to Be Announced, *Stephen E. Harris; Stanford Univ., USA.* No abstract available.

CMD2 • 11:00 a.m. **•Invited•**
Manipulating Attosecond Electrons for Coherent X-Ray Generation from Atoms and Molecules, *Margaret Murnane, Henry Kapteyn; Univ. of Colorado, USA.* We demonstrate phase matching in the soft-x-ray region using trains of counterpropagating light pulses, by manipulating electron dynamics on the fastest, attosecond, time-scales. We enhance the x-ray output by almost 1000.

CMD3 • 11:30 a.m. **•Invited•**
Quantum Control of Rydberg Wavepackets in One- and Two-Electron Atoms, *Robert Jones; Univ. of Virginia, USA.* The ability to characterize and manipulate Rydberg electron wavepackets is a key capability for exploiting their exaggerated properties to investigate a variety of problems, from time-dependent electron-electron correlation in atoms to quantum decoherence suppression.

12:00 p.m.–1:30 p.m.
Lunch Break

CME • CQO9 Oral Session III

Landers Auditorium
1:30 p.m.–3:30 p.m.
CME • CQO9 Oral Session III
Miguel A. Alonso; Inst. of Optics, Univ. of Rochester, USA, Presider

CME1 • 1:30 p.m. **•Invited•**
Title to Be Announced, *Miles Padgett[1], Jonathan Leach[1], Sonja Franke-Arnold[1], Les Allen[1], Amanda Wright[2], John Girkin[2], Stephen Barnett[2]; [1]Univ. of Glagow, UK, [2]Strathclyde Univ., UK.* In the 1970s Jones demonstrated the mechanical Faraday effect where a spinning window slightly rotates linearly polarized light. A treatment for Orbital Angular Momentum predicts the rotation of the image. What do experiments reveal?

CME2 • 2:00 p.m. **•Invited•**
Real-Time Topological "Life Story" of Optical Singularities in Developing Random Light Fields (Speckle Pattern), *Marat S. Soskin, Vasil I. Vasil'ev; Inst. of Physics NAS of Ukraine, Ukraine.* Real-time scenario of topological 'Life story' for optical singularities and diabolos in developing generic speckle pattern were measured first by the elaborated technique of time resolved digital Stokes polarimetry.

CME3 • 2:30 p.m. **•Invited•**
Singular Optics for Novel Biomedical Tools, *Alexander Jesacher, Christian Maurer, Severin Fürhapter, Stefan Bernet, Monika Ritsch-Marte; Innsbruck Medical Univ., Austria.* Phase vortices have various applications in biotechnology: As holographic optical tweezers they serve as cell sorters, as all-optical pumps for micro-fluidics, and as contrast enhancing phase filters in spiral phase contrast microscopy.

CME4 • 3:00 p.m. ●Invited●

How to Circumnavigate Singularities to Realize Optical Invisibility, *Ulf Leonhardt, Thomas Philbin; Univ. of St. Andrews, UK.* Cloaking devices for microwave radiation have been demonstrated using electromagnetic metamaterials. Here we discuss ideas for invisibility in the optical range of the spectrum.

CMF • CQO9 Oral Session IV

Sloan Auditorium
1:30 p.m.–3:30 p.m.
CMF • CQO9 Oral Session IV
Kazimierz M. Rzazewski; Polish Acad. of Sciences, Poland, Presider

CMF1 • 1:30 p.m. ●Invited●

Fermion Pairing with Unequal Spin Populations, *Randall G. Hulet, Guthrie B. Partridge, Wenhui Li, Y. A. Liao; Rice Univ., USA.* We have produced a two-component gas of ultracold, fermionic 6Li atoms with unequal spin populations. The real-space densities reveal superfluid/normal phase separation at very low temperatures, and a partially polarized paired phase at higher temperatures.

CMF2 • 2:00 p.m. ●Invited●

Quantum Communications for Wavelength Multiplexed Optical Networks, *Prem Kumar; Northwestern Univ., USA.* Progress on telecom-band in-fiber entanglement generation and long-distance transmission will be described. Using fiber-generated degenerate-frequency entangled photon-pairs we have implemented a quantum controlled-not gate for distributed quantum information processing.

CMF3 • 2:30 p.m. ●Invited●

Atom-Photon Interface and Single-Photon Server, *Gerhard Rempe; Max Planck Inst. for Quantum Optics, Germany.* For a long time, the investigation of light-matter interaction at the single-particle level was considered purely academic. Today, fundamentally new applications are on the horizon, in particular in the optical domain. New light forces have been discovered, enabling one to store atoms for such a long time that genuine quantum protocols can be realized with just one single atom. The first example concerns the realization of a source of single photons with realtime control of its performance. The bit stream of photons delivered by such a single-photon server is useful in quantum information science. A second experiment concerns the deterministic entanglement of a single atom with a flying photon. Subsequent mapping of the atomic state onto a second photon makes possible to produce entangled photons on demand. The experimental demonstration of such a novel scheme is an important step towards the production of highly entangled many-photon quantum states and scalable quantum networks of atom-cavity systems.

CMF4 • 3:00 p.m. ●Invited●

Discrimination of Quantum States with Selected Applications, *Janos A. Bergou; Hunter College, City Univ. of New York, USA.* State discrimination constitutes the read-out stage of quantum information processing. Optimized discrimination strategies often involve generalized measurements (POVMs). The talk will review recent progress in mixed state discrimination, optical implementation of POVMs and selected applications.

3:30 p.m.–4:00 p.m.
Coffee Break

CMG • CQO9 Oral Session V

Landers Auditorium
4:00 p.m.–5:30 p.m.
CMG • CQO9 Oral Session V
Govind Agrawal; Inst. of Optics, Univ. of Rochester, USA, Presider

CMG1 • 4:00 p.m. ●Invited●

The Influence of Young's Interference Experiment on the Development of Statistical Optics, *Emil Wolf[1,2]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]College of Optics and Photonics/CREOL, Univ. of Central Florida, USA.* Two hundred years ago, in 1807, Thomas Young described a two-pinhole interference experiment which, as is well known, has had a tremendous impact on physics. What is, however, not generally appreciated is that the experiment has also proved of basic importance for the development of statistical optics. In this talk we will trace the impact of the Young interference experiment on two main branches of statistical optics, namely on the theory of coherence and on the theory of polarization of light. We will then briefly outline recent researches which have led to the unification of these two disciplines.

CMG2 • 4:30 p.m. ●Invited●

Nonlinear Opto-Mechanics Using Radiation Pressure in High-Q Microcavities, *Kerry Vahala[1], Tobias Kippenberg[2], Tal Carmon[1], Mani Hossein Zadeh[1]; [1]Caltech, USA, [2]Max Planck Inst. für Quantenoptik, Germany.* Recent experiments that use radiation pressure in microcavities either to create micro-wave-rate mechanical oscillations, or to cool a mechanical degree of freedom to cryogenic temperatures are overviewed. The implication of these results for new science is discussed.

CMG3 • 5:00 p.m. ●Invited●

Title to Be Announced, *Alexander Gaeta; Cornell Univ., USA.* No abstract available.

CMH • CQO9 Oral Session VI

Sloan Auditorium
4:00 p.m.–5:30 p.m.
CMH • CQO9 Oral Session VI
H. Jeff Kimble; Caltech, USA, Presider

CMH1 • 4:00 p.m. ●Invited●

Observing Quantum Jumps of Light by Quantum-Non-Demolition Measurement, *Michel Brune[1], Sébastien Gleyzes[1], Stefan Kuhr[2], Christine Guerlin[1], Julien Brenu[1], Samuel Deléglise[1], Ulrich Busk Hoff[1], Jean-Michel Raimond[1], Serge Haroche[1,3]; [1]Lab Kastler Brossel, France, [2]Inst. für Physik, Johannes Gutenberg Univ., Germany, [3]Collège de France, France.* Microwave photons stored in a superconducting cavity are non-destructively observed with a stream of Rydberg atoms. Collapse of the field into photon number states as well as quantum jumps between number sates are observed.

CMH2 • 4:30 p.m. ●Invited●

Factorization of Numbers and Gauss Sums, *Wolfgang Schleich; Univ. of Ulm, Germany.* Gauss sums play an important role in number theory as well as quantum physics. We analyze quantum systems which implement Gauss sums and allow us to factor large integers. We review recent experiments.

CMH3 • 5:00 p.m. ●Invited●

Cavity QED with Quantum Dots in Photonic Crystals, *Jelena Vuckovic, Andrei Faraon, Dirk Englund, Ilya Fushman, Nick Stoltz, Pierre Petroff; Ginzton Lab, Stanford Univ., USA.* We have experimentally demonstrated cavity QED with single quantum dots in photonic crystal cavities, both in the strong and weak coupling regimes. Quantum dots on chip are selectively and reversibly tuned into the strong coupling.

5:30 p.m.–7:30 p.m.
Dinner Break

CMI • CQO9 Poster Session II and JMO Reception

Wilson Commons
7:30 p.m.–10:30 p.m.
CMI • CQO9 Poster Session II and JMO Reception

CMI1 • 7:30 p.m.

Space-Time Maps for Single Pulse Four Wave Mixing, *Yuri Paskover, Ilya Sh. Averbukh, Yehiam Prior; Dept. of Chemical Physics, Weizmann Inst. of Science, Israel.* We demonstrate single-pulse retrieval of coherent vibrational evolution of molecules by geometrical space-time mapping combined with non-linear signal imaging. The method is tested experimentally to yield spectrum of simple liquids.

CMI2 • 7:30 p.m.

Optical Analogues of Gaussian Wave Packets and Sub-Planck Structures, *Krzysztof Wodkiewicz[1], Ludmila Praxmeyer[2], Piotr Wasylczyk[3], Czeslaw Radzewicz[3]; [1]Inst. of Theoretical Physics, Poland, [2]Theoretical Physics Div., Bulgaria, [3]Inst. of Experimental Physics, Poland.* Gaussian wave packets and optical pulses can exhibit interference, quantum entanglement and quantum sub-Planck structures in phase space. FROG measurements of light pulses reveals sub-Planck structures in phase space.

CMI3 • 7:30 p.m.

Optical Ferris Wheel for Ultracold Atoms, *Sonja Franke-Arnold[1], Jonathan Leach[1], Miles J. Padgett[1], Vassilis E. Lembessis[2], Demos Ellinas[3], Amanda J. Wright[4], John M. Girkin[4], Patrik Öhberg[5], Aidan S. Arnold[4]; [1]Univ. of Glasgow, UK, [2]New York College, Greece, [3]Technical Univ. of Crete, Greece, [4]Univ. of Strathclyde, UK, [5]Heriot-Watt Univ., UK.* We experimentally demonstrate bright and dark rotatable optical ring lattices, with tunable barriers, using frequency-shifted Laguerre-Gauss superpositions. The lattice will be ideal for trapping condensates to study persistent currents and a ring Mott insulator.

CMI4 • Paper withdrawn.

CMI5 • 7:30 p.m.

Four-Wave Mixing in a Diamond Configuration: Experiments with Rubidium Vapor, *Richard Thomas Willis, Francisco Elohim Becerra, Luis A. Orozco, Steven L. Rolston; Joint Quantum Inst., Univ. of Maryland, College Park, USA.* We investigate experimentally and theoretically non-degenerate four-wave mixing in a diamond configuration ($5s_{1/2}$, $5p_{1/2}$, $5p_{3/2}$, and $6s_{1/2}$ levels of rubidium vapor). Observations of the output light versus laser detunings include Doppler-free and Autler-Townes features.

CMI6 • 7:30 p.m.

Strongly Correlated Photon Transport in One-Dimensional Systems, *Jung-Tsung Shen, Shanhui Fan; Stanford Univ., USA.* We show that two-photon transport is strongly correlated in one-dimensional waveguide coupled to a two-level system. Moreover, we show that the two-level system can induce effective attractive or repulsive interactions in space for photons.

CMI7 • 7:30 p.m.

Chaotic Dynamics of a Gain Modulated YAG Ring Laser, *Fuad Rawwagah[1], Surendra Singh[2]; [1]Yarmouk Univ., Jordan, [2]Univ. of Arkansas, USA.* Quasi-periodic, synchronized and unsynchronized chaotic oscillations of light intensity are observed in a gain modulated YAG ring laser. Experimentally measured values of maximum Lyapunov exponent are in reasonable agreement with the theoretical predictions.

CMI8 • 7:30 p.m.

Field-Induced Transparency in a Photonic Crystal, *Paul M. Alsing, Dave A. Cardimona, Dan H. Huang; AFRL, USA.* We investigate field-induced transparency in a three-level system near a photonic band edge in the Heisenberg picture, beyond the few photon limit, and generalize to a four-level system to include electromagnetically-induced transparency.

CMI9 • 7:30 p.m.

Relative Particle Nature and Nonclassicality of Light, *Sung-Guk Shin, Jaewoo Noh, Kisik Kim; Inha Univ., Republic of Korea.* Theory on the creation of exactly n photon added pure quantum state is presented and its nonclassical property is studied.

CMI10 • 7:30 p.m.

Realization of Weak Values Using Electromagnetically Induced Transparency and Anisotropies, *Shubhrangshu Dasgupta[1], G. S. Agarwal[2]; [1]Univ. of Toronto, Canada, [2]Oklahoma State Univ., USA.* We show how the quantum mechanical "weak values" can be realized using the ideas of slow light pulses. The measurements can also change light propagation from subluminal to superluminal.

CMI11 • Paper withdrawn.

CMI12 • 7:30 p.m.

High Order Harmonics from a Molecule: Evidence of the Nuclear Motion, *Giuseppe Castiglia, Pietro Paolo Corso, Emilio Fiordilino, Franco Persico; Dept. di Scienze Fisiche e Astronomiche, Univ. di Palermo, Italy.* The electromagnetic spectrum emitted by a molecule driven by a laser presents harmonics and satellite lines whose separation is equal to the oscillation frequency of the nuclei. Full quantum and semiclassical calculations are presented.

CMI13 • 7:30 p.m.

Validity of the Markov Approximation in Quantum Master Equations for Composite Systems, *Masatoshi Nakatani, Tetsuo Ogawa; Osaka Univ., Japan.* We show that the Markov approximation cannot be generally applied for composite systems interacting with thermal reservoir even if characteristic time of the system is much larger than reservoir correlation time.

CMI14 • 7:30 p.m.

