Krystal Guo

Curriculum Vitæ

Centre de Recherches Mathématiques
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Fields of Research Interest

Discrete mathematics; algebraic graph theory, linear algebra, algebraic combinatorics, quantum computing and related areas.

Current Position

2019–2020	**Postdoctoral fellow**, *Labratory of Mathematical Physics*, Centre de Recherches Mathématiques, Université de Montréal. Supervisor: Dr. Luc Vinet

Previous Employment

2017–2019	**Postdoctoral fellow**, *Department of Mathematics*, Université libre de Bruxelles, Supervisor: Dr. Samuel Fiorini.
2017	**Visiting scholar**, *Simons Institute for the Theory of Computing*, University of California, Berkeley.
2015–2017	**Postdoctoral fellow**, *Department of Combinatorics & Optimization*, University of Waterloo, Supervisor: Dr. Christopher Godsil.

Education

2011–2015	**Ph.D. Mathematics**, *Simon Fraser University*.
Thesis title	*Simple eigenvalues of graphs and digraphs*
Supervisor	Dr. Bojan Mohar
Degree Conferred	June 9, 2015
2009–2010	**Master of Mathematics**, *University of Waterloo*, Combinatorics & Optimization.
Thesis title	*Quantum walks on strongly regular graphs*
Supervisor	Dr. Christopher Godsil
2004–2009	**Bachelor of Mathematics**, *University of Waterloo*, Honours Combinatorics & Optimization Co-operative Program, Honours Pure Mathematics, *with distinction*.

Publications

To Appear

1. C. Godsil, K. Guo, M. Kempton, G. Lippner, F. Münch. State transfer in strongly regular graphs with an edge perturbation. arxiv:1710.02181. To appear in *Journal of Combinatorial Theory, Series A*.

2. K. Guo, T. Huynh, M. Macchia. The biclique covering number of grids. arXiv:1811.03396. To appear in *Electronic Journal of Combinatorics*.

3. K. Guo. Partially ordering the class of invertible trees. *European Journal of Combinatorics* Volume 83, (2020), `https://doi.org/10.1016/j.ejc.2019.103019`.

Published

4. C. Godsil and K. Guo. Using the existence of t-designs to prove Erdős-Ko-Rado. *Discrete Mathematics* Volume 342, Issue 10 (2019) P2846-2849.

5. G. Coutinho, C. Godsil, K. Guo, H. Zhan. A new perspective on the average mixing matrix. *Electronic Journal of Combinatorics* Volume 25, Issue 4 (2018) P4.14 (12 pages).

6. C. Godsil, K. Guo, J. Sinkovic. Average mixing matrix of trees. *Electronic Journal of Linear Algebra* Volume 34 (2018) P269-282.

7. C. Godsil, K. Guo, T. Myklebust. Quantum walks on generalized quadrangles. *Electronic Journal of Combinatorics* Volume 24, Issue 4 (2017) P4.16 (6 pages).

8. K. Guo and B. Mohar. Digraphs with Hermitian spectral radius below 2 and their cospectrality with paths. *Discrete Mathematics* Volume 340, Issue 11 (2017) P2616-2632.

9. G. Coutinho, K. Guo and C. M. van Bommel. Pretty good state transfer between internal nodes of paths. *Quantum Information & Computation* Volume 17, No. 9&10 (2017) P0825-0830.

10. K. Guo. Spectral bound for separations in Eulerian digraphs. *Electronic Journal of Linear Algebra* Volume 32 (2017) P291-300.

11. K. Guo and B. Mohar. Hermitian adjacency matrix of digraphs and mixed graphs. *Journal of Graph Theory* Volume 85, Issue 1 (2017) P217-248.

12. G. Coutinho, C. Godsil, K. Guo, and F. Vanhove. Perfect state transfer on distance-regular graphs and association schemes. *Linear Algebra and its Applications* Volume 478 (2015) P108-130.

13. K. Guo and B. Mohar. Large regular bipartite graphs with median eigenvalue 1. *Linear Algebra and its Applications* Volume 449 (2014) P68-75.

14. C. Godsil and K. Guo. Quantum walks on regular graphs and eigenvalues. *Electronic Journal of Combinatorics* Volume 18, Issue 1 (2011) P165 (9 pages).

