

# Curriculum Vitae – Moritz Weber

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## Personal information

Born: October 31, 1981, Frankfurt am Main, Germany  
Citizenship: German  
Languages: German (native speaker), English (fluent), French (fluent)

## Employment

Since March 2015 Junior Professor (W1) at Saarland University, Germany  
with positive evaluation (equivalent to Habilitation)  
2010–2015 Postdoc at Saarland University, Germany  
(with Prof. Dr. Roland Speicher, Faculty of Mathematics)  
2010 Graduate assistant at the SFB 878 (collaborative research center)  
University of Münster, Germany  
(2008–2010) Scholarship (see below)  
2007–2008 Graduate assistant at the SFB 478 (collaborative research center)  
University of Münster, Germany, Department of Mathematics  
2005 Student assistant at the University of Münster, Germany  
2001–2002 Civil service at the Kindergarden Camp King, Oberursel, Germany

## Education

June 20, 2011 Ph. D. (Mathematics), University of Münster, Germany  
*Thesis title:*  $C^*$ -algebras generated by isometries with twisted  
commutation relations  
*Advisor:* Prof. Dr. Joachim Cuntz  
August 7, 2007 Diploma (Mathematics), University of Münster, Germany  
*Thesis title:*  $C^*$ -Algebren, die von einer partiellen Isometrie  
erzeugt werden  
*Advisor:* Prof. Dr. Joachim Cuntz  
May 29, 2001 Abitur, Gymnasium Oberursel, Germany

## Research interest

**Keywords:** functional analysis and operator algebras ( $C^*$ -algebras, von Neumann algebras); quantum symmetries (compact quantum groups, compact matrix quantum groups, Banica-Speicher quantum groups/ easy quantum groups, classification of quantum subgroups, quantum automorphism groups of finite graphs); free probability theory (de Finetti theorems, noncommutative distributions, bi-free probability); combinatorics (set partitions, noncrossing partitions, finite graphs)

My research is in functional analysis, with links to algebra, combinatorics and (free) probability theory. One of the main motivations is to study structures in mathematics when noncommutativity of the multiplication plays a role, for instance when dealing with matrices in linear algebra, operators on a Hilbert space in functional analysis, or with observables in quantum physics.

In such noncommutative theories, symmetries are no longer given only by groups, but by more general objects: by quantum groups. In 1987, Woronowicz gave an analytic definition based on  $C^*$ -algebras. In the 1990's, Wang introduced free quantum versions of the orthogonal group  $O_n$ , the unitary group  $U_n$  (both over the complex numbers) and the symmetric group  $S_n$ . His work was extended and put into a systematic framework – the one of Banica-Speicher quantum groups (also called easy quantum groups) – by Banica and Speicher in 2009. Their approach is based on the combinatorics of set partitions. These partitions also appear in Voiculescu's free probability theory. There are deep links between Banica-Speicher quantum groups and free probability theory for instance via de Finetti theorems.

Amongst other things, a main focus of my past research has been on the classification of Banica-Speicher quantum groups. This has been completed in the orthogonal case (partially joint work with Raum) and has been begun in the unitary case (joint work with Tarrago). Furthermore, I investigated the combinatorial nature of the representation theory of Banica-Speicher quantum groups and proved a de Finetti theorem for bifreeness (both in joint work with Freslon). New examples of partially quantized quantum groups (similar to the graph product of groups) have been given by Speicher and myself, building on partially quantized real spheres. This can be seen as the quantum isometry groups of some quantum spheres in the sense of Connes's noncommutative geometry. With Gabriel, I investigated fixed point algebras of the actions of Banica-Speicher quantum groups on the Cuntz algebra and we computed their  $K$ -groups.

With my PhD student Stefan Jung, I am working on quantum spaces fitting with Banica-Speicher quantum groups. With my PhD student Simon Schmidt, I am working on quantum automorphism groups of finite graphs. With my PhD student Daniel Gromada, I am developing computer algebraic methods for the classification of compact matrix quantum groups. With my PhD student Laura Maaßen, I am exploring the links between certain reflection groups and quantum groups.

## Publications

### *in peer-reviewed journals*

- [1] Tarrago, Pierre; Weber, M., The classification of tensor categories of two-colored non-crossing partitions, to appear in *Journal of Combinatorial Theory, Series A*, 2018.
- [2] Weber, M., *Introduction to compact (matrix) quantum groups and easy quantum groups*, notes of a lecture series at IMSc Chennai, India, to appear in *Indian Academy of Sciences. Proceedings. Mathematical Sciences*, 61 pages, 2017/2018.
- [3] Mai, Tobias; Speicher, Roland; Weber, M., Absence of algebraic relations and of zero divisors under the assumption of finite full non-microstates free entropy dimension, *Advances in Mathematics*, 304:1080–1107, 2017.
- [4] Tarrago, Pierre; Weber, M., Unitary easy quantum groups: the free case and the group case, *International Mathematics Research Notices*, **18**, 1 Sept 2017, 5710–5750, 2017.
- [5] Gabriel, Olivier; Weber, M., Fixed point algebras for easy quantum groups, *SIGMA Symmetry Integrability Geom. Methods Appl.* 12:097, 21 pages, 2016.
- [6] Freslon, Amaury; Weber, M., On bi-free de Finetti theorems, *Annales Mathématiques Blaise Pascal*, **23** (1), 21–51, 2016.
- [7] Raum, Sven; Weber, M., The full classification of orthogonal easy quantum groups, *Communications in Mathematical Physics*, **341** (3), 751–779, 2016.
- [8] Raum, Sven; Weber, M., Easy quantum groups and quantum subgroups of a semi-direct product quantum group, *Journal of Noncommutative Geometry*, **9** (4), 1261–1293, 2015.
- [9] Freslon, Amaury; Weber, M., On the representation theory of easy quantum groups, *Journal für die reine und angewandte Mathematik [Crelle's Journal]*, 42 pages, 2014 (ahead of print).
- [10] Raum, Sven; Weber, M., The combinatorics of an algebraic class of easy quantum groups, *Infinite Dimensional Analysis, Quantum Prob. and related topics*, **17** (3), 17 pages, 2014.
- [11] Weber, M., On the classification of easy quantum groups, *Advances in Mathematics*, **245**, 500–533, 2013.
- [12] Weber, M., On  $C^*$ -algebras generated by isometries with twisted commutation relations, *Journal of Functional Analysis*, **264** (8), 1975–2004, 2013.

### *in monographs*

- [13] Weber, M. Basics in free probability. In: *Free probability and operator algebras*. 6 pages. Münster Lectures in Mathematics, European Mathematical Society (EMS), Zürich, 2016.
- [14] Weber, M. Easy quantum groups. In: *Free probability and operator algebras*. 23 pages. Münster Lectures in Mathematics, European Mathematical Society (EMS), Zürich, 2016.

### *monograph*

- [15] Voiculescu, Dan-Virgil; Stammeier, Nicolai; Weber, M. (editors), *Free Probability and Operator Algebras*, Münster Lectures in Mathematics, European Mathematical Society (EMS), Zürich, 132 pages, 2016.

### *arXiv preprints*

- [16] Weber, M., Partition  $C^*$ -algebras, 2017. (See arXiv:1710.06199, 30 pages)
- [17] Weber, M., Partition  $C^*$ -algebras II – links to compact matrix quantum groups, 2017. (See arXiv:1710.08662, 27 pages)
- [18] Schmidt, Simon; Weber, M., Quantum symmetries of graph  $C^*$ -algebras, 2017. (See arXiv:1706.08833, 18 pages)
- [19] Cébron, Guillaume; Weber, M., Quantum groups based on spatial partitions, 2016. (See arXiv:1609.02321, 32 pages)
- [20] Speicher, Roland; Weber, M., Quantum groups with partial commutation relations, 2016. (See arXiv:1603.09192, 44 pages)

## Citation numbers

Google Scholar citations: 188, h-index: 9, i10-index: 6 (checked on 24 Oct 2017)

## Distinctions and awards

- *Landespreis Hochschullehre 2016* (federal state teaching award) awarded by the first minister of Saarland for the *preparatory math courses for refugees for studies in MINT-subjects*
- *Teaching Award* (Faculty of Mathematics, Saarland University) in summer term 2016, for the lecture on *(Real) Analysis I*
- *Honorary Research Associate* of Glasgow University, 2015
- *Teaching Award* (Faculty of Mathematics, Saarland University) in winter term 2013/2014, for the lecture on *Functional analysis*
- *Oberwolfach Leibniz Graduate Student* of the workshop  *$C^*$ -Algebras, Dynamics, and Classification*, 2012
- *Oberwolfach Leibniz Graduate Student* of the workshop  *$C^*$ -Algebras*, 2010
- Scholarship by the *Graduiertenkolleg Analytische Topologie und Metageometrie*, 2008–2010
- Scholarship by the *Studienstiftung des deutschen Volkes*, 2002–2006

## Third party funding

- Principal Investigator in the collaborative research center *SFB-TRR 195 Symbolic Tools in Mathematics and their Applications* (Saarland University, TU Kaiserslautern, RWTH Aachen), own project sum (PhD position for four years, 2017 – 2020) 200,000 Euro
- DFG support (*Sachbeihilfe*) for one PhD position, three years, 2017–2020, 190,000 Euro.
- DFG support (*internationale wissenschaftliche Veranstaltung*) for the conference *Compact Quantum Groups*, Greifswald, 2016, 12,000 Euro
- *Special funding by Saarland University* for preparation courses for the math entrance test for MINT studies (for refugees without certificates), 2016, 4,000 Euro
- Funding by the *Fields Institute* for the conference *Quantum Groups and Quantum Information Theory*, Herstmonceux castle, UK, 2015, 14,000 Euro
- Funding by the *SFB 878 in Münster* for the Masterclass on *Free Probability and Operator Algebras*, Münster, 2013, 30,000 Euro

## PhD students

- Laura Maaßen (since fall 2017, as a co-advisor, together with Prof. Dr. Gerhard Hiß, RWTH Aachen)
- Daniel Gromada (since July 2017, part of the SFB-TRR 195)
- Simon Schmidt (since July 2017, DFG support)
- Stefan Jung (since December 2015)

- *Winter term 2017/2018* (Saarbrücken)
  - Functional analysis
  - Students Seminar on The Millenium Prize Problems
- *Summer term 2017* (Sb.)
  - Students Seminar on Operators on Hilbert Spaces
- *Summer term 2016* (Sb.)
  - (Real) Analysis II
  - Reading seminar on quantum groups
  - Preparation courses for the math entrance test for MINT studies, for refugees without certificates (initiator/coordinator of the program)
- *Winter term 2015/2016* (Sb.)
  - Operator algebras/ Functional analysis II
  - Preparation courses for the math entrance test for MINT studies, for refugees without certificates (initiator/coordinator of the program)
- *Summer term 2015* (Sb.)
  - (Real) Analysis I
  - Seminar on operator algebras and free probability (together with Roland Speicher)
- *Summer term 2014* (Sb.)
  - Operator algebras (together with Roland Speicher)
- *Winter term 2013/2014* (Sb.)
  - Functional analysis
  - Seminar on operators on Hilbert spaces (Assistant)
- *Summer term 2013* (Sb.)
  - Operator algebras (Assistant)
  - Seminar on von Neumann algebras (Assistant)
- *Winter term 2012/2013* (Sb.)
  - Mathematics for biologists and chemists (Lecturer)
  - Functional analysis (Assistant)
  - Seminar on free probability theory (Assistant)
- *Summer term 2012* (Sb.)
  - $C^*$ -algebras and  $K$ -theory (Lecturer)
  - Random matrices (Assistant)
- *Winter term 2011/2012* (Sb.)
  - $C^*$ -algebras (Lecturer)
- *Summer term 2011* (Sb.)
  - (Real) Analysis II (Assistant)
  - Seminar on von Neumann algebras (Assistant)
- *Winter term 2010/2011* (Sb.)
  - (Real) Analysis I (Assistant)
- *Sept/Oct 2009* (Münster)
  - Revision course on (Real) Analysis II (Lecturer)
- *March 2009* (Ms.)
  - Revision course on (Real) Analysis I (Lecturer)
- *Summer term 2005* (Ms.)
  - Operator algebras (Teaching Assistant)

## Conferences, summer schools and seminar talks

Note that only those events are listed where I was an organizer or where I gave a talk.