Slow Higher-Order Optical Solitons in a Resonance Photonic Crystal, *Igor V. Mel'nikov[1,2], Anton N. Knigavko[2,3]; [1]Optolink Ltd, Russian Federation, [2]High Q Labs, Inc., Canada, [3]Brock Univ., Canada.*

We demonstrate previously unforeseen properties of stable propagation and trapping of a higher-order solitons of self-induced transparency which is mediated by an inversion inside the resonance photonic crystal.

CMI15 • 7:30 p.m.
Breakdown of the Few-Level Approximation in Collective Systems, *Jörg Evers, Martin Kiffner, Christoph H. Keitel; Max-Planck-Inst. für Kernphysik, Germany.* In contrast to single atoms, in collective systems, the vacuum couples transitions with orthogonal dipole moments. This leads to a geometry-dependent dynamics and to a breakdown of the few-level approximation in collective systems.

CMI16 • 7:30 p.m.
Measurement of Cross-Kerr Nonlinearity Induced by a Few Photons in a Photonic Crystal Fiber, *Nobuyuki Matsuda[1,2], Ryosuke Shimizu[2], Yasuyoshi Mitsumori[1,2], Hideo Kosaka[1,2], Keiichi Edamatsu[1,2]; [1]Res. Inst. of Electrical Communication, Tohoku Univ., Japan, [2]CREST, Japan Science and Technology Agency, Japan.* Utilization of weak cross-Kerr interaction will be a key to the photonic quantum information processing. We propose a novel technique to measure tiny cross-Kerr phase shifts and demonstrate it using a photonic crystal fiber.

CMI17 • 7:30 p.m.
Entanglement Measurement in a Cavity QED System, *Matthew L. Terraciano[1], Rebecca Olson Knell[1], David G. Norris[1], Jietai Jing[1], Luis A. Orozco[1], James P. Clemens[2], Perry R. Rice[2]; [1]Univ. of Maryland, College Park, USA, [2]Miami Univ., USA.* We measure an entanglement witness of a cavity QED system with the cross correlation of its orthogonal modes. The driven mode has information about the field, while the nondriven about the atom through spontaneous emission.

CMI18 • 7:30 p.m.
Phase Dynamics in Electro-Magnetically Induced Transparency, *Jon P. Davis, Frank A. Narducci; Naval Air Systems Command, USA.* We present results from our time dependent model on electro-magnetically induced transparency in a standard Λ configuration. We show that sudden phase jumps in either field leads to transient enhanced absorption for the probe field.

CMI19 • 7:30 p.m.
Violation of Bell Inequality with the Fractional Momentum of the Photon: A Step Towards a New Q-Bit, *Paulo H. Souto-Ribeiro[1], Daniel S. Tasca[1], Stephen P. Walborn[1], Marcelo P. de Almeida[1], Carlos H. Monken[2], Pierre Pellat-Finet[3]; [1]Federal Univ. of Rio de Janeiro, Brazil, [2]Federal Univ. of Minas Gerais, Brazil, [3]Groupe d'Optique Théorique et Appliquée, Univ. de Bretagne Sud,, France.* Bell inequality is violated with transverse spatial variables of twin photons, through optical implementation of Fractional Fourier Transforms. A q-bit can be constructed and manipulated in the same way, with promising applications to quantum information.

CMI20 • 7:30 p.m.
Harmonics Generation on Three-Level Atomic Systems at the Multiphoton Resonant Interaction with Laser Fields, *Hamlet Avetissian, Babken R. Avchyan, Garnik Mkrtchian; Yerevan State Univ., Armenia.* Coherent light scattering by a three-level atom due to multiphoton resonant excitation by laser radiation is studied towards the coherent shortwave radiation generation. The spectrum corresponding to harmonics generation is investigated both analytically and numerically.

CMI21 • 7:30 p.m.
Polarization of Light in Multimode Quantum States, *Nadja K. Bernardes[1], C. H. Monken[2]; [1]Univ. de São Paulo, Brazil, [2]Univ. Federal de Minas Gerais, Brazil.* We characterize the polarization of multimode two-photon states generated by parametric down-conversion. By means of the effective density matrix approach, we show that the single mode approximation for the polarization of these states is appropriate.

CMI22 • 7:30 p.m.
Creating Stable Atom-Molecule Oscillations, *Andrew Robertson[1], Lei Jiang[2], Han Pu[2], Weiping Zhang[3], Hong Ling[1]; [1]Rowan Univ., USA, [2]Rice Univ., USA, [3]East China Normal Univ., China.* Stable coherent oscillations between BCS paired atoms and ground molecules are shown possible in a BEC-BCS crossover model involving both magnetic coupling (Feshbach resonance) and optical coupling between the ground and excited molecular states.

CMI23 • 7:30 p.m.
Using Transverse Patterns for All-Optical Switching, *Andrew M. C. Dawes, Daniel J. Gauthier; Duke Univ., USA.* We observe that a transverse optical pattern changes orientation in the presence of an ultra-low-light-level beam. This switch displays transistor-like behavior.

CMI24 • 7:30 p.m.
Quantum Noise of Single-Photon Sources Based on Electromagnetically Induced Transparency, *Gor Nikoghosyan[1], Michael Fleischhauer[1], Matthew D. Eisaman[2], Mikhail D. Lukin[3]; [1]Fachbereich Physik, Germany, [2]Optical Technology Div., NIST, USA, [3]Physics Dept., Harvard Univ., USA.* We analyze the quantum properties of single-photon sources based on atomic ensembles under realistic experimental conditions. This explains the experimentally observed enhanced photon correlations in the wings of a spectrally resolved g^2 measurement.

CMI25 • 7:30 p.m.
Control of Single Neutral Atoms for Cavity QED, *Soo Y. Kim, Michael J. Gibbons, Kevin M. Fortier, Peyman Ahmadi, Michael S. Chapman; Georgia Tech, USA.* Individual atoms are deterministically loaded into a high finesse optical cavity using an optical lattice. With cavity-assisted cooling, long interaction times of the atoms with the cavity field are achieved.

CMI26 • 7:30 p.m.
Bright Entangled Beams from an Above-Threshold Optical Parametric Oscillator, *Katiúscia N. Cassemiro, Alessandro S. Villar, Paulo Valente, Marcelo Martinelli, Paulo A. Nussenzveig; Inst. de Fisica, Univ. de São Paolo, Brazil.* We generated bright entangled beams in an optical parametric oscillator, operating above threshold. Tripartite pump-signal-idler entanglement, all with different frequencies, was also predicted and three-color quantum correlations already measured.

CMI27 • 7:30 p.m.
Demonstration of Temporal Distinguishability of Three and Four Photons with Asymmetric Beam Splitter, *Zhe-Yu J. Ou[1,2], Bi-Heng Liu[2], Fang-Wen Sun[2], Y. X. Gong[2], Yun-Feng Huang[2], Guang-Can Guo[2]; [1]Indiana Univ.-Purdue Univ. Indianapolis, USA, [2]Univ. of Science and Technology of China, China.* By using an asymmetric beam splitter, we observe the generalized Hong-Ou-Mandel effects for three and four photons, respectively. Furthermore, we can use this generalized

Hong-Ou-Mandel interferometer to characterize temporal distinguishability.

CMI28 • 7:30 p.m.
Correlations and Anti-Correlations in EIT: Laser Noise versus Atomic Dipole Noise, *Paulo Valente[1], Katiuscia N. Cassemiro[1], Luciano S. Cruz[1], Daniel Felinto[1,2], Jose G. A. Gomez[1,3], Marcelo Martinelli[1], Arturo Lezama[4], Paulo A. Nussenzveig[1]; [1]Inst. de Fisica, Brazil, [2]Dept. de Fisica, Univ. Federal de Pernambuco, Brazil, [3]Dep. de Fisica, Fac. de Ciencias Fisicas y Matematicas, Univ. de Concepcion, Chile, [4]Inst. de Fisica, Fac. de Ingenieria, Univ. de la Republica, Uruguay.* Diode and Ti:Sapphire lasers were used to analyze the laser noise influence on an EIT resonance. In the first case phase-to-amplitude noise conversion dominates while atomic dipole fluctuations emerge in the latter.

CMI29 • 7:30 p.m.
Observation of de Broglie Wavelength of Three and Four Photons by Projection Measurement, *Bi-Heng Liu[1], Fang-Wen Sun[1], Y. X. Gong[1], Yun-Feng Huang[1], Guang-Can Guo[1], Zhe-Yu J. Ou[1,2]; [1]Univ. of Science and Technology of China, China, [2]Indiana Univ.-Purdue Univ. Indianapolis, USA.* By using the method of projection measurement with coincidence counting, we observe interference fringes with de Broglie wavelength of three and four photons.

CMI30 • 7:30 p.m.
Multimode Quantum Optical Logic, *Mark S. Everitt[1], Barry M. Garraway[2]; [1]Univ. of Leeds, UK, [2]Univ. of Sussex, UK.* We embed qubits within simple two-mode states and effect a Fredkin gate by a resonant multi-photon interaction with an atom.

CMI31 • 7:30 p.m.
Orbital Angular Momentum and Geometric Phase Conjugation in an Optical Parametric Oscillator, *Antonio Z. Khoury, Bernardo Coutinho dos Santos, Kaled Dechoum, Carlos E. R. Souza; Univ. Federal Fluminense, Brazil.* We discuss the spatial mode dynamics of an optical parametric oscillator under injection of orbital angular momentum. By considering the adiabatic mode conversion of the injected signal, we predict a geometric phase conjugation effect.

CMI32 • 7:30 p.m.
Arbitrary Unitary Operations in Confined Harmonic Oscillators, *Marcelo F. Santos; Univ. Federal de Minas Gerais, Brazil.* We present a quantum circuit that allows for the universal manipulation of the quantum state of harmonic oscillators. The scheme can be implemented in any confined harmonic oscillator interacting with three-level systems.

CMI33 • 7:30 p.m.
Optical Vortices and Topology, *Kevin O'Holleran[1], Mark R. Dennis[2], Miles J. Padgett[1,2]; [1]Univ. of Glasgow, UK, [2]Univ. of Southampton, UK.* Optical vortices are nodal lines in 3-D optical fields. These lines exist in various topologies. In this paper, the vortex topology in random light fields is investigated numerically with results given for loop size distribution.

CMI34 • 7:30 p.m.
Continuous-Variable Entanglement in a Nondegenerate Three-Level Cascade Laser with a Parametric Amplifier, *Eyob Alebachew; Addis Ababa Univ., Ethiopia.* We consider a nondegenerate three-level cascade laser with a nondegenerate parametric amplifier coupled to a two-mode vacuum reservoir. We analyze, applying the master equation, the squeezing and entanglement properties of the two-mode light.

CMI35 • 7:30 p.m.
Two Pulse Propagation with Non-Pure Ground State, *B. David Clader, Joseph H. Eberly; Univ. of Rochester, USA.* We analyze the effect on bi-pulse transmission of mixed-state vs. pure-state preparation of the two lower levels in a three-level medium. Dark state dominance is weakened, and matched-pulse formation is strikingly altered.

CMI36 • 7:30 p.m.
Sagnac Effect in Superposition of Vortex States in Bose-Einstein Condensates, *Sulakshana N. Thanvanthri[1], Kishor T. Kapale[1,2], Jonathan P. Dowling[1]; [1]Louisiana State Univ., USA, [2]JPL, Caltech, USA.* Creating vortex state superposition in Bose-Einstein Condensates (BEC) has been studied by coupling BEC with superpositions of orbital angular momentum states of light. We study the Sagnac effect occurring in superpositions of BEC vortex states.

CMI37 • 7:30 p.m.
AC Stark Splitting of Sub-Doppler Hyperfine Structure of Infrared Transitions of Nitric Oxide Detected Using Pulse Modulated Quantum Cascade Lasers, *Geoffrey Duxbury[1], James F. Kelly[2], Thomas A. Blake[2], Nigel Langford[1]; [1]Dept. of Physics, Univ. of Strathclyde, UK, [2]Environmental Molecular Lab, Pacific Northwest Natl. Lab, USA.* Using a low power modulated quantum cascade laser, collective coherent effects in the 5 μm spectrum of NO have been demonstrated by the observation of sub-Doppler hyperfine splitting caused by a large AC Stark effect.

CMI38 • 7:30 p.m.
Photon Correlations for Two-Mode Cavity QED, *Matthias Kronenwett, A. Scott Parkins, Howard J. Carmichael; Univ. of Auckland, New Zealand.* Photon correlation functions in two-mode cavity QED with orthogonal linear polarizations are computed. The full atomic level structure is treated for an F=3 to F=4 transition. An extremely long correlation time is identified and explained.

CMI39 • 7:30 p.m.
Optical Switching in Arrays of Quantum Dots with Dipole-Dipole Interactions, *Julio Gea-Banacloche, Min Xiao, Mambwe Mumba; Univ. of Arkansas, USA.* We investigate the use of quantum dimers whose transmission for an optical beam may be switched on or off using a second optical beam. This effect should be demonstrable in quantum dot structures.

CMI40 • 7:30 p.m.
Quantum Light–Matter Interactions with Cold Ensembles, *Marcin Kubasik[1], Sebastian R. de Echaniz[1], Marco Koschorreck[1], Eugene S. Polzik[1,2], Morgan W. Mitchell[1]; [1]ICFO - Inst. de Ciencies Fotoniques, Spain, [2]Niels Bohr Inst., Denmark.* Cold, trapped atomic ensembles present new opportunities for light-matter interfaces, including tomographic measurements and new light-matter interactions. By way of illustration, we describe spin-squeezing experiments in a dipole-trapped ^{87}Rb ensemble.

CMI41 • 7:30 p.m.
Generation of an Optical Frequency Comb from a Monolithic Micro-Resonator via the Kerr Nonlinearity, *Pascal Del'Haye, Albert Schliesser, Tobias Wilken, Ronald Holzwarth, Tobias Kippenberg; Max-Planck-Inst. for Quantum Optics, Germany.* It is shown that the cascaded optical sidebands generated via optical parametric

oscillations in a monolithic microcavity are equidistant and lead to the generation of femtosecond pulses in time domain.

CMI42 • 7:30 p.m.
Beyond the Quantum Limit of a Nanomechanical Oscillator, *Aziz Kolkiran, Girish S. Agarwal; Oklahoma State Univ., USA.* We study quantized nature of a Nanomechanical oscillator having an externally controlled Euler buckling nonlinearity and demonstrate the existence of amplitude squeezing.

