

Thomas Gerber

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Personal Data

Date of birth: 14 December 1987

Place of birth: Besançon, France.

Citizenship: Swiss, French.

Professional address: EPFL SB MATH GR-TES, MA B3 434, Station 8, 1015 Lausanne, Switzerland.

Education

PhD in Mathematics 2011-2014

Université de Tours, France

Thesis title : *Decomposition Matrices of Ariki-Koike algebras and crystal isomorphisms in Fock spaces.*

Supervisors : Cédric Lecouvey and Nicolas Jacon.

Examiners : Iain Gordon and David Hernandez.

Jury : Jean-Philippe Anker, Iain Gordon, Jérémie Guilhot, David Hernandez, Gerhard Hiss, Nicolas Jacon, Cédric Lecouvey, Peng Shan.

MSc in Mathematics 2008-2011

Université de Besançon, France

Thesis title : *Cellular algebras.*

Supervisor : Nicolas Jacon.

BSc in Mathematics 2007-2008

University of Wales Swansea, UK

Professional experience

Research.....

Postdoc (Ambizione SNSF grant) 2019-2022

École Polytechnique Fédérale de Lausanne, Switzerland

Postdoc (research assistant) 2014-2019

Lehrstuhl D für Mathematik, RWTH Aachen, Germany

PhD student 2011-2014

Université de Tours, France

Teaching.....

Lecturer 2019-2022

École Polytechnique Fédérale de Lausanne, Switzerland

- Quantum groups and crystal bases, PhD course.
- Representation theory, 3rd and 4th year.
- Galois Theory, 3rd year.

Teaching assistant

2014-2019

Lehrstuhl D für Mathematik, RWTH Aachen, Germany

- Linear algebra, 2nd year.
- Computational algebra, 2nd year.
- Algebra, 2nd year.
- Galois theory, 2nd year.
- Group theory, 3rd year.
- General topology, 3rd year.
- Representation theory, 4th year.
- Modular representation theory, 5th year.
- Algebraic topology, 5th year.

Teaching assistant

2011-2014

Université de Tours, France

- General analysis, 1st year.
- Probability, 1st year.
- Calculus, 1st year.

Teaching assistant

2010-2011

Université de Besançon, France

- General algebra, 1st year.
- Linear algebra, 2nd year.
- Bilinear algebra, 2nd year.

Supply teacher

2010

Lycée V. Hugo, Besançon, France

Class : terminale scientifique.

Research interests

My main area of interest is combinatorial representation theory. More specifically, my research is concerned with modular representations of Coxeter and reflections groups and their Hecke algebras. I am also interested in the representation theory of finite classical groups (linear, orthogonal, symplectic, unitary groups). In this setting, there many elementary questions are still to be answered, such as how to compute decomposition matrices or determine branching rules.

Via categorification phenomenons, these classical problems are known to be linked to the representation theory of quantum groups. This constitutes another of my research subjects. More precisely, I investigate questions arising from the combinatorics given by the theory of crystals and canonical bases naturally attached to representations of quantum groups, such as Fock spaces.

As it turns out, the study of crystals is linked with another mathematical field, namely the combinatorics on words, and provides new perspectives for certain classical constructions such as Schensted's bumping algorithm or the Robinson-Schensted-Knuth correspondence. In turn, there is a close connection with Littelmann's path model, as well as with random walks theory. Understanding and developing these connections is also one of my goals.

Research Papers

Recent output.....

1. **Duality, crystals, and the Robinson-Schensted correspondence** (with C. Lecouvey).
In preparation.
2. **Affine Greene invariants**.
In preparation.
3. **A positive combinatorial formula for symplectic Kostka-Foulkes polynomials I: Rows** (with M. Dołęga and J. Torres).
2019. arXiv:1911.06732.
4. **Cylindric multipartitions and level-rank duality**.
2018. arXiv:1809.09519.

Published or accepted.....