2018 (planned)

- *Quantum homogeneous spaces*, International Centre for Mathematical Sciences, Edinburgh, UK, 11–15 June 2018.  
**invited speaker**
- *NCGOA 2018 – Noncommutative Geometry and Operator Algebras*, Münster, 14–19 May 2018.  
**invited speaker**
- *Oberwolfach Workshop 1819, Interactions between operator space theory and quantum probability with applications to quantum information*, Oberwolfach, 6–12 May 2018.
- *Workshop on tensor categories, Hopf algebras and quantum groups*, Marburg, 22–26 January 2018.  
**Organizer**, together with Istvan Heckenberger and Sonia Natale

2017

- *First annual meeting of the DFG collaborative research center SFB-TRR 195*, RWTH Aachen, 25–28 September 2017.  
**Talk:** Some computational problems when working on compact quantum groups
- *Summer school on Mathematical aspects of quantum information*, Institut des Etudes Scientifiques de Cargèse, Corsica, 4–8 September 2017.  
**Lecture:** Introduction to free probability
- *Joint Seminar on Algebra and Analysis*, Hannover, 6 July 2017.  
**Seminar talk:** Quantum symmetry,  $C^*$ -algebras and combinatorics
- *Operator algebras seminar*, KU Leuven, Belgium, 10 February 2017.  
**Seminar talk:** Quantum groups based on spatial partitions

2016

- *Analytic versus Combinatorial in Free Probability*, Banff, Canada, 4–9 December 2016.  
**Talk:** Quantum groups versus combinatorics in free probability
- *Compact Quantum Groups*, Satellite conference of the 7th European Congress of Mathematics (7ECM, Berlin), Alfried Krupp Wissenschaftskolleg, Greifswald, Germany, 11–15 July 2016.  
**Organizer**, together with Uwe Franz, Malte Gerhold and Adam Skalski
- *Quantum Groups: Geometry, Representation, and Beyond*, Oslo, Norway, 9–13 May 2016.  
**Talk:** Quantum Groups with Partial Commutation Relations
- *Micro Workshop on  $SU_q(3)$* , Saarbrücken, Germany, 18–22 January 2016.  
**Organizer**

2015

- *Analysis Seminar*, Wrocław, Poland, 15 October 2015.  
**Seminar talk:** From Woronowicz’s Tannaka-Krein result to examples of combinatorial quantum groups
- *Noncommutative Geometry Seminar*, IMPAN, Warsaw, Poland, 12 October 2015.  
**Seminar talk:** From Woronowicz’s Tannaka-Krein result to examples of combinatorial quantum groups
- *Operator Algebras Seminar*, KU Leuven, Belgium, 2 October 2015.  
**Seminar talk:** From combinatorics to (easy) quantum groups and more
- *George Boole Mathematical Sciences Conference, Theme 8: Quantum Probabilistic Symmetries & Quantized Boolean Algebras*, Cork, Ireland, 17 – 28 August 2015.  
**Talk:** Unitary easy quantum groups
- *Quantum Groups and Quantum Information Theory*, Workshop partially funded by the Fields Institute and the London Mathematical Society, Herstmonceux castle, UK, 13 – 17 July 2015.

**Organizer**, together with Benoit Collins, James Mingo, Ashley Montanaro and Maria Grazia Viola

- *Oberwolfach Workshop 1524, Free Probability Theory*, Oberwolfach, Germany, June 7 – 13, 2015.
- *Analysis Seminar*, Aberdeen, UK, 30 March, 2015.  
**Seminar talk:** Quantum Groups meet Free Probability
- *Analysis and Probability Seminar*, Lancaster, UK, 25 March, 2015.  
**Seminar talk:** Quantum Groups meet Free Probability
- *Mathematical Physics Seminar*, Cardiff, UK, 19 March, 2015.  
**Seminar talk:** Quantum Groups meet Free Probability
- *Algebraic and Analytic Aspects of Quantum Levy Processes*, Alfried Krupp Wissenschaftskolleg Greifswald, Germany, March 9 – 13, 2015  
**Talk:** Easy quantum groups go unitary – how combinatorics provides an easy access to quantum groups
- *Analysis Seminar*, Glasgow, UK, 4 March, 2015.  
**Seminar talk:** Quantum Groups meet Free Probability
- *Lecture series on (easy) quantum groups*, IMSc Chennai, India, January 5 - 24, 2015.  
**Lecturer** for eight lectures on quantum groups