CMI43 • 7:30 p.m.
Radiation-Pressure Cooling of a Micro-Mechanical Oscillator Using Dynamical Backaction, *Albert Schliesser[1], Nima Nooshi[1], Pascal Del'Haye[1], Remi Rivière[1], Georg Anetsberger[1], Kerry Vahala[2], Tobias J. Kippenberg[1]; [1]Max-Planck-Inst. of Quantum Optics, Germany, [2]Caltech, USA.* We demonstrate how dynamical backaction of radiation pressure can be exploited for passive laser-cooling of high-frequency (>50 MHz) mechanical oscillation modes of ultra-high finesse optical microcavities from room temperature to 8 K.

CMI44 • 7:30 p.m.
Intracavity Electromagnetically Induced Transparency in Cold Atoms, *Gessler Hernandez, Jiepeng Zhang, Yifu Zhu; Florida Intl. Univ., USA.* We present experimental measurements of the transmission spectrum of an optical cavity coupled with cold Rb atoms and observation of cavity-linewidth narrowing manifested by electromagnetically induced transparency.

CMI45 • 7:30 p.m.
Spatial Entanglement and Efficient Coupling to Single Spatial Modes, *Warren P. Grice[1], Ryan S. Bennink[1], Douglas S. Goodman[1], Andrew T. Ryan[2]; [1]Oak Ridge Natl. Lab, USA, [2]Gemfire Corp., USA.* Single-mode coupling efficiency of photons produced via spontaneous parametric down-conversion is limited by entanglement in the photons' spatial degree of freedom. Results are presented illustrating the relationship between pump divergence and the photons' spatial entanlglement.

CMI46 • 7:30 p.m.
Intensity Correlation in a Degenerate Parametric Oscillator Injected with a Squeezed Vacuum at the Pump Frequency, *Daniel B. Erenso; Middle Tennessee State Univ., USA.* By deriving the Wigner function for a degenerate parametric oscillator operating above threshold with injected squeezed vacuum mode at the pump frequency, we have studied the second-order intensity correlation for the intracavity modes.

CMI47 • 7:30 p.m.
Generation of Photon Pairs with Engineered Spectral Properties by Spontaneous Four-Wave Mixing, *Alfred B. U'Ren, Karina Garay-Palmett, Raúl Rangel-Rojo, Rodger Evans, Santiago Camacho-López; Ctr. de Investigacion Cientifica y Educacion Superior de Ensenada (CICESE), Mexico.* We study the generation of photon pairs by spontaneous four-wave mixing in microstructured optical fibers. We show that it is possible to engineer states with special spectral entanglement properties suitable for quantum information processing applications.

CMI48 •Paper withdrawn.

CMI49 • 7:30 p.m.
Non-Markovian Master Equations with Quantum Trajectory Unravellings, *James D. Cresser[1], Sarah Croke[2]; [1]Macquarie Univ., Australia, [2]Univ. of Strathclyde, UK.* Non-Markovian master equations are constructed from underlying classical stochastic processes. These equations therefore have quantum trajectory unravellings, including unravellings that have an immediate measurement interpretation, usually only found for Markovian (Lindblad) master equations.

CMI50 • 7:30 p.m.
Single Qutrit Entanglement, *Sinem Binicioglu Cetiner, Alexander A. Klyachko, Alexander S. Shumovsky; Bilkent Univ., Turkey.* We discussed a recent approach to quantum entanglement. The approach is based on presetting of basic observables of quantum system. Entangled states are interpreted as states with maximal amount of uncertainty of all basic observables.

CMI51 • 7:30 p.m.
Phase-Space Analysis of Cavity-Assisted Photo-Association of Molecules, *Markku Jääskeläinen, Jaeyoon Jeong, Christopher P. Search; Stevens Inst. of Technology, USA.* We study the photo-association of ultracold atoms into molecules using a cavity field. The semiclassical stationary solutions are found and compared with numerical quantum simulations. The results are analyzed using a reduced phase-space representation.

CMI52 • 7:30 p.m.
Widely Tunable Low-Threshold Semiconductor Two-Photon Laser, *Alex Hayat, Pavel Ginzburg, Meir Orenstein; Dept. of Electrical Engineering, Technion, Israel.* We propose low-threshold mode-locked and externally-started CW two-photon semiconductor laser schemes, based on non-degenerate stimulated two-photon emission. Two-photon lasers can have low thresholds and high output powers due to the separate cavities for different wavelengths.

CMI53 • 7:30 p.m.
Experimental Analysis of Multi-Photon Entanglement, *Christian Schmid[1,2], Nikolai Kiesel[1,2], Witlef Wiezcorek[1,2], Reinhold Pohlner[1,2], Wieslaw Laskowski[3], Markus Weber[2], Harald Weinfurter[1,2]; [1]Max-Planck-Inst. of Quantum Optics, Germany, [2]Ludwig-Maximilians-Univ. Munich, Germany, [3]Inst. Fizyki Teoretycznej i Astrofizyki, Poland.* We report on the experimental observation and analysis of four-photon entangled states. We analyze the particular entanglement properties of these states and introduce criteria, which enable the experimental differentiation of multi-partite entanglement classes.

CMI54 • 7:30 p.m.
Angular Momentum Transfer to BEC by a Two-Photon Stimulated Raman Technique, *Kevin C. Wright[1], L. Suzanne Leslie[2], Nicholas P. Bigelow[1,2]; [1]Dept. of Physics, Univ. of Rochester, USA, [2]Inst. of Optics, Univ. of Rochester, USA.* We have used two near-resonant Raman detuned beams of differing optical angular momentum (OAM) to couple two different internal atomic spin states and coherently transfer OAM to the center-of-mass motion of a BEC.

CMI55 • 7:30 p.m.
3-D-Vortex Labyrinths in the Near Field of Solid-State Microchip Laser, *Alexey Y. Okulov; P.N.Lebedev Physical Inst. of Russian Acad. of Sciences, Russian Federation.* The usage of vortex labyrinths and Talbot lattices as optical dipole traps for neutral atoms is considered. The macroscopic wavefunction in the form of superfluid vortex array built.

CTuA • CQO9 Plenary Session II

Hubbell Auditorium
8:30 a.m.–10:00 a.m.
CTuA • CQO9 Plenary Session II
Mikhail Lukin; Harvard Univ., USA, Presider

CTuA1 • 8:30 a.m. **●Plenary●**
Long Range Forces and Torques Due to Quantum Fluctuations: Design, Measurements and Future Directions, *Federico Capasso; Harvard Univ., USA.* We discuss advances in the physics of QED forces. Experiments on attractive and repulsive Casmir forces, QED torques and new directions with possible relevance to quantum optics and quantum information processing are also discussed.

CTuA2 • 9:15 a.m. **●Plenary●**
Optical Coherence and the Feynman Propagator, *James Franson; Univ. of Maryland, Baltimore County, USA.* The Feynman propagator has nonzero values outside of the forward light cone. Although that does not allow superluminal messages, it does allow optical coherence and entanglement to be generated outside the light cone.

10:00 a.m.–10:30 a.m.
Coffee Break

CTuB • CQO9 Oral Session VII

Landers Auditorium
10:30 a.m.–12:00 p.m.
CTuB • CQO9 Oral Session VII
Mikhail Lukin; Harvard Univ., USA, Presider

CTuB1 • 10:30 a.m. **●Invited●**
Title to Be Announced, *Immanuel Bloch; Univ. Mainz, Germany.* No abstract available.

CTuB2 • 11:00 a.m. **●Invited●**
Title to Be Announced, *Keith Schwab; Cornell Univ., USA.* No abstract available.

CTuB3 • 11:30 a.m. **●Invited●**
Title to Be Announced, *Anders Sorensen; Copenhagen Univ., Denmark.* No abstract available.

CTuC • CQO9 Oral Session VIII

Sloan Auditorium
10:30 a.m.–12:00 p.m.
CTuC • CQO9 Oral Session VIII
John Howell; Univ. of Rochester, USA, Presider

CTuC1 • 10:30 a.m. **●Invited●**
Cooperative Spontaneous Emission and Scattering of Light by Ensembles of Atoms, *Roy J. Glauber; Harvard Univ., USA.* The spontaneous emission of light by groupings of identical atoms is a collective process that takes place only in certain favored radiation modes. These have in general a variety of different lifetimes that obey an interesting sum rule and correspondingly different spectral widths and frequency shifts. The light that these atoms scatter resonantly also reflects this complex structure.

CTuC2 • 11:00 a.m. **●Invited●**
Photon Wave Mechanics and the Wolf Equations of Classical Coherence Theory, *Michael G. Raymer[1], Brian J. Smith[2]; [1]Univ. of Oregon, USA, [2]Clarendon Lab, Univ. of Oxford, UK.* The quantum wave function for two photons is a tensor field obeying a generalized Maxwell equation. The duality between the two-photon detection amplitude and the Wolf equations of partial coherence theory follows from the two-photon Maxwell equation.

CTuC3 • 11:30 a.m. **●Invited●**
Strong Relative-Intensity Squeezing of Light from Four-Wave Mixing in Hot Rb Vapor, *Paul Lett; NIST, USA.* We use nondegenerate four-wave mixing in hot atomic vapor to measure up to -7.1dB of relative-intensity squeezing. This narrowband, squeezed light near an atomic resonance is of interest for experiments involving atomic ensembles.

12:00 p.m.–1:30 p.m.
Lunch Break

CTuD • CQO9 Oral Session IX

Landers Auditorium
1:30 p.m.–3:00 p.m.
CTuD • CQO9 Oral Session IX
Presider to Be Announced

CTuD1 • 1:30 p.m. **●Invited●**
Title to Be Announced, *Eugene Demler; Harvard Univ., USA.* No abstract available.

CTuD2 • 2:00 p.m. **●Invited●**
The Photon and the Vacuum Cleaner, *Ian Walmsley; Univ. of Oxford, UK.* No abstract available.

CTuD3 • 2:30 p.m.
Observing the Spin Hall Effect of Light via Quantum Weak Measurements, *Onur Hosten, Paul G. Kwiat; Univ. of Illinois at Urbana Champaign, USA.* Using the techniques of "quantum weak-measurements" as a coherent amplification mechanism for small signals, for the first time we have measured the recently proposed "spin Hall effect" of light.

CTuE • CQO9 Oral Session X

Sloan Auditorium
1:30 p.m.–3:00 p.m.
CTuE • CQO9 Oral Session X
Presider to Be Announced

CTuE1 • 1:30 p.m. **●Invited●**
Entanglement and Decoherence: Global Versus Local Dynamics, *Luiz Davidovich, M. P. Almeida, F. de Melo, M. Hor-Meyll, A. Salles, S. P. Walborn, P. H. Souto Ribeiro; Univ. Federal do Rio de Janeiro, Brazil.* We demonstrate, using an all-optical setup, the difference between local and global dynamics of entangled quantum systems coupled to independent environments. Even when the decay of each system is asymptotic, quantum entanglement may suddenly disappear.

CTuE2 • 2:00 p.m. **●Invited●**
Quantum Stochastic Heating of a Trapped Ion, *Levente Horvath[1], Robert Fisher[2], Matthew Collett[1], Howard Carmichael[1]; [1]Univ. of*

Auckland, New Zealand, [2]Technical Univ. of Munich, Germany. The resonant heating of a harmonically trapped ion by a standing-wave light field is described as a quantum stochastic process combining a coherent Schrödinger evolution with Bohr-Einstein quantum jumps. Quantum and semi-quantum treatments are compared.

CTuE3 • 2:30 p.m. **●Invited●**

High-Flux Pulsed Polarization-Entangled Photon Source for Generating Single Photons on Demand, *Franco N. C. Wong, Onur Kuzucu, Jeffrey H. Shapiro; MIT, USA.* We demonstrate a pulsed entanglement source with a flux high enough to reduce quantum-interference visibility due to multiple pairs. An array of such pulsed downconverters can be configured to yield single photons on demand.

3:00 p.m.–4:00 p.m.
Coffee Break

CTuF • CQO9 Plenary Session III

Hubbell Auditorium
4:00 p.m.–6:15 p.m.
CTuF • CQO9 Plenary Session III
Emil Wolf; Univ. of Rochester, USA, Presider

CTuF1 • 4:00 p.m. **●Plenary●**

Title to Be Announced, *James P. Gordon; Consultant, USA.* No abstract available.

CTuF2 • 4:45 p.m. **●Plenary●**

A Short History of Cavity Quantum Electrodynamics, *Serge Haroche; Ecole Normale Superieure de Paris, France.* Starting with early experiments about lifetimes of excited atoms near metallic boundaries, I review various aspects of the physics of photons interacting with atoms in cavities, from micromasers to atom-field entanglement and quantum information studies.

CTuF3 • 5:30 p.m. **●Plenary●**

Title to Be Announced, *Marlan O. Scully; Inst. for Quantum Studies, Texas A&M Univ., USA.* No abstract available.

● Wednesday, June 13, 2007 ●

IWA—ICQI Introduction

Hubbell Auditorium
8:15 a.m.–8:30 a.m.
IWA—ICQI Introduction
Robert Boyd; Inst. of Optics, Univ. of Rochester, USA, Presider
Bahaa Saleh; Boston Univ., USA, Presider

JWA—Joint CQO9/ICQI Plenary Session I

Hubbell Auditorium
8:30 a.m.–10:00 a.m.
JWA—Joint CQO9/ICQI Plenary Session I
Serge Haroche; Ecole Normale Supérieure de Paris, France, Presider

JWA1 • 8:30 a.m. **●Plenary●**
Quantum Computation and Quantum Communication with Entangled Photons, *Anton Zeilinger; Univ. Wien, Austria.* Entangled photons are used in quantum cryptography over distances of 100km in telecom fibers and 144km in free space. One-way quantum computation with entangled cluster states are realized with active feed-forward cycle times of ~100ns.

JWA2 • 9:15 a.m. **●Plenary●**
Title to Be Announced, *Peter Knight; Imperial College, UK.* No abstract available.

10:00 a.m.–10:30 a.m.
Coffee Break

CWA • CQO9 Oral Session XI

Sloan Auditorium
10:30 a.m.–12:00 p.m.
CWA • CQO9 Oral Session XI
Andrew Jordan; Univ. of Rochester, USA, Presider

CWA1 • 10:30 a.m. **●Invited●**
Coherence and Correlations in Atom-Lasers, *Peter D. Drummond, Timothy Vaughan, Joel Corney; ACQAO Ctr., Univ. of Queensland, Australia.* In dynamical atom-laser experiments, first order correlation measures of condensation are no longer adequate. We define higher order coherence and correlation measures, and illustrate this with a direct simulation of an evaporative cooling experiment.