In Submission

15. C. Godsil, K. Guo, G. Royle. Transversal polynomial of r-fold covers. arXiv:1910.05478.

16. C. Godsil, K. Guo, M. Sobchuk. Diagonal entries of the average mixing matrix. arXiv:1910.02039.

17. S. M. Cioaba, K. Guo, W. H. Haemers. The chromatic index of strongly regular graphs. arXiv:1810.06660. (Submitted to *Journal of Graph Theory.*)

18. M. DeVos, M. Drescher, D. Funk, S. González Hermosillo de la Maza, K. Guo, T. Huynh, B. Mohar, A. Montejano. Short rainbow cycles in sparse graphs. arXiv:1806.00825. (Submitted to *Journal of Graph Theory.*)

19. C. Godsil and K. Guo. Cycle space of digraphs. arXiv:1609.09118. (Submitted to *Electronic Journal of Combinatorics.*)

Conference Proceedings

20. S. Fiorini, K. Guo, M. Macchia, M. Walter. Lower bound computations for the nonnegative rank. In *Proceedings, 17th Cologne-Twente Workshop on Graphs and Combinatorial Optimization* (2019).

21. K. Guo and G. Gong. New constructions of completely non-cyclic Hadamard matrices, related function families and LCZ sequences. In *Proceedings, Sequences and their Applications 2010*, Lecture Notes in Computer Science, Volume 6338 (2010) P259-269.

Teaching and Supervision

Courses Taught

Winter 2017   **Instructor**, Algebraic Graph Theory, University of Waterloo.

Spring 2016   **Instructor**, Introduction to Combinatorics for Electrical and Computer Engineering, University of Waterloo.

Spring 2015   **Instructor**, Calculus I for Social Sciences, Simon Fraser University.

Winter 2011   **Instructor and Course Coordinator**, Calculus I for Honours Mathematics, University of Waterloo.

Undergraduate Supervision

Spring 2017   **Undergraduate Research Project Mentor**, *Mariia Sobchuk*, Project title: Traces of Average Mixing Matrix of Quantum Walks, University of Waterloo.
Co-supervised with Dr. Chris Godsil

Spring 2016   **Undergraduate Research Project Mentor**, *Linda Cook*, Project title: Colin de Verdière Number of Strongly Regular Graphs, University of Waterloo.

Presentations

1. *Traces of average mixing matrices*

   Quantum Information on Graphs, Canadian Mathematics Society Winter Meeting, December 2019.

2. *Algebraic graph theory and quantum walks*

   Connect Combinatorics of Networks and Computation Research Day 2019, Universitat Politècnica de Catalunya, June 2019.

3. *Quantum walks on regular graphs*

   Discrete Math Day of the Northeast, Saint Michael's College, Colchester, Vermont, October 2016.

4. *Quantum walks on regular graphs*

   Ottawa-Carleton Discrete Math Days 2016, Carleton University, Ottawa, May 2016.

5. *Eigenvalue interlacing in digraphs*

   Invited Mini-symposium on Spectral Methods in Graph Theory, Canadian Discrete and Algorithmic Mathematics Conference 2015. Saskatoon, Saskatchewan, June 2015.

6. *Perfect state transfer on distance regular graphs*

   Algebraic Combinatorics: Spectral Graph Theory, Erdős-Ko-Rado Theorems and Quantum Information Theory, University of Waterloo, Waterloo, June 2015.

Conference and Seminar Research Presentations

7. *Inverses of trees*

   Algebraic Combinatorics Seminar, University of Waterloo, December 2019.

8. *Transversal polynomials of covers of graphs*

   Theory Seminar, University of Toronto Computer Science, November 2019.

9. *Inverses of trees*

   Discrete Mathematics Seminar, York University, November 2019.

10. *Algebraic graph theory and quantum walks*

    Discrete Mathematics and Algebra Seminar, University of Delaware, October 2019.

11. *Transversal polynomials of covers of graphs*

    Comparative Theory for Graph Polynomials Workshop, Schloss Dagstuhl Leibniz-Zentrum für Informatik, October 2019.

12. *Average mixing matrix of quantum walks*

    Canadian Discrete and Algorithmic Mathematics Conference 2019, Simon Fraser University, May 2019.

13. *Average mixing of quantum walks*

    Quantum Walks and Information Task Workshop, Banff International Research Station, Apr 2019.

14. *Average mixing matrix of quantum walks*

    Quantum Lunch Seminar, Centre for the Mathematics of Quantum Theory, University of Copenhagen, March 2019.

15. *Quantum walks and graph invariants*

    Graph Theory Seminar, Technical University of Denmark, March 2019.

16. *Quantum walks, state transfer and perturbations of graphs*

    Algebra Seminar, Vrei Universiteit Brussel, December 2018.

