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○ ISSUE 6  
○ SPRING  
○ 2007

THE INSTITUTE FOR QUANTUM COMPUTING

# NewBit

## TAMING THE QUANTUM WORLD

IQC AND THE PERIMETER INSTITUTE TEAM UP FOR MONTH LONG CONFERENCE



Taming the Quantum World is an international series of quantum events that occurred during the month of May and June 2007. The series included events for graduate students, post-doctoral fellows and faculty members with varying knowledge in areas of quantum information.

The series of events were organized by the Institute for Quantum Computing and the Perimeter Institute for Theoretical Physics with the help of other organizations, such as the University of Guelph and the Combinatorics and Optimization Department as part of their 40th anniversary celebration. The Canadian Institute for Advanced Research, MITACS, FIELDS, and Quantum Works have also sponsored some of the events in the series.

The goal of series was to bring quantum information researchers from around the world and increase the scientific activities happening in Waterloo in this field. The series was a success; about 500 researchers came to the Waterloo region where they participated in about 10 events.

Events included The Canadian Summer School on Quantum Information who had nearly a hundred participants from Canada and around the world as an opportunity for young researchers to learn the basics of quantum computing from ten of the most distinguished researchers in the field.

The Operational Quantum Physics and the Quantum-Classical Contrast workshop was intended to facilitate exchanges of insights and ideas between these research programs and to encourage and focus joint research efforts on a better understanding of characteristic quantum structures and their relevance for the research problems at hand.

The Theory and Realisation of Practical Quantum Key Distribution workshop was devoted to all aspects of practical QKD, including such topics as, Components, Mature QKD Systems and QKD related Theory.

For more information on the Quantum World series, visit: [www.quantumworld.ca](http://www.quantumworld.ca)

## NEW FACULTY ARRIVAL

Andrew Childs, a new member of the Institute's faculty, has joined this summer.

Andrew Childs works on the theory of quantum information processing, with particular emphasis on algorithms for quantum computers. His interests include continuous-time information processing protocols, such as quantum walks on graphs; quantum algorithms for algebraic problems, such as the hidden subgroup problem; and quantum query complexity.



Before coming to the IQC, Andrew was a Lee A. DuBridge Postdoctoral Scholar at the Institute for Quantum Information at the California Institute of Technology. He received a Ph.D. in physics in 2004 as a Hertz Foundation Fellow at the Massachusetts Institute of Technology, and a B.S. in physics in 2000 from the California Institute of Technology.

Andrew is joined by his wife, Sidney Chang, a software developer at EveryScope Inc.



# POTENTIAL ON THE RISE



## Visitors

IQC IS HONOURED TO HAVE HOSTED THESE DISTINGUISHED GUESTS OVER THE SUMMER OF 2007:

Benjamin Levi - MIT  
 Sagarmoy Dutta - ITT Kanpur  
 Michael Keyl - Institute for Scientific Interchange Foundation  
 Alex Hutchinson - The Walrus  
 Man-Hong Yung - University of Illinois  
 Vadim Makarov - NTNU  
 Jan Korsbakken - U of California, Berkeley  
 Lawrence Ioannou - University of Cambridge  
 Masahito Hayashi - Japan Science and Technology Agency  
 Richard Jozsa - University of Bristol  
 Steffen Glaser - Technische Universität München  
 Dietrich Leibfried - National Institute of Standards and Technology  
 David Poulin - Caltech  
 Gerardo Ortiz - University of Indiana  
 Oded Regev - Tel Aviv University  
 Julia Kempe - Laboratoire de Recherche en Informatique  
 Ronald de Wolf - CWI  
 Dorit Aharonov - Hebrew University  
 Gilles Brassard - University of Montreal  
 Ujjwal Sen - ICFO  
 Aditi Sen - ICFO  
 Luca Mannarino - Loyola School  
 Paulo Bencio Melo de Sousa - University of Ceara  
 Rubens Viana Ramos - University of Ceara  
 Dominik Janzing - University of Central Florida

## QUANTUM PHYSICS EXPERTS VISIT WATERLOO

On June 20th, 2007, the Taming the Quantum World: Challenges and Opportunities open house and panel discussion took place, hosted by Tom Brzustowski. Mike Lazaridis sat in as the panel chair while other panel members included: Gilles Brassard, Sir Anthony Leggett, Peter Shor, and Raymond Laflamme.