CWA2 • 11:00 a.m. **●Invited●**
Applications of Squeezed States of Light—Quantum Teleportation and Related Quantum Information Processing, *Akira Furusawa; Univ. of Tokyo, Japan.* We have succeeded in creating 9dB quadrature squeezing with a periodically poled $KTiOPO_4$ crystal. By using the high level of squeezing, we also have succeeded in high-fidelity quantum teleportation and related quantum information processing.

CWA3 • 11:30 a.m. **●Invited●**
Quantum Electronics: From Schottky to Bell, *Markus Buttiker; Univ. of Geneva, Switzerland.* Concepts in quantum optics find their counterparts in quantum coherent electrical conductors. I illustrate this with the theoretical prediction of a two particle Aharonov-Bohm effect and its very recent experimental realization.

IWB—ICQI Oral Session I

Landers Auditorium
10:30 a.m.–12:00 p.m.
IWB—ICQI Oral Session I
Ian Walmsley; Univ. of Oxford, UK, Presider

IWB1 • 10:30 a.m. **●Invited●**
Optical Manipulation and Measurement of a Quantum Dot Spin, *Atac Imamoglu; ETH Zürich, Switzerland.* We describe experiments demonstrating high-fidelity spin-state preparation and time-averaged single-spin measurement in a single electron charged quantum dot. The prospects for a quantum non-demolition measurement of a single confined spin are discussed.

IWB2 • 11:00 a.m. **●Invited●**
Universal Dynamical Control of Decoherence and Thermodynamics, *Goren Gordon, Noam Erez, Gershon Kurizki; Dept. of Chemical Physics, Weizmann Inst. of Science, Israel.* Universal formulae yield driving-field spatiotemporal profiles that minimize multipartite decoherence and disentanglement in thermal environments. They also allow entropy- and heat-flow control on non-Markovian time scales.

IWB3 • 11:30 a.m. **●Invited●**
Decoherence and Distinguishability in Optical and Atomic Experiments on Quantum Tomography, *Aephraim Steinberg; Univ. of Toronto, Canada.* Experiments on tomography and coherence with entangled photons and with atoms in optical lattices reveal surprises and challenges related to distinguishability and inhomogeneity. I describe our latest results on triphoton tomography and lattice pulse echoes.

12:00 p.m.–1:30 p.m.
Lunch Break

JWB—Joint CQO9/ICQI Plenary Session II

Hubbell Auditorium
1:30 p.m.–2:15 p.m.
JWB—Joint CQO9/ICQI Plenary Session II
Peter Knight; Imperial College, UK, Presider

JWB1 • 1:30 p.m. **●Plenary●**
Quantum Optics with Single Atoms and Photons, *H. Jeff Kimble; Caltech, USA.* No abstract available.

2:15 p.m.–2:30 p.m.
Coffee Break

CWB • CQO9 Oral Session XII

Sloan Auditorium
2:30 p.m.–4:30 p.m.
CWB • CQO9 Oral Session XII
Michael Raymer; Univ. of Oregon, USA, Presider

CWB1 • 2:30 p.m. **●Invited●**
Towards a Practical Quantum Repeater, *Alexander Kuzmich; Georgia Tech, USA.* We will outline our program on the use of atomic ensembles as an interface for quantum information transfer and the prospects for long distance quantum networks.

CWB2 • 3:00 p.m. **●Invited●**

Superfluidity and Coherence in Two-Dimensional Bose Gases, *Peter Krüger, Zoran Hadzibabic, Jean Dalibard; Ecole Normale Supérieure de Paris, France.* Dimensionality can drastically affect order phenomena. We study the Berezinskii-Kosterlitz-Thouless phase transition in a two dimensional ultracold Bose gas. This transition to superfluidity without true long-range order replaces Bose-Einstein condensation known from three dimensional systems.

CWB3 • 3:30 p.m. **●Invited●**

Nonclassicality and Entanglement with Continuous Variables, *Werner Vogel; Inst. of Physics, Univ. of Rostock, Germany.* Observable quantities, such as characteristic functions or moments, are used to formulate conditions for nonclassicality and entanglement. Appropriate detection methods for the conditions are analyzed and their application for highly sensitive measurements is considered.

CWB4 • 4:00 p.m.

Experimental Realization of Wheeler's Delayed-Choice Gedanken Experiment, *Vincent Jacques[1], E. Wu[1,2], Frédéric Grosshans[1], François Treussart[1], Philippe Grangier[3], Alain Aspect[3], Jean-François Roch[1]; [1]Lab de Photonique Quantique et Moléculaire, UMR CNRS 8537, France, [2]Key Lab of Optical and Resonance Spectroscopy, East China Normal Univ., China, [3]Lab Charles Fabry de l'Inst. d'Optique, UMR CNRS 8501, France.* We report an almost ideal realization of Wheeler Delayed-Choice Gedanken Experiment, using single-photons and a relativistically separated quantum number generator.

IWC—ICQI Oral Session II

Landers Auditorium
2:30 p.m.–4:30 p.m.
IWC—ICQI Oral Session II
Andrew White; Univ. of Queensland, Australia, Presider

IWC1 • 2:30 p.m. **●Invited●**

Controlling Individual Nuclear Spin Qubits in Diamond: From Coherence to Scalability, *Mikhail Lukin; Harvard Univ., USA.* No abstract available.

IWC2 • 3:00 p.m. **●Invited●**

Atomic Physics in Artificial Atoms: Toward Coherent Manipulation of Single Electron Spins and Quantum Computing, *Duncan G. Steel; Univ. of Michigan, USA.* No abstract available.

IWC3 • 3:30 p.m. **●Invited●**

Quantum Phase Transitions with Photons and Polaritons, *M. J. Hartmann, F. G. S. L. Brandão, Martin B. Plenio; Imperial College London, UK.* In this work we demonstrate that polaritons, combined atom and photon excitations, in an array of cavities can form a strongly interacting many body system such as the Bose-Hubbard model or effective spin models.

IWC4 • 4:00 p.m. **●Invited●**

Nonlinear Gates with Single Photon States, *Gerard Milburn[1], W. J. Munro[2], K. Nemoto[3]; [1]Univ. of Queensland, Australia, [2]Hewlett-Packard Labs, UK, [3]Natl. Inst. of Informatics, Japan.* A theory of intracavity nonlinearities for single photon input states shows that there is a source of intrinsic phase noise in such systems. We show that nonetheless, qubus quantum computation schemes remain viable.

JWC—Joint CQO9/ICQI Poster Session and APS Reception

Wilson Commons
4:30 p.m.–6:30 p.m.
JWC—Joint CQO9/ICQI Poster Session and APS Reception

JWC1 • 4:30 p.m.

Generation of Dicke States in Distant Matter Qubits with Linear Optics, *Christoph Thiel[1], Joachim von Zanthier[1], Thierry Bastin[2], Enrique Solano[3], Girish S. Agarwal[4]; [1]Inst. for Optics, Information and Photonics, Germany, [2]Inst. de Physique Nucléaire, Atomique et de Spectroscopie, Univ. de Liège au Sart Tilman, Belgium, [3]Physics Dept., ASC, and CeNS, Ludwig-Maximilians-Univ., Germany, [4]Dept. of Physics, Oklahoma State Univ., USA.* We propose a method for generating all symmetric Dicke states of distant particles requiring linear optics only. Thereby we grant access to genuine entanglement of any number of qubits via measurement using multifold detection techniques.

JWC2 • 4:30 p.m.

Thermal Light Manipulation by Addition or Subtraction of Single Photons, *Alessandro Zavatta[1,2], Valentina Parigi[3,1], Marco Bellini[2,3]; [1]Dept. of Physics, Univ. of Florence, Italy, [2]Inst. Nazionale di Ottica Applicata, Italy, [3]LENS, Italy.* We report the generation of thermal light states manipulated by the controlled addition or subtraction of single photons. A full tomographic analysis is used to characterize the resulting states and study conditions for nonclassicality.

JWC3 • 4:30 p.m.

Reversible State Transfer between Light and a Single Trapped Atom, *A. David Boozer, Andreea Boca, Russell Miller, Tracy E. Northup, H. Jeffrey Kimble; Caltech, USA.* We demonstrate reversible mapping of a coherent state of light to and from the hyperfine states of an atom trapped within a high finesse optical cavity, a significant step towards cavity-QED based quantum networks.

JWC4 • 4:30 p.m.

Quantum-Field Model for Dispersive-Microcavity Spontaneous Photon Conversion, *Alex Hayat, Meir Orenstein; Dept. of Electrical Engineering, Technion, Israel.* We develop a quantum-field model for dispersive cavity photon conversion, incorporating dispersion into spatial eigenmodes enabling direct calculations of spontaneous photon-to-photon decay rates similar to atomic radiative transitions, that cannot be achieved by classical optics.

JWC5 • 4:30 p.m.

Radiation-Pressure Effects upon a Micro-Mirror in a High-Finesse Optical Cavity, *Pierre-Francois Cohadon, Olivier Arcizet, Chiara Molinelli, Tristan Briant, Michel Pinard, Antoine Heidmann; Lab Kastler Brossel, France.* We present an experiment where the motion of a micro-mechanical resonator is optically monitored with a quantum-limited sensitivity. Directs effects of intracavity radiation pressure are experimentally demonstrated. Applications to quantum optics are discussed.

JWC6 • 4:30 p.m.

Self-Phasematched Nonlinear Optics in Integrated Semiconductor Microcavities, *Alex Hayat, Meir Orenstein; Dept. of Electrical Engineering, Technion, Israel.* We fabricated semiconductor microcavities for self-phase-matched nonlinear optics. The measured efficiency shows a strong maximum at cavity resonance due to cavity enhanced pump input power and dispersion-induced wavelength-detuning effect on the mode overlap.

JWC7 • 4:30 p.m.
Effects of Depolarizing Noise on the Precision of an Atomic Clock Using GHZ States, *Andrew R. Jacobs, Matthew Briel, James P. Clemens; Miami Univ., USA.* We consider the imperfect preparation on an N ion GHZ state for use as an atomic clock incorporating the depolarizing noise model. There is a tradeoff between N and the single qubit error rate p.

JWC8 • 4:30 p.m.
Quantum Optics Teaching Laboratory, *Svetlana G. Lukishova, Anand K. Jha, Nickolaos Savidis, Sean White, Luke J. Bissell, Laura Elgin, Carlos R. Stroud, Jr; Inst. of Optics, Univ. of Rochester, USA.* Quantum optics teaching laboratory consists of four experiments for undergraduates: (1) entanglement and Bell's inequalities, (2) single-photon interference, (3) confocal microscope imaging of single-emitter fluorescence, (4) Hanbury Brown and Twiss setup. Fluorescence antibunching.

JWC9 • 4:30 p.m.
Bistability in Resonant Fermi Superfluid, *Lei Jiang[1], Han Pu[1], Andrew Robertson[2], Hong Y. Ling[2]; [1]Rice Univ., USA, [2]Rowan Univ., USA.* The resonant Fermi superfluid model can be mapped to one describing a single-mode laser field interacting with an ensemble of inhomogeneously broadened two-level atoms. Using this analogy, we study the bistability of the Fermi superfluid.

JWC10 • 4:30 p.m.
Coherent Pulse Propagation in Water, *Heejeong Jeong, Anna Fox, Armin Ellis, David Lukofsky, Ulf L. Österberg; Dartmouth College, USA.* We show how transmission through 5.7 meters of water varies with pulse energy and temporal width. 3 orders increase in transmission is observed compared with Beer's law predictions. The experimental results are compared with 0π-pulses.

JWC11 • 4:30 p.m.
Off-Axis Vortices and Polarization Rotation via Orbital Angular Momentum Exchange, *Luat T. Vuong[1], Eric R. Eliel[2], Amiel A. Ishaaya[1], Gert t'Hooft[2], Alexander L. Gaeta[1], Taylor D. Grow[1]; [1]School of Applied and Engineering Physics, Cornell Univ., USA, [2]Huygens Lab, Netherlands.* We investigate coupled optical vortices in a Kerr medium and observe orbital angular momentum exchange, novel off-axis vortex trajectories, and polarization rotation. We describe how beams of differing topological charge can evolve non-orthogonally.

JWC12 • 4:30 p.m.
Time Dependence of the Many-Body Interactions in a One-Dimensional Sample of Ultracold Rydberg Atoms, *Thomas J. Carroll[1], Cordelia Ochis[2], Peter D. Maenner[2], Michael W. Noel[2]; [1]Swarthmore College, USA, [2]Bryn Mawr College, USA.* We study resonant energy exchange among atoms in an ultracold Rydberg gas. We explore the transition between two- and many-body interactions by exciting a long thin tube of atoms that restricts the sample's dimensionality.

JWC13 • 4:30 p.m.
Tunable Negative Refraction without Absorption Using Electromagnetically Induced Chirality, *Jürgen Kästel[1], Michael Fleischhauer[1], Susanne F. Yelin[2,3], Ronald L. Walsworth[4,3]; [1]TU Kaiserslautern, Germany, [2]Univ. of Connecticut, USA, [3]ITAMP, USA, [4]Harvard Univ., USA.* We propose a novel approach that uses effects similar to EIT leading to resonantly enhanced chirality, negative refraction and suppression of absorption. The refractive index can be fine-tuned by means of external laser fields.

JWC14 • 4:30 p.m.
Conditional Displacement Operator for Traveling Modes, *Simone Souza[1], Ardiley T. Avelar[1], Basilio Baseia[1], Jorge M. C. Malbouisson[2]; [1]Inst. de Física, Univ. Federal de Goiás, Brazil, [2]Inst. de Física, Univ. Federal da Bahia, Brazil.* We propose a scheme to implement the action of the conditional displacement operator upon an arbitrary state of a traveling mode. Applications to generation of states and measurement of Wigner functions are also considered.

JWC15 • 4:30 p.m.
Type I Optical Parametric Oscillators above Threshold Are Perfect Squeezers for Empty Gauss-Hermite Modes at Any Pumping Level, *Carlos Navarrete, Eugenio Roldán, Germán J. de Valcárcel; Univ. de Valencia, Spain.* A type I optical parametric oscillator pumped by a Gaussian beam above threshold and tuned to its first transverse mode family is shown to yield a perfectly squeezed, empty Gauss-Hermite mode at any pumping level.