5. **Generalized Mullineux involution and perverse equivalences**. (with Nicolas Jacon and Emily Norton).
2019. To appear in *Pacific Journal of Mathematics*.
6. **Heisenberg algebra, wedges and crystals**.
Journal of Algebraic Combinatorics 49 (2019), 99-124.
7. **The \mathfrak{sl}_∞ -crystal combinatorics of higher level Fock spaces** (with E. Norton).
Journal of Combinatorial Algebra 2 (2018), 103-145.
8. **Triple crystal action in Fock spaces**.
Advances in Mathematics 329 (2018), 916-954.
9. **Branching graphs for finite unitary groups in non-defining characteristic** (with G. Hiss).
Communications in Algebra 45 (2016), 561-574
10. **Harish-Chandra series in finite unitary groups and crystal graphs** (with G. Hiss and N. Jacon).
International Mathematics Research Notices 22 (2015), 12206-12250.
11. **Crystal isomorphisms in Fock spaces and Schensted correspondence in affine type A**.
Algebras and Representation Theory 18 (2015), 1009-1046.
12. **Generalised canonical basic sets for Ariki-Koike algebras**.
Journal of Algebra 413 (2014), 364-401.

Communications

Selected conference talks.....

- *Kostka-Foulkes polynomials and type C charge*, Groups and Representations in Amiens and Paris, Amiens, 18-19 September 2019.
- *Generalized Mullineux involution and cyclotomic wall-crossings*, Representations in Lie Theory and Interactions, CIRM (Luminy), 4-9 September 2018.
- *Heisenberg crystals and applications*, Algebraic Combinatorics in Ancona, Università Politecnica delle Marche, Ancona, 13-15 June 2018.
- *Cylindric multipartitions and level-rank duality*, Séminaire Lotharigien de Combinatoire 80, Lyon, 25-28 March 2018.
- *Representations of cyclotomic Cherednik algebras and crystals*, Colloque tournant du GDR *Théorie de Lie algébrique et géométrique*, Université Versailles, 7-9 February 2018.
- *Triple crystal structure for Fock spaces*, Algebraic Combinatorics and Representation Theory, CIRM (Luminy), 29 August - 2 September 2016.

- *Heisenberg crystal for the Fock space and applications*, Representation Theory in Samos, Samos island, 4-8 July 2016.
- *Harish-Chandra series for finite unitary groups*, Colloque tournant du GDR *Théorie de Lie algébrique et géométrie*, Université Paris-Sud (Orsay), 7-9 January 2015.
- *Basic sets for $G(\ell, 1, n)$* , YAC 2014, Lausanne, 9-13 June 2014.
- *Ariki's theorem*, ARTY 2, Erlangen, 8-10 May 2014.
- *An analogue of the bumping algorithm in affine type A*, Séminaire Lotharigien de Combinatoire 72, Lyon, 23-26 March 2014.
- *Crystal isomorphisms in Fock spaces*, Nikolaus conference, Aachen, 2-4 December 2013.
- *Decomposition matrices of Ariki-Koike algebras*, YRRT, Wuppertal, 7-10 October 2013 and ARTY, Erlangen, 23-25 May 2013.
- *Représentations du groupe symétrique*, Journée des Doctorants, Blois, October 2012.

Invitations to seminars.....

- AGATA seminar, Université de Montpellier, February 2019.
- LBfM oberseminar, RWTH Aachen, January 2019.
- Graduate school colloquium, RWTH Aachen, October 2018.
- Algebra and Geometry seminar, Karlsruhe Institute of Technology, July 2018.
- Algebra seminar, Vrije Universiteit Brussel, April 2018.
- Quantum seminar, Université de Strasbourg, March 2018.
- Groups and quantization seminar, Université de Reims, February 2018.
- Algebra and geometry seminar, Université de Caen, November 2017.
- Group theory seminar, Université d'Amiens, November 2017.
- Algebra seminar, Université de Lyon, April 2016.
- Algebra and geometry seminar, Université de Versailles, April 2016.
- LDfM oberseminar, RWTH Aachen, April 2016.
- Algebraic geometry seminar, Université de Montpellier, March 2016.
- Algebra and geometry seminar, Université de Caen, March 2016.
- Algebra seminar, Université de Reims, June 2015.
- Algebra seminar, TU Kaiserslautern, June 2015.
- Séminaire Chevalley, Université Paris Diderot, March 2015.
- Algebra oberseminar, Universität Stuttgart, February 2015.
- Group theory seminar, EPFL, Lausanne, November 2014.
- Graduate school colloquium, RWTH Aachen, October 2014.
- Representation theory seminar *CCCP*, Université Paris Diderot, May 2014.
- LDfM oberseminar, RWTH Aachen, January 2014.
- Algebra oberseminar, Universität zu Köln, December 2013.
- Algebra and number theory seminar, Université de Besançon, May 2013.
- PhD students seminar, Université de Tours, April 2012.