17. *Transversals in covers of graphs*

    Pure Mathematics Seminar, Royal Holloway, University of London, November 2018.

18. *Average mixing of quantum walks on graphs*

    Symmetry vs. Regularity, University of West Bohemia Conference, Czech Republic, July 2018.

19. *Transversals in covers of graphs*

    Tutte Colloquium, University of Waterloo, April 2018.

20. *Transversals in covers of graphs*

    Tree and Combinatorial Optimization Day, Maastricht University, April 2018.

21. *Inverses of trees*

    Algorithms Seminar, Université Libre de Bruxelles, Brussels, Belgium, March 2018.

22. *Discrete-time quantum walks and quantum search*

    Algorithms Seminar, Université Libre de Bruxelles, Brussels, Belgium, December 2017.

23. *Quantum walks, state transfer and perturbations of graphs*

    Computer Science Seminar, Ghent University, November 2017.

24. *Quantum walks, state transfer and perturbations of graphs*

    Combinatorics Seminar, University of Wisconsin-Madison, October 2017.

25. *Quantum walks on graphs*

    Algebraic and Extremal Graph Theory Conference, University of Delaware, August 2017.

26. *Quantum walks and graph isomorphism*

    Meeting of the International Linear Algebra Society, Iowa State University, July 2017.

27. *Quantum walks on regular graphs*

    Tutte Colloquium, University of Waterloo, Waterloo, October 2016.

28. *Quantum walks on regular graphs*

    Operations Research Seminar, Tilburg University, Tilburg, Netherlands, April 2016.

29. *Quantum walks on regular graphs*

    Computer Science Seminar, Université Libre de Bruxelles, Brussels, Belgium, April 2016.

30. *Eigenvalue interlacing in digraphs*

    Tutte Colloquium, University of Waterloo, Waterloo, September 2015.

31. *Hermitian adjacency matrix of digraphs*

    Systems of Lines: Applications of Algebraic Combinatorics Conference, Worcester Polytechnic Institute, August 2015.

32. *Hermitian adjacency matrix of digraphs*

    Connections in Discrete Mathematics Conference, Simon Fraser University, June 2015.

33. *Perfect state transfer in distance regular graphs*

    Math Department Colloquium, California State University, Northridge, February 2014.

34. *Simple eigenvalues of vertex transitive graphs*

    37th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing, Perth, Australia, December 2013.

35. *Simple eigenvalues of vertex transitive graphs*

    Discrete Mathematics Seminar, Princeton University, November 2013.

36. *Simple eigenvalues of vertex transitive graphs*

    Discrete Mathematics Seminar, University of Delaware, November 2013.

37. *Quantum walks on strongly regular graphs*

    Discrete Mathematics Seminar, Simon Fraser University and Pacific Institute for the Mathematical Sciences, November 2013.

38. *Simple eigenvalues of vertex transitive graphs and digraphs*

    Rocky Mountain Mathematics Consortium Summer School: Algebraic Graph Theory, Laramie, Wyoming, June 2013.

39. *Simple eigenvalues of vertex transitive graphs and digraphs*

    Canadian Discrete and Algorithmic Mathematics Conference 2013, St. John's NL, June 2013.

40. *Quantum walks on strongly regular graphs*

    ICTP-IPM Workshop and Conference in Combinatorics and Graph Theory, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, September 2012.

41. *Quantum walks on strongly regular graphs*

    PhD Summer School in Discrete Mathematics and Symmetries of Graphs and Networks III, Rogla, Slovenia, June 2012.

42. *Quantum walks on regular graphs*

    Graphs, Designs and Algebraic Combinatorics Conference, University of Regina, July 2011.

43. *New constructions of completely non-cyclic Hadamard matrices, related function families and LCZ sequences.*

    6th Conference on Sequences and their Applications, Telecom ParisTech, Sept 2010.

Summer School Lectures and Math Outreach

44. *Are these graphs the same?*

    Brussels Summer School in Mathematics, Université Libre de Bruxelles, September 2019.

    This was a presentation aimed at undergradute students in their first or second year of studies.

45. *Mini-course: using the Sage Mathematics Software System in algebra and discrete math*

    2019 Canadian Mathematical Society Summer Meeting, University of Regina, June 2019.

    This was a three-hour mini-course that I was invited to give.

46. *Graph theory: helping map-makers and tourists since 1735*

    A Taste of Pi Lecture Series, Simon Fraser University, March 2015.

