



PRESS RELEASE

2 May 2007

PUSHING THE FRONTIERS OF INFORMATION PROCESSING

First Research Centre of Excellence in Quantum Information Science and Technology Aspires to be among World Leaders in Five Years

The National University of Singapore's (NUS) proposal for a Research Centre of Excellence (RCE) in Quantum Information Science and Technology (QIST) was approved by the Research, Innovation and Enterprise Council (RIEC) in March 2007¹ as the first of several RCEs to be set up with co-funding from the National Research Foundation (NRF) and the Ministry of Education (MOE). This will be the first research institute in Southeast Asia dedicated to QIST. The RCE is expected to be in operation by December 2007, and aims to become one of the world's top centres in this area within five years.

A five-year budget of S\$750 million (S\$500 million from NRF and S\$250 million from MOE) has been set aside to fund RCEs. Of this, about S\$150 million will go into the funding of the RCE in QIST. Hosted at NUS, the RCE in QIST will conduct interdisciplinary theoretical and experimental research aimed at overcoming the fundamental limits to information processing. Singaporeans will benefit from the investment in RCEs in the long term, because RCEs will conduct world-class investigator-led research aligned with the economic and strategic interests of Singapore.

NRF recognises that there is a need to enhance Singapore's research capacity by growing a pool of top research talent and developing the platforms through which they can create research breakthroughs. One way is to strengthen the capabilities of our local universities by establishing RCEs within them. NRF and MOE's investment in the RCE in QIST highlights the Government's continued drive for excellence in the learning of basic sciences. The RCE in QIST will conduct outreach activities and provide attachment opportunities to enthuse and inspire our students in the learning of basic sciences, in particular Quantum Information Science. MOE sees the RCE in QIST as a significant milestone in the development of NUS as a research-intensive university.

¹ The RIEC is chaired by Prime Minister Lee Hsien Loong, comprising several Cabinet Ministers and distinguished local and foreign members from the business, science and technology community. Dr Tony Tan is Deputy Chairman of the RIEC.

A New Science

QIST - a new field of science and technology combining and drawing on the disciplines of physical science, mathematics, computer science and engineering - has attracted significant attention from industry and government agencies. The quest for the ultimate limits of information processing leads to the microworld of individual atoms and photons. Quantum theory allows atoms, photons and other quantum objects to store information in an inherently new way. Controlling and manipulating individual photons, atoms and ions in a coherent manner could exploit properties of these quantum objects for a wide array of applications.

The potential economic impact of QIST is enormous – its applications hold promise to revolutionary advances in fields of science and engineering involving computation, communication, precision measurement and fundamental quantum science. For instance, quantum cryptography can create unbreakable codes and guarantee perfectly secure communication; and quantum computers, if they can be built in the future, will be capable of efficiently solving some problems for which there is believed to be no efficient classical algorithm. Other commercial applications include quantum frequency standards (for atomic clocks) as well as quantum-enhanced positioning (for new generation of GPS) and clock synchronisation (for a number of metrology applications).

RCE : Well-Structured, Coordinated Effort in Quantum Information Research

Over the last decade, centres and research institutes in QIST have been established in most of the US top universities, in many countries in Europe (including the United Kingdom, Germany, France and Austria), Canada, Australia, Japan and China. Singapore, with a good track record in mathematics of coding and cryptography, and a good engineering base for the development of cutting-edge technologies, has both the potential and the opportunity to be among the world leaders in information science and technology. The RCE in QIST, therefore, brings together teams of experts from the relevant contributing fields into a well structured and coordinated research effort, providing a significant focused interdisciplinary effort for Singapore to remain competitive in this field in the future.

Building upon an existing NUS research programme in quantum information, the RCE in QIST will develop quantum technologies and explore both the theory and practical possibilities of constructing quantum devices for the purposes of cryptography and computation. With the establishment of the RCE in QIST, the 30-member Quantum Information Technology Group will expand significantly to become a research centre comprising 210 researchers. There will be about 16 Principal Investigators (PIs), each leading a research team of post-doctoral fellows, postgraduate research students and support staff.

NUS President Professor Shih Choon Fong said, “NUS’ proposal for an RCE in QIST was selected after stringent peer scientific review. It gives a boost to our continuing efforts to build global research excellence. Professor Artur Ekert is a pioneer in quantum information science and co-inventor of quantum cryptography. Under his leadership, this RCE promises to break new ground in this exciting field as well as attract other top-rate researchers in quantum information science and technology to NUS and Singapore.”

Prof Ekert is currently a Lee Kong Chian Centennial Professor at NUS and Professor of Quantum Physics at Mathematical Institute, University of Oxford. As the Director of the RCE, Prof Ekert has a proven track record in managing research centres of a similar nature. He founded and directed the first centre in quantum information technologies at the University of Oxford, an institution which is very prominent in setting the agenda and research trends in the field. He has advised government agencies and research institutes in the EU, US and

Japan on setting up international and national projects in quantum information technology. Please see [Annex A](#) for Prof Ekert's CV.

On his decision to take up the appointment, Professor Artur Ekert said, "I like challenges and setting up this new research centre for quantum information science and technology is indeed a challenge. After five years of on and off visits to Singapore, I know the place, I know its potential, I have good friends and colleagues and I am happy to be given the opportunity to spend more time in Singapore to run the first RCE."

Plans are underway to set up temporary laboratories and research facilities by December 2007. The RCE expects to move into a dedicated location and be in full operation by June 2008.

Research Focus

In its first five years, the RCE in QIST will focus on the development of reliable quantum components and their interoperability, such as trapped ions and atoms. The subsequent five years will be devoted to integrating the quantum components and scaling them up – for instance constructing quantum structures on chips and using them to run quantum algorithms and quantum simulations.

Some examples of research projects that will be undertaken include developing advanced technologies to store atoms, ions and photons on micro-chips, creating light sources for electronic transfer of atoms and photons that store information for secure communication, and implementation of quantum computers.

The RCE in QIST will also collaborate with NUS research institutes, the Agency for Science, Technology and Research (A*STAR), Defence Science & Technology Agency (DSTA) and DSO National Laboratories on both theoretical and experimental research on QIST.

For more information, please contact:

*Ms Fun Yip
Assistant Manager (Media Relations)
Office of Corporate Relations
National University of Singapore
Tel: 6516-1374
E-mail: ocrfy@nus.edu.sg*

*Ms Lisa Poh
Corporate Communications Executive
Corporate Communications Division
Ministry of Education
Tel: 6879-6123
Email: lisa_poh@moe.gov.sg*

*Ms Chong Wan Yieng
Manager, Corporate Communications
National Research Foundation
Tel: 6332-9008
Email: chong_wan_yieng@nrf.gov.sg*

About National University of Singapore (NUS)

The National University of Singapore (NUS) is a multi-campus university of global standing, with distinctive strengths in education and research and an entrepreneurial dimension. A growing university, NUS now spans three locations - its principal 150-hectare Kent Ridge campus, Bukit Timah campus and Duke-NUS Graduate Medical School Singapore. It has an enrolment of 22,000 undergraduate and more than 6,000 graduate students from 80 countries.

NUS offers a broad-based curriculum underscored by multi-disciplinary courses and cross-faculty enrichment. There are 13 faculties offering courses from architecture to medicine to music. A special feature of NUS education is the global dimension of its courses in partnership with some of the world's best institutions. NUS also enjoys a close teaching-research association with 13 national-level, 11 university-level and 80 faculty-based research institutes and centres. Research activities are strategic and robust, and a 'no walls' collaborative culture forms the bedrock of NUS' research-intensive vibrancy. A spirit of entrepreneurship and innovation promotes creative enterprise university-wide. This is aided by a venture support eco-system that helps students, staff and alumni nurture the development of start-ups into regional and global companies.

NUS plays an active role in international academic networks such as the International Alliance of Research Universities (IARU) and Association of Pacific Rim Universities (APRU). It is ranked amongst the best universities in the world, and is well-regarded for disciplines such as Technology, Biomedicine and the Social Sciences.

For more information, please visit: www.nus.edu.sg

About the National Research Foundation (NRF)

The National Research Foundation (NRF), set up on 1 January 2006, is a department under the Prime Minister's Office.

The NRF sets the national direction for research and development (R&D) by developing policies, plans and strategies for research, innovation and enterprise, funds strategic initiatives, builds up R&D capabilities and capacities through nurturing our own and attracting foreign talent, and coordinates the research agenda of different agencies to transform Singapore into a knowledge-intensive, innovative and entrepreneurial economy. It provides secretariat support to the Research, Innovation and Enterprise Council (RIEC), chaired by the Prime Minister. A five-year budget of \$5 billion has been allocated to the NRF in 2006 to achieve this mission.

The NRF aims to:

- Transform Singapore into a vibrant R&D hub that contributes towards a knowledge-intensive, innovative and entrepreneurial economy.
- Make Singapore a talent magnet for scientific and innovation excellence.

For more information, please visit www.nrf.gov.sg

Annex A: Professor Artur Ekert – Curriculum Vitae

Current Position



Professor of Quantum Physics
Mathematical Institute
University of Oxford, U.K.

Lee Kong Chian Centennial Professor
National University of Singapore
Singapore

Education and Degrees

D. Phil.	1991	Physics, Oxford University
	1988-1991	Graduate student, Physics, Oxford University
	1987-1988	Visiting student, Oxford University & Imperial College, London
M. Sc.	1985	Physics and Mathematics, Jagiellonian University, Kraków, Poland.
	1980-1985	Undergraduate, Jagiellonian University, Kraków, Poland.
Baccalaureate	1980	

Academic Appointments

2007-	Professor of Quantum Physics, Mathematical Institute, University of Oxford
2006-	Lee Kong Chian Centennial Professor, National University of Singapore
2005-2006	Distinguished Professor, National University of Singapore
2002-2006	Professorial Fellow, King's College, Cambridge
2002-2006	Leigh-Trapnell Professor in Quantum Physics, University of Cambridge
2002-2005	Temasek Professor, Singapore
1998-2002	Professor of Physics, University of Oxford
1998-2002	Fellow and Tutor in Physics, Keble College, Oxford
1994-1998	Research Fellow, Merton College, Oxford
1994-2001	Royal Society Howe Research Fellow
1991-1994	Junior Research Fellow, Merton College, Oxford.

Academic awards and distinctions

- The European Union Descartes Prize (2004)
- Fellow of Institute of Physics (2004)
- Honorary Fellow of Institute of Physics Singapore (2002)
- US Air Force "Windows on Science Award" (1996)
- The Institute of Physics Maxwell Medal & Prize (1995)
- Pirie-Reid Award/Scholarship (1988-1991)

Selected Publications

- [1] A.K.Ekert, **Quantum cryptography based on Bell's theorem**, Phys. Rev. Lett. 67, 661 - 663, (1991).
 - [2] J.A. Jones, V. Vedral, A. Ekert and G. Castagnoli, **Geometric quantum computation with NMR**, Nature vol. 403 pp. 869-871 (2000)
 - [3] J.I. Cirac, A. K. Ekert, and C. Macchiavello, **Optimal purification of a single qubit**, Phys. Rev. Lett. vol. 82, p.4344 - 4347 (1999).
 - [4] A.Barenco, D.Deutsch, A.Ekert, and R.Jozsa, **Conditional Quantum Dynamics and Logic Gates**, Physical Review Letters, vol. 74 pp.4083 - 4086 (1995)
 - [5] M. Christandl, N. Datta, A. Ekert, and A.J. Landahl, **Perfect state transfer in quantum spin networks**, Physical Review Letters 92, 187902 (2004)
-