15th Workshop on Quantum Information Processing


# Montréal, Québec, Canada
# December 12 - 16, 2011

http://www.crm.umontreal.ca/QIP2012

# Our Sponsors










# Welcome Message

Dear friends and colleagues,

I would like to welcome you all in Montreal for the 15th workshop on Quantum Information Processing. This document contains most of the information you'll need in order to take advantage of all what the program has to offer.

The idea of holding QIP2012 in Montreal was triggered by the intention of the CRM (Centre de Recherches Mathématiques) to organize a thematic semester on quantum information from June to December 2011. The semester started with the *11th Canadian summer school on quantum information*, and the *8th Canadian student conference on quantum information*. Workshops on *quantum computer science*, *quantum information in quantum many-body physics*, *quantum codes, geometry and random structures*, and *quantum foundations in the light of quantum information* all took place at the CRM (University of Montreal) from October to December 2011. The thematic semester had two important figures of our field as Aisenstadt chairs: John Preskill and Renato Renner. The closing act of this successful semester is the reason why you are all here today.

Andreas Winter, general chair of QIP2011, described extremely accurately the state of mind that prevails when you realize you are the general chair for the next QIP. I won't repeat his description here except the three words he chose: disbelief, excitement and terror. My only contribution to this perfect description would be to propose a rotation of the three words one position to the right in order to represent the amplitude of each of my initial feelings in decreasing order.

At the end, the only reason this workshop was made possible is due to extremely dedicated and qualified persons having served different committees (see next page) and having helped us unstintingly. Withtout their altruism, nothing could have been done. The program committee, chaired by Dorit Aarhonov, did a tremendous job in a shorter time than usual to pick 40 papers and 122 posters. I offer all my gratitude to the program committee for having provided the solid foundation upon which this workshop could be erected. The CRM has been extremely important in helping us with all the stuff we did not know, we did not want to know, and did not even realize had to be known. With all these persons doing their job so professionally and relentlessly, the three words coined by Andreas (and initially rotated one position to the right) then started shifting to the left, finally leaving only the word 'excitement'.

The first goal of the local organizing committee was to find an illustration representing the location, our field, and the 20th anniversary of quantum teleportation discovered here in Montreal. I believe that teleporting ice hockey players will be one of the first Canadian applications of a working teleportation prototype. Or simply, teleporting Canadian ice hockey players in their suits will certainly contribute to remain among the top ice hockey countries in the world. What else could we do with this device? Why the Canadian government has contributed so generously to our field? I bet the answer is in our national sport.

I wish you all plenty of talks and posters that you will remember, meetings and experiences that you'll appreciate,

Have a good time in Montreal,

Louis Salvail

# Committees

### Program Committee

Dorit Aharonov [chair] (Hebrew University)
Michael Ben-Or (Hebrew University)
Fernando Brandao (Universidade Federal de Minas Gerais)
Sergey Bravyi (IBM, T.J. watson)
David DiVencenzo (Julich-Aachen)
Matt Hastings (UCSB)
Sandy Irani (UCI)
Hirotada Kobayashi (NII)
Debbie Leung (Waterloo)
Renato Renner (ETH)
Christian Schaffner (U. Amsterdam)
Norbert Schuch (Caltech)
Peter Shor (MIT)
Graeme Smith (IBM, T.J. Watson)
Thomas Vidick (UCB)
John Watrous (Waterloo)
Stephanie Wehner (NUS)
Ronald de Wolf (CWI)

### Steering Committee

Ignacio Cirac (MPQ, Garching)
Eddie Farhi (MIT)
Aram Harrow (U. Washington)
Patrick Hayden (McGill)
Louis Salvail [chair] (U. de Montréal)
Barbara M. Terhal (RWTH Aachen)
Andreas Winter (U. Bristol/CQT, NUS)
Andrew Yao (Tsinghua)

### Local Organisers

Kassem Kalach (Poster session)
Marc Kaplan (Visas and support)
Magalie Lascar (Coordinator)
Louis Salvail (General chair)
Benno Salwey (Rump session)
Dave Touchette (Webmaster)

# Table of Contents

# General Information

## Workshop Overview

| | |
|---|---|
| Workshop Venue | Cœur des Sciences de l'UQAM, Amphithéâtre SH-2800<br>200, Sherbrooke West St, Montreal, Qc, Canada<br>**Métro:** Place des Arts<br>Monday, December 12th – Friday, December 16th ,2011<br>**Note:** Lunch will not be provided |
| Poster Sessions | Cœur des Sciences de l'UQAM, Salle Polyvalente<br>(Above amphitheatre) 200, Sherbrooke West St, Montreal<br>Monday, December 12th , 2011, 5:15 p.m.<br>Tuesday, December 13th ,2011, 5:15 p.m. |
| Social Dinner | Marché Bonsecours<br>350 rue Saint-Paul Est, Vieux Montréal, Québec, Canada<br>**Métro:** Champ de Mars<br>Wednesday, December 14th ,2011, 7 p.m. |
| Rump Session | Université de Montréal, Amphithéâtre K-500 + Hall d'honneur<br>Pavillon Roger Gaudry,<br>2900, Chemin de la Tour, Montréal<br>**Métro:** Université de Montréal<br>Thursday, December 15th ,2011, 7 p.m. |

## Instructions for Speakers

All speakers should provide their presentations before the start of the break taking place before their session. There will be one PC and one Mac from which your presentation can be shown. The 5 minutes between talks is only used for the transition between speakers. If your talk takes place in the first morning session then your presentation should be provided before 8:00 a.m. If your talk is scheduled in the first afternoon session then it should be provided before 1:00 p.m. Please send us your presentation at qip.speakers@iro.umontreal.ca.

## Business Meeting

The business meeting is open to all participants to the conference. This is where the community can influence future QIP conferences. The organizers of the next QIP will present their venue and proposals for the following QIP conferences can be presented and discussed. An advisory vote is then taken among the participants. The final decision is taken by the Steering Committee as soon as possible after the conference. Other matters regarding the organization of our yearly meetings are also encouraged to be discussed.

# About UdeM

## Quantum Information Processing at the University of Montreal (LITQ)

**Background**

The LITQ (Laboratoire d'informatique théorique et quantique) is a laboratory of the computer science department at the University of Montreal, involved in theoretical and quantum computer science. The lab counts 6 professors and is very active both in research and education. The lab is working on several aspects of computer science and physics. In particular, classical and quantum cryptography, computational complexity, quantum information processing, the foundations of quantum mechanics and graph theory. See www.iro.umontreal.ca/~utheorie for more details.

**Quantum Information Processing at the LITQ**

The department of computer science at the University of Montreal is certainly one of the world first computer science department involved in research in quantum information processing, dating back to the early work of Gilles Brassard around 1981. Among other realizations of their members over the years, we mention quantum key distribution, quantum teleportation, quantum one-time-pad, quantum pseudo-telepathy, formalization of Grover algorithm, and the quantum bit commitment no-go theorem. This year, Gilles Brassard has been awarded the most prestigious science and engineering prize in Canada for his pioneer work in quantum information processing.
The laboratory has currently about a dozen graduate students (Postdoc, Ph.D., and Master) and four professors (Michel Boyer, Gilles Brassard, Louis Salvail, Alain Tapp) working on topics related to quantum information processing. The lab is always looking for students to join us.

# About CRM

With its world-renowned thematic programming introduced by the CRM in the 80's, its scientific workshops and outreach activities, its 1,500 annual visiting scientists from around the world, and ten laboratories directly involving more than 200 researchers from twelve major universities in Quebec and Ontario, the Centre de recherches mathématiques (CRM) is a major hub for the mathematical sciences. The dual structure on which the CRM is built -- top level international scientific programming running in parallel with ten high-performance research laboratories -- is unique in Canada. It is also unique in the world.
The Centre de recherches mathématiques (CRM) was founded in 1968. Under the direction of Professor François Lalonde as of June 1, 2011, the Centre's mandate is to serve as a national centre for fundamental research in mathematics and their applications. The CRM's scientific personnel includes more than one hundred members and postdoctoral fellows. Further, the Centre hosts from year to year a large number of guest researchers.

The CRM coordinates advanced courses and is instrumental in the training of young researchers. Throughout the world one finds numerous researchers who have had the opportunity to complete their research training at the CRM. The Centre is a major meeting place where all members benefit from a large number of scientific exchanges and collaborative projects.

# About Montreal

## Transportation

The Montréal metro is made up of 68 stations spread out along four lines, running from 5:30 a.m. to somewhere between 0:30 and 1:30 a.m. depending on the line and day of the week. The bus network consists of 186 daytime and 23 nighttime service routes. You can travel with one ticket for 120 minutes regardless of neither the transport mode used nor the number of connections. There are also taxis everywhere: you can either call one, or get in one from taxi stands or hail one by the roadside. Here are some companies offering a bilingual service.

| | |
|---|---|
| Taxi Diamond | 514-273-6331 |
| Coop de Taxi de Montréal | 514-725-9885 |
| Taxi Champlain | 514-271-1111 |

## Medical Facilities

In case of emergency (ambulance, police, fire), dial **911**. You will talk to someone and then be redirected if necessary. If you have a medical question, you can dial **811** to talk to a nurse. Pharmaceuticals are available at pharmacies. The main ones are Jean Coutu, Pharmaprix, Brunet, Uniprix, and Proxim. They are usually open 7 days a week, from 8 a.m. to 10 p.m. You can also ask medical questions to a pharmacist.

## Lost Passport

If you have lost your passport, you need to make a police report at any police station, then go to your embassy or consulate to get a temporary visa. Do not forget to ask a copy of the police report with the file number to hand it to your embassy.

## Useful Numbers

| | |
|---|---|
| QIP2012 Secretariat | 514-343-6111 # 47612 |
| Police/Ambulance/Fire | **911** |
| Directory assistance | **411** |
| Montreal Tourism Board | 514-273-2015 |

To know the phone number of your embassy / consulate or high commission, dial **411**.

# Things to do, not to do, and see in Montreal

Do not cross the street out of the zebra crossing or when the red hand is on (you might be fined for that);
Do not drink alcohol in the street (you might also be fined for that);
Give 15% tip or more of the total amount of the invoice in restaurants, bars, cafés (because service is not included). Tips are also expected by taxi drivers. In bars, a good heuristic is to give 1$ tip per drink.
Remember all displayed prices do not include taxes (add around 15%);
Wait at the entrance of a restaurant to be seated.

## If you want to feel "local"

Have your dinner/supper between 5 and 6 p.m.
Always have something to drink (usually a coffee) or eat in your hands while you are walking in the street (a bit of a challenge with the snow!);
Try one of the numerous cafés because Montréal has a café culture;
Have a beer in a bar during a hockey game, supporting the "Canadiens" of course (the local team, they don't win often anymore, but who cares? Just enjoy!);
Challenge your stomach by eating a "poutine" at the Banquise, open 24h/24 www.restolabanquise.com or somewhere else;
Taste the famous "Smoked Meat" at Schwartz's (3895 Bd St Laurent, www.schwartzsdeli.com);
Taste a hot bagel at Fairmount, open 24h/24 (74 Fairmount West ave, www.fairmountbagel.com );
Taste the multicultural cuisine of Montréal! (see our selection or the touristic guide);
Stay warm by shopping in the "Underground City" named RÉSO, the biggest of all the man-made underground networks in the world; RÉSO has 32km (20 miles) of pedestrian walkways, indoor areas and tunnels linking many business centres, some 1,700 boutiques, 7 major hotels, banks, offices, dwellings, close to 200 restaurants, museums, exhibitions halls, 2 universities pavilions, 10 métro (subway) stations, 2 train stations, 2 regional bus stations and even an arena. It can be accessed through 120 different entrances.

Stay warm by visiting a museum and even warmer by visiting the Biodôme:

Museums Montreal http://www.museesmontreal.org/en/Montreal_Museums.htm

Biodôme de Montréal http://www2.ville.montreal.qc.ca/biodome/

# Where to have lunch around the conference location

Here is our personal selection; you can also check the touristic guide given with your personal kit.

All along Parc avenue, until Prince Arthur, you will find places to eat at reasonable prices.
You can also go to the city centre (stop at McGill metro station) and try one of the numerous food courts located at the bottom of the shopping centres. There is also a food court at the shopping centre Complexe Desjardins, just 5 min walk from the conference location. The Latin Quarter is a nice place to go (stop at Berri-Uqam metro station), along St-Denis street.

**$ Benelux** : Micro brewery and café: nice beers, paninis and European hot dogs
245, Sherbrooke West avenue, metro Place des Arts

**$ Café République** : sandwiches, burgers, pastas, grillades, fishes
3563, Bd St Laurent (550m from the Conference Venue), Bus 80

**$ Lola Rosa Café**: small but good vegetarian restaurant
545, Milton Street (650m from QIP2012)

**$ Pikolo:** sandwiches
Corner of Sherbrooke and Parc

**$$ Chez Gautier** : Parisian brasserie, free internet
3487, Parc Avenue

**$ Patisserie Belge (next to Chez Gautier)**: nice sandwiches, quiches, take away

**Marché 27:** european bistro
27 Prince Arthur Street, corner of Clark

**$ Amelio's** : pizzeria
201 rue Milton, coin Ste Famille

**$$ Bistro Isakaya** : sushi,fishes
3469, Parc avenue

**$$ Brasserie T!**: Québec, *nouvelle cuisine*
1425, rue Jeanne Mance, metro Place des Arts

**$$ Circos Café Resto Bar**: Mediterranean
380, Sherbrooke West St, métro Place des Arts

**$$ Confusion/Tapas du Monde**: France
1635-7 St Denis Street, metro Berri-Uqam

**$$ Le Commensal** : Very good vegetarian self-service restaurant
1720, St Denis Street, Berri-Uqam metro or 1204 McGill College (corner of Ste Catherine Street), McGill metro

# Conference Venue Information

## Venue Address

**COEUR DES SCIENCES DE L'UQAM**
Amphithéatre (SH-2800)
200, rue Sherbrooke Ouest
Montréal, Québec, Canada
www.coeurdessciences.uqam.ca/

### Wireless

Choose « réseau invité ». Type password : faire

### Activities at Cœur des Sciences de l'UQAM

| | |
|---|---|
| Conference Talks | December 12 -16, Amphitheater SH2800 |
| Welcoming Cocktail | December 12th, 5:15 p.m., Salle Polyvalente |
| Poster Sessions | December 12-13, Salle Polyvalente |

### Activities at Marché Bonsecours, Vieux-Montréal

| | |
|---|---|
| Social Dinner | December 14th, 7 p.m., Salle de la Commune |

### Activities at Université de Montréal

| | |
|---|---|
| Rump Session | December 15th, 7 p.m., K-500, pavillon Roger Gaudry |

## Getting to Montréal City Centre

### By taxi

The journey to the city centre is a fixed fare of 38$. Don't forget to give a tip!

### By Express Bus 747 (STM)

The cost is 8$ for a one-way trip. At the airport, tickets are sold at the International Currency Exchange (ICE) counter on the international arrivals level.

**More information** http://www.stm.info/English/info/a-747.htm

# Scientific Program

**Monday, December 12th**

8:15-9:00 **Registration**

9:00-9:15 **Opening remarks**
**Guest of Honor: Dr François Lalonde**
Director of the CRM (Centre de Recherches Mathématiques)
Université de Montréal

9:15 **Sergey Bravyi** (Plenary lecture)
*Topological qubits stability against thermal noise*

10:10 **Omar Fawzi, Patrick Hayden, Ivan Savov, Pranab Sen and Mark Wilde** (Featured talk)
*Advances in classical communication for network quantum information theory*

10:40 **BREAK**

11:05 **Nilanjana Datta, Min-Hsiu Hsieh and Mark Wilde**
*Quantum rate distortion, reverse Shannon theorems, and source*-channel separation

11:30 **Graeme Smith, John A. Smolin and Jon Yard**
*Quantum communication with gaussian channels of zero quantum capacity*

11:55 **Nengkun Yu, Runyao Duan and Quanhua Xu**
*Bounds on the distance between a unital quantum channel and the convex hull of unitary channels, with applications to the asymptotic quantum Birkhoff conjecture*

12:15 **LUNCH BREAK**

14:00 **Markus Greiner** (Plenary lecture)
*Quantum Magnetism with Ultracold Atoms - A Microscopic View of Artificial Quantum Matter*

14:55 **André Chailloux and Iordanis Kerenidis** (Featured talk)
*Optimal Bounds for Quantum Bit Commitment*

15:25 **BREAK**

15:50 **Gilles Brassard, Peter Høyer, Kassem Kalach, Marc Kaplan, Sophie Laplante and Louis Salvail** (Featured talk)
*Merkle Puzzles in a Quantum World*

16:25 **Salman Beigi and Robert Koenig**
*Simplified instantaneous non-local quantum computation with applications to position-based cryptography*

16:50 **Harry Buhrman, Serge Fehr, Christian Schaffner and Florian Speelman**
*The Garden-Hose Game and Application to Position-Based Quantum Cryptography*

17:15 **Poster session #1**

**Tuesday, December 13th**

9:00 **Itai Arad, Zeph Landau and Umesh Vazirani** (Plenary lecture)
*An improved area law for 1D frustration-free systems*

9:55 **Spyridon Michalakis and Justyna Pytel**
*Stability of Frustration-Free Hamiltonians*

10:15 **BREAK**

10:40 **Toby Cubitt, Martin Schwarz, Frank Verstraete, Or Sattath and Itai Arad**
*Three Proofs of a Constructive Commuting Quantum Lovasz Local Lemma*

11:05 **Norbert Schuch**
*Complexity of commuting Hamiltonians on a square lattice of qubits*

11:30 **Josh Cadney, Noah *Linden* and Andreas Winter**
*Infinitely many constrained inequalities for the von Neumann entropy*

11:50 **LUNCH BREAK**

14:00 **Jeongwan Haah** (Plenary lecture)
*Local stabilizer codes in three dimensions without string logical operators*

14:55 **Andrew Landahl, Jonas Anderson and Patrick Rice**
*Fault-tolerant quantum computing with color codes*

15:15 **BREAK**

15:40 **Guillaume Duclos-Cianci, Héctor Bombin and David Poulin** (Featured talk)
*Equivalence of Topological Codes and Fast Decoding Algorithms*

16:15 **Joseph M. Renes, Frederic Dupuis and Renato Renner**
*Quantum Polar Coding*

16:40 **Sergey Bravyi and Robert Koenig** (Featured talk)
*Disorder-assisted error correction in Majorana chains*

17:15 **Poster session #2**

**Wednesday, December 14th**

9:00 **Troy Lee and Jérémie Roland** (Featured talk)
*A strong direct product theorem for quantum query complexity*

9:35 **André Chailloux and Or Sattath**
*The Complexity of the Separable Hamiltonian Problem*

10:00 **Yaoyun Shi and Xiaodi Wu**
*Epsilon-net method for optimizations over separable states*

10:20 **BREAK**

10:45 **Abel Molina and John Watrous**
*Hedging bets with correlated quantum strategies*

11:10 **Jop Briet and Thomas Vidick**
*Explicit lower and upper bounds on the entangled value of multiplayer XOR games*

11:35 **Gus Gutoski and Xiaodi Wu** (Featured talk)
*Parallel approximation of min-max problems with applications to classical and quantum zero-sum games*

12:05 **LUNCH BREAK & FREE AFTERNOON**

19:00 **Conference diner** (Marché Bonsecours)

**Thursday, December 15th**

9:00 **Aleksandrs Belovs** (Plenary lecture)
*Span Programs for Functions with Constant-Sized 1-certificates*

9:55 **Francois Le Gall**
*Improved Output-Sensitive Quantum Algorithms for Boolean Matrix Multiplication*

10:20 **Dominic Berry, Richard Cleve and Sevag Gharibian**
*Discrete simulations of continuous-time query algorithms that are efficient with respect to queries, gates and space*

10:40 **BREAK**

11:05 **Thomas Decker, Gábor Ivanyos, Miklos Santha and Pawel Wocjan**
*Hidden Symmetry Subgroup Problems*

11:30 **Rahul Jain and Ashwin Nayak**
*A quantum information cost trade-off for the Augmented Index*

11:55 **Sevag Gharibian and Julia Kempe**
*Hardness of approximation for quantum problems*

12:15 **LUNCH BREAK**

14:00 **Jérémie Roland (Plenary lecture, based on joint work with Maris Ozols and Martin Roetteler**
*Quantum rejection sampling*

14:55 **Rolando Somma and Sergio**
*Spectral Gap Amplification*

15:15 **BREAK**

15:40 **Troy Lee, Rajat Mittal, Ben Reichardt, Robert Spalek and Mario Szegedy** (Featured talk) *Quantum query complexity for state conversion*

16:15 **Fernando Brandao, Aram Harrow and Michal Horodecki** (Featured talk)
*Local random quantum circuits are approximate polynomial-designs*

16:45 **Business Meeting**

19:30 **Rump Session** (Université de Montréal, K-500)

**Friday, December 16th**

9:00 **Eric Chitambar, Wei Cui and Hoi-Kwong Lo** (Plenary lecture)
*Increasing Entanglement by Separable Operations and New Monotones for W-type Entanglement*

9:55 **Rodrigo Gallego, Lars Erik Würflinger, Antonio Acín and Miguel Navascués**
*Quantum correlations require multipartite information principles*

10:15 **BREAK**

10:40 **Martin Schwarz, Kristan Temme, Frank Verstraete, Toby Cubitt and David Perez-Garcia**
*Preparing projected entangled pair states on a quantum computer*

11:05 **Esther Haenggi and Marco Tomamichel**
*The Link between Uncertainty Relations and Non-Locality*

11:30 **Salman Beigi and Amin Gohari**
*Information Causality is a Special Point in the Dual of the Gray-Wyner Region*

11:50 **LUNCH BREAK**

13:35 Marcus **P. Da Silva, Steven T. Flammia, Olivier Landon-Cardinal, Yi-Kai Liu and David Poulin**
*Practical characterization of quantum devices without tomography*

14:00 **Robin Blume-Kohout**
*Paranoid tomography: Confidence regions for quantum hardware*

14:25 **Sandu Popescu** (Plenary lecture)
*The smallest possible thermal machines and the foundations of thermodynamics*

15:15 **Closing Remarks**

# Poster Sessions

Two poster sessions will be taking place on Monday, December 12th and on Tuesday, December 13th. The posters will be located at the salle polyvalente (SH-4800), just above the conference hall. The list of posters below is in an almost totally random order. All participants can vote for their favorite posters (in a few categories) using the ballots included in your kit.
The welcoming cocktail will be held on Monday December 12th. Some drinks and food will also be served on Tuesday December 13th.

## Instructions for poster presenters

Please check below whether your session is on Monday or Tuesday. Your poster number will tell you where to install it. You can install your poster starting from noon, the day of your session. Posters will be rewarded symbolic prices (at the social dinner) based on the outcome of the votes.

## Monday, December 12th

1. **A.C. Cem Say and Abuzer Yakaryilmaz**
   *Quantum computation with narrow CTCs*

2. **Miguel Navascues, David Perez-Garcia and Ignacio Villanueva**
   *Inverting the Central Limit Theorem*

3. **Christian Weedbrook, Stefano Pirandola, Seth Lloyd and Timothy Ralph**
   *Quantum Cryptography Approaching the Classical Limit*

4. **Iordanis Kerenidis and Shengyu Zhang**
   *A quantum protocol for sampling correlated equilibria unconditionally and without a mediator.*

5. **Johannes Wilms, Julien Vidal, Frank Verstraete and Sébastien Dusuel**
   *Mutual information in the Lipkin-Meshkov-Glick model*

6. **Bill Rosgen**
   *Testing quantum circuits and detecting insecure encryption*

7. **Anna Vershynina, Bruno Nachtergaele and Valentin Zagrebnov**
   *Lieb-Robinson Bounds and the Existence of the Thermodynamic Limit for a Class of Irreversible Quantum Dynamics*

8. **Loïck Magnin and Jérémie Roland**
   *Quantum adversary lower bounds by polynomials*

9. **Shen Chen Xu and Mark Wilde**
   *Sequential, successive, and simultaneous decoders for entanglement-assisted classical communication*

10. **David Lyons and Scott Walck**
    *Local unitary classes of symmetric mixed states*

11. **Maarten Van Den Nest**
    *A monomial matrix formalism to describe quantum many-body states*

12. **Alastair Kay**
    *The Capabilities of a Perturbed Toric Code as a Quantum Memory*

13. **Nengkun Yu, Runyao Duan and Mingsheng Ying**
    *Distinguishing Maximally Entangled States by PPT Operations and Entanglement Discrimination Catalysis*

14. **Nilanjana Datta and Min-Hsiu Hsieh**
    *One-shot entanglement-assisted classical communication*

15. **Sevag Gharibian, Jamie Sikora and Sarvagya Upadhyay**
    *QMA variants with polynomially many provers*

16. **Rahul Jain and Ashwin Nayak**
    *A short proof of the Quantum Substate Theorem*

17. **Sandeep Narayanaswami and Sean Hallgren**
    *9-State 1-Dim Hamiltonians is QMA-complete*

18. **Andris Ambainis, Artūrs Bačkurs, Balodis Kaspars, Dmitry Kravcenko, Raitis Ozols, Juris Smotrovs and Madars Virza**
    *Quantum strategies are better than classical in almost any XOR game*

19. **Akbar Fahmi**
    *Inequalities for Testing Non-local Hidden Variable Models Versus Quantum Correlations*

20. **Zhaohui Wei and Shengyu Zhang**
    *On characterizing quantum correlated equilibria*

21. **Shengshi Pang and Shengjun Wu**
    *Unambiguously determining the orthogonality of multiple quantum states*

22. **Tsuyoshi Ito**
    *Parallelization of entanglement-resistant multi-prover interactive proofs*

23. **Marcio F. Cornelio, Marcos C. De Oliveira and Felipe F. Fanchini**
    *Entanglement Irreversibility from Quantum Discord and Quantum Deficit*

24. **Andrew Childs, Shelby Kimmel and Robin Kothari**
    *The quantum query complexity of read-many formulas*

25. **Felipe Fanchini, Marcio Cornelio, Marcos De Oliveira and Caldeira Amir**
    *Conservation law for distributed entanglement of formation and quantum discord*

26. **Marcelo França Santos, Marcelo Terra Cunha, Rafael Chaves and André Carvalho**
    *Quantum computing with incoherent resources and quantum jumps*

27. **Masaki Owari and Masahito Hayashi**
    *Asymptotic local hypothesis testing between a pure bipartite state and the completely mixed state*

28. **Matthew Mckague**
    *On the power quantum computation over real Hilbert spaces*

29. **Robin Blume-Kohout, Sarah Croke and Michael Zwolak**
    *The power of O(1) qubits: perfect state discrimination with tiny quantum computers*

30. **Jin Woo Jun**
    *Entanglement Swapping in an Imperfect Channel*

31. **Gorjan Alagic and Edgar Bering**
    *Quantum Algorithms for Invariants of Triangulated Manifolds*

32. **Roman Orus and Tzu-Chieh Wei**
    *Topological Geometric Entanglement of Blocks in Toric Codes*

33. **David Rosenbaum and Aram Harrow**
    *Uselessness for an oracle model with internal randomness*

34. **Sadegh Raeisi, Nathan Wiebe and Barry Sanders**
    *Designing quantum circuits for efficient many-body quantum simulation*

35. **Clare Horsman**
    *Quantum picturalism for topological cluster-state computing*

36. **Yoshifumi Nakata, Peter Turner and Mio Murao**
    *Entanglement of phase-random states*

37. **Go Kato and Koji Azuma**
    *Optimal entanglement manipulation via coherent-state transmission*

38. **Tony Dorlas and Ciara Morgan**
    *The invalidity of a strong capacity for a quantum channel with memory*

39. **Joonwoo Bae, Won-Young Hwang and Yeong-Deok Han**
    *No-Signaling Principle, Guessing Probability, and General Structure of Optimal Quantum State Discrimination*

40. **Giannicola Scarpa and Simone Severini**
    *The Rank-1 Quantum Chromatic Number*

41. **Andris Ambainis, Arturs Backurs, Nikolajs Nahimovs, Raitis Ozols and Alexander Rivosh**
    *Search by quantum walks on two dimensional grid without amplitude amplification*

42. **Earl Campbell and Jens Eisert**
    *Gaussification and entanglement distillation of continuous variable systems: a unifying picture*

43. **Pawel Wocjan and Pradeep Sarvepali**
    *Quantum Algorithms for One-Dimensional Infrastructures*

44. **Farid Ablayev and Alexander Vasiliev**
    *Quantum Fingerprinting for Quantum Branching Programs*

45. **Mamdouh Abbara and Jean-Pierre Tillich**
    *Quantum turbo-codes with unbounded minimum distance and excellent error-reducing performance*

46. **Aman Chawla**
    *Reliability of a classical-quantum communication system with noisy feedback*

47. **Martin Kliesch, Thomas Barthel, Christian Gogolin, Michael Kastoryano and Jens Eisert**
    *Efficient simulation of dissipative quantum dynamics on a quantum computer*

48. **Runyao Duan, Simone Severini and Andreas Winter**
    *On zero-error communication via quantum channels in the presence of noiseless feedback*

49. **Seiichiro Tani**
    *Optimally Fast Quantum Solitude Detection on Anonymous Directed Networks*

50. **Mateus De Oliveira Oliveira**
    *Band Diagonal Strategies for Two-Prover One-Round Entangled Non-Local Games*

51. **Marco Tlúio Quintino, Mateus Araújo, Daniel Cavalcanti, Marcelo França Santos and Marcelo Terra Cunha**
    *Maximal CHSH violations with low efficiency photodetection and homodyne measurements*

52. **Mario Berta, Matthias Christandl, Fernando Brandao and Stephanie Wehner**
    *Entanglement Cost of Quantum Channels*

53. **Mario Berta, Fabian Furrer and Volkher Scholz**
    *The Smooth Entropy Formalism on von Neumann Algebras*

54. **Yun Shang, Xian Lu and Ruqian Lu**
    *Linear bounded automata based on unsharp quantum logic*

55. **Sayyed Yahya Mirafzali and Ali Ahanj**
    *Measurement-induced nonlocality for an arbitrary bipartite state*

56. **Matthias Ohliger, Vincent Nesme and David Gross**
    *Quantum compressed sensing with general measurements*

57. **Robert Raussendorf, Pradeep Sarvepalli, Tzu-Chieh Wei and Poya Haghnegahdar**
    *Measurement based quantum computation as a toy-model for a quantum theory of spacetime*

58. **Mirmojtaba Gharibi**
    *Reduction from non-injective hidden shift problem to injective hidden shift problem*

59. **Iman Marvian and Robert Spekkens**
    *A generalization of Schur-Weyl duality with applications in quantum estimation*

60. **Nathan Harshman**
    *I Come To Bury Entanglement, Not To Praise It*

61. **Thiago Maciel, Andre Cesario and Reinaldo Vianna**
    *Variational quantum tomographies with incomplete information*

# Tuesday, December 13th

62. **Tiago Debarba**
    *Relativistic Quantum Bit via Foundations of Relativistic Quantum Theory*

63. **Oscar Dahlsten, Daniel Lercher and Renato Renner**
    *Tsirelson's bound from a Generalised Data Processing Inequality*

64. **Adrian Hutter, Lí-dia Del Rio, Renato Renner and Stephanie Wehner**
    *An information-driven approach to thermodynamics*

65. **Peter Høyer and Jibran Rashid**
    *Quantum Nonlocal Boxes Exhibit Stronger Distillability*

66. **Santosh Shelly Sharma and Naresh Kumar Sharma**
    *Classification of Multipartite Entanglement via Negativity Fonts*

67. **Fernando Iemini**
    *Quantifying Quantum Correlations in Fermionic Systems using Witness Operators*

68. **Daniel J. Brod and Ernesto F. Galvão**
    *Extending matchgates into universal quantum computation*

69. **J K Sharma, Sushamana Sharma and Rajshri Vyas**
    *On obtaining maximally nonclassical state from arbitrary classical state using inverse boson operators*

70. **Laszlo Gyongyosi and Sandor Imre**
    *Superactivated Quantum Repeaters*

71. **Raphael Dias Da Silva and Ernesto F. Galvão**
    *Translating measurement-based quantum computation into compact quantum circuits*

72. **Mark Wilde and Saikat Guha**
    *Polar codes for classical-quantum channels*

73. **Ashley Montanaro, Richard Jozsa and Graeme Mitchison**
    *Exact quantum query algorithms for small boolean functions*

74. **Sheng-Mei Zhao, Xiang-Liang Dong, Fei Cao and Long-Yan Gong**
    *A novel quantum key distribution protocol and its experimental implement*

75. **Daniel Nagaj, Libor Caha and Sergey Bravyi**
    *Quantum 2-SAT in 1D with Qutrits*

76. **Raqueline A. M. Santos, Renato Portugal and Franklin L. Marquezino**
    *Decoherence on Szegedy's Quantum Walk*

77. **Davide Girolami and Gerardo Adesso**
    *Observable measure of quantum correlations*

78. **Courtney Brell, Stephen Bartlett and Andrew Doherty**
    *A Perturbative Approach to PEPS Parent Hamiltonians*

79. **Dominic Else, Stephen Bartlett and Andrew Doherty**
*Measurement-based quantum computation with the cluster state is robust to symmetric perturbations in the parent Hamiltonian*

80. **Fuyuhiko Tanaka and Takuma Takeuchi**
*Hypothesis testing of a maximally entangled state under the unknown unitary process*

81. **Prashant Kumar and Andrew Doherty**
*A Class of Quantum Double Subsystem Codes*

82. **Viv Kendon**
*Where to quantum walk?*

83. **Junghee Ryu, James Lim, Changhyoup Lee and Jinhyoung Lee**
*Nonlocality test for continuous variable system with local symplectic operation*

84. **Naresh Kumar Sharma, Santosh Shelly Sharma and Paulo Jose Dos Reis**
*Entanglement generation between remote atomic qubits interacting with two mode Squeezed vacuum field*

85. **Santosh Shelly Sharma, Naresh Kumar Sharma and Paulo Jose Dos Reis**
*Classification of Four qubit Entangled States via negativity Fonts*

86. **Si-Hui Tan, Leonid Krivitsky and Berthold-Georg Englert**
*Measuring quantum correlations using lossy photon-number-resolving detectors with saturation*

87. **Yingkai Ouyang**
*Improved Upper Bounds on the Quantum Capacity of the Depolarizing Channel with Higher Dimension Amplitude Damping Channels*

88. **Mike Mullan and Emanuel Knill**
*Optimal Algorithms for Quantum Clocks*

89. **Radel Ben-Av and laakov Exman**
*Z-States Algebra for the Multi-Party Entanglement-Distillation Protocol*

90. **Smarajit Das, Naresh Sharma and Siddharth Muthukrishnan**
*On some special cases of the Entropy Photon-Number Inequality*

91. **Dvir Kafri and Jacob Taylor**
*Algorithmic Cooling of a Quantum Simulator*

92. **Christian Schuette-Nuetgen, Cyril Stark and Renato Renner**
*Dipole-Dipole-Interaction-Induced Anyon Dynamics in the Toric Code*

93. **Ernesto Galvao, Raphael Dias Da Silva and Elham Kashefi**
*Closed timelike curves in measurement-based quantum computation*

94. **Tina Yu and Chen-Hsiang Yeang**
*Quantum Clustering-Based Sampling Algorithms for Active Machine Learning*

95. **Abuzer Yakaryilmaz and A.C. Cem Say**
*NP has log-space verifiers with fixed-size public quantum registers*

96. **Jean-Daniel Bancal, Stefano Pironio, Antonio Acin, Yeong-Cherng Liang, Valerio Scarani and Nicolas Gisin**
*Revealing nonlocal correlations without measuring them: Hidden influence explanations of quantum correlations can not remain hidden*

97. **Siddhartha Santra, N. Tobias Jacobson, Lorenzo Venuti and Paolo Zanardi**
*Exact infinite-time statistics of the Loschmidt echo for a quantum quench*

98. **Siddhartha Santra, Alioscia Hamma and Paolo Zanardi**
*Quantum Entanglement in Random Physical States*

99. **David Reeb, Teiko Heinosaari, Anastasia Jivulescu and Michael M. Wolf**
*Extension Theorems for Quantum Operations*

100. **Eyuri Wakakuwa and Mio Murao**
*Extended Nonlocality-Assisted Random Access Coding and Information Causality*

101. **Maxime Hardy and William A. Coish**
*Heisenberg scaling of time-limited quantum metrology with realistic decoherence*

102. **Yuji Hirono, Shojun Nakayama, David Jennings, Terry Rudolph and Mio Murao**
*An extension of the exchange fluctuation theorem for initially correlated systems*

103. **Fernando Brandão, Jonathan Oppenheim and Sergii Strelchuk**
*When does noise increase the quantum capacity?*

104. **Cedric Beny**
*Causal structure of MERA*

105. **Marc Kaplan and Gilles Brassard**
*Simulating equatorial measurements on GHZ states with finite expected communication cost*

106. **Rodrigo Gallego, Lars Erik Würflinger, Antonio Acin and Miguel Navascues**
*Quantum correlations require multipartite information principles*

107. **Moritz Ernst and Rochus Klesse**
*Tackling Quantum Channel Capacities using suitable Random Codes*

108. **Emilie Pelchat and David Poulin**
*Degenerate Viterbi Decoding*

109. **Jens Eisert, Markus Mueller, Christian Gogolin and Martin Kliesch**
*Undecidability of quantum measurement occurrence*

110. **Yasuhito Kawano**
*Extended Clifford Group Circuit and Applications*

111. **Jeonghoon Park and Soojoon Lee**
*Zero-error classical capacity of qubit channels cannot be superactivated*

112. **Nicolas Menicucci, Steven Flammia and Peter Van Loock**
*Graphical calculus for Gaussian pure states*

113. **Michael Walter, Matthias Christandl, Stavros Kousidis and Brent Doran**
*Non-Abelian Duistermaat-Heckman Measures and the Quantum Marginal Problem*

114. **Keisuke Fujii and Yuuki Tokunaga**
*Error Correction Property of the Surface Codes with General Lattices*

115. **Giulio Chiribella**
*Perfect discrimination of no-signalling channels via quantum superposition of causal structures*

116. **Dmitry Kravchenko**
*EWL Scheme for Quantum Voting*

117. **Paul Pham and Krysta Svore**
*A Nearest-Neighbor Architecture for Shor's Factoring Algorithm with Sub-Quadratic Depth*

118. **Domingo Rodriguez**
*A Computational Modeling Framework for Quantum Fourier Transform Algorithms*

119. **Philippe Faist, Johan Aaberg and Renato Renner**
*On the Optimality of Work Extraction in Small Thermodynamical Systems*

120. **Pascal Basler, Normand Beaudry and Renato Renner**
*In the search of operational quantities for characterizing large quantum systems*

121. **Devin Hugh Smith, Geoff Gillett, Marcelo P. De Almeida, Cyril Branciard, Alessandro Fedrizzi, Till J. Weinhold, Adriana Lita, Brice Calkins, Thomas Gerrits, Sae Woo Nam, Howard Wiseman and Andrew G. White**
*Steering with superconducting transition edge sensors*

122. **Nilanjana Datta and Min-Hsiu Hsieh**
*The apex of the family tree of protocols: Optimal rates and resource inequalities.*

# Social Dinner

## Wednesday, December 14th

| | |
|---|---|
| **Venue** | Marché Bonsecours, Salle de la Commune (lower level)<br>350 rue St Paul Est, Vieux-Montréal<br>**Métro:** Champ de Mars (orange line) |
| **Time** | 7:00 – 11 p.m. |
| **Theme** | Illegal Casino in Nouvelle-France, 18th century… |
| **Entertainment** | Try your hand at the illegal gambling house where you may play and leave covered with gold…or debts!<br>Those who have lost everything at the Krabs, roulette or Black Jack will be able to console themselves by listening to sailors'songs and traditional music from the band "Les Murènes". Beware of your wallets, there will be a magician in the room… |
| **Food** | You will have the chance to taste some Amerindian food and local gastronomy from Québec. For example, wild meats, cheeses, cider and micro brewed beers will be offered. |
| **How does it work?** | Upon your arrival, you will be given Spanish money for drinks and gambling at the cloakroom. |
| **How to get there** | From the métro station Champ de Mars, head for the Vieux-Montréal by turning on the right handside and getting under the highway (stairs down and up), then go up the rue Gosford, cross the street and then go down on street St Paul until its end and you will arrive right at the entrance of the Marché Bonsecours. It is about 400m from the metro. |

# Rump Session

## Thursday, December 15th

The rump session has been introduced to our community at QIP2010 in Zurich. A rump session has also been organized in Singapore in 2011. QIP2012 is proud to continue the experiment. The rump session is the unique opportunity to give short presentations on new results, works in progress, open questions, announcements, and funny thoughts on topics of interest to the QIP community. Presentations are very short, something like 5 minutes each. The session takes place in a relax atmosphere with food and drinks served. Non-technical and humorous contributions are very much appreciated.

Organiser: Benno Salwey (DIRO, UdeM)
**Session Chair:** Claude Crépeau (McGill)

## Rump submission guideline

Maximum 1/2 page (standard margin), single column, font size= 11pt min. Submissions will be made by email to: qip.rump@iro.umontreal.ca
Submissions are accepted from Monday, December 12 to Wednesday, December 14 at 2 p.m.

## Venue

Université de Montréal
Amphitheatre K500, Pavilion Roger Gaudry
2900, Bvd Édouard Montpetit
**Métro:** Université de Montréal
**Bus lines:** 51, 119, 368

**Time** 7:00 – 10:30 p.m.

## Directions to the Rump session

From the metro station, take the travelator, then go on your right handside, there will be a sign for K500 and a paper sign for QIP2012. Out of the building, walk up to the main building of the university and take the main entrance. The amphitheatre is right there!

# QIP Charter

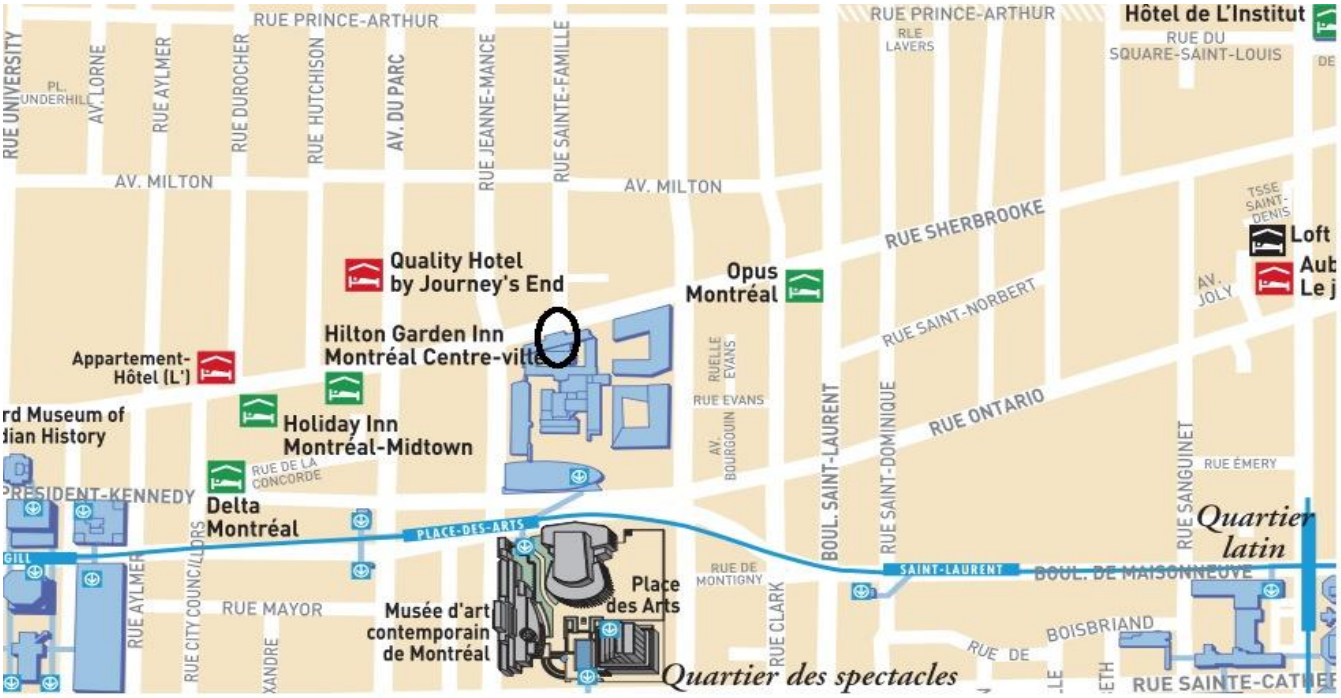
Goal of the Conference: The Workshop on Quantum Information Processing (QIP) is an annual conference about quantum computation and information which is usually held around January. Its goal is to represent the preceding year's best research in the area, in the form of both plenary talks and submitted papers. The conference has no published proceedings, and commonly includes the presentation of work published in proceedings of other conferences or in journals.
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, and to select and invite the plenary speakers for each meeting of the conference. 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 organizing committee. The SC consists of 9 people, including the local organizers of the previous, next, and subsequent QIPs, and is chaired by the local organizer of the next/current QIP. Members typically serve for 3 years, with the 3 longest-serving members being replaced once a year, typically soon after QIP. The current SC decides on the replacement of outgoing SC members. The SC chooses the chair of the programme committee (PC) for the next QIP. Starting typically in late summer, the SC invites roughly 5 plenary presentations (of the best recent research, but possibly also some 1 to 3 perspective or survey talks) and possibly some tutorial speakers, but otherwise leaves the details of the conference programme to the PC.
Business Meeting: 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 organizer for the next QIP gives a presentation, and proposals for the venue of the QIP following the next one 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 organizational 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 talks among the submitted papers is competitive, with typically between 32 and 50 accepted submissions; it is recommended to keep the number of acceptances minimal but the PC has flexibility to accommodate exceptional breadth and quality of submissions in a given year. The PC can suggest to the SC promotion of a few of the best submitted papers to plenary status, and can distinguish between longer and shorter time slots for the rest (typically 30 and 20 minutes, called *featured* and *contributed* talks, respectively). Poster submissions will generally be accepted unless they are off-topic or clearly wrong, to enable people to obtain funds for travel. At the discretion of the PC, best poster prizes can be awarded.
Typical Conference Outline: On the days immediately preceding the conference, tutorials can take place, typically each a half or a full day of lectures on a specific topic, aimed at students. If no or only limited tutorials can be offered, this has to be decided by the local organizer in conjunction with the SC. 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 40- to 45-minute plenary talk, followed by contributed/featured 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 (optional; for short impromptu presentations of very recent results) are held in late afternoons. The poster session forms an integral part of the QIP conference, and activities such as poster prizes or advertisements for excellent posters are encouraged.

Conflict of Interest:
1. SC member cannot be a plenary speaker, but PC members can be plenary 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 papers.

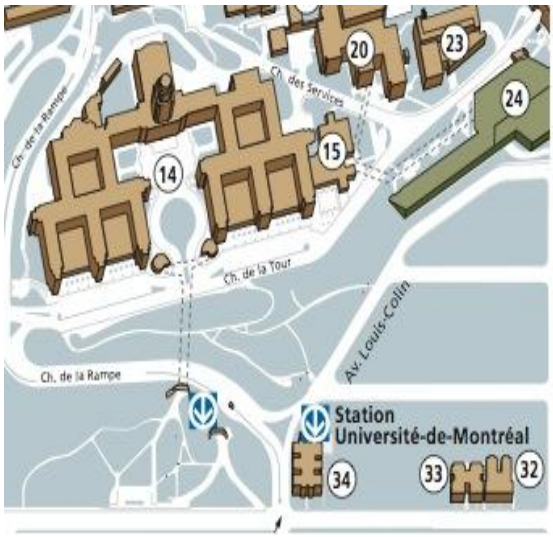
# Maps

## Conference Venue




## Social Dinner at Marché Bonsecours


## Rump Session at #14



| Monday | | Tuesday | | Wednesday | | Thursday | | Friday | |
|---|---|---|---|---|---|---|---|---|---|
| 9h00 | **Welcome & Opening Remarks** | 9h00 | Itai Arad | 9h00 | Troy Lee | 9h00 | Aleksandrs Belovs | 9h00 | Eric Chitambar |
| 9h15 | Sergey Bravyi | 9h55 | Spyridon Michalakis | 9h35 | Or Sattath | 9h55 | François Le Gall | 9h55 | Rodrigo Gallego |
| 10h10 | Mark Wilde | 10h15 | **Break** | 10h00 | Xiaodi Wu | 10h20 | Richard Cleve | 10h15 | **Break** |
| 10h40 | **Break** | 10h40 | Toby Cubitt | 10h20 | **Break** | 10h40 | **Break** | 10h40 | Martin Schwarz |
| 11h05 | Nilanjana Datta | 11h05 | Norbert Schuch | 10h45 | Abel Molina | 11h05 | Miklos Santha | 11h05 | Esther Haenggi |
| 11h30 | Jon Yard | 11h30 | Josh Cadney | 11h10 | Jop Briet | 11h30 | Ashwin Nayak | 11h30 | Salman Beigi |
| 11h55 | Runyao Duan | 11h50 | **Lunch Break** | 11h35 | Xiaodi Wu | 11h55 | Sevag Gharibian | 11h50 | **Lunch Break** |
| 12h15 | **Lunch Break** | 14h00 | Jeongwan Haah | 12h05 | **Lunch Break** | 12h15 | **Lunch Break** | 13h35 | Olivier Landon-Cardinal |
| 14h00 | Markus Greiner | 14h55 | Andrew Landahl | | | 14h00 | Jérémie Roland | 14h00 | Matthias Christandi |
| 14h55 | André Chailloux | 15h15 | **Break** | | | 14h55 | Rolando Somma | 14h25 | Sandu Popescu |
| 15h25 | **Break** | 15h40 | Guillaume Duclos-Cianci | | | 15h15 | **Break** | 15h15 | **Closing Remarks** |
| 15h50 | Gilles Brassard | 16h15 | Joseph M. Renes | | | 15h40 | Rajat Mittal | | |
| 16h25 | Salman Beigi | 16h40 | Robert Koenig | | | 16h15 | Fernando Brandao | | |
| 16h50 | Florian Speelman | 17h15 | Poster #2 | | | 16h45 | **Business Meeting** | | |
| 17h15 | Poster #1 | | | 19h00 | **Conference Diner** | 19h00 | **Rump Session** | | |