Mike Lazaridis takes his turn at the podium



The panel listens on as Tom Brzustowski welcomes everyone to the event of the evening

The open house exhibits were presented by members of our team including, Frank Wilhelm, Michele Mosca, Chris Erven, Kevin Resch, and David Fransen and began at 5:30pm.



The presentations that took place were as follows:

Raymond Laflamme: "NMR - A Quantum Computer Prototype"

Frank Wilhelm: "Small is Different - Quantum Nanoelectronics"

Michele Mosca: "Quantum Cryptography - Securing Communication the Quantum Way"

Chris Erven: "Free-Space Quantum Key Distribution"

Kevin Resch: "Entangling Light in the Optics Laboratory"

David Fransen: "Building for the Future"



Kevin Resch is underway with his presentation in the Optics Laboratory



David Fransen (left) gives an overview of the new IQC building with UW President, David Johnston (right) looking on

For additional information about this event, please visit the news section of our website at: [http://www.iqc.ca/institute/news\\_fulltext.php?id=45](http://www.iqc.ca/institute/news_fulltext.php?id=45)

## LEGGETT SEMINAR SERIES

IQC was pleased to have Anthony J. Leggett from the University of Illinois at Urbana-Champaign, as a long-term visiting professor from May 15 to July 31, 2007. While at IQC he hosted an informal seminar series. The lectures concentrated on microscopic theory of superconductivity and ended with material on superconducting qubits. The series was held on Thursdays 12:00 - 1:00 p.m. May 18, 25, June 15-29, July 6 and Friday's 1:30 - 2:30 p.m. May 19, 26, June 16-30, July 7.

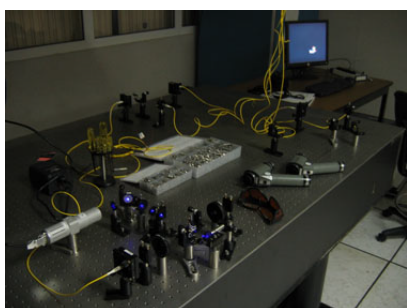
Sir Anthony James Leggett (born March 26, 1938 in Camberwell, London, England,) is John D. and Catherine T. MacArthur Chair and Center for Advanced Study Professor of Physics at the University of Illinois at Urbana-Champaign.

He is widely recognized as a world leader in the theory of low-temperature physics, and his pioneering work on superfluidity was recognized by the 2003 Nobel Prize in

Physics. He has shaped the theoretical understanding of normal and superfluid helium liquids and other strongly coupled superfluids. He set directions for research in the quantum physics of macroscopic dissipative systems and use of condensed systems to test the foundations of quantum mechanics.

He is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, the Russian Academy of Sciences (foreign member), and is a Fellow of the Royal Society (U.K.), the American Physical Society, and the American Institute of Physics.

His areas of research are theoretical condensed matter physics, low-temperature phenomena, foundations of quantum mechanics, quantum fluids, statistical physics, macroscopic quantum systems, and quantum theory of measurement.