JWC16 • 4:30 p.m.
Experimental Demonstration of the Topological Phase for Entangled Qubits, *Carlos E. R. Souza[1], Jose A. O. Huguenin[1], Perola Milman[2], Antonio Z. Khoury[1]; [1]Univ. Federal Fluminense, Brazil, [2]Universite Paris Diderot-Paris 7, France.* We investigate the topological phase associated with the SO(3) representation in terms of maximally entangled states. An experimental demonstration of this topological phase is provided for polarization and spatial mode transformations of a laser beam.

JWC17 • 4:30 p.m.
Quantization of Light in a Planar Dielectric Structure, *Antonin Lukš, Vlasta Peřinová; Palacký Univ., Czech Republic.* Quantization of light in a homogeneous isotropic lossless linear dielectric has been carried out with a choice of field--matter coupling and it has been extended to a planar dielectric structure.

JWC18 • Paper withdrawn.

JWC19 • 4:30 p.m.
Theory of Quantum Fluctuations of Optical Dissipative Structures — Application to the Study of Squeezing and Intensity Fluctuations of DOPO Cavity Solitons, *Isabel Pérez-Arjona[1], Eugenio Roldán[2], Germán J. de Valcárcel[2]; [1]Univ. Politecnica de Valencia, Spain, [2]Univ. de Valencia, Spain.* We present a general theory of quantum fluctuations of dissipative structures in nonlinear optical cavities with transverse translation invariance. Perfect squeezing of the transverse momentum, detectable under homodyning, occurs irrespectively of the system parameters.

JWC20 • Paper withdrawn.

JWC21 • 4:30 p.m.
Robust Control of Entanglement by Quantum-Jump Based Feedback, *André R. R. Carvalho[1], Joseph J. Hope[2]; [1]Dept. of Physics, Australian Natl. Univ., Australia, [2]Australian Ctr. for Quantum-Atom Optics, Australian Natl. Univ., Australia.* We present a feedback strategy, based on quantum-jump detection, to generate highly entangled steady states. The scheme overcomes spontaneous emission effects, and is robust against detection inefficiencies and errors in the control Hamiltonian.

JWC22 • Paper withdrawn.

JWC23 • 4:30 p.m.
Entanglement Dynamics of a Four Particle System, *Elizabeth Groves; Univ. of Rochester, USA.* We calculate the time evolution of entanglement for a simple four particle system. The appearance of the sudden death effect is found to depend critically on the choice of initial state.

JWC24 • 4:30 p.m.
Collective Entangled Dark States, *Hideomi Nihira, Carlos R. Stroud, Jr.; Univ. of Rochester, USA.* We describe a type of collective entangled dark state which exists when a group of many-level atoms interact simultaneously with both high-Q cavity modes and free space modes of the electromagnetic field.

JWC25 • 4:30 p.m.
Decoherence Free Subspaces for Generalized Schrödinger Cat States, *Mayer A. Landau, Carlos R. Stroud Jr.; Univ. of Rochester, USA.* We investigate interactions by which wave packets are entangled and appropriate time dependent measures of this entanglement. We explore their symmetry properties and show that certain symmetries result in long lived superpositions and entangled states.

JWC26 • 4:30 p.m.
Cluster State LOQC with Entangled Spatial Modes, *Cody C. Leary, M. G. Raymer; Oregon Ctr. for Optics and Dept. of Physics, Univ. of Oregon, USA.* We present a scheme for cluster state linear optical quantum computation using Hermite-Gauss (HG) transverse spatial modes. We describe HG fusion gate elements, an HG-entangled biphoton source, and multi-photon spatial cluster state characterization.

JWC27 • Paper withdrawn.

JWC28 • 4:30 p.m.
Magneto-Optical Trap of Cadmium, *Ming-Shien Chang[1], Kathy-Ann Brickman[1], Mark Acton[1], Andrew Chew[1], Dzmitry Matsukevich[1], Paul Haljan[2], Vanderlai Bagnato[3], Christopher Monroe[1]; [1]Univ. of Michigan, USA, [2]Simon Fraser Univ., Canada, [3]Inst. de Fisica e Quimica de Sao Carlos, Brazil.* We achieve the first magneto-optical trap of Cadmium. When integrated with a nearby ion trap, this allows for the possibility of protecting quantum information from environment perturbations via charge neutralization of trapped ions.

JWC29 • 4:30 p.m.
Experimental Hyperentanglement-Assisted Bell-State Analysis, *Julio T. Barreiro, Tzu-Chieh Wei, Paul G. Kwiat; Univ. of Illinois at Urbana-Champaign, USA.* Utilizing photons entangled independently in every degree of freedom, or "hyperentangled", we realize complete and deterministic Bell-state analysis with only linear optics and single-photon interference. We investigate the limits of Bell-state analysis of hyperentangled states.

JWC30 • 4:30 p.m.
Characterizing the Family of Triphoton States and Their Wigner Representation on the Poincaré Sphere, *Lynden K. Shalm, Robert B. A. Adamson, Aephraim M. Steinberg; Ctr. for Quantum Information and Quantum Control and Inst. for Optical Sciences, Dept. of Physics, Univ. of Toronto, Canada.* We present reconstructions of Wigner distributions for the polarization state of three indistinguishable photons on the generalized Poincare sphere. We study a variety of states and examine their suitability for quantum lithography and metrology applications.

JWC31 • 4:30 p.m.
Generation and Analysis of Entangled Two-Photon States in Spatial-Parity Space, *Timothy Yarnall[1], Ayman F. Abouraddy[2], Bahaa E. A. Saleh[1], Malvin C. Teich[1]; [1]Boston Univ., USA, [2]MIT, USA.* We demonstrate the generation of two-photon states entangled in the parity of their transverse spatial coordinates. Continuous superpositions of the |Φ+> and |Ψ+> Bell states are synthesized and analyzed with simple linear optical components.

JWC32 • 4:30 p.m.
A Bootstrapping Approach for Generating Maximally Path-Entangled Photon States, *Kishor T. Kapale[1], Jonathan P. Dowling[2]; [1]JPL, USA, [2]Louisiana State Univ., USA.* We propose a bootstrapping approach to generate maximally path-entangled states of photons---the so-called NOON states.

JWC33 • 4:30 p.m.
Sub-Rayleigh Lithography Using a Multiphoton Absorber, *Heedeuk Shin, Malcolm N. O'Sullivan-Hale, Hye Jeong Chang, Robert W. Boyd; Inst. of Optics, Univ. of Rochester, USA.* We demonstrate sub-Rayleigh lithography for enhancing the resolution of optical interferometric patterns using poly(methyl-methacrylate)(PMMA). We exceed standard Rayleigh resolution limit by a factor of three and calculate the multiphoton absorption cross section of PMMA.

JWC34 • 4:30 p.m.
Violation of Bell's Inequality in Spatial Parity Space, *Ayman Abouraddy[1], Timothy Yarnall[2], Bahaa Saleh[2], Malvin Teich[2]; [1]MIT, USA, [2]Boston Univ., USA.* We demonstrate an approach to violating Bell's inequality with the continuous spatial variables of entangled-photon pairs using simple optical components that manipulate the spatial parity of the transverse coordinate in one dimension.

JWC35 • 4:30 p.m.
Temporal and Spatial Compensation Techniques for Brighter Entanglement Sources, *Radhika Rangarajan[1], Michael Goggin[2], Gleb Akselrod[1], Joseph Yasi[1], Jaime Valle[1], Paul Kwiat[1]; [1]Univ. of Illinois, USA, [2]Truman State Univ., USA.* We report on using temporal compensation to improve the entanglement from two-crystal type-I pulsed, cw-diode and LED sources, using both BBO and BiBO. The fidelity of these sources can be further increased by spatially compensation.

JWC36 • 4:30 p.m.
Pulsed Homodyne Detection of Squeezed Light at Telecommunication Wavelength, *Yujiro Eto, Tajima Takashi, Yun Zhang, Takuya Hirano; Dept. of Physics, Gakushuin Univ., Japan.* We present the generation of squeezed light at 1.535 μm by single-pass optical parametric amplification in a periodically poled MgO-doped $LiNbO_3$ waveguide. Squeezing of -4.2 dB was observed by using a temporally matched local oscillator.

JWC37 • 4:30 p.m.
Unambiguous Discrimination of Mixed States: A Description Based on System-Ancilla Coupling, *Xiang-Fa Zhou, Yong-Sheng Zhang, Guang-Can Guo; Key Lab of Quantum Information, Univ. of Science and Technology of China, China.* We propose a general description on the unambiguous discrimination of mixed states according to the system-environment coupling. In the two states

case, we present a series of new bounds of the total success probability.

JWC38 • 4:30 p.m.
Pulsed Coupling to Ancilla to Control Decoherence of States of Continuous Variable Systems, *Asoka Biswas[1], G. S. Agarwal[2]; [1]Univ. of Southern California, USA, [2]Oklahoma State Univ., USA.* We present a general scheme using the pulsed coupling to an ancilla to control the decoherence of a large class of states of continuous variable systems. Destructive interference causes decoupling to bath modes.

JWC39 • 4:30 p.m.
Preparation of General Single-Ququart States Using Ultrafast Spontaneous Parametric Down-Conversion, *So-Young Baek[1], Stanislav S. Straupe[2], Sergei P. Kulik[2], Yoon-ho Kim[1]; [1]Pohang Univ. of Science and Technology, Republic of Korea, [2]Moscow State Univ., Russian Federation.* We report an experiment on preparing general four-dimensional quantum states (ququart) using ultrafast-pumped frequency-nondegenerate spontaneous parametric down-conversion. All possible single-ququart states (mixed, pure, and intermediate states) can be prepared in our scheme.

JWC40 • 4:30 p.m.
Additive Multipartite Entanglement Measures, *Gerardo A. Paz Silva, John H. Reina; Univ. del Valle, Colombia.* We propose general conditions for a measure of total correlations to be a fully additive entanglement monotone using its convex-roof extension, as the natural way to generalize the Entanglement of Formation to the multipartite scenario.

JWC41 • 4:30 p.m.
Selective Excitation of Exciton Molecule States for the Entanglement of Excitons in a Coupled Quantum Dots, *Keishiro Goshima[1,2], Kazuhiro Komori[1,2], Takeyoshi Sugaya[1,2], Toshihide Takagahara[3]; [1]AIST, Japan, [2]CREST, Japan Science and Technology Corp. (JST), Japan, [3]Dept. of Electronics and Information Science, Kyoto Inst. of Technology, Japan.* We propose 2-qubit quantum gates using an exciton molecule state in a coupled quantum dots (CQDs) and demonstrate the selective creation of correlated exciton states for the exciton entanglement in CQDs by two color excitations.

JWC42 • 4:30 p.m.
Generating Entangled States of Two Ququarts Using Linear Optical Elements, *So-Young Baek, Yoon-Ho Kim; Pohang Univ. of Science and Technology (POSTECH), Republic of Korea.* We propose linear-optical schemes for generating entangled-states of two ququarts (four-dimensional quantum systems) in which single-ququart states are constructed with frequency-nondegenerate biphoton polarization states of spontaneous parametric down-conversion. The schemes require beamsplitters and coincidence post-selection.

JWC43 • Paper withdrawn.

JWC44 • 4:30 p.m.
Remote Entanglement Generation via Purely Local Interactions, *Ting Yu; Univ. of Rochester, USA.* We consider a quantum system consisting of four subsystems (Aa, Bb). The Aa location is prepared entangled with the Bb location. We show how to generate entanglement between two remote sites by purely local interactions.

JWC45 • 4:30 p.m.
Enhancement of Spin Coherence in Microdisk Lasers, *Sayantani Ghosh[1], Felix Mendoza[2], Roberto Myers[2], Art C. Gossard[2], David D. Awschalom[2], Wei-Hua Wang[3], Xia Li[3], Nitin Samarth[3]; [1]Univ. of California at Merced, USA, [2]Univ. of California at Santa Barbara, USA, [3]Pennsylvania State Univ., USA.* We examine the modification of electron spin dynamics by stimulated emission in optically-pumped GaAs microdisk lasers and observe an enhancement of the spin coherence when the optical excitation resonates with a high-Q lasing mode.

JWC46 • 4:30 p.m.
Measurements of Phase Correlations between Polarization-Entangled Photons, *Enrique J. Galvez, Mehul Malik, Brad Melius, Bryce Gadway, Ushnish Ray; Colgate Univ., USA.* Correlated photon pairs going in different directions were prepared in a polarization-entangled Bell state. Each photon passed through a Pancharatnam phase shifter and polarizer. We measured the correlations as a function of the inserted phases.

JWC47 • 4:30 p.m.
Study of Nonclassicality and Decoherence of Photon-Subtracted Squeezed Vacuum, *Asoka Biswas[1], G. S. Agarwal[2]; [1]Univ. of Southern California, USA, [2]Oklahoma State Univ., USA.* We discuss nonclassical properties of single-photon subtracted squeezed vacuum states and study its decoherence under different models. We find that the state is especially robust under phase diffusion model though its phase properties are lost.

JWC48 • Paper withdrawn.

JWC49 • 4:30 p.m.
High-Speed Quantum Random Number Generation, *Michael A. Wayne, Gleb Akselrod, Evan R. Jeffrey, Paul G. Kwiat; Univ. of Illinois at Urbana Champaign, USA.* Using a single-photon counter and FPGA-based data processing, we implement a quantum random number generator which produces random numbers at rates greater than 20 Mbit/s.

JWC50 • 4:30 p.m.
Optimal Bounded Error Strategies for Projective Measurements in Non-Orthogonal State Discrimination, *Max A. P. Touzel, Robert B. A. Adamson, Aephraim M. Steinberg; Dept. of Physics, Univ. of Toronto, Canada.* We present the experimentally relevant problem of discriminating states using projective measurements in schemes which interpolate between minimum error and unambiguous discrimination. We find the optimal projective measurement is comparable to the optimal generalized measurement.

JWC51 • 4:30 p.m.
Simple Probabilistic Non-Gaussian Operation on Two-Mode Squeezed Vacuum States, *Jonas Söderholm, Shuichiro Inoue; Nihon Univ., Japan.* We show that non-Gaussian operations on two-mode squeezed vacuum states can be realized by photon detection in one mode. This scheme is simpler than previous ones and result in lower minimum of the Wigner function.

JWC52 • 4:30 p.m.
Coherence Stability for a Three-Level System, *Luis Roa[1], Annette Kruegel[2]; [1]Ctr. for Quantum Optics and Quantum Information, Dept. de Física, Univ. de Concepción, Chile, [2]Inst. für Festkörpertheorie, Westfälische Wilhelms-Univ., Germany.* We have found, for a specific

model of interaction, an expression to estimate the decoherence time scale. We find for a symmetric cascade-system a bidimensional subspace whose states are stable against decoherence.

