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Nanotechnology Forum

Quantum Communication

The First of the Quantum Information Industries

DISTINGUISHED SPEAKERS

Bob Gelfond, CEO, MagiQ
Dr. Richard Hughes, Laboratory Fellow, Los Alamos National Laboratory
Prof. Yoshihisa Yamamoto, Stanford University
Dr. Colin Williams, Program Manager Advanced Computing Paradigms, Jet Propulsion Labs

MODERATOR & EVENT CHAIR

Richard Gordon, President, T-Zero Engineering

VENUE

NASA Ames Research Center, Building 943
October 20, 2005
6:00-9:30 pm

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AGENDA

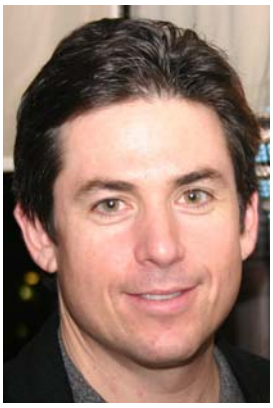
6:00 – 6:50 pm	Registration, Refreshments and Networking
7:00 – 7:05 pm	Introduction ***Richard Gordon**, Moderator and Event Chair*
7:05 – 9:00 pm	Speaker presentations
9:00 – 9:30 pm	Q&A session

ABSTRACT

Twenty years since the initial discoveries of quantum cryptography, quantum communication is flourishing and not all of it just in research. Efforts are ongoing in quantum cryptography, photonics, quantum electronics, materials science, and quantum information theory. In quantum cryptography, for instance, a party exchanging encryption keys is guaranteed by quantum key distribution (QKD) to be alerted to the nefarious aims of a third-party eavesdropper. At least two startup companies are already commercializing this security feature. More exotic quantum communications, such as quantum teleportation, have only recently been demonstrated in the lab but are already being designed into the fascinating quantum networks of research quantum computers. Components crucial to the creation of a quantum communication infrastructure, such as higher-bandwidth single photon sources and detectors, are being constructed out of engineered structures like nano-scale quantum dots and photonic band-gap crystals. All of these trends are converging to deliver brighter, exotic states of entangled light over longer distances.

SPEAKER BACKGROUND INFORMATION

Bob Gelfond, MagiQ



Abstract:

The impacts of quantum engineering and quantum information processing (QIP) are just beginning to reverberate throughout the technology industry. As the space begins to mature, many of the technologies are ripe for commercialization. In the case of quantum cryptography, they are already being brought to market.

This talk will describe the basics of quantum information processing; the potential impacts of such technologies in the 21st century; and will explain how MagiQ's quantum cryptography solution operates (Quantum Private Network.)

This presentation will address:

- The basics of quantum information processing
- What near and longer term potential exists for commercial applications of QIP
- Why quantum key distribution is needed now
- Sample deployments and configurations of MagiQ's quantum key distribution product, the Quantum Private Network (QPN™) 7505

Bio:

Bob Gelfond provides the vision and leadership which have established MagiQ's reputation as a next-generation technology leader with its pioneering work in commercializing quantum information processing.

Prior to founding MagiQ in 1999, Bob had extensive experience evaluating and investing in early-stage, high technology companies. An active angel, he was a first-round investor in Amazon.com, Vindigo, and CoAxia. Bob was also a first-round investor and sits on the Board of Directors of Actuality Systems, Inc. – manufacturers of spatial 3D displays.

Before founding MagiQ, Bob enjoyed a very successful career on Wall St. He was a Managing Director at Millennium Partners, L.P. from 1992-1998, where he developed proprietary quantitative financial forecasting and risk models. His track record of profitable portfolio management earned him the highest documented Sharpe ratio (risk-adjusted returns) of any trader in the industry in 1995 and 1996.

Prior to Millennium Partners, Bob was Director of International Trading at D. E. Shaw & Co, from 1989-1992. There, he was in charge of research, development, and implementation of a series of successful trading and arbitrage strategies in the global financial markets.

In 1982, Bob founded Statistical Analysis Research and Development Co. where he developed revolutionary trading strategies for stock index futures and options.

Bob graduated from the University of Virginia with degrees in Mathematics and Economics in 1981.

SPEAKER BACKGROUND INFORMATION

Richard J. Hughes, Los Alamos National Laboratory

Abstract:

"Quantum Key Distribution"

I will describe the background, basic principles, and significance of quantum key distribution (QKD), as well as its potential information assurances applications in secure satellite communications and in optical fiber networks. I will illustrate these points with the results of QKD experiments performed by our Los Alamos QKD team and collaborators over the past 12 years. Finally, I will describe a quantum cryptography research roadmap, which sets out desired goals for this field over the next decade (http://qist.lanl.gov).

Bio:

Dr. Richard J. Hughes is a Laboratory Fellow in the Physics Division at Los Alamos National Laboratory. He is co-principal investigator of projects in both free-space and optical fiber based quantum key distribution and holds two US patents in these areas. Richard obtained his Ph.D. in Theoretical Elementary Particle Physics from the University of Liverpool, England in 1978 and has held research positions at: Oxford University and The Queen's College, Oxford; the California Institute of Technology; and CERN, Geneva, Switzerland. He has held distinguished visiting scientist positions at Oxford University (Dr. Lee Fellow, Christ Church, 1994) and at the University of Oslo, Norway (1993). In 1996 and 1998 he was awarded Los Alamos Distinguished Performance Awards for his quantum cryptography research, and in 1997 he was awarded the Los Alamos Fellows' Prize for his work on quantum information science. He became a Fellow of the American Physical Society in 1999. In 2001 he was co-winner of an R&D100 Award for "Free-space quantum cryptography". In 2004 Richard and the Los Alamos Quantum Key Distribution Team were co-winners of the European Union's Descartes Prize. Richard chairs the Advanced Research and Development Activity's Quantum Information Science and Technology roadmap project (http://qist.lanl.gov). He has authored over 120 scientific papers on quantum field theory, the foundations of quantum mechanics, quantum cryptography and quantum computation.

SPEAKER BACKGROUND INFORMATION

Prof. Yoshihisa Yamamoto, Stanford University

Abstract:

"Differential Phase Shift Quantum Key Distribution and Beyond"

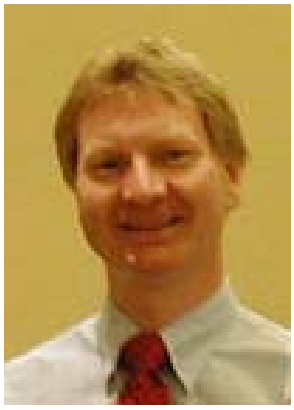
A differential phase shift quantum key distribution (DPS-QKD) is a new QKD protocol which is robust against Eve's photon splitting attack and phase disturbance of transmission lines. A first QKD experiment with GHz clock frequency was recently implemented and secure keys were generated over 105km fiber. In this talk I will describe this DPS-QKD experiment and also future directions of quantum communication technologies, such as quantum repeaters, quantum information processing and single photon sources.

Bio:

Prof. Yoshihisa Yamamoto has been professor of Applied Physics and Electrical Engineering at Stanford University since 1992 and at the National Institute of Iinformatics since 2003. Professor Yamamoto is also an NTT R&D Fellow and a leader of the JST/SORST and JST/CREST project on quantum information. After receiving his Ph.D. from the University of Tokyo in 1978, he worked for the NTT Basic Research Laboratories from 1987 to 1992 as a leader of Yamamoto research group. He was a visiting scientist at MIT in 1982-83, at the Royal Institute of Technology in Sweden in 1985, and at Bell Laboratories in 1989. He was a visiting professor at Stanford University in 1991 and at Tianjin and Fudan Universities in China in 1992. From 1993 to 1998, he served as director of the Yamamoto Quantum Fluctuation Project, ERATO/JRDC and from 1999 to 2003, he served as co-leader of the Quantum Entanglement Project, ICORP/JST. Professor Yamamoto is the recipient of many awards, including the Carl Zeiss Research Award (1992) and the Nishina Memorial Prize (1992), the Minister Award of Science and Technology of Japan (1995), the NTT Fellow Award (1999) and the IEEE/LEOS Quantum Electronics Award (2000). Professor Yamamoto's current research interests are quantum optics, mesoscopic physics, solid-state NMR spectroscopy and quantum information.

SPEAKER BACKGROUND INFORMATION

Dr. Colin Williams, Jet Propulsion Laboratory



Abstract:

"Quantum Communications Beyond Key Distribution"

What else is quantum communication good for besides secure key distribution? In this talk I will describe some of the opportunities afforded by sending and receiving quantum, as opposed to classical, information. In particular, I will summarize similarities and differences between quantum and classical schemes for compressing, copying, relaying, and teleporting information and describe some capabilities that would be enabled if one had a quantum communications infrastructure of the sort being developed for QKD. I'll also mention some of the challenges in realizing such networks on a global scale.

Bio:

Dr. Colin P. Williams is a Senior Research Scientist (SRS), and Program Manager for Advanced Computing Paradigms, in the Information Technology Program Office at the Jet Propulsion Laboratory, California Institute of Technology. He holds a Ph.D. in artificial intelligence from the University of Edinburgh, an M.Sc. and D.I.C. in atmospheric physics and dynamics from Imperial College, University of London, and a B.Sc. in mathematical physics from the University of Nottingham. He was formerly a research assistant in quantum cosmology to Prof. Stephen W. Hawking, at the University of Cambridge, and a research computer scientist at Xerox PARC. Colin's research interests have spanned many areas connecting physics with computer science. In his thesis work Colin developed an A.I. system for reasoning about the physical world via qualitative and quantitative differential equations. He then became interested in the links between statistical physics and computer science, co-invented with Tad Hogg the theory of computational phase transitions, and applied it understanding the deep structure of NP-Complete problems. Later, Colin became interested in the connections between quantum physics and computer science. In 1998 he published the first two books on quantum computing, "Explorations in Quantum Computing", and "Ultimate Zero and One", launched the Quantum Computing Technologies Group at JPL, and quickly broadened its scope to include research on quantum communications and quantum sensors. Lately, Colin has been developing quantum algorithms for solving computationally hard problems such as Boolean satisfiability and other NP-Complete problems. He has developed powerful software for automatically designing quantum circuits that can implement any quantum algorithm and automatically specialize those circuits for implementation in spin-based, and charge-based quantum computing hardware. This software has now been licensed to D-Wave Systems, Inc., the first private quantum computer company. Colin has written five books, and been a guest editor of two special issues, one on computational phase transitions, and the other on quantum computing. Colin co-invented and holds a patent on "quantum lithography", a photolithographic scheme for fabricating semiconductor structures with dimensions arbitrarily smaller than the wavelength of the light used. He has another patent pending on his quantum computer design software. From 2000-2002 Colin was on remote assignment from JPL as an acting Associate Professor of Computer Science at Stanford University where he taught courses on quantum computing and communications, and programming in *Mathematica.* In his spare time Colin loves to fly small planes in the invariably blue and frequently turbulent skies of Northern California.

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Introduction and Mission Statement

The Nanotechnology Forum is the largest nanotechnology focused organization in the Bay Area. It is dedicated to promoting the burgeoning field of nanotechnology by connecting ideas, technology and people. It is a unique organization, run entirely by unpaid volunteers under the umbrella of the alumni associations of the three universities.

The Nanotechnology Forum primarily serves the alumni communities of MIT, Stanford and the University of California, Berkeley, but events are open to anyone interested or active in the field of nanotechnology. We provide opportunities for industry experts, researchers, entrepreneurs, venture capitalists, private investors, technologists and the interested public to discuss, understand and evaluate the state-of-the art in nanotechnology.

Our events feature leading researchers, business leaders, investors, policy makers and entrepreneurs active or interested in the field of nanotechnology.

Steering Committee

Kitu Bindra, Dr. Wasiq Bokhari (Chair), Elizabeth Curran, Terry Fuqua, Peter Chou, Dr. Fred Lam, Vivek Nadkarni, Camille Olufsson, Gina Reiger, Dr. Jane Scheiber, Anthony Waitz, Qian Wu.

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Hitachi Ltd

Hitachi Ltd., headquartered in Tokyo, Japan, is a leading global electronics company, with approximately 326,000 employees worldwide. Fiscal 2003 (ended March 31, 2004) consolidated sales totaled 8,632.4 billion yen ($81.4 billion). The company offers a wide range of systems, products and services in market sectors including, information systems, electronic devices, power and industrial systems, consumer products, materials and financial services. For more information on Hitachi please visit the company's web-site at http://www.hitachi.com.

Quantum Insight

Quantum Insight is a pioneering business strategy services firm in the field of emerging new materials and nanotechnology. Our customers include Fortune 500 companies as well as venture and corporate funds. We provide strategic business and market development services to companies active or interested in the fields of emerging new materials and nanotechnology. We also provide investment research and targeted deal sourcing services to venture and corporate funds seeking to build new technology startups.

Burns Doane

We at Burns Doane are proud to say that among our 100 plus scientists and attorneys from all the major scientific disciplines we have some of the pioneers in the field of nanotechnology. Our attorneys have developed patent portfolios around some of the fundamental building blocks of this emerging area, including carbon nanotubes, photo-voltaics, MEMS, NEMS, and fuel cells. Our attorneys have founded some of the most successful nanotechnology networking organizations across the country and are well positioned to introduce clients to venture capitalists, industry leaders, and others who can help establish successful businesses.

Girvan Institute of Technology, NASA

The Girvan Institute of Technology is a non-profit corporation focused on research, technology development, technology transfer, and technology commercialization at the NASA Research Park, Moffett Field, California. Girvan's primary mission is to accelerate the convergence of commercial markets and government-developed technologies, and to spur the use of innovative commercial technology for NASA missions. Girvan identifies commercially developed technologies of interest to NASA, and assists small companies in accessing technology developed by US government agencies for eventual application in commercial markets.

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