# THE SPOUSE NETWORK



## Arrivals

- Haig Atikian joins us as a Masters Student from the University of Waterloo
- David Poulin is recruited as a new faculty member and will arrive in February 2008
- Immo Soellner, of the University of Waterloo joins the team as a research assistant

## Departures

- Scott Aaronson has left IQC to start at MIT as an Assistant Professor in the Electrical Engineering and Computer Science Department. He would like to add, "I'll miss Waterloo and am grateful to everyone at IQC for a wonderful two years"
- Lorna Schmalz has transferred over to the School of Pharmacy
- Connie Slaughtner has transferred to the Mathematics Faculty
- Jake Nicoll will be entering his first year at Dalhousie University where he will be studying the History and Philosophy of Science and Technology in September



The Spouse Network members are all related to IQC and PI by their spouses who work in administration or as students, post-doctoral fellows or faculty. Most of them have an international background, ranging from countries all over the world and have also previously lived in different countries in the past. They all share common experiences: the initial culture shock, the making of new friends, getting used to a new way of living, and building a home for their families away from their country of origin.

The Spouse Network has a board, currently consisting of Birgit, Fanny and Sharon. They organize weekly meetings, outings to local attractions, activities such as the International Cooking Club, and events including First Aid classes. Their main goal is to give every member a starting point whether it is simply for gathering information, to get involved in a few fun activities, or to meet new friends. As an example, the group took a trip to the Toronto Zoo during the summer, as seen in the above photos.

Beginning in October, the Spouse Network will be starting a new book club. The plan is to meet up once every four to six weeks at someone's house to discuss the book chosen at the previous meeting. Whoever



hosts the book club that particular week will provide drinks and snacks, as well as a cozy, adult only retreat in which to escape the daily responsibilities.

The first meeting, which will be held at Birgit's house. For location information, please e-mail for details. On Tuesday, October 2nd at 7.30pm, there will be a meet & greet, as well as a discussion to decide what books will be chosen, whether they will be taken from a list compiled elsewhere (ex. Oprah's Book Club, the Booker Prize shortlist, etc) as well as determining what time would be the most accommodating for the members.



If you are interested in any of the services that are offered or would like to become a member, feel free to contact the network at: [Spousal.Network@gmail.com](mailto:Spousal.Network@gmail.com)

For more information, please visit:  
[www.iqc.ca/piqcsn/index.html](http://www.iqc.ca/piqcsn/index.html)

## IQC'S YOUNGEST MEMBERS

Congratulations to IQC members Rolf Horn and Rahul Jain who recently welcomed new IQC family members.

Rolf and fiancée Karen Gordon added another baby girl, Clara on July 10, 2007.

Rahul and Ashmika Jain celebrated the birth of their new daughter, Aarushi on June 26th at 1:29pm.



Aarushi Jain (Above)

For questions, comments or general feedback regarding the IQC Newsletter, please feel free to contact:

[iqc@IQC.ca](mailto:iqc@IQC.ca)





# INQUISITIVE MINDS

## OUTREACH TOURS

Throughout the month of July, every Tuesday from 2:00 until 5:00, a group of inquisitive young minds from numerous high schools made a visit to our institute for a number of presentations, demonstrations and discussion groups by members of our faculty. The events also included visits from high school physics teachers that was based on a similar layout as these tours.



The students arrive and meet in the lobby

The tours kicked off with an overview presentation of the institute from Michele Mosca and Frank Wilhelm. This presentation included information on the strategic objectives,

the research agenda, and the new building to be built in the future. Frank then took over the presentation to discuss the basics of Quantum Mechanics.

Once the tours got underway, each group spent approximately 20 minutes at each lab where a 10 minute presentation took place followed by a short question and answer session. The labs being presented were the Optics Lab which was shown by faculty member, Kevin Resch, the Photonics Lab was led by Gregor Weihs, the QKD Experiment was presented by

Masters Student, Chris Erven, and finally the NMR Lab was shown by PhD student, Martin Laforest.

The students arrived having a familiarity with the concepts of basic quantum mechanics, superposition, the uncertainty principle, and entanglement. They brought with them great questions and we have hopefully stimulated their minds with the new information they gained through the visits. As they left, our members were able to suggest further reading materials based on their areas of interest.