    This was a presentation for high school students; the idea is to expose the students to areas of mathematics that they would not see in school, in an accessible manner.

47. *Algebraic graph theory*

    MITACS/PIMS/SFU Summer School of Undergraduates in Algebraic Graph Theory, Simon Fraser University, July 2012

    I gave a series of lectures on spectral graph theory; I also ran tutorials on using SageMath to do research and supervised students' research projects.

Honors, Awards, and Scholarships

Major Awards

2011–2014 Postgraduate Scholarship, Natural Sciences and Engineering Research Council of Canada, CAD 21,000 per year for three years.

2011–2014 C. D. Nelson Memorial Graduate Entrance Scholarship, Simon Fraser University, CAD 18,000 per year for three years.

(This was the highest, most prestigious graduate entrance scholarship awarded by Simon Fraser University in 2011.)

Honors and Minor Awards

2014 President's Ph.D. Scholarship, Simon Fraser University, CAD 6,250.

2013 Finalist, Three Minute Thesis Competition, Simon Fraser University.

2013/2014 Travel and Minor Research Award, Department of Mathematics, Simon Fraser University, CAD 2,500.

2011–2014 Provost Prize of Distinction, Simon Fraser University, CAD 5,000 per year for three years.

2006-2009 Faculty of Mathematics GVMA Scholarship, University of Waterloo, total value CAD 3,900.

2004–2007 Academic All-Canadian Student Athlete, Canadian Interuniversity Sport.

2004 Rene Descartes Scholarship, University of Waterloo.

Graduate and Undergraduate Research Fellowships

Spring 2015 Research Associate, Simon Fraser University

2010, 2011 Graduate Research Assistant, Professor Chris Godsil, University of Waterloo

Spring 2008 Undergraduate Research Assistant, Professor Chris Godsil, University of Waterloo

I was funded by the Undergraduate Student Research Award, Natural Sciences and Engingeering Research Council of Canada

Spring 2007 Undergraduate Research Assistant, Professor Chris Godsil, University of Waterloo.

Fall 2006 Undergraduate Research Assistant, Professor Chris Godsil.

2019 **Conference co-organizer**, *Graph theory: structure, surfaces, spectra*, Sept 19–21, 2020, Shanghai Center for Mathematical Sciences, Fudan University.

Organizers: Z. Dvorak, K. Guo, K. Kawarabayashi, A. Harutyunyan and H. Wu.

2019 **Conference co-organizer**, *Algebraic graph theory and quantum information*, May 4–8, 2020, The Fields Institute for Research in Mathematical Sciences.

Organizers: A. Chan, G. Coutinho, K. Guo, C. Tamon, H. Zhan, and L. Vinet. We applied for and were granted funding from the Fields Institute. We have also applied for supplementary funding from the National Science Foundation, U.S.A.

2018 **Workshop co-organizer**, *Algebraic graph theory and quantum walks*, April 23–27, 2018, University of Waterloo.

Organizers: G. Coutinho, C. Godsil and K. Guo. We were funded by the Natural Sciences and Engineering Research Council of Canada and the Dept of Combinatorics & Optimization at University of Waterloo.

2017 **Co-organizer**, *Contributed Mini-symposium "Algebraic graph theory in quantum computing"*, Canadian Discrete and Algorithmic Mathematics Conference 2017.

Organizers: A. Chan, C. Godsil, K. Guo, and C. Tamon.

2015–2016 **Seminar Organizer**, *Algebraic Graph Theory Seminar*, University of Waterloo.

2013 **Seminar Organizer**, *Seidel Seminar*, Simon Fraser University.

Refereeing

- Discrete Mathematics
- Electronic Journal of Combinatorics
- European Journal of Combinatorics
- Journal of Algebraic Combinatorics
- Linear Algebra and its Applications
- Linear and Multilinear Algebra
- SIAM Journal of Optimization
- Journal of Graph Theory

Representation and Volunteer Work

2015–2017 **Postdoctoral Representative**, *Women in Mathematics Committee*, University of Waterloo.

2014 **Volunteer**, *Math Catchers Outreach Program*, Simon Fraser University.

This program promotes mathematics by conducting school visits to elementary and high schools in rural British Columbia. Using 3D-printed models, mathematical puzzles and an interactive presentation, we introduce students to mathematical concepts and also give them a glimpse of careers in STEM. With two other volunteers, I visited half a dozen schools over four days; at each school, we gave one or two two-hour presentations, where we interacted with students who range from grade two to grade twelve.