JWC53 • 4:30 p.m.

Entanglement Generation Using Two Counterpropagating Fields, *Byoung S. Ham; Inha Univ., Republic of Korea.* An entanglement generation is presented for on-demand quantum coherent control by using a pair of counterpropagating control fields in highly absorptive nonlinear optical medium under electromagnetically induced transparency conditions.

JWC54 • 4:30 p.m.

Mapping Continuous Variables Transverse Spatial Degrees of Freedom of Photons on a Spin ½ System, *Daniel S. Tasca[1], Alejo Salles[1], Fabricio Toscano[2], Stephen P. Walborn[1], Paulo H. Souto Ribeiro[1]; [1]Inst. de Física, Univ. Federal do Rio de Janeiro, Brazil, [2]Fundação Ctr. de Ciências e Educação Superior a Distância do Estado do Rio de Janeiro, Brazil.* Transverse spatial degrees of freedom of photons are mapped onto a spin ½ system. This task can be accomplished by dividing the transverse space into two semi-planes, and using fractional Fourier transform operations as rotations.

JWC55 • 4:30 p.m.

Heisenberg Limited Sagnac Interferometry with Higher Order Entanglement, *Aziz Kolkiran, Girish S. Agarwal; Oklahoma State Univ., USA.* We show how four photon entanglement and special detection scheme can be used for improving the sensitivity of Sagnac interferometer by a factor of four taking us towards Heisenberg limited measurements.

JWC56 • 4:30 p.m.

Entanglement Degradation of Biphotons Propagating in Turbulent Medium, *Kam Wai Clifford Chan[1], Malcolm N. O'Sullivan-Hale[1], Robert W. Boyd[1], Glenn A. Tyler[2]; [1]Inst. of Optics, USA, [2]Optical Sciences Co., USA.* We study the entanglement of transverse spatial coordinates of biphotons propagating through a turbulent medium. The degree of entanglement is quantified by calculating the second moments of the spatial coordinates.

JWC57 • 4:30 p.m.

Time Evolution of Entangled Excitonic State in Two Coupled Quantum Dots Interacting with a Squeezed Coherent Field, *Daniel B. Erenso[1], Arnab Mitra[2], Reeta Vyas[2], Surendra Singh[2]; [1]Middle Tennessee State Univ., USA, [2]Physics Dept., Univ. of Arkansas, USA.* For two coupled semiconductor quantum dots (QDs) initially prepared in a maximally entangled excitonic Bell state we have investigated quantum statistical properties when the QDs are interacting with a squeezed coherent light.

JWC58 • 4:30 p.m.

Bipartite Entanglement by Means of Dispersive Interactions, *Luis Roa[1], Rogelio Pozo[1,2], Marius Schaefer[1,3], Paola Utreras[1]; [1]Dept. de Física, Univ. de Concepción, Chile, [2]Dept. de Física, Tecnológico de Monterrey, Mexico, [3]Eidgenössisches Inst. für Schnee und Lawinenforschung, Switzerland.* We study the entanglement dynamics of two not interacting atoms coupled dispersively with the same single mode. In the high energy limit there is no entanglement, the initial entanglement is as suddenly recovered as removed.

JWC59 • 4:30 p.m.

Quantifying Quantum Information via Uncertainties, *Bariş Öztop, Alexander Klyachko, Alexander Shumovsky; Bilkent Univ., Turkey.* We show, for a state ψ of a quantum system with the dynamic symmetry given by the Lie group G, total amount of quantum information and entanglement is provided by summarized uncertainty of basic observables.

JWC60 • 4:30 p.m.

Two Photon Microscopy Enhanced by Anti-Bunching, *Ashok Muthukrishnan; Swarthmore College, USA.* Anti-bunching in two-photon correlations from a doubly driven Raman source is shown to have spatial periodicity comparable to optical two-slit interference. This can be applied to enhance microscopic resolution.

JWC61 • 4:30 p.m.

Photonic N00N States for Practical Quantum Interferometry, *Gerald Gilbert, Michael Hamrick, Yaakov S. Weinstein; MITRE, USA.* We show that an N photon attenuated separable state will produce a better phase estimate than an equally attenuated N00N state unless the transmittance of the medium is very high.

JWC62 • 4:30 p.m.

Quantum Correlations in Parametric Down-Conversion, *Vlasta Peřinová, Antonin Lukš; Palacký Univ., Czech Republic.* We focus on conditional and unconditioned joint distributions of the signal-mode photon numbers in two down-converters on the possible condition that the idler-mode photon number is known. Respective negative and positive correlations are explained.

JWC63 • 4:30 p.m.

Entangled Photon Spectroscopy and Communications Based on Semiconductor Two-Photon Process, *Alex Hayat, Pavel Ginzburg, Meir Orenstein; Dept. of Electrical Engineering, Technion, Israel.* We propose an entanglement-based scheme for spectroscopy and communications consisting of semiconductor two-photon emission entanglement source and two-photon absorption low-noise infrared detector having linear dependence and thus highly efficient for entangled photon pairs.

JWC64 • 4:30 p.m.

Multipartite Entanglement in Non-Equilibrium Quantum Phase Transition in a Collective Atomic System, *Kishor T. Kapale[1], Girish S. Agarwal[2]; [1]JPL, USA, [2]Oklahoma State Univ., USA.* We study multipartite entanglement in non-equilibrium quantum phase transition in a coherently driven atomic ensemble undergoing collective decay.

JWC65 • 4:30 p.m.

Qudits in Two Way Deterministic Quantum Key Distribution, *Jesni Shamsul Shaari[1], Mohamed Ridza Wahiddin[1,2], Stefano Mancini[3]; [1]Intl. Islamic Univ. Malaysia, Malaysia, [2]Information Security Lab, MIMOS Berhad, Malaysia, [3]Univ. of Camerino, Italy.* We consider the extension of the two way determinstic QKD protocols to qudits (quantum systems of d-dimensional Hilbert space) and note the security as well as practical efficiencies.

JWC66 • 4:30 p.m.

Numerical Simulation of Quantum Teleportation in a Chain of Three Nuclear Spins System Taking into Account Second Neighbor Iteration, *Gustavo López, Lorena Lara; Univ. of Guadalajara, Mexico.* For a chain of three nuclear spins, we make the numerical simulation of quantum teleportation including second neighbor spins-interaction. This interaction determines the Rabi's frequency to control the non-resonant effects.

JWC67 • 4:30 p.m.
Construction of Cluster States Using Graph State Equivalence Classes, *Gerald Gilbert, Michael Hamrick, Yaakov S. Weinstein; MITRE, USA.* We demonstrate an efficient method of constructing cluster state primitives by exploiting graph state equivalency class properties. We also present a recursion relation for photonic cluster chain length in terms of average resources required.

JWC68 • 4:30 p.m.
A Single-Photon Server with Just One Atom, *Markus Hijlkema[1], Bernhard Weber[1], Holger P. Specht[1], Simon C. Webster[1], Axel Kuhn[2], Gerhard Rempe[1]; [1]Max Planck Inst. for Quantum Optics, Germany, [2]Dept. of Physics, Univ. of Oxford, UK.* We trap a single atom in a cavity, and use it to produce a stream of up to 300,000 single photons. Such a single-photon server is useful for quantum information science.

● Thursday, June 14, 2007 ●

IThA—ICQI Plenary Session I

Hubbell Auditorium
8:30 a.m.–10:00 a.m.
IThA—ICQI Plenary Session I
Presider to Be Announced

IThA1 • 8:30 a.m. **●Plenary●**
The Interference of Signal and Idler Waves in Parametric Down-Conversion, *Luigi A. Lugiato, Enrico Brambilla, Alessandra Gatti; Univ. dell'Insubria, Italy.* We focus on Type I materials, in the regime of high gain. Following the quantum image approach, we show that the spatial correlation function of quadrature components displays the quantum features of the interference.

IThA2 • 9:00 a.m. **●Plenary●**
Quantum Information Processing with Trapped Ca^+ Ions — Multi-Particle Entanglement and Quantum Metrology, *Rainer Blatt; Leopold-Franzens Univ. Innsbruck, Austria.* Strings of trapped Ca^+ ions serve as a quantum register to produce and characterize multipartite quantum states. Using a decoherence-free subspace with specifically designed entangled states we demonstrate precision spectroscopy with two trapped Ca^+ ions.

IThA3 • 9:30 a.m. **● Plenary●**
Quantum Networks with Trapped Ions, *Christopher Monroe; Univ. of Michigan, USA.* No abstract available.

IThB—ICQI Oral Session III

Hubbell Auditorium
10:30 a.m.–12:00 p.m.
IThB—ICQI Oral Session III
Presider to Be Announced

IThB1 • 10:30 a.m. **●Invited●**
Shor's Algorithm with a Linear-Optics Quantum Computer, *Daniel F. V. James; Univ. of Toronto, Canada.* No abstract available.

IThB2 • 11:00 a.m.
Polarization-Sensitive Quantum-Optical Coherence Tomography with Entangled Photons, *Zhi Zhao, Kent A. Meyer, William B. Whitten, Robert W. Shaw; Oak Ridge Natl. Lab, USA.* We present an experimental demonstration of polarization-sensitive quantum-optical coherence tomography that not only provides the advantages of dispersion cancellation and resolution doubling, but also the capability for determining information about the birefringence of the sample.

IThB3 • 11:15 a.m.
Quantum Computation with Donor-Based Qubits in Silicon Cavities, *Ruynet L. Matos Filho[1], Miguel Abanto[2], Belita Koiller[1], Luiz Davidovich[1]; [1]Inst. de Física, Univ. Federal do Rio de Janeiro, Brazil, [2]Univ. Federal do Acre, Campus Floresta, Brazil.* We propose a scalable quantum computation scheme, which combines a silicon donor quantum computing architecture with the optical initialization, manipulation, and detection processes already demonstrated in ion traps.

IThB4 • 11:30 a.m.
Robust Quantum Searching with Spontaneously Decaying Qubits, *Robert J. C. Spreeuw, Tom W. Hijmans; Univ. of Amsterdam, Netherlands.* We show numerically for up to 36 qubits that weak spontaneous decay of qubits only weakly affects the performance of a single-item quantum search, provided that the algorithm is properly modified.

IThB5 • 11:45 a.m.
A General Linear-Optical Quantum State Generator, *Dmitry B. Uskov[1,2], Nickolas M. VanMeter[2], Pavel Lougovski[2], Jonathan P. Dowling[2], Jens Eisert[3], Konrad Kieling[3]; [1]Tulane Univ., USA, [2]Louisiana State Univ., USA, [3]Inst. for Mathematical Sciences, Imperial College, UK.* Linear-optical quantum state generator prepares a desired quantum state using product inputs from photon sources, linear-optical networks, and post-selection using photon counters. We solve the mathematical problem of constucting a generator for a desired state.

IThC—ICQI Oral Session IV

Landers Auditorium
10:30 a.m.–12:00 p.m.
IThC—ICQI Oral Session IV
Peter Reynolds; ARO Physics, USA, Presider

IThC1 • 10:30 a.m. **●Invited●**
Quantum Limits in Image Processing, *Claude Fabre[1], V. Delaubert[1], N. Treps[1], H. A. Bachor[2], P. Réfrégier[3]; [1]Univ. de Paris VI, France, [2]ARC Ctr. of Excellence for Quantum-Atom Optics, Australian Natl. Univ., Australia, [3]Fresnel Inst., France.* We determine the general limit to the maximum achievable sensitivity in the estimation of a parameter from the information contained in an optical image in the presence of quantum noise, either coherent or squeezed.

IThC2 • 11:00 a.m.
Large Optical Pulse Delays in Cesium Vapor, *Ryan Camacho, A. Schweinsberg, M. V. Pack, J. C. Howell, R. W. Boyd; Univ. of Rochester, USA.* We report on a recent demonstration of the large tunable delays of optical pulses in cesium vapor.

IThC3 • 11:15 a.m.
Quantum Imaging with Incoherent Photons, *Joachim von Zanthier[1], Christoph Thiel[1], Thierry Bastin[1], Enrique Solano[2], Girish S. Agarwal[3]; [1]Inst. for Optics, Information and Photonics, Germany, [2]Physics Dept., ASC and CeNS, Ludwig-Maximilians-Univ., Germany, [3]Dept. of Physics, Oklahoma State Univ., USA.* We propose a technique to obtain sub-wavelength resolution in imaging with 100% contrast using incoherent light. We can obtain a resolution of λ/N using coincidence detection of N photons emitted from N excited atoms.

IThC4 • 11:30 a.m.
High-Sensitivity Imaging with Quantum Spatial Correlation of Twin Beams, *Alessandra Gatti[1], Enrico Brambilla[2], Lucia Caspani[2], Ottavia Jedrkiewicz[2], Luigi A. Lugiato[2]; [1]CNR-CNISM, Univ. of Insubria, Italy, [2]CNISM, Univ. of Insubria, Italy.* We propose an imaging scheme based on the quantum spatial correlation of twin beams generated by PDC, and we show that it provides a substantial enhancement of the signal-to-noise ratio with respect to classical schemes.

IThC5 • 11:45 a.m.
Spatial Measurements Beyond Classical Limit, *Jörg Evers; Max-Planck-Inst. für Kernphysik, Germany.* We discuss spatial measurements with sub-wavelength precision using far-field

imaging techniques only. Apart from localization, our observables are center-of-mass wavefunction for single particles, interparticle distance for pairs, and ensemble properties for many particles.

12:00 p.m.–1:30 p.m.
Lunch Break

IThD—ICQI Plenary Session II

Hubbell Auditorium
1:30 p.m.–2:30 p.m.
IThD—ICQI Plenary Session II
James Franson; Univ. of Maryland, Baltimore County, USA, Presider

IThD1 • 1:30 p.m. **•Plenary•**
Imaging with Phase-Sensitive Light, *Jeffrey H. Shapiro, Baris I. Erkmen; MIT, USA.* We show that almost all the characteristics of quantum optical coherence tomography and quantum ghost imaging are due to phase-sensitive cross correlations, and hence are obtainable with classical phase-sensitive sources.

IThD2 • 2:00 p.m. **•Plenary•**
Towards Quantum Simulation with Neutral Atoms in Optical Lattices, *Carl J. Williams, Kaushik Mitra, Carlos A. Sa de Melo; Univ. of Maryland, NIST, USA.* A key approach to initializing a neutral atom quantum computer is the superfluid to Mott-insulating quantum phase transition. This paper elucidates the wedding cake structure when Bosonic atoms are in a harmonically confined optical lattice.