2014

- *Free Probability and Random Matrices*, Bielefeld, Germany, Sept 22 – 25, 2014.  
**Talk:** Quantum groups in free probability
- *IWOTA 2014 (International Workshop on Operator Theory and its Applications)*, Amsterdam, Netherlands, July 14 – 18, 2014.  
**Organizer** of the *Special Session on Free Probability and Operator Theory*, together with Serban Belinschi and Roland Speicher
- *Quantum Symmetries in Free Probability*, Workshop on easy quantum groups and other symmetries in free probability, Saarbrücken, Germany, Mar 31 – Apr 4, 2014.  
**Organizer**, together with Roland Speicher  
**Talk:** Partitions and quantum groups

2013

- *Masterclass on Free Probability and Operator Algebras*, Münster, Germany, Sept 2 – 6, 2013.  
**Organizer**, together with Nicolai Stammeier  
**Lecture:** Easy quantum groups
- *Focus Program on Noncommutative Distributions in Free Probability Theory*, Fields Institute, Toronto, Canada, July 2013.  
**Talk:** Partitions and quantum groups  
**Lecture** (in the inter-workshop program): Quantum groups and their relation with free probability
- *Seminar on Operator Algebras*, Leuven, Belgium, Mar 15, 2013.  
**Seminar talk:** Easy quantum groups – a combinatorial class of quantum groups
- *PLUS Workshop*, Meeting of the probability groups of Technische Universität Kaiserslautern, University of Luxembourg, Université de Lorraine, Saarland University, third edition held in Saarbrücken, Germany, Feb 21 – 22, 2013.  
**Local organizer**, together with Roland Speicher

2012

- *Arbre de Noël*, Annual Christmas Conference of the Non-Commutative Geometry GDR, Metz, France, Dec 6 – 8, 2012.  
**Talk:** Easy quantum groups – a combinatorial class of quantum groups
- *Séminaire d'Analyse Fonctionnelle*, Besançon, France, Nov 27, 2012.  
**Seminar talk:** Easy quantum groups – a combinatorial class of quantum groups
- *Oberwolfach Workshop 1244, C\*-Algebras, Dynamics, and Classification*, Oberwolfach, Germany, Oct 28 – Nov 3, 2012.

**Talk:** The classification of easy quantum groups is difficult

- *DMV-Jahrestagung 2012* (Annual meeting of the German Mathematical Society), Saarbrücken, Germany, Sept 17 – 20, 2012.

**Organizer** of the *Minisymposium on Free Probability and Random Matrices*, together with Roland Speicher

**Talk** (in the Section on Functional Analysis):  $C^*$ -algebras generated by isometries with twisted commutation relations

- *Canadian Operator Symposium 2012*, Kingston, Canada, May 21 – 25, 2012.

**Talk:**  $C^*$ -algebras generated by isometries with twisted commutation relations

- *Masterclass on Quantum Groups*, Copenhagen, Denmark, Mar 5 – 9, 2012.

**Participant's talk:** On the classification of easy quantum groups

- *Funktionalanalysis-Seminar Metz-Saarbrücken*, Saarbrücken, Germany, Feb 6, 2012.

**Seminar talk:** Deforming the tensor product of two Cuntz algebras

2011

- *Non-commutative Harmonic Analysis*, 14th Workshop at Bedlewo, Poland, Sept 25 – Oct 1, 2011.

**Talk:** Easy quantum groups (joint talk with Roland Speicher)

- *Séminaire Analyse, Géométrie et Algèbre*, Metz, France, 27 May, 2011.

**Seminar talk:**  $C^*$ -algebras of twists of isometries

2010

- *Oberwolfach Workshop 1010,  $C^*$ -Algebras*, Oberwolfach, Germany, Mar 7 – 13, 2010.

**Reporter** (for the Oberwolfach Report 13/2010)

2009

- *Masterclass on the Classification of  $C^*$ -Algebras*, Copenhagen, Denmark, Nov 16 – 27, 2009.

**Participant's talk:** Twists of isometries

- *Focused Semester on  $KK$ -Theory and its Applications*, Münster, Germany, May 4 – July 24, 2009.

**Participant's talk:** Twists of isometries

## Research visits (min. three weeks)

- Glasgow University, UK, Feb 28 – April 10, 2015 (6 weeks).
- Institute of Mathematical Sciences, Chennai, India, Jan 5 – 23, 2015 (3 weeks).
- Fields Institute, Toronto, Canada, July 2013 (4 weeks).

## Professional membership

- Deutscher Hochschulverband (DHV)
- Deutsche Mathematiker-Vereinigung (DMV)
- European Mathematical Society (EMS)