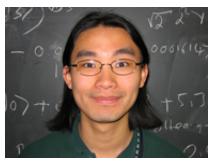


Paying close attention, the students listen as faculty member, Gregor Weihs answers their questions regarding the Photonics Lab

For More information regarding IQC and Perimeter Institute's Outreach program, please visit: [www.perimeterinstitute.ca/en/Outreach/General/Outreach\\_Overview/](http://www.perimeterinstitute.ca/en/Outreach/General/Outreach_Overview/)

## DONNY CHEUNG DEFENDS HIS THESIS

Donny Cheung, a PhD student here at the institute defended his thesis on June 27th, 2007. His thesis was titled, "On Algorithms, Separability and Cellular Automata in Quantum Computing". The thesis combines three research projects which he undertook during his PhD studies. The first project explored a new quantum model for cellular automata. The second project looked at finding entanglement witnesses with a computer, and the final project looked at classical post-processing techniques for quantum phase estimation.



People in attendance included, IQC Members, Michele Mosca, Richard Cleve, Ashwin Nayak, Kevin Resch and from the University of New Mexico, Cris Moore.

Everyone here at IQC would like to congratulate Donny on his achievement.

## SCHOLARSHIPS

### ▶ The Bell Family Fund Recipients: (From left to right)



Chris Erven (Winter, 2006)  
Adam Hubbard (Winter, 2006)  
Colm Ryan (Spring, 2006)  
Chris Ferrie (Winter, 2007)  
Martin Laforest (Spring, 2007)  
Peter Groszkowski (Fall, 2007)

### ▶ Mike & Ophelia Lazaridis Fellowship Recipients: (From left to right)



Casey Myers (2006)  
Lana Sheridan (2006 & 2007)  
Behnood Ghamsari (2006 & 2007)  
Yingkai Ouyang (2007)  
Devon Biggerstaff (2007)  
Chandrashekar Madaiah (2007)



## Speakers

### SUMMER COLLOQUIUMS:

- ▶ MAY 7 - Yaoyun Shi  
"Quantum communication complexity of block-composed functions"
- ▶ MAY 14 - Anthony J. Leggett  
"Ultracold atoms in optical lattices"
- ▶ MAY 18 - Vadim Makarov  
"Practical attacks on quantum key distribution systems"
- ▶ MAY 25 - Jan Korbakken  
"Lions or kittens? A measure of "size" for Schrödinger cat states"
- ▶ MAY 28 - Masahito Hayashi  
"Theoretical analysis and implementation on QKD with the decoy-state method"
- ▶ MAY 28 - Renato Renner  
"On the impossibility of extracting randomness from partially untrusted quantum devices"
- ▶ JULY 5 - Aditi Sen(De)  
"Trapped Ion Chain as a Neural Network: Error Resistant Quantum Computation"
- ▶ JULY 6 - Ujjwal Sen  
"Classical Communication over Distributed Quantum Channels"
- ▶ JULY 9 - Alain Tapp  
"Anonymous Message Transmission"
- ▶ JULY 13 - Phillip Kaye  
"Reliable Computation using Globally Controlled Arrays of Qubits"
- ▶ JULY 27 - Carlos Perez-Delgado  
"Quantum Cellular Automata: Theoretical Results"
- ▶ AUG 3 - Tzvetan Metodi  
"Designing a Large-Scale Quantum Architecture"
- ▶ AUG 17 - Carlos Perez-Delgado  
"Applications of Quantum Cellular Automata"
- ▶ AUG 27 - Dominik Janzing  
"Finding the hardest problems that the quantum computer can solve"

For more information regarding the colloquiums please visit: [www.iqc.ca/activities/seminar.php](http://www.iqc.ca/activities/seminar.php)







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IQC THANKS ITS PARTNERS FOR THEIR  
CONTINUING SUPPORT OF OUR VISION



MIKE LAZARIDIS

- AND -

Advanced Research Development Activity  
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The City of Waterloo  
Communications Securities Establishment  
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