IThE—ICQI Oral Session V

Hubbell Auditorium
2:45 p.m.–3:30 p.m.
IThE—ICQI Oral Session V
Mikhail Lukin; Harvard Univ., USA, Presider

IThE1 • Paper withdrawn.

IThE2 • 2:45 p.m.
Entangled States of Photon Pairs from Radiative Cascades in Semiconductor Quantum Dots, *Netanel H. Lindner[1], Eli Meirom[1], Nikolay Akopian[1], E. Poem[1], Joseph Avron[1], David Gershoni[1], Brian Geradot[2], Pierre M. Petroff[2]; [1]Technion- Israel Inst. of Technology, Israel, [2]Univ. of California at Santa Barbara, USA.* The polarization state of pairs of photons resulting from the biexciton decay cascade becomes entangled when spectral filtering is applied. The phase in the density matrix is shown to result from the spectral filtering process.

IThE3 • 3:00 p.m.
Room-Temperature Single Photon Sources with Fluorescent Emitters in Liquid Crystal Hosts, *Svetlana G. Lukishova[1], Luke J. Bissell[1], Simon K. H. Wei[2], Ansgar W. Schmid[3], Zhimin Shi[1], Heedeuk Shin[1], Russell Knox[4], Patrick Freivald[4], Robert W. Boyd[1], Carlos R. Stroud, Jr[1], Shaw H. Chen[2], Kenneth L. Marshall[3]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]Dept. of Chemical Engineering, Univ. of Rochester, USA, [3]Lab for Laser Energetics, Univ. of Rochester, USA, [4]Dept. of Physics and Astronomy, Univ. of Rochester, USA.* A single-photon source on demand based on single CdSe quantum-dot fluorescence in a chiral-photonic-bandgap liquid-crystal microcavity manifests itself in observed fluorescence antibunching. The aligned liquid crystal host also provides deterministically polarized fluorescence of single emitters.

IThE4 • 3:15 p.m.
Quantum Electrodynamics for Surface Plasmons, *Jérémie Choquette, Karl-Peter Marzlin, René Stock, Barry C. Sanders; Inst. for Quantum Information Science, Univ. of Calgary, Canada.* A full quantum description of photons and surface plasmons (SP) near an interface between lossy dielectrics is given, allowing estimation of SP-induced noise. The emitted radiation of a decaying atom near the interface is characterized.

IThF—ICQI Oral Session VI

Landers Auditorium
2:30 p.m.–3:15 p.m.
IThF—ICQI Oral Session VI
Christopher Monroe; Univ. of Michigan, USA, Presider

IThF1 • 2:30 p.m.
Experimental Direct Characterization of a Quantum Process, *Robert B. Adamson, Aephraim M. Steinberg; Physics Dept., Univ. of Toronto, Canada.* We present the first experimental implementation of Direct Quantum Process Tomography. Direct tomography uses ideas from quantum error correction to reduce the number of experimental configurations required to characterize a quantum process.

IThF2 • 2:45 p.m.
Experimental Determination of Entanglement by a Projective Measurement, *Stephen P. Walborn[1], Paulo H. Souto Ribeiro[1], Luiz Davidovich[1], Florian Mintert[1,2,3], Andreas Buchleitner[3]; [1]Inst. de Física - Univ. Federal do Rio de Janeiro, Brazil, [2]Dept. of Physics, Harvard Univ., USA, [3]Max-Planck Inst. für Physik Komplexer Systeme, Germany.* We show that entanglement can be measured by projective measurements on two copies of a bipartite state. We present the experimental realization of this scheme, using two copies encoded into a pair of photons.

IThF3 • 3:00 p.m.
High-Efficiency Source of a Three-Photon W State and Its Full Characterization Using Quantum State Tomography, *Takayoshi Kobayashi[1,2,3,4], Hideharu Mikami[1,2], Yongmin Li[1,2], Kyosuke Fukuoka[1,2]; [1]Core Res. for Evolutional Science and Technology (CREST), Japan Science and Technology Agency (JST), Japan, [2]Dept. of Physics, Graduate School of Science, Univ. of Tokyo, Japan, [3]Dept. of Applied Physics and Inst. of Laser Res., Univ. of Electro-Communications, Japan, [4]Dept. of Electrophysics, Advanced Ultrafast Laser Ctr., Natl. Chiao-Tung Univ., Taiwan.* We proposed and demonstrated a new high-efficiency generation scheme of the three-photon polarization-entangled W state, which is one of two typical three-qubit entangled states. The obtained state is characterized using a method of quantum-state tomography.

IThF4 • Paper withdrawn.

3:30 p.m.–4:00 p.m.
Coffee Break

IThG—ICQI Oral Session VII

Hubbell Auditorium
4:00 p.m.–6:30 p.m.
IThG—ICQI Oral Session VII
Peter Haaland; DARPA, USA, Presider

IThG1 • 4:00 p.m. ●Invited●

Nonlinear Quantum Optics in Micro-Ring Resonators: Promise and Problems, *John Sipe, Zhenshan Yang; Univ. of Toronto, Canada.* We show that second-order nonlinear optical effects can be greatly enhanced in microring-resonator structures even in the presence of material and modal dispersion, without the need for artificially structuring the nonlinear properties of the waveguides.

IThG2 • 4:30 p.m. ●Invited●

Linear Optical Quantum Information Processing, Imaging and Sensing, *Jonathan Dowling; Louisiana State Univ., USA.* We investigate linear optical approaches to quantum information processing, clarifying how linear optics and projective measurements can be used to create designer optical nonlinearities at the few photon level.

IThG3 • 5:00 p.m. ●Invited●

Qubus Computation, *Samuel L. Braunstein[1], W. J. Munro[2,3], G. J. Milburn[4], Kae Nemoto[3], T. P. Spiller[2], P. van Loock[3]; [1]York Univ., UK, [2]Hewlett-Packard Labs, UK, [3]Natl. Inst. of Informatics, Japan, [4]Ctr. for Quantum Computer Technology, Univ. of Queensland, Australia.* We present a proposal for hybrid quantum computation where qubits store the quantum information, but all communication, including the qubit-qubit couplings is mediated by a continuous-variable mode (the "qubus"). Only typical light-atom interactions are used.

IThG4 • 5:30 p.m. ●Invited●

Quantum Lithography and Microscopy, *M. Suhail Zubairy[1,2]; [1]Texas A&M Univ., USA, [2]Texas A&M Univ. at Qatar, Qatar.* We discuss two related problems: qauntum lithography with classical light and the precision measurement of small separations between two atoms or molecules placed in a standing wave laser field.

IThG5 • 6:00 p.m.

Towards Real-World Quantum Teleportation over Existing Telecommunication Networks, *Jeroen V. Houwelingen, Olivier Landry, Alexios Beveratos, Hugo Zbinden, Nicolas Gisin; Univ. of Geneva, Switzerland.* We present our recent work towards a real-world quantum teleportation experiment. We performed an experiment over 800m with prior entanglement distribution and we present what further elements are required and our progress towards realizing them.

IThG6 • 6:15 p.m.

Coherent Communication of Continuous Quantum Variables with Linear Optics, *Mark M. Wilde[1], Hari Krovi[1], Jonathan P. Dowling[2,3], Todd A. Brun[1]; [1]Univ. of Southern California, USA, [2]Louisiana State Univ., USA, [3]Inst. for Quantum Studies, Dept. of Physics, Texas A&M Univ., USA.* We provide experimental proposals for coherent communication with linear optics. The first proposal suggests a linear-optical scheme for coherent superdense coding. The second proposal gives a linear-optical coherent teleportation scheme.

IThH—ICQI Oral Session VIII

Landers Auditorium
4:00 p.m.–6:30 p.m.
IThH—ICQI Oral Session VIII
Gerard Milburn; Univ. of Queensland, Australia, Presider

IThH1 • 4:00 p.m. ●Invited●

Deriving Optimal Measurements from the No-Signalling Theorem, *Stephen M. Barnett, Erika Andersson, Sarah Croke; Univ. Strathclyde, UK.* We shall show how the no-signalling theorem can be used to place tight bounds on a number of quantum measurement strategies.

IThH2 • 4:30 p.m. ●Invited●

Quantum Communication with Photon Number Resolved Detection and Waveguided Parametric Downconversion, *Christine Silberhorn[1], Wolfgang Mauerer[1], Malte Avenhaus[1], Andreas Eckstein[1], Patrick Bronner[1], Hendrik Coldenstrodt-Ronge[2], Ian A. Walmsley[2]; [1]Max-Planck-Inst. für Optik, Germany, [2]Clarendon Lab, UK.* We investigate the photon number statistics of a wave-guided parametric downconversion source with a fiber based, time multiplexed detector. Our setup is particularly suited for a quantum key distribution scheme with passive decoy state preparation.

IThH3 • 5:00 p.m. ●Invited●

Towards Long-Distance Quantum Communication, *Wolfgang Tittel[1], M. Afzelius[2], N. Gisin[2], R. Ricken[3], S. Hastings-Simon[2], V. Scarani[2], H. Suche[3], W. Sohler[3], M. Staudt[2]; [1]Univ. of Calgary, Canada, [2]Univ. of Geneva, Switzerland, [3]Univ. of Paderborn, Germany.* We study Erbium-doped $LiNbO_3$ waveguides for storage and readout of light pulses based on stimulated photon-echoes. Our results are promising in view of storage of single-photon quantum states as required for a quantum repeater.

IThH4 • 5:30 p.m. ●Invited●

Quantum Information Processing in a System of Trapped Ions, *D. Leibfried, J. Amini, R. B. Blakestadt, J. J. Bollinger, J. Britton, K. R. Brown, J. Chiaverini, R. Epstein, J. Home, W. M. Itano, J. D. Jost, E. Knill, C. Langer, C. Ospelkaus, R. Ozeri, R. Reichle, S. Seidelin, N. Shiga, J. H. Wesenberg, D. J. Wineland; Natl. Inst. of Standards and Technology, USA.* Atomic ions in interconnected traps represent a potentially scalable approach to quantum information processing. Scaling the system to many qubits while minimizing errors requires extremely challenging technological improvements, but no fundamental roadblocks are currently foreseen.

IThH5 • 6:00 p.m.

Generation of Ultra-Broadband Spontaneous Parametric Down Conversion from Chirped Periodically Poled Near-Stoichiometric Lithium Tantalate, *Magued Nasr[1], Alexander Sergienko[1], Bahaa Saleh[1], Silvia Carrasco[2], Malvin Teich[1], David Hum[3], Martin Fejer[3]; [1]Boston Univ., USA, [2]Harvard Univ., USA, [3]Stanford Univ., USA.* We measure the ultra-broadband spectrum of collinear spontaneous parametric down conversion (SPDC) generated in chirped periodically poled near-stoichiometric lithium tantalate (C-PPSLT) gratings. The spectral broadening is accompanied by a decrease in the photon flux.

IThH6 • 6:15 p.m.

Towards Highly Entangled Two Photon States: Observation of Ultra-Broadband Parameteric Downconversion, *Kevin A. O'Donnell, Alfred B. U'Ren; Ctr. de Investigacion Cientifica y Educacion Superior de Ensenada (CICESE), Mexico.* We demonstrate a parametric downconversion source with an exceptionally large bandwidth (1080nm full-width half-maximum about the 1885nm degenerate wavelength), as a step towards the generation of photon pairs with high dimensional entanglement.

● Friday, June 15, 2007 ●

IFA—ICQI Plenary Session III

Hubbell Auditorium
8:30 a.m.–10:00 a.m.
IFA—ICQI Plenary Session III
Jeffrey H. Shapiro; MIT, USA, Presider

IFA1 • 8:30 a.m. **●Plenary●**
Qubits, Qutrits and Gaussian States in Noisy Quantum Channels, *Krzysztof Wodkiewicz; Warsaw Univ., Poland.* Entanglement for qubits, qutrits and Gaussian states in quantum channels is investigated. The channels involve stochastic noise with zero-bandwidth or spontaneous emission. Exact results concerning entanglement of Werner states in such channels are presented.

IFA2 • 9:00 a.m. **●Plenary●**
Quantum Entanglement of Singular Photons, *J. P. Woerdman, J. B. Pors, S. S. R. Oemrawsingh, M. P. van Exter, A. Aiello, G. W.'t Hooft, E. R. Eliel; Univ. Leiden, Netherlands.* We manipulate the azimuthal degrees of freedom of twin photons by rotating singular quantum projectors in signal and idler beams of a SPDC set-up. This allows generation of high-dimensional entangled two photon states.

IFA3 • 9:30 a.m. **●Plenary●**
Advanced Quantum Communication, *Paul Kwiat, J. Altepeter, J. Barreiro, E. Jeffrey, R. Rangarajan, A. VanDevender, M. Wayne, T.-C. Wei; Univ. of Illinois, USA.* Recent advances for optical quantum information processing, including hyperentangled photon sources, quantum memories, high-speed quantum random number generators, and high-efficiency detectors, enable new capabilities in quantum communication, such as high-yield quantum key distribution and dense-coding.

10:00 a.m.–10:30 a.m.
Coffee Break

IFB—ICQI Oral Session IX

Hubbell Auditorium
10:30 a.m.–12:00 p.m.
IFB—ICQI Oral Session IX
Presider to Be Announced

IFB1 • 10:30 a.m. **●Invited●**
Efficient Fault Tolerant Optical Quantum Computing, *A. P. Lund[1], H. Hasselgrove[2], Tim C. Ralph[1]; [1]Univ. of Queensland, Australia, [2]Information Sciences Labs, Defence Science and Technology Organisation, Australia.* We show that linear optics quantum computing based on coherent state qubits can be made fault tolerant. The resource overhead is found to be significantly smaller than single photon schemes.

IFB2 • 11:00 a.m.
Quantum Logic With Quantized Fields: Beyond the 1/n Limit? *Julio Gea-Banacloche; Univ. of Arkansas, USA.* A formal Hamiltonian is presented that allows quantum logic with quantized fields beyond the 1/n error level, if the field is in a number state. The possibility of realizing this Hamiltonian approximately is discussed.

IFB3 • 11:15 a.m.
Efficient Quantum Logic Circuits: Or, How I Learned to Stop Worrying and Love Hilbert Space, *Andrew G. White[1], Marcelo Pereira de Almeida[1], Marco Barbieri[1], Devon N. Biggerstaff[1], Rohan B. Dalton[1], Alexei Gilchrist[1], Geoffrey Gillett[1], Daniel F. V. James[2], Nathan K. Langford[1], Benjamin P. Lanyon[1], Kevin J. Resch[3], Till Weinhold[1]; [1]Univ. of Queensland, Australia, [2]Univ. of Toronto, Canada, [3]Univ. of Waterloo, Canada.* We demonstrate significantly compacted quantum algorithms and demonstrate a Fock-state filter by going outside the qubit corner of Hilbert space. We obtain a complete error budget for an entangling gate when driven with independent photons.

IFB4 • 11:30 a.m.
Compact Optical Generation of Continuous-Variable Graph States, *Olivier Pfister[1], Nicolas C. Menicucci[2,3], Steven T. Flammia[4], Hussain Zaidi[1]; [1]Univ. of Virginia, USA, [2]Princeton Univ., USA, [3]Univ. of Queensland, Australia, [4]Univ. of New Mexico, USA.* We report on our current efforts to compactly generate Gaussian continuous-variable graph states, with the goal to create large-scale cluster states for one-way quantum computing.

IFB5 • 11:45 a.m.
Shining Light over Mathematical Abstractions: A Direct Measurement of the Geometry of Entanglement, *Daniel Cavalcanti[1], Pablo L. Saldanha[2], Olavo Cosme Silva[2], Fernando Guadalupe Santos Lins Brandão[3,4], Marcelo Oliveira Terra Cunha[5,6], Marcelo Paleólogo França Santos[2], Carlos Henrique Monken[2], Sebastião José Nascimento Pádua[2]; [1]ICFO-Inst. de Ciencies Fotoniques, Spain, [2]Dept. de Física, Univ. Federal de Minas Gerais, Brazil, [3]QOLS, Blackett Lab, Imperial College, UK, [4]Inst. for Mathematical Sciences, Imperial College London, UK, [5]Dept. de Matemática, Univ. Federal de Minas Gerais, Brazil, [6]School of Physics and Astronomy, Univ. of Leeds, UK.* We develop a general approach to investigate the geometry of the set of different kinds of entangled states. We provide the first measurements of the border of the set of separable states for two qubits.

IFC—ICQI Oral Session X

Landers Auditorium
10:30 a.m.–12:00 p.m.
IFC—ICQI Oral Session X
Paul Kwiat; Univ. of Illinois, USA, Presider

IFC1 • 10:30 a.m. **●Invited●**
Engineering Robust Optical Entanglement for Quantum Communication, *Alexander Sergienko, Martin Jaspan, Olga Minaeva, Bahaa E. A. Saleh, Malvin C. Teich; Boston Univ., USA.* A robust source of polarization-entangled photons for quantum communication at telecom wavelength is implemented. The benefits of using Superconducting Photon Counting Detectors (SSPD) have been evaluated.

IFC2 • 11:00 a.m.
Strong Anisotropy, Unusually Narrow Coincidence Angular Distributions, and Very High Degree of Entanglement of SPDC Biphotons, *Mikhail Fedorov[1], Petr Volkov[1], Maxim Efremov[1], Ekaterina Moreva[2], Stanislav Straupe[3], Sergei Kulik[3]; [1]General Physics Inst., Russian Federation, [2]Moscow Engineering Physics Inst. (State Univ.), Russian Federation, [3]Moscow State Univ., Russian Federation.* Conditions are found when the coincidence angular distribution of SPDC biphotons is much narrower than earlier assumed and, it's shown to depend

strongly on the crystal orientation. The effect is predicted theoretically and observed experimentally.

IFC3 • 11:15 a.m.
Photon-Number Entanglement in Twin Beams Generated in Spontaneous Parametric Down-Conversion, *Jan Perina Jr., Ondrej Haderka, Martin Hamar, Jan Perina, Vaclav Michalek; Joint Lab of Optics, Czech Republic.* Joint signal-idler photon-number distribution and quantum phase-space quasi-distributions are measured for light generated in intense spontaneous parametric down-conversion. Entanglement in the signal- and idler-photon numbers is observed.

IFC4 • 11:30 a.m.
Exploring Non-Conservation of Angular Momentum in Spontaneous Parametric Down-Conversion, *Sheng Feng, Chao-Hsiang Chen, Geraldo A. Barbosa, Prem Kumar; Northwestern Univ., USA.* We propose an efficient method to measure the total angular momentum of down-converted beams in cases when the angular momentum is not conserved due to azimuthal asymmetry in spontaneous parametric down-conversion.

IFC5 • 11:45 a.m.
Spontaneous Parametric Down-Conversion in Structured Environments, *Ryan S. Bennink; Oak Ridge Natl. Lab, USA.* I analyze, in a general and quantitative way, the ability of transverse and longitudinal structure in an optical system to enhance the flux and modal purity of spontaneous parametric down-conversion.

12:00 p.m.–1:30 p.m.
Lunch Break

IFD—ICQI Plenary Session IV

Hubbell Auditorium
1:30 p.m.–2:30 p.m.
IFD—ICQI Plenary Session IV
Krzysztof Wodkiewicz; Inst. of Theoretical Physics, Poland, Presider

IFD1 • 1:30 p.m. **•Plenary•**
Continuous Variable Amplification and Cloning, *Gerd Leuchs[1], Metin Sabuncu[2], Ulrik L. Andersen[2]; [1]Inst. für Optik, Information und Photonik, Germany, [2]Dept. of Physics, Technical Univ. of Denmark, Denmark.* Quantum limited amplification and cloning of coherent states and their phase conjugates are demonstrated using linear optics, detection and feed forward to modulators.

IFD2 • 2:00 p.m. **•Plenary•**
Tools for Spatial Multimode Quantum Optics, *Hans Albert Bachor[1], M. Lassen[2], V. Delaubert[3], J. Janousek[2], K. Wagner[1], H. Zou[1], P. K. Lam[1], N. Treps[3], P. Buschhave[2], C. Fabre[3], C. C. Harb[1]; [1]Australian Natl. Univ., Australia, [2]Dept. of Physics, Technical Univ. of Denmark, Denmark, [3]Lab Kastler Brossel, France.* The spatial properties of laser beams can be used to encode, transfer and detect quantum information into high order modes with high efficiency. We demonstrate the use of such states, including spatial squeezing and entanglement.

IFE—ICQI Oral Session XI

Hubbell Auditorium
2:30 p.m.–3:30 p.m.
IFE—ICQI Oral Session XI
Daniel F. V. James; Univ. of Toronto, Canada, Presider

IFE1 • 2:30 p.m.
Relativistic Quantum Cryptography with Optical Storage, *Evan R. Jeffrey[1], Joseph B. Altepeter[2], Paul G. Kwiat[1]; [1]Univ. of Illinois at Urbana Champaign, USA, [2]Northwestern Univ., USA.* Using a low-loss optical storage loop and polarization entangled photons, we demonstrate a quantum cryptography protocol in which the sifting step is eliminated and every photon may contribute to the final key.

IFE2 • Paper withdrawn.

IFE3 • 3:00 p.m.
Quantum Key Distribution with Bright Twin Beams, *Katiuscia N. Cassemiro, Alessandro S. Villar, Jonatas E. S. Cesar, Nadja K. Bernardes, Marcelo Martinelli, Paulo A. Nussenzveig; Inst. de Física, Univ. de São Paolo, Brazil.* We have implemented quantum key distribution with bright twin beams produced by an optical parametric oscillator. Switching between amplitude and phase quadrature measurements is done by self-homodyne detection without local oscillators.

IFE4 • 3:15 p.m.
Quantum Mutual Information and the One-Time Pad, *Benjamin Schumacher[1], Michael D. Westmoreland[2]; [1]Kenyon College, USA, [2]Denison Univ., USA.* Quantum mutual information is a measure of the correlation between subsystems of a joint quantum system. We exhibit a quantum cryptographic protocol that provides an operational meaning for quantum mutual information.

IFF—ICQI Oral Session XII

Landers Auditorium
2:30 p.m.–3:30 p.m.
IFF—ICQI Oral Session XII
J. P. (Han) Woerdman; Univ. Leiden, Netherlands, Presider

IFF1 • 2:30 p.m.
Quantum Interference of Electromagnetic Fields from Two Remote Trapped Atomic Ions, *Dzmitry Matsukevich, Peter Maunz, David Moehring, Steve Olmschenk, Kelly Younge, Christopher Monroe; Univ. of Michigan, USA.* We observe quantum Hong-Ou-Mandel interference between electromagnetic fields emitted from two remote trapped ytterbium ions. This result points the way toward scaling to large entangled networks of remote qubits.

IFF2 • 2:45 p.m.
Realizing Three-Qubit Quantum-Gate Operation in a Cavity-QED System, *Amitabh Joshi, Min Xiao; Dept. of Physics, Univ. of Arkansas, USA.* Three-qubit quantum phase-gate and C^2-NOT gate realization in a cavity-QED system is proposed where highly detuned field modes interact with a four-level system in an inverted-Y configuration. Its potential application to Grover's algorithm is discussed.

IFF3 • 3:00 p.m.
Remote Preparation of a Single Atom Quantum Memory, *Markus Weber[1], Stefan Berner[1], Wenjamin Rosenfeld[1], Jürgen Volz[1], Harald Weinfurter[1,2]; [1]Dept. für Physik, Ludwig-Maximilians-Univ. München, Germany, [2]Max-Planck Inst. für Quantenoptik, Germany.* Here, using atom-photon entanglement, we experimentally demonstrate the preparation of a distant single atom quantum memory via a quantum teleportation protocol. We evaluated the performance by a full tomography of the prepared atomic state.

IFF4 • 3:15 p.m.
Experimental Generation of Broadband Quadrature Entanglement Using Laser Pulses, *Yun Zhang, Ryuhi Okubo, Tatsuya Fututa, Takuya Hirano; Dept. of Physics, Gakushuin Univ., Japan.* We report the generation of broadband pulsed quadrature entanglement by combing two squeezed vacua with squeezing of 3.4±0.2 dB and bandwidth of 200 MHz, which are generated from two degenerate optical parametric amplifiers.

3:30 p.m.–4:00 p.m.
Coffee Break

IFG—ICQI Oral Session XIII

Hubbell Auditorium
4:00 p.m.–6:00 p.m.
IFG—ICQI Oral Session XIII
Gerd Leuchs; Inst. für Optik, Information und Photonik, Germany, Presider

IFG1 • 4:00 p.m. **●Invited●**
Quantum Limits of Superresolution for Imaging of Discrete Subwavelength Structures, *Mikhail Kolobov; Univ. de Lille, France.* We present quantum theory of superresolving imaging of discrete subwavelength structures. We demonstrate that the standard quantum limit of superresolution for imaging of such structures is much higher than for continuous objects.

IFG2 • 4:30 p.m. **●Invited●**
Towards Multimode Memories with Atomic Ensembles in the Solid State, *Hugues de Riedmatten, Christoph Simon, Sara Hastings-Simon, Matthias Staudt, Jiří Minář, Björn Lauritzen, Nicolas Sangouard, Mikael Afzelius, Nicolas Gisin; Group of Applied Physics, Univ. of Geneva, Switzerland.* Atomic ensembles in the solid state using rare-earth ion doped materials can be used to implement a quantum memory for the storage of multiple temporal modes. First experimental steps will be presented.

IFG3 • 5:00 p.m. **●Invited●**
Bell's Inequality Tests and Quantum Communication with Entangled Photon Holes, *Todd B. Pittman, James D. Franson; Univ. of Maryland, Baltimore County, USA.* We report on experimental work towards the realization of quantum communication with entangled photon holes. These experiments involve two-photon interferometry and photon hole states generated through quantum interference effects.

IFG4 • 5:30 p.m.
Loss of Quantum Information Due to the Kerr Effect in Optical Fibers, *Armando N. Pinto[1], Govind P. Agrawal[2]; [1]Univ. of Aveiro, Inst. of Telecommunications, Portugal, [2]Inst. of Optics, Univ. of Rochester, USA.* We quantify and analyze the growth of quantum noise in a Kerr medium, and show how this effect limits the capability of transmitting information over optical fibers at the most fundamental level.

IFG5 • 5:45 p.m.
Micro-Structured Fibers for Quantum Information, *Jeremie Fulconis[1], Olivier Alibart[1], Jeremy L. O'Brien[1], John G. Rarity[1], William J. Wadsworth[2]; [1]Univ. of Bristol, UK, [2]Univ. of Bath, UK.* We report on a versatile source of photon pairs for quantum information applications based on micro-structured fibres. We confirm the suitability of the source by demonstrating high non-classical interference and entangled photon pair emission.

IFH—ICQI Oral Session XIV

Landers Auditorium
4:00 p.m.–5:30 p.m.
IFH—ICQI Oral Session XIV
Hans Albert Bachor; Australian Natl. Univ., Australia, Presider

IFH1 • 4:00 p.m. **●Invited●**
Quantum Imaging, *Yanhua Shih; Univ. of Maryland, Baltimore County, USA.* Quantum imaging has demonstrated two peculiar features: (1) reproducing ghost images in a nonlocal manner, and (2) enhancing spatial resolution beyond diffraction limit. This talk will review the history and emphasize its non-classical nature.

IFH2 • 4:30 p.m. **●Invited●**
All-Optical Manipulation and Control: Towards Coherent Transport of Atomic Ensembles, *I. V. Arakelyan[1,2], N. Chattrapiban[1,2], S. Mitra[1,3], Wendell T. Hill[1,2,3]; [1]Joint Quantum Inst., Univ. of Maryland, USA, [2]Dept. of Physics, Univ. of Maryland, USA, [3]Inst. for Physical Science & Technology, USA.* We introduce a *tunnel lock* that when used in conjunction with blue-detuned optical tunnels can divide, delay and shift traveling clouds of cold atoms. We show that Rb atoms can be manipulated without heating with an efficiency limited by the overlap volume.

IFH3 • 5:00 p.m. **●Invited●**
Conservation and Entanglement of Orbital Angular Momentum of Light in Parametric Downconversion, *Carlos H. Monken; Univ. Federal de Minas Gerais, Brazil.* No abstract available.

IFH4 • 5:30 p.m. **●Invited●**
All-Optical Delay of Images Using Slow Light, *Ryan Camacho, Curtis Broadbent, Irfan Ali Khan, John Howell; Univ. of Rochester, USA.* We will report on slow light experiments in which both quantum and classical images were delayed in hot vapors. We will show that key properties of the images were preserved in the process.

CQO9/ICQI Key to Authors and Presiders

(Bold denotes presider or presenting author; sessions are listed in alphabetical order)