Mark William Girard

PhD candidate in Applied Mathematics

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Education and Research Experience

2012 – 2017 **University of Calgary**, Calgary, Alberta, Canada
Degree: PhD in Applied Mathematics
Thesis: *Mathematics of Bipartite Quantum Entanglement*
Adviser: Gilad Gour

2010 – 2012 **Albert-Ludwigs-Universität Freiburg**, Freiburg im Breisgau, Germany
Degree: Diplom Physics
Thesis: *Optimal Control of Many-Body Entanglement with Measures Optimized on the Fly*
Adviser: Florian Mintert
– Full scholarship from the German Academic Exchange Service (DAAD)

Summer 2010 **National Institute for Standards and Technology**, Boulder, Colorado, USA.
Role: Summer undergraduate researcher
Topic: Improving algorithms for quantum state tomography
Advisers: Scott Glancy and Emmanual Knill

2006 – 2010 **Trinity University**, San Antonio, Texas, USA
Degree: B.Sc. with majors in Physics, Mathematics and German
– Magna cum laude, Outstanding Graduating Senior in Physics

2002 – 2006 **Centaurus High School**, Lafayette, Colorado, USA. (valedictorian)

Awards and Achievements

2016 Eric Milner Prize for Excellence in Mathematics Communication. University of Calgary.

2016 – 2017 Killam Pre-Doctoral Award. Izaak Walton Killam Trust, University of Calgary.

2015 Graduate Assistant Teaching Excellence Award. Department of Mathematics and Statistics, University of Calgary. (Awarded for both Winter and Fall terms of 2015.)

2014 – 2016 Alberta Innovates – Technology Futures, Graduate Student Scholarship.

Winter 2014 Faculty of Science Recruitment Award. University of Calgary.

2012 – 2013 Queen Elizabeth II Award. Department of Physics & Astronomy, University of Calgary.

2010 – 2012 German Academic Exchange Service – Study Scholarship.

2010 Outstanding Graduating Senior. Department of Physics & Astronomy, Trinity University.

2010 Meritorious Award winner in COMAP (math modeling competition).
– Honourable Mention in 2008 competition

2007, 2009 Putnam Mathematical Competition – achieved a score of 20.

2006 – 2010 Murchison Scholar. Trinity University.

PUBLICATIONS

REFEREED JOURNALS

5. M.W. Girard, G. Gour. Computable entanglement conversion witness that is better than the negativity, New Journal of Physics **14** 093013 (2015). arXiv:1410.7094.
4. M.W. Girard, Y. Zinchenko, S. Friedland, G. Gour. Numerical estimation of the relative entropy of entanglement, Physics Review A **91** 029901 (2015).
3. M.W. Girard, G. Gour, S. Friedland. On convex optimization problems in quantum information theory, Journal of Physics A: Mathematical and Theoretical **47** 505302 (2014). arXiv:1402.0034.
   – Selected by editors for *Highlights of 2014*.
2. S. Glancy, M. Girard, E. Knill. Gradient-based stopping rules for maximum-likelihood quantum state tomography algorithms, New Journal of Physics **14** 095017 (2012).
1. D. Ugolini, M. Girard, G.M. Harry, V.P. Mitrofanov. Discharging Fused Silica Test Masses with Ultraviolet Light, Physics Letters A **327** 5741 (2008).

PREPRINTS

1. M.W. Girard, G. Gour. Entanglement monotones and transformations of symmetric bipartite states (2016). arXiv:1609.08016.

IN PREPARATION

1. M.W. Girard, G. Gour. On the binegativity of two-qubit states (2016). [link]

PRESENTATIONS

INVITED TALKS

Symmetric bipartite quantum entanglement. Workshop on Representation Theory in Quantum Information, University of Guelph. August 22-25, 2016.

Quantum entanglement and positive maps. Department of Mathematics and Statistics Graduate Seminar, University of Calgary. October 5, 2015.

Quantum information theory and conversion witnesses. The Sixth Northwest Functional Analysis Seminar, Banff International Research Station, Banff, Alberta, Canada. April 11-13, 2015.

Improving bounds on distillable entanglement. Canadian Mathematical Society Winter Meeting – Matrix Theory in Quantum Information. Ottawa, Ontario, Canada, December 6-9, 2013.

CONTRIBUTED TALKS

Entanglement conversion witnesses better than negativity. Theory Canada 10. University of Calgary. June 13, 2015.

Quantum entanglement and completely positive maps. Department of Mathematics and Statistics Graduate Student Seminar. University of Calgary. October 7, 2014.

Quantum entanglement and completely positive maps. 11th PIMS Young Researchers Conference in Mathematics and Statistics. University of British Columbia, Vancouver, Canada. June 2-4, 2014.

Improving bounds on distillable entanglement. Canadian Quantum Information Students' Conference. Institute for Quantum Information Science, University of Calgary, Calgary, Alberta, Canada. June 26, 2013.

Entanglement Control with Measures Optimized on the Fly. German Physical Society (DPG) Spring Meeting. Dresden, March 2011.

Maximum Likelihood Quantum State Estimation for Optical Cat State Generation. Quantum Optics and Statistics Seminar. Physikalisches Institut of the Albert-Ludwigs-Universität Freiburg. October 18, 2010.

Maximum Likelihood Quantum State Estimation for Optical Cat State Generation. Student SURF Colloquium. NIST Boulder, August 5 2010.

Exploring the Geometry and Topology of Quantum States. Departmental seminar. Trinity University, Department of Mathematics. April 18, 2010.

GEANT Modeling of Optical Charging from Cosmic Rays. Departmental seminar. Trinity University, Department of Physics and Astronomy. April 27, 2010.

Using UV Illumination to Mitigate Excess Charge on Optics in Vacuum. American Physical Society March Meeting. New Orleans, March 10, 2008.

Using UV Illumination to Mitigate Excess Charge on Optics in Vacuum. Texas Section of the APS. October 19, 2007.

Posters

All convex-roof entanglement monotones under symmetry. Workshop on Multipartite Entanglement. Centro de Ciencias de Benasque, Spain. May 23-27, 2016.

Entanglement conversion witnesses in quantum information. 19th Conference on Quantum Information Processing. The Banff Center, Banff, AB, Canada. January 11-15, 2016.

Improving bounds on distillable entanglement. Quantum Information and Foundations of Quantum Mechanics. University of British Columbia, Vancouver, Canada. July 2-5, 2013.

Conferences, Summer Schools and Workshops

Summer School and Workshop Attendance

13th Canadian Summer School on Quantum Information. Institute for Quantum Information Science, University of Calgary. June 17-21, 2013.

Les Houches School of Physics – Quantum machines: measurement and control of engineered quantum systems. Les Houches, France. Summer School July 4-29, 2011.

Joint Freiburg-Garching Workshop on Quantum Information and Quantum Optics. Max-Planck-Institut für Quantenoptik, Garching, Germany. Sept 30 - Oct 2, 2010.

Conference Attendance

Workshop on Representation Theory in Quantum Information, University of Guelph. August 22-25, 2016.

Workshop on Multipartite Entanglement. Centro de Ciencias de Benasque, Benasque, Spain. May 23-27, 2016.

19th Conference on Quantum Information Processing. The Banff Center, Banff, AB, Canada. January 11-15, 2016.

2016 Joint Mathematics Meeting. Seattle, WA, USA. January 6-9, 2016.

Theory Canada 10. University of Calgary, Alberta, Canada. June 11-13, 2015.

12th PIMS Young Researchers Conference in Mathematics and Statistics. University of Calgary, Alberta, Canada. May 27-29, 2015.

Alberta Mathematics Dialogue 2015. University of Lethbridge, Alberta, Canada. May 8-9, 2015.

The Sixth Northwest Functional Analysis Seminar. Banff International Research Station, Banff, Alberta, Canada. April 11-13, 2015.

11th PIMS Young Researchers Conference in Mathematics and Statistics. University of British Columbia, Vancouver, British Columbia, Canada. June 2-4, 2014.

Canadian Mathematical Society Winter Meeting – Matrix Theory in Quantum Information. Ottawa, Ontario, Canada. December 6-9, 2013.

Quantum Information and Foundations of Quantum Mechanics. University of British Columbia, Vancouver, British Columbia, Canada. July 2-5, 2013.

Canadian Quantum Information Students' Conference. Institute for Quantum Information Science, University of Calgary, Calgary, Alberta, Canada. June 24-28, 2013.

German Physical Society (DPG) Spring Meeting, Dresden, March 2011.

Fall Meeting of the Texas Section of the APS, October 22-24 2009.

American Physical Society March Meeting, New Orleans, March 2008.

Fall Meeting of the Texas Section of the APS, October 18-20 2007.

Teaching experience

Department of Mathematics and Statistics at University of Calgary

- Sessional instructor:
  MATH 271 – Discrete Mathematics (Summer 2016)
- Instructor-in-training:
  MATH 271 – Discrete Mathematics (Winter 2016)
- Teaching Assistant:
  MATH 271 – Discrete Mathematics (Winter 2015, Fall 2015)
  MATH 311 – Linear Methods II (Winter 2015)
  AMAT 307 – Differential Equation for Engineers (Fall 2014)
  MATH 273 – Honours Mathematics: Numbers and Proofs (Fall 2014)
  MATH 211 – Linear Methods I (Winter 2014).
  MATH 283 – Honors Calculus II (Winter 2014).

Department of Physics and Astronomy at University of Calgary:

- Laboratory assistant
  PHYS 323 – Optics and Electronics (Fall 2012, Fall 2013).
  PHYS 259 – Electromagnetic Theory for Engineers (Winter 2013).

Instructor training programs

- Graduate Student Instruction Training Program (Department of Mathematics and Statistics, University of Calgary), under the mentorship of Dr. Thi Dinh.
  - Completed Step 1 Winter 2015.
  - Completed Step 2 Winter 2016.
- Instructional Skills Workshop (Taylor Institute for Teaching and Learning, University of Calgary), 16-20 February 2015.

Teaching awards

- *Graduate Assistant Teaching Excellence Award*. Department of Mathematics and Statistics, University of Calgary. (Awarded for both Winter and Fall terms of 2015.)

Academic Service and Contributions

Academic governance

- President of the Graduate University of Calgary Mathematics Society (GUMS), 2014-2016.
- Mathematics and Statistics student representative to Graduate Student Association (University of Calgary), 2014-2016.
- President of Society of Physics Students chapter, Trinity University, 2007-2010.

Conference organization

- 19th Conference on Quantum Information Processing – Tutorial Programme, University of Calgary, January 9-10, 2016. (assited with registration, organization and logistics)
- 12th PIMS Young Researchers Conference in Mathematics and Statistics, University of Calgary, May 27-29, 2015. (Primary organizer)
- Theory Canada 10, University of Calgary, June 11-13, 2015. (Made abstract booklet, assisted with organization and logistics.)

Undergraduate student supervision

- Fall 2016 – assisted in supervising two undergraduate senior thesis projects
- Summer 2016 – supervised two summer undergraduate student researchers

Refereed papers for the following journals

- Physical Review A
- Journal of Physics A: Mathematical and Theoretical
- Quantum Information Processing
- European Physical Journal D
- Physical Review Letters

Technical Skills

LaTeX, Mathematica, MATLAB, CVX, QETLAB, C, Unix operating systems

Hobbies

- Ultimate Frisbee
- Board games
- Skiing
- Hiking and camping
- Beer and homebrewing
- Traveling

Miscellaneous

Date of birth: 24 May 1988. *Birthplace:* Boulder, Colorado, USA.

Citizenships: United States of America, Germany

Languages:

- English – native speaker
- German – fluent

REFERENCES

Gilad Gour
Associate Professor, Department of Mathematics and Statistics, University of Calgary
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Barry C. Sanders
AITF iCORE Strategic Chair in Quantum Science and Technology
Director, Institute for Quantum Science and Technology
Office Address: University of Calgary, 2500 University Dr. NW, Calgary, AB, Canada, T2N 1N4
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Clifton Cunningham
Associate Professor, Department of Mathematics and Statistics, University of Calgary
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22 November 2016