Posters.....

- *Representations of reflection groups and of quantum groups*, Journée des doctorants, Tours, 17 October 2013. Best poster award.

Selected attended Conferences

- *Summer School in Algebraic Combinatorics*, University of Kraków, 6-10 July 2020.
- *Categorifications: Hecke algebras, finite groups and quantum groups*, IHP, Paris, 23-27 March 2020.

- *Geometry and representation theory*, IHP, Paris, 27-31 January 2020.
- *Groups and Representations in Amiens and Paris*, Amiens, 18-19 September 2019.
- *Algebraic and geometric Lie theory*, Université de Tours, 29-30 August 2019.
- *Formal Power Series and Algebraic Combinatorics*, University of Ljubljana, 1-5 July 2019.
- *Characters and decomposition numbers of finite reductive groups*, RWTH Aachen, 4-6 March 2019.
- *ABCD Seminar*, RWTH Aachen, 12-14 February 2019.
- *Nikolaus Conference*, RWTH Aachen, 7-8 December 2018.
- *Representations in Lie Theory and Interactions*, CIRM, Luminy, 5-9 November 2018.
- *Einstein Workshop on Algebraic Combinatorics*, FU Berlin, 1-2 November 2018.
- *Workshop on Algebraic Combinatorics*, Université de Reims, 21-22 June 2018.
- *Algebraic Combinatorics in Ancona*, Università Politecnica delle Marche, Ancona, 13-15 June 2018.
- *80ème Séminaire Lotharigien de Combinatoire*, Lyon, 25-28 March 2018.
- *Workshop for Young Researchers: Tropical Geometry meets Representation Theory*, Universität zu Köln, 12-16 March 2018.
- *Geometry and Representation Theory of Algebraic Groups*, Physikzentrum Bad Honnef, 5-9 March 2018.
- *Colloque tournant du GDR TLAG*, Université Versailles, 7-9 February 2018.
- *Representation Theory of Symmetric Groups and Related Algebras*, Institute for Mathematical Sciences, Singapore, 11-20 December 2017.
- *Workshop Categorification, representation theory and symplectic geometry*, Hausdorff Institute for Mathematics, Bonn, 27 November - 1 December 2017.
- *Winter School Categorification, representation theory and symplectic geometry*, Hausdorff Institute for Mathematics, Bonn, 20-24 November 2017.
- *Representation Theory in Kaiserslautern*, TU Kaiserslautern, 13-14 July 2017.
- *Current Topics in the Theory of Algebraic Groups*, Université de Bourgogne, Dijon, 3-7 July 2017.
- *Algebraic and Geometric Combinatorics of Reflection Groups*, Montréal, 29 May - 9 June 2017.
- *Asymptotic Representation Theory*, Institut Henri Poincaré, Paris, 20-24 February 2017.
- *Darstellungstheoretage*, Bergische Universität Wuppertal, 27-28 January 2017.
- *Nikolaus Conference*, RWTH Aachen, 9-10 décembre 2016.
- *Representation Theory of Finite and p -adic Groups of Lie Type*, CIRM, Luminy, 7-10 November 2016.
- *Journées de Combinatoire Algébrique*, Université de Lyon, 5-6 September 2016.
- *Algebraic Combinatorics in Representation Theory*, CIRM, Luminy, 29 August - 2 September 2016.
- *Workshop on the representation theory of finite groups*, EPFL, Lausanne, 11-15 July 2016.
- *Representation theory in Samos*, Samos island, 4-8 July 2016.
- *An Invitation to the Representation Theory of Finite Groups*, Università degli Studi di Padova, 11 April 2016.
- *Groupes algébriques, géométrie et représentations*, Université de Caen, 16-18 March 2016.
- *Representation Theory of Symmetric Groups*, Technische Universität Kaiserslautern, 15-17 February 2016.
- *Winter School on Algebraic groups/Finite groups*, KIAS, Seoul, 14-16 December 2015.
- *Categorical Representation Theory and Combinatorics*, KIAS, Seoul, 8-11 December 2015.
- *Darstellungstheoretage*, Universität Stuttgart, 13-14 November 2015.
- *Summer school Representations of Algebraic Groups and Lie Algebras in Characteristic p* , Marienheide, 7-11 September 2015.
- *Colloquium on Algorithms and Representations*, RWTH Aachen, 26-27 July 2015.
- *Applied Representation Theory*, Université d'Amiens, 7-10 July 2015.
- *Conference on the Interaction of Representation Theory with Geometry and Combinatorics*, Hausdorff Research Institute for Mathematics, Bonn, 27-31 March 2015.
- *Darstellungstheorie Schwerpunkttagung*, Physikzentrum Bad Honnef, 9-13 March 2015.
- *Representations of Finite and Algebraic Groups*, École de Physique des Houches, 9-13 February 2015.

