

GEMMA DE LAS CUEVAS

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[Google Scholar page](#)



PROFESSIONAL CAREER

- 2018 Offered a position as Lecturer in Quantum Physics at the University of Sydney (declined)
- 9/2016 - Present [Elise Richter Fellow](#) at the [Institute of Theoretical Physics](#) of the University of Innsbruck
- 9/2016 - 2017 [Emmy Noether Visiting Fellow](#) at the [Perimeter Institute](#), Waterloo, Canada
- 9/2011 - 8/2016 Postdoc at the Theory Division of the Max-Planck-Institut for Quantum Optics (MPQ)
(1/2012 - 12/2013 as an [Alexander von Humboldt](#) postdoctoral fellow)

EDUCATION

- 2007 - 2011 Ph.D. in Theoretical Physics at the Universität of Innsbruck (Austria)
supervised by Prof. Hans J. Briegel [“1.0 mit Auszeichnung”]
- 2006 - 2007 Master Thesis at the Universitat Autònoma de Barcelona (Catalonia, Spain)
supervised by Prof. Jordi Faraudo and in collaboration with [Sepmag](#) [“Matrícula d’Honor”]
- 2002 - 2007 “Licenciada” in Physics, Universitat Autònoma de Barcelona

AWARDS

- 2012 PhD Prize ([SAMOP-Dissertationspreis](#)) of the German Physical Society
(see [IQOQI news](#), [MPQ news](#), [Physik Journal](#))
- 2005 First prize to a literary creation related with Physics and publication:
[Ser i res](#). Gemma de las Cuevas i Millan. *Revista de Física* **3**, 20 (2006).

FELLOWSHIPS

- 2016 ARC Discovery Project "Ultimate limits to quantum coherence"
(Chief Investigator: Prof. Howard Wiseman; Partner Investigators: Prof. Ignacio Cirac and myself)
- 2016 [Elise Richter Fellowship](#) of the FWF for 4 years (see [here](#))
- 2016 [Emmy Noether Visiting Fellowship](#) of the Perimeter Institute for Theoretical Physics (see [here](#))
- 2011 Alexander von Humboldt fellowship for Postdoctoral Researchers for 24 months.
- 2006 Undergraduate student fellowship from the Spanish National Research Council (CSIC) (neglected).
- 2002 A with Honors in High School. First year degree grant at Universitat Autònoma de Barcelona.

PUBLICATIONS AND PREPRINTS

- 16. **RADI (Reduced Alphabet Direct Information): Improving execution time for direct-coupling analysis**
Bernat Anton, Mireia Besalu, Oriol Fornes, Jaume Bonet, Gemma De las Cuevas, Narcis Fernandez-Fuentes, Baldo Oliva
Submitted (2018)
- 15. **Continuum limits of Matrix Product States**
G. De las Cuevas, N. Schuch, D. Perez-Garcia, J. I. Cirac
[arXiv:1708.00880](#) (2017)
- 14. **Irreducible forms for Matrix Product States: Theory and Applications**
G. De las Cuevas, J. I. Cirac, N. Schuch, D. Perez-Garcia
J. Math. Phys. **58**, 121901 (2017). [arXiv:1708.00029](#)
- 13. **Energy as a detector of nonlocality of many-body spin systems**
J. Tura, G. De las Cuevas, R. Augusiak, M. Lewenstein, A. Acín, J. I. Cirac
Phys. Rev. X, **7**, 021005 (2017), [arXiv:1607.06090](#).
See [UIBK news](#)
- 12. **Fundamental limitations in the purifications of tensor networks**
G. De las Cuevas, T. S. Cubitt, J. I. Cirac, M. M. Wolf, D. Pérez-García
J. Math. Phys. **57**, 071902 (2016). [arXiv:1512.05709](#)
- 11. **Simple universal models capture all classical spin physics**
G. De las Cuevas, T. S. Cubitt
Science **351**, 1180 (2016). [arXiv:1406.5955](#)
See [Piece by Adrian Cho](#), [Perspective by Stephanie Wehner](#), [This Week in Science by Jelena Stajic](#), [Interview at Welt der Physik](#), [Press release at MPQ](#), [Phys.org](#)
- 10. **Reducing spacetime to binary information**
S. Weinfurter, G. De las Cuevas, M. A. Martin-Delgado, H. J. Briegel
J. Phys. A **47** 095301 (2014). [arXiv:1210.5182](#)

9. Purifications of multipartite states: limitations and constructive methods
G. De las Cuevas, N. Schuch, D. Perez-Garcia, J. I. Cirac
[New J. Phys. **15**, 123021 \(2013\). arXiv:1308.1914](#)
8. A quantum information approach to statistical mechanics
Gemma De las Cuevas
[J. Phys. B **46**, 243001 \(2013\). arXiv:1312.6007](#)
7. Projective simulation for artificial intelligence
H. J. Briegel and G. De las Cuevas
[Sci. Rep. **2**, 400 \(2012\). arXiv:1104.3787](#)
See IQOQI, Uni Innsbruck, ÖAW, Pro-physik, APA-Science, Solid, Der Standard, ORF, Die Presse
6. Quantum algorithms for classical lattice models
G. De las Cuevas, W. Dür, M. Van den Nest, M. A. Martin-Delgado
[New J. Phys. **13**, 093021 \(2011\). arXiv:1104.2517](#)
5. The U(1) Lattice Gauge Theory Universally Connects All Classical Models with Continuous Variables, Including Background Gravity
Y. Xu, G. De las Cuevas, W. Dür, H. J. Briegel, M. A. Martin-Delgado
[J. Stat. Mech. P02013 \(2011\). arXiv:1010.2041](#)
4. Mapping all classical spin models to a lattice gauge theory
G. De las Cuevas, W. Dür, H. J. Briegel, M. A. Martin-Delgado
[New J. Phys. **12**, 043014 \(2010\). arXiv:0911.2096](#)
3. Unifying All Classical Spin Models in a Lattice Gauge Theory
G. De las Cuevas, W. Dür, H. J. Briegel, M. A. Martin-Delgado
[Phys. Rev. Lett. **102**, 230502 \(2009\). arXiv:0812.3583](#)
2. Completeness of classical spin models and universal quantum computation
G. De las Cuevas, W. Dür, M. Van den Nest, H. J. Briegel
[J. Stat. Mech. P07001 \(2009\). arXiv:0812.2368](#)
1. Low-Gradient Magnetophoresis through Field-Induced Reversible Aggregation
G. De las Cuevas, J. Faraudo, J. Camacho
[J. Phys. Chem. C **112** 945-950 \(2008\)](#)

ARTICLES FOR THE GENERAL PUBLIC

1. La unificación de los modelos de espín
Gemma De las Cuevas
[Investigación y Ciencia, Noviembre 2016, N° 482.](#)

INVITED PRESENTATIONS

17. *Matrix Product States: Continuum limits and irreducible forms*, QuICS, University of Maryland, USA, May 2, 2018.
16. *On the concepts of universality in physics and computer science*, Algorithmic Information, Induction and Observers in Physics, Perimeter Institute, Waterloo, Canada, April 9 to 13, 2018. (Available at [pirsa](#)).
15. *Matrix Product States: Irreducible forms and continuum limits*, Quantum Innovators in Computer Science and Mathematics, IQC, Waterloo, Canada, September 18 to 21, 2017.
14. *An introduction to tensor networks*, QI Summer School 2016, Innsbruck, Austria, July 12 to 14, 2016.
13. *Simple universal models capture all classical spin physics*, Last Frontiers in Quantum Information Science 4, Juneau, Alaska, USA, June 20 to 24, 2016.
12. *Simple universal models capture all classical spin physics*, Johannes Gutenberg University Mainz, Germany, May 20, 2016.
11. *Simple universal models capture all classical spin physics*, Quantum simulations: theory meets experiment – A workshop for young researchers, October 30 to 31, 2015. Oxford, UK.
10. *Which states have a continuum limit?*, Perimeter Institute, Waterloo, Canada, May 11 to 17, 2015. (Available at [pirsa](#)).
9. *Which discrete states have a continuum limit?*, Coogee Workshop, Sydney, Australia, January 21 to 23, 2015.
8. *Simple universal models capture all spin physics*, Quantum Information workshop, Seefeld in Tirol, Austria, June 29 to July 4, 2014.
7. *Universal Hamiltonian simulators: the full characterization*, Perimeter Institute, Waterloo, Canada, November 11, 2013. (Available at [pirsa](#)).
6. *Bounding the purification rank of mixed states*, Perimeter Institute, Waterloo, Canada, February 25, 2013. (Available at [pirsa](#)).
5. *Reducing spacetime to binary information*, 6th AFI Symposium “Gravitational Puzzles”. Innsbruck, Austria, December 7, 2012.
4. *A quantum information approach to statistical mechanics*, DPG Frühjahrstagung. Stuttgart, Germany, March 12, 2012.
3. *A quantum information approach to statistical mechanics*, El Escorial Summer School 2011: Quantum Information meets Statistical Mechanics. El Escorial, Madrid, Spain, July 11 to 15, 2011.
2. *A quantum information approach to discrete quantum gravity*, University of Utrecht, The Netherlands, May 30, 2011.

1. *Unifying all classical spin models using a quantum formalism*, Workshop on Quantum Algorithms, Computational Models, and Foundations of Quantum Mechanics. Vancouver, Canada, July 23 to 25, 2010.

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Talks

16. *On open and closed quantum systems*, Symposium on Open quantum systems, Annual Conference of the British Society for the Philosophy of Science, Oxford, UK, July 5 and 6, 2018.
15. *Representing continuum limits of matrix product states*, Optimising, Renormalising, Evolving and Quantising Tensor Networks, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, June 18 to 20, 2018.
14. *Continuous limits of matrix product states*, MPQ Theory Group workshop, Ötz, Tirol, Austria, May 2 to 4, 2016.
13. *Give good lower bounds on purification rank, and show that the separation with operator Schmidt rank is not robust under perturbations*, Open problems workshop, April 13, 2015, Institute of Advanced Studies, TUM, Garching, Germany.
12. *SIQS Progress report of the MPQ Theory Division*, SIQS 2015 Workshop, ICFO, Castelldefels, Catalonia, Spain, March 18 to 20, 2015.
11. *Fundamental limitations of purification problems*, Quantum computation, quantum information and the exact sciences, LMU, 30 January 2015.
10. *Which discrete states have a continuum limit?*, Passau, Theory Group Workshop, November 27, 2014.
9. *Purifications of multipartite states: limitations and constructive methods*, QIP, Barcelona, Catalonia, Spain, February 3 to 7, 2014.
8. *Triggering Markovianity of quantum channels*, MPQ Theory Group workshop. Kitzbühel, Austria, December 11 to 14, 2013.
7. *Mixed states decomposition: tensor networks and beyond*, Joint MPQ - ICFO workshop. Barcelona, Catalonia, Spain, May 22 to 24, 2013.
6. *On Matrix Product Density Operators*, MPQ Theory Group Workshop, Friedrichshafen, Germany, September 12 to 14, 2012.
5. *Mappings of the partition function using a quantum formulation*, Fifth International Workshop DICE2010, Castiglione, Italy, September 13 to 17, 2010.
4. *Unifying all classical spin models in a lattice gauge theory*, SFB meeting, Vienna, Austria, April 23 to 24, 2009.

3. *Unifying all classical spin models in a lattice gauge theory*, DPG Frühjahrstagung, Hamburg, Germany, March 2 to 6, 2009.
2. *Completeness of classical spin models and universal quantum computation*, The mathematical foundations of quantum control and quantum information theory, Madrid, Spain, May 26 to 30, 2008.
1. *Completeness of classical spin models and universal quantum computation*, DPG Frühjahrstagung, Darmstadt, Germany, March 10 to 14, 2008.

Posters

17. *Fundamental limitations in the purifications of tensor networks*, Quantum Information workshop, Seefeld in Tirol, Austria, 26 June to 1 July 2016.
16. *Simple universal models capture all classical spin physics*, SIQS Final Workshop, Venice, Italy, March 14 to 18, 2016.
15. *Simple universal models capture all classical spin physics*, Munich Quantum Center workshop, November 13, 2015, LMU, Munich, Germany.
14. *Purifications of multipartite states: limitations and constructive methods*, Munich Quantum Center workshop, April 24, 2015, Walter Schottky Institute, Garching, Germany.
13. *Purifications of multipartite states: limitations and constructive methods*, Workshop on Tensor Networks and Simulations, Simons Institute for the Theory of Computing, Berkeley, California, USA, April 21 to 25, 2014.
12. *Purifications of multipartite states: limitations and constructive methods*, New Mathematical Directions for Quantum Information. Cambridge, UK, September 2 to 6, 2013.
11. *Bounding the purification rank of mixed states*, Tensor network algorithms in computational physics and numerical analysis. Zürich, Switzerland, May 15 to 17, 2013.
10. *NP-hard spin models can simulate any other model*, QIP, Beijing, China, January 21 to 25, 2013.
9. *Reducing spacetime to binary information*, Netzwerktagung der Alexander von Humboldt-Stiftung. Karlsruhe, Germany, November 28 to 30, 2012.
8. *Spacetime from bits*, Quantum Information meets Statistical Mechanics 2012. Innsbruck, Austria, September 24 to 28, 2012.
7. *Quantum algorithms for classical spin models*, Quantum Information workshop, Seefeld in Tirol, Austria, July 1 to 6, 2012.
6. *Computational complexity of classical lattice models*, Obergurgl Quantum Optics Conference 2010. Obergurgl, Austria, February 22 to 26, 2010.
5. *Unifying all classical spin models in a lattice gauge theory*, ICREA Workshop on Quantum Gauge Theories and Ultracold Atoms. Sant Benet, Catalonia, Spain, September 2 to 4, 2009.

4. *Unifying all classical spin models in a lattice gauge theory*, SCALA Conference 2009. Cortina d'Ampezzo, Italy, February 15 to 22, 2009.
3. *Unifying all classical spin models in a lattice gauge theory*, SFB Meeting. Innsbruck, Austria, January 29 to 31, 2009.
2. *Completeness of classical spin models and universal quantum computation*, Foundational structures for quantum information and computation. Obergurgl, Austria, September 14 to 20, 2008.
1. *Completeness of classical spin models and universal quantum computation*, Obergurgl Quantum Optics Conference 2008. Obergurgl, Austria, 24 February to March 1, 2008.

Attendance

11. Quantum Information workshop, Seefeld in Tirol, Austria, July 1 to 3, 2018.
10. Conference on Topological quantum matter, KITP, Santa Barbara, USA, 17 to 21 October, 2016.
9. Frontiers of Quantum Physics 2015. 30x3 Roy / 30x2 Maciej. ICFO, Barcelona, October 22 to 23, 2015.
8. Quantum information workshop. Benasque, Spain, June 21 to July 10, 2015.
7. QIP, Sydney, Australia, 12 to 16 January 2015.
6. Quantum information workshop. Benasque, Spain, June 24 to July 12, 2013.
5. Networking Tensor Networks. Benasque, Spain, March 7 to 19, 2012.
4. 10th Canadian Summer School on Quantum Information. Vancouver, Canada, July 17 to 30, 2010.
3. WE-Heraeus-Summerschool: Steps in Evolution: Perspectives from Physics, Biochemistry and Cell Biology 150 Years after Darwin. Jacobs University Bremen, Germany, June 28 to July 5, 2009.
2. The human brain as the most powerful computer. IST Austria Campus Opening, Vienna, Austria, 1 to June 4, 2009.
1. Interfaces between Physics and Computer Science. Jacobs University, Bremen, Germany, June 10 to 20, 2007.

SEMINARS

29. *Universality in spin models*, QuICS, University of Maryland, USA, May 2, 2018.
28. *Matrix Product States: irreducible forms and continuum limits*, University of Leiden, The Netherlands, January 25, 2018.
27. *Matrix Product States: irreducible forms and continuum limits*, Universitat Autònoma de Barcelona, December 18, 2017.
26. *Simple universal models capture all classical spin physics*, University of Havana, Cuba, November 2, 2017.
25. *Simple universal models capture all classical spin physics*, ICFO, July 18, 2016.
24. *Which discrete states have a continuum limit?*, Ulm University, November 5, 2015.
23. *Which discrete states have a continuum limit?* Grup d'Informació Quàntica, Universitat Autònoma de Barcelona, September 29, 2015.
22. *On positivity and tensor networks*, ITP Hannover, July 16, 2015.
21. *Which discrete states have a continuum limit?*, University of Innsbruck, June 17, 2015.
20. *Purifications of multipartite states: limitations and constructive methods*, Ludwig Maximilian Universität München, Munich, Germany, October 22, 2014.
19. *Purifications of multipartite states: limitations, constructive methods and connections to other fields*, University of Cambridge, UK, October 9, 2014.
18. *Purifications of multipartite states: limitations and constructive methods*, Universidad Complutense de Madrid, Madrid, Spain, April 9, 2014.
17. *On universal Hamiltonian simulators*, IQOQI Innsbruck, Austria, March 3, 2014.
16. *Purifications of multipartite states: limitations and constructive methods*, CWI Amsterdam, Netherlands, February 10, 2014.
15. *Purifications of multipartite states: limitations and constructive methods*, Universitat Autònoma de Barcelona, Bellaterra, Catalonia, Spain, October 29, 2013.
14. *Part I: Mixed state decompositions: Tensor Networks and beyond. Part II: NP-hard spin models can simulate any other model*, IQOQI Innsbruck, Austria. June 12, 2013.
13. *Reducing spacetime to binary information*, Facultad de ciencias matemáticas, Universidad Complutense de Madrid, Madrid, Spain, October 16, 2012.
12. *A quantum information approach to statistical mechanics*, Colloquium at the Max Planck Institute for Quantum Optics, Garching, Germany, May 29, 2012.
11. *A quantum information approach to statistical mechanics*, Institut de Ciències Fotòniques (ICFO), Barcelona, Catalonia, Spain, April 16, 2012.

10. *Undecidability: a sketch of Gödel's proof*, Max Planck Institut für Quantenoptik, Theory division, Garching, Germany, March 28, 2012.
9. *Quantum algorithms for classical lattice models*, Facultad de ciencias físicas, Universidad Complutense de Madrid, Madrid, Spain, February 21, 2012.
8. *A quantum information perspective to statistical mechanics*, Instituto de Ciencias Matemáticas (ICMAT), Madrid, Spain, February 14, 2012.
7. *A Quantum Information perspective to Statistical Mechanical problems*, Max Planck Institute for Quantum Optics, Garching, Germany, October 15, 2010.
6. *Quantum formulations of the partition function and approaches to quantum gravity*, Maria Waldraat, Tirol, Austria, September 28, 2010.
5. *Unifying classical spin models using a quantum formalism*, Gravity group, University of British Columbia, Vancouver, Canada, July 19, 2010.
4. *Unifying all classical spin models in a lattice gauge theory*, Max Planck Institut für Quantenoptik, Theory Division, Garching, Germany, August 25, 2009.
3. *Unifying all classical spin models in a lattice gauge theory*, Institute for Quantum Optics and Quantum Information, Innsbruck, Austria, February 4, 2009.
2. *Completeness of classical spin models and universal quantum computation*, Universidad Complutense de Madrid, Madrid, Spain, July 31, 2008.
1. *Magnetic separation of nanoparticles*, Institute for Quantum Optics and Quantum Information, Innsbruck, Austria, March 10, 2007.

LONG RESEARCH VISITS

2. Perimeter Institute, Waterloo, Canada, February 12 to 25, 2017.
1. Perimeter Institute, Waterloo, Canada, September 5 to 30, 2016.

SHORT RESEARCH VISITS

39. Max Planck Institute for Quantum Optics, Garching, Germany, May 17 and 18, 2018.
38. University of Maryland, USA, April 30 to May 4, 2018.
37. Perimeter Institute, Waterloo, Canada, April 9 to 13, 2018.
36. LIACS and LION, University of Leiden, The Netherlands, January 24 and 25, 2018.
35. Grup d'Informació Quàntica, Universitat Autònoma de Barcelona, December 18, 2017.

34. KITP, Santa Barbara, USA, 17 to 28 October, 2016.
33. Perimeter Institute, Waterloo, Canada, September 5 to 30, 2016.
32. ICFO, Castelldefels, Barcelona, Catalonia, