14th Workshop on Quantum Information Processing
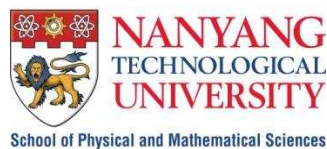## Singapore, 10-14 January 2011 (tutorials 8-9 January)

Schrödinger's monkey (Bukit Timah) courtesy of Ben Ravilious

$| \rangle$

QIP 2011

10 ~ 14 JANUARY

SINGAPORE

Centre for Quantum Technologies

NUS
National University of Singapore

qip2011.quantumlah.org

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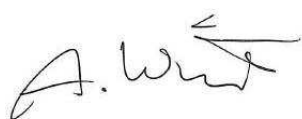
Welcome Message

Dear friends and colleagues,

Welcome to Singapore and the 14th workshop on Quantum Information Processing. The booklet you're holding in your hands contains the essential information for you to navigate the packed programme of this week.

Instead of boring you with things that you can read in it yourself, let me do so rather by a couple of personal reflections. When I first faced the possibility of organising QIP in Singapore, it was with a mixture of disbelief, excitement and terror. Disbelief that evidently responsible people would entrust to me the foremost conference in the field; obvious excitement over the prospect of bringing three hundred scientists to Singapore; terror in the face of daunting logistical challenges, not to mention the pitfalls of scientific credibility.

That I didn't despair I owe to the thirty-five uniquely professional, enthusiastic and inspired persons of the committees listed overleaf (plus two of such eminent importance that we are not even allowed to name them). In particular the programme committee, chaired by Daniel Gottesman, did a tremendous job of sifting through more than two hundred papers submitted, to select 35 talks and 156 posters. Once local preparations started, we had our good moments too: "Schrödinger's monkey'' was the first discovery of QIP 2011 – and still remains to be entered into the books of taxonomists. The mighty durian on the other poster came to help later – although I should probably have anticipated that the fruit would divide the local organising committee sharply into lovers and loathers …

But enough of that: you don't want to know the story of organising this QIP – you want to enjoy the talks and posters, to interact with your colleagues, and to explore Singapore.

Have fun

Andreas Winter

Committees

Programme Committee

Andris AMBAINIS (University of Latvia)
Steve BARTLETT (University of Sydney)
Sergey BRAVYI (IBM)
Wim van DAM (UC Santa Barbara)
Daniel GOTTESMAN (Perimeter Institute) (chair)
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Iordanis KERENIDIS (Universite Paris-Sud)
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Peter SHOR (MIT)
Graeme SMITH (IBM)
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Ignacio CIRAC (MPQ, Garching)
Eddie FARHI (MIT)
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Louis SALVAIL (Universite de Montreal)
Barbara M. TERHAL (RWTH Aachen)
John WATROUS (University of Waterloo)
Andreas WINTER (University of Bristol / CQT, NUS) (chair)
Andrew Chi-Chih YAO (Tsinghua University)

Local Organisers

Cédric BÉNY (Poster Sessions)
Rahul JAIN (Local Arrangement and Social Events)
Hartmut KLAUCK (Tutorials)
KWEK Leong Chuan (Sponsorship)
Darwin GOSAL (Webmaster)
Markus GRASSL (Outreach and Publicity)
Ethan LIM (Webmaster)
Matthew MCKAGUE (Tutorials)
Ciara MORGAN (Conference Booklet)
Tomasz PATEREK (Rump Session)
Miklos SANTHA (Advisor)
Stephanie WEHNER (Coordinator)
Andreas WINTER (Coordinator)

Table of Contents

General Information

Workshop Overview

Tutorial Sessions	Lecture Theatre 32, National University of Singapore Campus
	Saturday, 8 January & Sunday, 9 January 2011
Welcome Reception	Bob's Bar, Level 2, The Capella, Sentosa, Singapore
	Sunday, 9 January 2011, 19:00
Workshop Venue	Grand Ballroom, Level 1, The Capella, Sentosa, Singapore
	Monday, 10 January – Friday, 14 January 2011
	Note: Lunch will be provided each day
Social Dinner	Convention Centre Ballroom, Level 4, Marina Bay Sands, Singapore
	Wednesday, 12 January 2011, 19:00
Rump Session	Sapphire Pavilion, Siloso Beach, Sentosa, Singapore
	Thursday, 13 January 2011, 19:00 onwards

Instructions for Speakers

A laptop will be provided onto which all speakers are requested to upload their presentations before the relevant session. The 5 minutes scheduled before each talk should only be used for the transition between speakers.

Business Meeting

The business meeting can be attended by all conference participants, to enable the community to influence the future of QIP democratically. There, the organiser for the next QIP gives a presentation, and proposals for the venue of the QIP after that are presented and discussed, with an advisory vote taken among the participants. The actual decision about the venue is taken by the Steering Committee soon after that. Also other organisational matters can be discussed at the business meeting.

About CQT

Mission

Our mission is to conduct interdisciplinary theoretical and experimental research into the fundamental limits of information processing. The discovery that quantum physics allows fundamentally new modes of information processing has required the existing theories of computation, information and cryptography to be superseded by their quantum generalisations. We focus on the development of quantum technologies for coherent control of individual photons and atoms and explore both the theory and the practical possibilities of constructing quantum-mechanical devices for the purpose of cryptography and computation.

Origins

Research in quantum information science in Singapore was initiated in 1998 by Kwek Leong Chuan, Lai Choy Heng, Oh Choo Hiap and Kuldip Singh as a series of informal seminars at the National University of Singapore. The seminars attracted local researchers and resulted in forming the Quantum Information Technology Group, informally referred in Singlish as "quantum lah".

In February 2002 the support from the Agency for Science, Technology and Research (A*STAR) - the Temasek Project - consolidated research efforts in the field and led to a number of faculty appointments. In 2007 the Quantum Information Technology Group was selected as the core of the first Research Centre of Excellence in quantum information science and technology. Since then, the Centre has attracted a number of other researchers and continues to expand.

The Centre is funded by the Singapore National Research Foundation and the Ministry of Education. It is hosted by the National University of Singapore, but enjoys a significant autonomy both in pursuing its research goals and in governance. The Centre has its own Governing Board, a Scientific Advisory Board and is headed by Director Artur Ekert.

About Singapore

Transportation

Traveling around Singapore is a cinch! An efficient public transportation network of taxis, buses and the modern Mass Rapid Transit (MRT) rail system ensures that getting from point A to point B is hassle-free and extremely affordable. There are also taxis which can be hired from taxi stands, hailed by the roadside, or booked by phoning the numbers listed below. A booking fee is usually charged when hired by telephone.

CityCab	+65 6552 2222
Comfort CabLink	+65 6552 1111
SMRT Taxis Skytrek Bookings / Premier Cabs	+65 6555 8888

Medical Facilities

Most hotels have an on-call doctor. In the case of emergency, dial 995 for an ambulance. Pharmaceuticals are available at many outlets including supermarkets, department stores, hotels and shopping centres.

Lost Passport / Singapore Immigration Service

If you have lost your passport, you need to make a police report, then go to the Immigration & Checkpoints Authority to get a temporary visa. Finally, inform your embassy so that you can get through customs when you reach home.

Website: http://www.ica.gov.sg

Things to do and see in Singapore

- Chinatown   http://www.chinatown.org.sg

- Clarke Quay   http://www.clarkequay.com.sg

- Esplanade Theatre Singapore   http://www.esplanade.com

- Singapore Botanic Gardens   http://www.sbg.org.sg

- National Museum of Singapore   http://www.nationalmuseum.sg

- Singapore Art Museum   http://www.singaporeartmuseum.sg

- Singapore Zoo & Night Safari   http://www.zoo.com.sg

- Alliance Francais de Singapore   http://www.alliancefrancaise.org.sg

Useful Numbers

QIP 2011 Secretariat	+65 6516 7019
Police	999 (toll-free)
Ambulance / Fire	995 (toll-free)
Singapore Tourism Board	1800 736 2000

Embassies / Consulates / High Commissions

Australia	+65 6836 4100
Austria	+65 6396 6350
Belgium	+65 6220 7677
Brazil	+65 6256 9365
Canada	+65 6854 5900
Chile	+65 6223 8577
Denmark	+65 6355 5010
Finland	+65 6253 4042
France	+65 6880 7800
Germany	+65 6533 6002
Great Britain	+65 6424 4200
Greece	+65 6875 1205
Hungary	+65 6883 0882
India	+65 6737 6777
Ireland	+65 6238 7616
Italy	+65 6250 6022
Japan	+65 6235 8855
Latvia	+65 6256 6597
Malaysia	+65 6235 0111
Mexico	+65 6298 2678
Netherlands	+65 6737 1155
New Zealand	+65 6235 9966
People's Republic of China	+65 6418 0224
Poland	+65 6235 9478
Portugal	+65 6224 2256
Republic of Korea	+65 6256 1188
Slovak Republic	+65 6236 6111
Spain	+65 6725 9220
Sweden	+65 6415 9720
Switzerland	+65 6468 5788
Taiwan	+65 6500 0100
Turkey	+65 6533 3390
United States of America	+65 6476 9100

Conference Venue Information

Venue Address	The Capella Hotel
	Grand Ballroom
	1 The Knolls
	Sentosa Island
	Singapore
Telephone	+65 6377 8888
Website	www.capellasingapore.com
Wireless	Free Wi-Fi is available at the Capella without password

Activities at the Capella

Welcome Reception	Sunday, 9 January 2011, Bob's Bar, Level 2, 19:00
Conference Talks	10-14 January 2011, Grand Ballroom, Level 1
Poster Sessions	10 & 11 January 2011, Outside Grand Ballroom, Level 1

Getting to Sentosa Island

By Taxi

You may instruct the cab driver to The Capella at The Sentosa Island.

By Mass Rapid Transit (MRT) and Sentosa Express

Take the North-East Line and alight at the Harbour Front MRT Station. From there, you may either go to the 3rd level (Lobby L) of VivoCity shopping mall, transfer onto the Sentosa Express or you may follow the signs to the HarbourFront Bus interchange. Hop onto the orange Sentosa bus and you'll be on your way to Sentosa.

More Information www.sentosa.com.sg/en/getting-around/sentosa-express

Tutorial Programme

Venue   National University of Singapore (NUS) Campus, Lecture Theatre 32

<u>Getting to NUS from Sentosa/Harbourfront (also see map on page 28)</u>

Take the Sentosa Express from Sentosa to the Vivo City mall. Take the escalators down to the first floor. Walk straight for a few meters and then turn right. You should see signs pointing towards the bus stop and to the taxi stand nearby (a taxi from there should cost approx. 8 S$). Alternatively, use the orange Sentosa bus and alight at the Harbourfront bus stop. From the bus stop take bus 97, but avoid the express bus 97e. Alight at the bus stop opposite Dover Institute of Technical Education, AYE, which is 13 stops after Vivo City and 12 stops after Harbourfront. From there it's a short walk to the tutorial venue LT32.

<u>Tutorial Schedule</u>

Saturday, 8 January 2011

09:00	Registration
09:30	**Patrick Hayden**, McGill University Montreal *Quantum Information Theory via Decoupling*
11:00-11:30	Coffee Break
13:00	Buffet Lunch
14:00	**Ben Reichardt**, IQC, University of Waterloo *Quantum Query Complexity*
15:30-16:00	Coffee Break
17:30	End

Sunday, 9 January 2011

09:00	Registration
09:30	**Maciej Lewenstein**, ICFO Barcelona *Anything Goes, or Everything Fails: Quantum Simulators*
11:00-11:30	Coffee Break
13:00	End
from 19:00	Welcome reception at The Capella, with registration

Tutorial Abstracts

Quantum Information Theory via Decoupling
by **Patrick Hayden**, McGill University Montreal

Abstract
Quantum information theorists are lucky. If a classical information theorist wants to send bits through a noisy channel, (s)he has little choice but to specify in detail matching encoding and decoding procedures that will protect the data from noise. Quantum information theorists only have to work half as hard: they need to specify the encoding but then the decoding comes for free. This "free lunch" is a consequence of the no-cloning theorem: if no information leaks to the environment, then the quantum information theorist can conclude that a decoding exists without having to worry about the details. Of course, the free lunch may be a bit hard to digest. Casual readers of papers on quantum channel capacities are often put off by what look like formidable technicalities. The tutorial will teach participants how to prove some key capacity theorems from start to finish, breaking the technicalities into bite-sized chunks. The end of the tutorial will be devoted to discussing potential consequences of the results to information leakage from black holes.

Quantum Query Complexity
by **Ben Reichardt**, IQC, University of Waterloo

Abstract
The general adversary bound is a lower bound on quantum query complexity that can also be used to design quantum algorithms with a very simple form. In this tutorial, we will study the adversary bounds and how to design quantum algorithms based upon them.

Anything Goes, or Everything Fails: Quantum Simulators
by **Maciej Lewenstein**, ICFO Barcelona

Abstract
"Anything goes" is a musical by Cole Porter. The title song of it was used in the beginning of Steven Spielberg's movie "Indiana Jones and the Temple of Doom". Here it applies to a concept of so-called quantum simulators, that is simple physical systems that are supposed to mimic other not so simple physical systems, i.e. serve as quantum computers of special purpose. In recent years most of such quantum simulators have been proposed in the area of quantum optics and atomic physics using ultracold atoms and ions. In this tutorial I will review the fundamentals of quantum simulators based on ultracold matter, and argue that although in principle "anything goes", sometimes "everything might fail".

Scientific Programme

Sunday, 9 January 2011

from 19:00   Welcome reception and registration: Bob's Bar, Level 2, The Capella

Monday, 10 January 2011

08:00-09:00   **Registration**

09:00-09:30   **Opening Remarks**
Guest of Honor: Mr. Lam Chuan Leong
Chairman of the CQT Governing Board
Ambassador-at-large, Ministry of Foreign Affairs
Chairman, Competition Commission of Singapore
Director, Singapore Cooperation Enterprise
Director, ST Electronics (Info-Software Systems) Pte Ltd

09:30-10:20   **Ashley Montanaro** (plenary, based on joint work with A. W. Harrow)
An efficient test for product states, with applications to quantum Merlin-Arthur games

10:20-10:50   **Break**

10:50-11:20   **Julia Kempe and Thomas Vidick** (featured)
Parallel repetition of entangled games

11:25-11:45   **Tsuyoshi Ito, Hirotada Kobayashi and John Watrous**
Quantum interactive proofs with weak error bounds

11:50-12:10   **Shengyu Zhang**
Quantum strategic game theory

12:10-14:00   **Lunch**

14:00-14:50   **John Martinis** (plenary, based on joint work with H. Wang, M. Mariantoni, R. C. Bialczak, M. Lenander, E. Lucero, M. Neeley, A. O'Connell, D. Sank, M. Weides, J. Wenner, T. Yamamoto, Y. Yin, J. Zhao and A. N. Cleland)
Synthesis of complex microwave photon states with superconducting qubits

14:55-15:15   **Tzu-chieh Wei, Ian Affleck and Robert Raussendorf (UBC); Akimasa Miyake (PI)**
The 2D AKLT state is universal for measurement-based quantum computation

15:15-15:45 **Break**

15:45-16:05 **David Poulin**, Angie Qarry, Rolando Somma and Frank Verstraete
Quantum simulation of time-dependent Hamiltonians and the convenient illusion of Hilbert space

16:10-16:30 **Ramis Movassagh** and Alan Edelman
Isotropic entanglement

16:35-16:55 Sarah Harrison, **Norbert Schuch**, Tobias Osborne and Jens Eisert
Information propagation for interacting particle systems

from 17:15 **Poster session 1**
organised by Cédric Bény

Tuesday, 11 January 2011

09:00-09:50 **Oded Regev** (plenary, based on joint work with B. Klartag)
Quantum one-way communication can be exponentially stronger than classical communication

09:55-10:15 **Loïck Magnin**, Martin Roetteler and Jérémie Roland
On the additive and multiplicative adversary methods

10:15-10:45 **Break**

10:45-11:15 **Harry Buhrman, Oded Regev, Giannicola Scarpa** and **Ronald de Wolf** (featured)
Near-optimal and explicit Bell inequality violations

11:20-11:40 **Marius Junge and Carlos Palazuelos**
Large violation of Bell inequalities with low entanglement

11:45-12:05 **Tobias Fritz**
Tsirelson's problem and Kirchberg's conjecture

12:05-14:00 **Lunch**

14:00-14:20 **Adán Cabello, Simone Severini** and **Andreas Winter**
(Non-)Contextuality of physical theories as an axiom

14:25-14:55 **Jonathan Oppenheim and Stephanie Wehner** (featured)
The uncertainty principle determines the non-locality of quantum mechanics

14:55-15:30 **Break**

15:30-16:00	**Hari Krovi, Frédéric Magniez, Maris Ozols and <u>Jérémie Roland</u>** (featured) *Finding is as easy as detecting for quantum walks*
16:05-16:25	**Jianxin Chen, <u>Xie Chen</u>, Runyao Duan, Zhengfeng Ji, Zhaohui Wei and Bei Zeng** *On the solution space of quantum 2-SAT problems*
16:30-16:50	**Andrew Childs and <u>Robin Kothari</u>** *Quantum query complexity of minor-closed graph properties*
16:55-17:15	**<u>Fernando Brandão</u> and Michał Horodecki** *Exponential quantum speed-ups are generic*
from 17:15	**Poster session 2** organised by Cédric Bény

Wednesday, 12 January 2011

09:00-09:50	**Sergey Bravyi** (plenary, based on joint work with M. B. Hastings and S. Michalakis) *Topological quantum order: stability under local perturbations*
09:55-10:15	**Teiko Heinosaari and <u>Michael Wolf</u>** *Topological implications in quantum tomography*
10:15-10:45	**Break**
10:45-11:15	**Earl Campbell** (featured) *Catalysis and activation of magic states in fault tolerant architectures*
11:20-11:40	**<u>James Wootton</u>, Robert Heath and Jiannis Pachos** *Localization assisted quantum error correction in the toric code*
11:45-12:15	**Hector Bombin** (featured) *Anyons, twists and topological codes*
12:15	**Lunch & free time**
16:30-17:00	Registration and Reception for Public Lecture
17:00-18:00	**Public Lecture** ***Information is Quantum*** **Charles Bennett,** IBM Research, USA **Venue:** Singapore Management University (SMU)

from 19:00 **Social dinner**
Marina Bay Sands Ballroom, Marina Bay Sands Convention Hall, Level 4,
10 Bayfront Avenue

Thursday, 13 January 2011

09:00-09:50 **Andrew Lutomirski** (plenary, based on joint work with E. Farhi, D. Gosset, A. Hassidim and P. W. Shor)
Quantum money

09:55-10:15 **Andrew Childs, David Jao and Vladimir Soukharev**
Constructing elliptic curve isogenies in quantum subexponential time

10:15-10:45 **Break**

10:45-11:15 **Sean Hallgren, Adam Smith and Fang Song** (featured)
Classical cryptographic protocols in a quantum world

11:20-11:40 **Hang Dinh, Cristopher Moore and Alexander Russell**
The McEliece cryptosystem resists quantum Fourier sampling attacks

11:45-12:05 **Hirotada Kobayashi, François Le Gall, Harumichi Nishimura and Martin Roetteler**
Constructing quantum network coding schemes from classical nonlinear protocols

12:05-14:00 **Lunch**

14:00-14:50 **Omar Fawzi** (plenary, based on joint work with P. Hayden and P. Sen)
From low-distortion norm embeddings to explicit uncertainty relations and efficient information locking

14:55-15:25 **Fernando Brandão and Jonathan Oppenheim** (featured)
The quantum one-time pad and superactivation

15:25-16:00 **Break**

16:00-17:00 **Business meeting**

from 19:00 **Rump Session @ Sapphire Pavillion, Siloso Beach**
chaired by **Louis Salvail**
organised by **Stephanie Wehner and Tomasz Paterek**

Friday, 14 January 2011

09:00-09:50   **Serge Fehr** (plenary, based on joint work with H. Buhrman, N. Chandran,
                 R. Gelles, V. Goyal, R. Ostrovsky and C. Schaffner)
                 Position-based quantum cryptography: impossibility and constructions

09:55-10:25   **Debbie Leung, Laura Mancinska, <u>William Matthews</u>, Maris Ozols and
                 Aidan Roy** (featured)
                 *Entanglement can increase asymptotic rates of zero-error classical
                 communication over classical channels*

10:25-11:00   **Break**

11:00-11:20   **<u>Christian Gogolin</u>, Markus Müller and Jens Eisert**
                 *Under what conditions do quantum systems thermalise? New insights from
                 quantum information theory*

11:25-11:45   **<u>Man Hong Yung</u> and Alán Aspuru-Guzik**
                 A quantum-quantum metropolis algorithm

11:50-12:10   **<u>Ersen Bilgin</u> and Sergio Boixo**
                 Preparing thermal states of quantum systems by dimension reduction

12:10-14:00   **Lunch**

14:00-14:30   **<u>Bill Fefferman</u> and Christopher Umans** (featured)
                 Pseudorandom generators and the BQP vs. PH problem

14:35-14:55   **<u>Michael Bremner</u>, Richard Jozsa and Dan Shepherd**
                 *Classical simulation of commuting quantum computations implies collapse
                 of the polynomial hierarchy*

14:55-15:30   **Break**

15:30-16:20   **Fernando Brandão** (plenary, based on joint work with M. Christandl and
                 J. T. Yard)
                 Faithful squashed entanglement

16:20-16:30   **Closing Remarks**

Poster Sessions

There will be two poster sessions, one on Monday 10 January and one on Tuesday 11 January 2011. The posters will be located just outside the conference hall, and arranged loosely according to topic. The list of posters below is sorted by the last name of the first author.

Instructions for poster presenters

Please check your session (Monday or Tuesday) and poster number below. Your poster number will tell you where to attach it. You have the whole day to set up your poster. Please remove it at the end of your session. Posters will be rewarded by prizes presented during the social dinner.

Monday Session

29a **Mamdouh Abbara and Jean-Pierre Tillich**
Quantum serial turbo-like codes with minimum distance growing polynomially in the code length

65a **Abbas Al-shimary and Jiannis Pachos**
Energy gaps of Hamiltonians from graph Laplacians

5a **Armen Allahverdyan and Karen Hovhannisyan**
Transferring elements of a density matrix

32a **Jonas Anderson, Andrew Landahl and Pat Rice**
Fault-tolerant quantum computing with color codes

58a **Motonori Ando, Takayuki Miyadera and Hideki Imai**
The uncertainty principle for simultaneous measurement of arbitrary number of POVMs on a qubit

6a **Koenraad Audenaert, Milán Mosonyi and Frank Verstraete**
State discrimination bounds for finite sample size

33a **Sean Barrett and Thomas Stace**
Fault tolerant quantum computation with very high threshold for loss errors

60a **Thomas Barthel, Martin Kliesch and Jens Eisert**
For D>1 MERA states are a subclass of PEPS

70a **Almut Beige and Jonathan Busch**
Generating single-mode behavior in fiber-coupled optical cavities

20a **Ville Bergholm and Jacob Biamonte**
Categorical quantum circuits

43a   **Dominic W. Berry**
Quantum algorithm for solving linear differential equations

21a   **Jacob Biamonte, Stephen Clark, Dieter Jaksch and Ville Bergholm**
Categorical tensor network states

52a   **Jan Bouda, Matej Pivoluska, Libor Caha, Paulo Mateus and Nikola Paunkovic**
Quantum simultaneous contract signing

1a   **Kamil Bradler, Patrick Hayden and Prakash Panangaden**
Private quantum capacity

11a   **Fernandao Brandão, Jens Eisert, Michał Horodecki and Dong Yang**
Entanglement cannot make imperfect quantum channels perfect

36a   **Courtney Brell, Steven Flammia, Stephen Bartlett and Andrew Doherty**
Toric codes and quantum doubles from two-body Hamiltonians

38a   **Brielin Brown, Steven Flammia and Norbert Schuch**
Computational complexity of computing the density of states

76a   **Katherine Brown, Suvabrata De, Bill Munro and Viv Kendon**
Improvements in quantum simulation using a qubus quantum computer

22a   **Oliver Buerschaper, Matthias Christandl, Liang Kong and Miguel Aguado**
Electric-magnetic duality and topological order on the lattice

71a   **Abudhahir Buhari, Zuriati Zukarnain, Shamala Subramaniam and Hishamuddin Zainuddin**
A single photon quantum user bi-directional authentication scheme over noiseless channel

72a   **Abudhahir Buhari, Zuriati Zukarnain, Shamala Subramaniam and Hishamuddin Zainuddin**
Efficient modeling and simulation of BB84 type protocols using OptiSystem™: an approach

10a   **Francesco Buscemi**
Statistical morphisms and a quantum Blackwell theorem

50a   **André Chailloux, Iordanis Kerenidis and Jamie Sikora**
Lower bounds for quantum oblivious transfer

7a   **Lin Chen, Huangjun Zhu and Tzu-Chieh Wei**
Connections of geometric measure of entanglement of pure symmetric states to quantum state estimation

19a   **Oscar Dahlsten and Markus Müller**
Typical subsystem entropy in convex probabilistic theories

62a   **Niel de Beaudrap, Matthias Ohliger, Tobias Osborne and Jens Eisert**
Solving frustration-free spin systems

57a   **Lídia Del Rio, Johan Aaberg, Renato Renner, Oscar Dahlsten and Vlatko Vedral**
The thermodynamic meaning of negative entropy

2a   **Frédéric Dupuis, Jan Florjanczyk, Patrick Hayden and Debbie Leung**
Locking classical information

39a   **Sevag Gharibian and Julia Kempe**
Approximation algorithms for QMA-complete problems

73a   **Pavel Ginzburg, Michael Shalyt, Alex Hayat and Meir Orenstein**
Photon-energy qubit generation by spontaneous emission in a V-type system

27a   **Demerson N. Gonçalves and Renato Portugal**
The hidden subgroup problem for a class of noncommutative groups

63a   **Alexey Gorshkov, Johannes Otterbach, Eugene Demler, Michael Fleischhauer and Mikhail Lukin**
Photonic phase gate via an exchange of Fermionic spin waves in a spin chain

54a   **Matty Hoban and Dan Browne**
A bigger quantum region in multi-party Bell experiments

30a   **Monireh Houshmand, Saied Hosseini-Khayat and Mark Wilde**
Minimal-memory, non-catastrophic quantum convolutional encoders

56a   **Li-Yi Hsu, I-Ching Yu and Feng-Li Lin**
Information causality and noisy computations

77a   **Marcus Huber**
Experimentally implementable criteria for detection of genuine multipartite entanglement in high-dimensional systems

18a   **Peter Janotta, Christian Gogolin, Jonathan Barrett and Nicolas Brunner**
Limits on non-local correlations from the structure of the local state space

12a   **Nathaniel Johnston, David Kribs, Vern Paulsen and Rajesh Pereira**
Minimal and Maximal Operator Spaces and Operator Systems in Entanglement Theory

67a   **Jaewoo Joo, William J. Munro and Tim P. Spiller**
Quantum phase estimation in NOON, BAT, and entangled coherent states

51a   **Go Kato and Kiyoshi Tamaki**
Security of six-state quantum key distribution protocol with threshold detectors

25a   **Yasuhito Kawano and Hiroshi Sekigawa**
Matrix decomposition and its application to complex Hadamard matrices

34a   **Viv Kendon, Katherine Louise Brown, Clare Horsman and Bill Munro**
Robust, scalable cluster state generation using ancilla-based systems

66a   **Omid Khosravani**
Investigation of entanglement in cyclic atomic ensembles with Δ-type transitions

49a   **Yoshiyuki Kinjo, Mio Murao, Akihito Soeda and Peter S. Turner**
Quantum computation over the butterfly network

53a   **Dmitry Kravchenko**
Symmetric nonlocal games

44a   **Jaehak Lee, Hai-Woong Lee and Mark Hillery**
Quantum walk search on star graphs with multi-valued functions

17a   **Seung-Woo Lee and Hyunseok Jeong**
Testing high-dimensional Bell inequalities by reconstructing quasiprobability functions

74a   **Jiun-Yi Lien, Yueh-Nan Chen and Chung-Hsien Chou**
Detecting quantum phase transitions of photons through a defect cavity

23a   **Lucy Liuxuan Zhang and Hector Bombin**
Twists arising from group automorphisms in the Kitaev model

31a   **Prabha Mandayam Doddamane and Stephanie Wehner**
Achieving the physical limits of the bounded-storage model

28a   **Iman Marvian and Robert Spekkens**
A generalization of Noether's theorem and the information-theoretic approach to the study of symmetric dynamics

8a   **Keiji Matsumoto**
Characterization of quantum relative entropy and asymptotic state transformation

41a   **Masaki Nakanishi**
On the weakness of one-way quantum pushdown automata under empty-stack acceptance

59a   **Koji Nuida, Gen Kimura and Hideki Imai**
On derivation of qubit systems from physical principles

26a **Sam Ocko, Xie Chen, Bei Zeng, Beni Yoshida, Zhengfeng Ji, Mary Beth Ruskai and Isaac Chuang**
Quantum codes give counterexamples to the unique pre-image conjecture of the N-representability problem

3a **Yingkai Ouyang**
Strictly convex upper bounds on the quantum capacity of the depolarization channel

78a **Jiannis Pachos, Igacio Cirac and Paolo Maraner**
Cold atom simulation of interacting relativistic quantum field theories

35a **Adam Paetznick and Ben Reichardt**
Fault-tolerant ancilla preparation for the Golay code

13a **Jeonghoon Park and Soojoon Lee**
Separable states to distribute entanglement

68a **Carlos A. Perez Delgado, Marcin Zwierz and Pieter Kok**
General optimality of the Heisenberg limit for quantum metrology

47a **Dong Pyo Chi, Jinwon Hong, Taewan Kim and Soojoon Lee**
Entanglement purification protocol via two bilateral controlled-NOT operations

55a **Nikhil Ratanje and Shashank Virmani**
Non-local correlations and generalised state spaces in fault tolerant quantum computing schemes

4a **Joseph M. Renes and Renato Renner**
Repurposing (quantum) information processing protocols: from randomness extraction to channel coding

69a **Elisabeth Rieper**
Quantum coherence in biological systems

75a **Serge Rosenblum, Alex Hayat, Pavel Ginzburg, David Neiman and Meir Orenstein**
QND detection of photon holes by electromagnetically induced transparency

14a **Katarzyna Roszak, Paweł Horodecki and Ryszard Horodecki**
Sudden death of effective entanglement

48a **Takahiko Satoh and Rodney Van Meter**
Path selection in heterogeneous quantum networks

40a **Antonello Scardicchio and Daniel Nagaj**
The SAT-UNSAT transition in a satisfiability game gives an upper bound for the Quantum SAT threshold

45a **Arun Sehrawat, Le Huy Nguyen and Berthold-Georg Englert**
Test state approach to the search problem

24a **Ferenc Szollosi**
Understanding complex Hadamard matrices and mutually unbiased bases of order 6

61a **Kristan Temme and Frank Verstraete**
Stochastic matrix product states

37a **Graham White and Stephen Bartlett**
Efficient topological codes for quantum error correction

64a **Johannes Wilms and Frank Verstraete**
Mutual information as a tool to study phase transitions

46a **Abuzer Yakaryilmaz**
Exact quantum algorithms for promise problems in automata theory

9a **Nengkun Yu, Runyao Duan and Mingsheng Ying**
Any $2 \otimes n$ subspace is locally distinguishable

42a **Bohua Zhan, Shelby Kimmel and Avinatan Hassidim**
Super-polynomial quantum speed-ups for Boolean evaluation trees with hidden structure

15a **Dong Zhou and Robert Joynt**
Disappearance of entanglement: a topological point of view

16a **Huangjun Zhu, Lin Chen and Masahito Hayashi**
Additivity and non-additivity of multipartite entanglement measures

Tuesday Session

70b **David Aghamalyan and Yuri Malakyan**
Photonic time-bin qubit generation with a tripod atomic system

78b **Gonzalo Agustín Álvarez and Dieter Suter**
NMR quantum simulation of localization effects induced by decoherence

38b **Gorjan Alagic, Stephen Jordan, Robert Koenig and Ben Reichardt**
The quantum-computational complexity of approximating 3-manifold invariants

43b **Andris Ambainis**
Variable time amplitude amplification and a faster quantum algorithm for systems of linear equations

10b   **Martin Aulbach, Damian Markham and Mio Murao**
Visual characterization of symmetric state entanglement

71b   **Koji Azuma, Hitoshi Takeda, Masato Koashi and Nobuyuki Imoto**
Quantum repeaters and computation by a single module: remote nondestructive parity measurement

32b   **Dave Bacon and Jonathan Shi**
Graph state subsystem codes

49b   **Jeongho Bang, Changhyoup Lee and Jinhyoung Lee**
The role of quantum-mechanical superposition in machine learning

60b   **Normand Beaudry and Renato Renner**
An intuitive proof of the data processing inequality

28b   **Cédric Bény**
Operational commutativity of jointly-measurable observables

29b   **Cédric Bény**
Perturbative quantum error correction

56b   **Adán Cabello and Marcelo Terra Cunha**
Proposal of a two-qutrit contextuality test free of the finite-precision and compatibility loopholes

72b   **Juan Carlos Garcia-Escartin and Pedro Chamorro-Posada**
Hong-Ou-Mandel zero knowledge

36b   **Chris Cesare, Dave Bacon, Steve Flammia, Andrew Landahl and Alice Neels**
Adiabatic topological quantum computing with surface codes

39b   **André Chailloux, Iordanis Kerenidis and Bill Rosgen**
Quantum commitments from complexity assumptions

22b   **Jianxin Chen, Zhengfeng Ji, Mary Beth Ruskai, Bei Zeng and Duanlu Zhou**
Principle of maximum entropy and ground spaces of local Hamiltonians

67b   **Taeseung Choi, Jin Hur and Jaewan Kim**
Relativistic properties of mean spin entanglement of two massive Dirac particles

57b   **Bob Coecke and Raymond Lal**
Time-asymmetry and causal structure

33b   **Gregory Crosswhite and Dave Bacon**
Automated searching for quantum subsystem codes

62b   **Andrew Darmawan, Gavin Brennen and Stephen Bartlett**
Prospects for measurement based quantum computation in a 2D phase around the AKLT point

50b   **Nilanjana Datta and Min-Hsiu Hsieh**
Universal coding for transmission of private information

24b   **David Dolphin and Michael McGettrick**
Fairness in lazy quantum random walks

63b   **Raphael Drumond, Leonardo Souza and Marcelo Terra Cunha**
Asymptotic entanglement dynamics phase diagrams for two electromagnetic field modes in a cavity

1b   **Runyao Duan, Simone Severini and Andreas Winter**
Zero-error communication via quantum channels, non-commutative graphs and a quantum Lovasz theta-function

73b   **Mark Everitt and Barry Garraway**
Photonic qubit logic in multi-mode cavities

21b   **Edward Farhi, Jeffrey Goldstone, David Gosset, Sam Gutmann and Peter Shor**
Unstructured randomness, small gaps and localization

11b   **Marcio Fernando Cornelio, Marcos C. de Oliveira and Felipe F. Fanchini**
Entanglement irreversibility from quantum discord and quantum deficit

35b   **Keisuke Fujii and Yuuki Tokunaga**
Fault-tolerant topological one-way quantum computation with probabilistic two-qubit gates

34b   **Vlad Gheorghiu, Shiang Yong Looi and Robert Griffiths**
Location of quantum information in stabilizer codes and tripartitions of stabilizer states

15b   **Davide Girolami, Mauro Paternostro and Gerardo Adesso**
Faithful nonclassicality indicators and extremal two-qubit quantum correlations

58b   **Mile Gu, Karoline Wiesner, Elisabeth Rieper and Vlatko Vedral**
Sharpening Occam's razor with quantum mechanics

20b   **Poya Haghnegahdar**
On the group of local complementation of graphs

5b   **Masahito Hayashi**
Capacity with energy constraint in coherent state channel

6b   **Masahito Hayashi**
Comparison between the Cramer-Rao and the mini-max approaches in quantum channel estimation

74b   **Alex Hayat, Amir Nevet and Meir Orenstein**
Ultrafast g(4) measurement by HBT interferometery of upconverted autocorrelation

75b   **Alex Hayat, Pavel Ginzburg, Amir Nevet and Meir Orenstein**
Energy qubit QIP by semiconductor two-photon processes

9b   **Fumio Hiai, Milán Mosonyi, Dénes Petz and Cédric Bény**
Quantum f-divergences and error correction

51b   **Mahboobeh Houshmand, Monireh Houshmand and Habib Rajabi Mashhadi**
Game theory based view to the quantum key distribution BB84 protocol

40b   **Min-Hsiu Hsieh and François Le Gall**
NP-hardness of decoding quantum error correction codes

61b   **Tomi Johnson, Stephen Clark, Dieter Jaksch and Jacob Biamonte**
Dynamical simulations of classical stochastic systems using matrix product states

44b   **Yasuhito Kawano**
Hidden shift problem for quadratic functions on a product of cyclic groups

52b   **Takeshi Koshiba and Takanori Odaira**
Non-interactive statistically-hiding quantum bit commitment from any quantum one-way function

16b   **Younghun Kwon**
On the asymptotic relation between Bell violations and entanglement distillability

31b   **Ching-Yi Lai, Todd Brun and Mark Wilde**
Duals and identities for maximal-entanglement quantum codes

69b   **Chang-Woo Lee and Hyunseok Jeong**
Measure of macroscopic quantum interference as a new criterion for the size of macroscopic quantum superposition states

54b   **Yeong-Cherng Liang, Támas Vértesi and Nicolas Brunner**
Device-independent bounds on entanglement

7b   **Cheng Lu, Jianxin Chen and Runyao Duan**
Optimal perfect distinguishability between unitaries and quantum operations

Public Lecture

Information is Quantum:
how physics has helped us understand what information is and what can be done with it

Charles H. Bennett, IBM Research, USA

Abstract

The information revolution is largely based on what a physicist would call a classical view of information, assuming that it can be copied freely and is not disturbed by observation. Quantum effects in information processing, which prevent the information in microscopic objects like atoms or photons from being observed or copied accurately, were long regarded as a mere nuisance, but are now known to make possible feats such as quantum cryptography, quantum teleportation and dramatic computational speedups. Although progress toward a practical quantum computer is slow, other surprising quantum informational effects continue to be discovered, and quantum cryptographic systems are already available commercially. Most importantly, the quantum approach has led to a more coherent and powerful way of thinking about how physical objects interact and influence one another, and how that interaction can be used to compute, communicate, and protect privacy. This talk will avoid mathematical complications and instead aim to explain central quantum concepts like entanglement, which at first sight seem counterintuitive.

Date	Wednesday 12 January 2011
Registration	qip2011.quantumlah.org/publiclecture **before 11 January 2011, 12:00**
Venue	**Singapore Management University** School of Accountancy/School of Law Ngee Ann Kongsi Auditorium (Level 2) 60 Stamford Road
Registration & Reception	from 16:30
Lecture	17:00-18:00
Co-organised by	Centre for Quantum Technologies & Singapore Management University

How to get to the Public Lecture at SMU (also see map on page 28)

You can take the North East MRT line from Harbour Front MRT (NE 1) to Dhoby Ghaut MRT (NE 6), from there it is a ca 800 m walk along Orchard Road/Stamford Road.

How to get to the Social Dinner after the Public Lecture

- walking in groups with local guides
- by bus:
  - walk north on Stamford Road, turn right into Bras Basah Road
  - board Bus No. 106 in front of NTUC Income Centre
  - alight at Marina Bay Sands MICE, Bayfront Avenue 10, 6 stops later (6-8 min.)
- by taxi

Social Dinner

Wednesday, 12 January 2011

Venue   Marina Bay Sands, Convention Centre Ballroom, Level 4
   10 Bayfront Ave, Singapore 018956

Time   19:00

Entertainment   Musical performances by local groups

Prizes for posters presented earlier in the week will be awarded during the evening of the social dinner

Getting to the Marina Bay Sands

- **Circle Line (by foot):** Exit at Promenade MRT Station and take a 10-minute walk from the station to Bayfront Avenue via the pedestrian footpath adjacent to the public road
- **Circle Line (by bus):** Exit at Promenade MRT Station and board the public buses (no. 133, no. 97, no. 97e, no. 106) from bus stop along Temasek Ave outside the station.
- **North South Line:** Exit at Marina Bay MRT Station and board the public buses (no. 133, no. 97, no. 97e, no. 106) from the bus stop opposite the station.
- **From Harbourfront:** Take the no. 100 bus
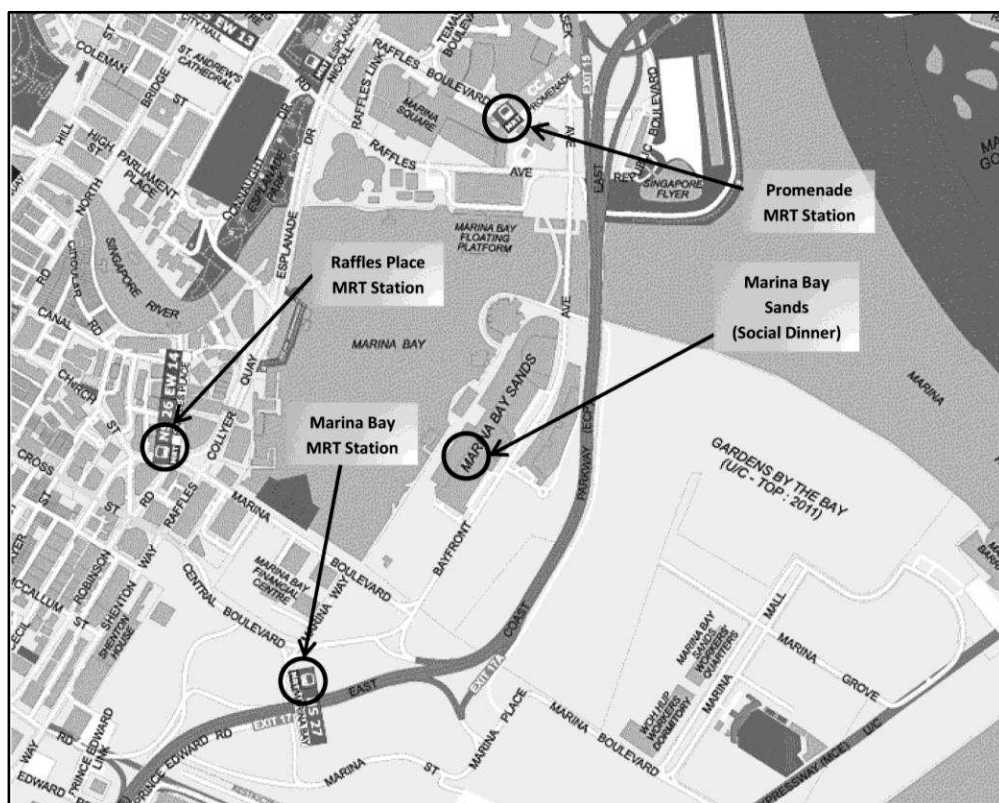
Rump Session

The rump session is intended to be an informal session (2-3 hours) in which participants give short presentations on new results from tomorrow's arXiv, work in progress, and other topics of interest to the QIP community, e.g., workshop announcements. The length of the rump presentation should not be longer than 4.31 minutes. The session will be in a relaxed atmosphere by the beach and there will be BBQ food and drinks served. In order to contribute to this spirit, non-technical and humorous contributions are highly encouraged.

Organisers   Stephanie Wehner (CQT, NUS) and Tomasz Paterek (CQT, NUS)
Session Chair   Louis Salvail (University of Montreal)

Rump Submission Guideline

Maximum (!!!) one page (standard margin), single column, font size = 11pt
Online Submission will open on Monday, 10 January 2011, 10:00 (Singapore Time) and close on Wednesday, 12 January 2011, 13:00 (Singapore Time).

Date   Thursday 13 January 2011, 19:00 – 23:00
Venue   Sapphire Pavilion, Siloso Beach, Sentosa Island

Rump Schedule
19:00   BBQ Buffet Opens
20:00   Talk Session I
20:45   Break
21:30   Talk Session II

Directions to the Rump Session (also see map on page 28)

- By Sentosa Bus
  Take the Red Line or Blue Line bus and alight at the Underwater World Station and walk to the Sapphire Pavilion.
- By Sentosa Express
  Alight at the Beach Station and walk about 5-8 minutes to the Sapphire Pavilion.
  Alternatively, you can also hop on to the Siloso Beach Tram from the Beach station.

From City
Take the North East Line (NEL) train and alight at the Harbour Front MRT station. From there take the Sentosa Express from Vivo City Shopping Centre, Level 3 and alight at the Beach Station.

Note
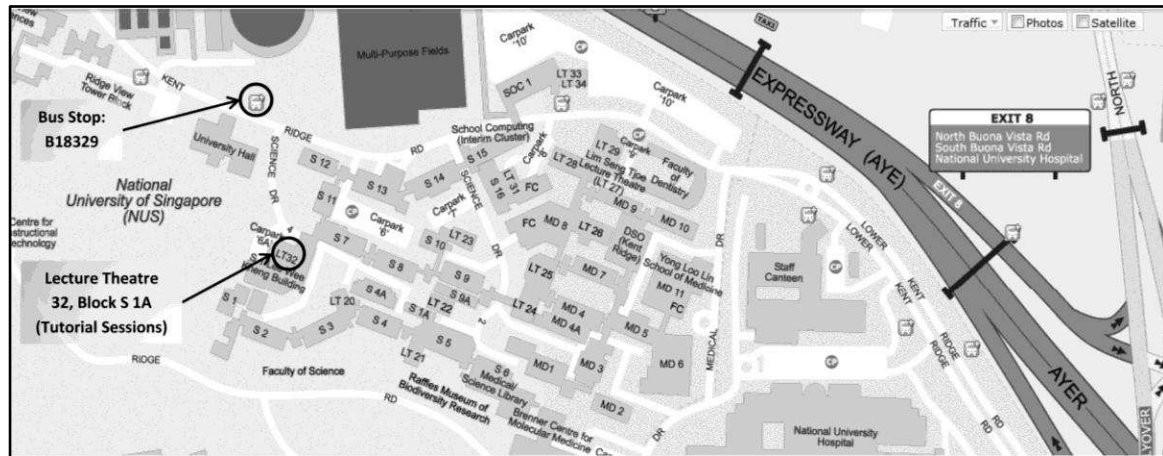Beach tram service from 9am – 11pm (Sunday – Thursday), 9am – 12 midnight (Fri and Sat). Frequency: 15-20 minutes.
Blue Line service from 7am – 11pm, Last Bus: 10.40pm (Sunday – Thursday), 7am – 12.30am, Last Bus: 12mn (Fri and Sat).
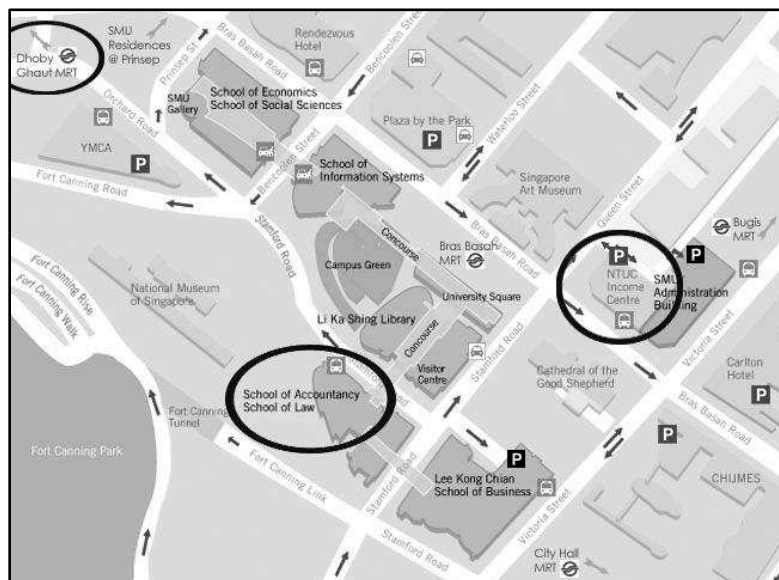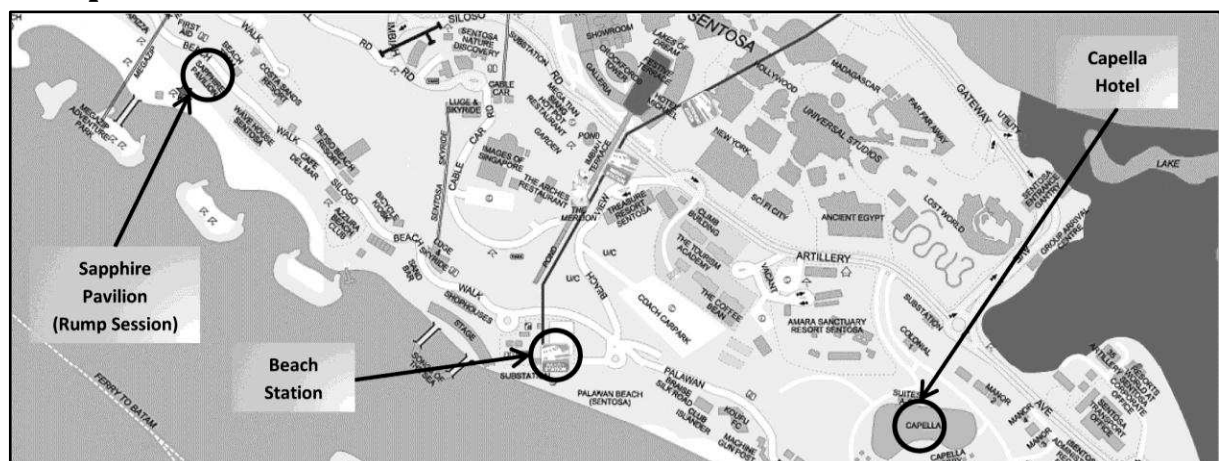Red Line service from 9am – 9pm daily.

Maps

Tutorial Sessions

Public Lecture

Rump Session

QIP Charter

Goal of the Conference

Workshop on Quantum Information Processing (QIP) is an annual conference about quantum computation and information which is usually held around January. Its goal is to represent the preceding year's best research in the area, in the form of both invited and contributed talks. To be able to also represent work already published elsewhere, the conference has no published proceedings of itself.

The Steering Committee

The role of the Steering Committee (SC) is to determine the longer-term course of the conference and to decide upon venues for the next conferences. It should also serve as a watchdog and make sure there are no obvious mistakes, e.g., in the choice of time of the conference by the local organiszing committee. The SC consists of 9 people, including the local organisers of the previous, next, and subsequent QIPs, and is chaired by the local organiser of the next QIP. Members typically serve for 3 years, with the 3 longest-serving members being replaced once a year, typically soon after QIP. The SC chooses the chair of the programme committee (PC) for the next QIP. Starting typically in late summer, the SC invites roughly 5 presentations (of the best recent research, but possibly also some more perspective/survey talks) and possibly some tutorial speakers, but otherwise leaves the details of the conference programme to the PC. At each QIP there is a business meeting that can be attended by all conference participants, to enable the community to influence the future of QIP democratically. There, the organiser for the next QIP gives a presentation, and proposals for the venue of the QIP after that are presented and discussed, with an advisory vote taken among the participants. The actual decision about the venue is taken by the SC soon after that. Also other organiszational matters can be discussed at the business meeting.

The Programme Committee

The role of the Programme Committee (PC) is to select the best submitted papers and to put together a programme for the next QIP. The PC chair chooses the members of the PC (helped by advice from the SC), typically 15 or more people representing the broad range of subfields, both from computer science and from physics. The PC chair determines (in cooperation with the SC) the rules for submission and puts out a call for submissions. The selection of contributed talks among the submitted papers is competitive, with typically around 32 accepted submissions. The PC can promote up to 4 of the best contributed talks to "invited" status, and can distinguish between longer and shorter time slots for the rest (typically 30 and 20 minutes). Poster submissions will generally be accepted unless they are off-topic or clearly wrong, to enable people to obtain funds for travel.

On the days preceding the conference, tutorials can take place, typically each a half or a full day of lectures on a specific topic, aimed at students. The actual conference takes place from Monday to Friday, with (usually) Wednesday afternoon off for scientific discussions and social excursions. Each morning and afternoon session starts with a 45-minute invited talk (either invited by the SC or a contributed talk promoted to invited status by the PC), followed by contributed talks. Each talk is followed by 5 minutes for questions and for setting up the next talk. The poster session(s), business meeting, and a rump session (for short impromptu presentations of very recent results) are held in late afternoons.

Conflict of Interest

1. SC member cannot be an invited speaker, but PC members can be invited speakers.
2. Both SC and PC member are allowed to submit papers and as a paper presenter if the paper submission is accepted.
3. PC members must declare a conflict of interest on certain submissions (such as their own), so that they are not involved in the discussion concerning these paper

THE CENTRE FOR QUANTUM TECHNOLOGIES AND

SINGAPORE MANAGEMENT UNIVERSITY ARE PLEASED TO ANNOUNCE A

FREE PUBLIC LECTURE

Speaker:

Charles H. Bennett

IBM Research, USA

INFORMATION IS QUANTUM

HOW PHYSICS HAS HELPED US UNDERSTAND WHAT INFORMATION IS AND WHAT CAN BE DONE WITH IT

12 January 2011 (Wednesday), 5pm

Registration & reception at 4.30pm

Singapore Management University
School of Accountancy / School of Law
Ngee Ann Kongsi Auditorium (Level 2)

Monday		Tuesday		Wednesday		Thursday		Friday	
09:00-09:30	**Welcome** *Mr. Lam Chuan Leong, Chairman CQT GB*	09:00-09:50	Oded Regev	09:00-09:50	Sergey Bravyi	09:00-09:50	Andrew Lutomirski	09:00-09:50	Serge Fehr
09:30-10:20	Ashley Montanaro	09:55-10:15	Loïck Magnin	09:55-10:15	Michael Wolf	09:55-10:15	Andrew Childs	09:55-10:25	William Matthews
10:20-10:50	**Break**	10:15-10:45	**Break**	10:15-10:45	**Break**	10:15-10:45	**Break**	10:25-11:00	**Break**
10:50-11:20	Thomas Vidick	10:45-11:15	Giannicola Scarpa	10:45-11:15	Earl Campbell	10:45-11:15	Fang Song	11:00-11:20	Christian Gogolin
11:25-11:45	Tsuyoshi Ito	11:20-11:40	Carlos Palazuelos	11:20-11:40	James Wootton	11:20-11:40	Hang Dinh	11:25-11:45	Man Hong Yung
11:50-12:10	Shengyu Zhang	11:45-12:05	Tobias Fritz	11:45-12:15	Hector Bombin	11:45-12:15	François Le Gall	11:50-12:10	Ersen Bilgin
12:10-14:00	**Lunch**	12:05-14:00	**Lunch**		**Lunch & Free Afternoon**	12:05-14:00	**Lunch**	12:10-14:00	**Lunch**
14:00-14:50	John Martinis	14:00-14:20	Simone Severini			14:00-14:50	Omar Fawzi	14:00-14:30	Bill Fefferman
14:55-15:15	Tzu-Chieh Wei/ Akimasa Miyake	14:25-14:55	Stephanie Wehner			14:55-15:25	Jonathan Oppenheim	14:35-14:55	Michael Bremner
15:15-15:45	**Break**	14:55-15:30	**Break**			15:25-16:00	**Break**	14:55-15:30	**Break**
15:45-16:05	David Poulin	15:30-16:00	Jérémie Roland			16:00-17:00	**Business Meeting**	15:30-16:20	Fernando Brandão
16:10-16:30	Ramis Movassagh	16:05-16:25	Xie Chen					16:20-16:30	**Closing Remarks**
16:35-16:55	Norbert Schuch	16:30-16:50	Robin Kothari	16:30-17:00	**Registration & Reception @ SMU**				
		16:55-17:15	Fernando Brandão	17:00-18:00	**Public Lecture @ SMU Charles H. Bennett**				
from 17:15	**Poster Session 1**	from 17:15	**Poster Session 2**	from 19:00	**Conference Dinner @ Marina Bay Sands**	from 19:00	**Rump Session @ Siloso Beach**		