- *Representation Theory*, Université Paris Diderot, 12-16 January 2015.
- Colloque tournant du GDR *Théorie de Lie algébrique et géométrique*, Université Paris-Sud (Orsay), 7 January 2015.
- Winter school on random walks, Université de Tours, 5-9 January 2015.
- *Nikolaus Conference*, RWTH Aachen, 5-6 December 2014.
- *Groupes Algébriques, Groupes finis, Géométries, Représentations* (50 ans de séminaire Chevalley), CIRM, Luminy, 22-26 September 2014.
- Journées de combinatoire algébrique *Champinatoire*, Université de Reims, 2-4 July 2014.
- Summer school on quiver Hecke algebras, IESC, Cargèse, 16-20 June 2014.
- *Young Algebraists' Conference*, EPFL, Lausanne, 9-13 June 2014.
- *Algebra & Representation Theory for Young Researchers 2*, Universität Erlangen-Nürnberg, 8-10 May 2014.
- *72ème Séminaire Lotharingien de Combinatoire*, Université de Lyon, 23-26 March 2014.
- *Probability and representation theory in Edinburgh*, ICMS, Edinburgh, 26-28 February 2014.
- *Nikolaus Conference*, RWTH Aachen, 4-7 December 2013.
- *Young Researchers in Representation Theory*, Wuppertal, 7-10 October 2013.
- *Groups, Nonassociative Algebras and Combinatorics*, CIRM, Luminy, 30 September - 4 October 2013.
- *Combin' à Tours*, Université de Tours, 3-5 July 2013.
- *Algebra & Representation Theory for Young Researchers*, Universität Erlangen-Nürnberg, 23-25 May 2013.
- *Automorphic Forms, Combinatorial Representation Theory and Multiple Dirichlet Series*, ICERM semester program, Brown University, Providence, RI. Attended between 3-15 March 2013 for the workshop *Whittaker Functions, Schubert calculus and Crystals*.
- *Théorie de Lie et analogues quantiques*, CIRM, Luminy, 23-27 April 2012.

Responsabilities

Students.....

- Fabrice Étienne (EPF Lausanne, ENS Rennes). Masters project *Around Schur-Weyl duality*, 2020.

Organisation of conferences.....

- *Combin' à Tours* (with J. Guilhot and V. Beck), Université de Tours, 3-5 July 2013, on combinatorial representation theory, supported by the ANR ACORT.
- *Journée des doctorants* (with V. Perrollaz), Université de Tours, 17 October 2013, aimed at PhD students from Tours and Orléans.

Organisation of working seminars.....

- Working seminar *Quiver Hecke algebras* (EPF, Lausanne), 2019–2020
- Working seminar *Modular Representations of Finite Groups* (Lehrstuhl D für Mathematik, Aachen), 2015–2016
- Working seminar *Categorification of Quantum Groups* (Lehrstuhl D für Mathematik, Aachen), 2014–2015.

Administrative activities

- Tutors coordinator in the teaching group of G. Hiss, Lehrstuhl D für Mathematik, RWTH Aachen, 2014–2019

- Member of the laboratory committee, Laboratoire de Mathématiques et Physique Théorique, Université de Tours, 2013–2014

Miscellaneous

Programming

Languages: Python, GAP, R.

Softwares: Sage, Scilab, Rstudio.

Languages

French: Native speaker

English: Fluent

German: Fluent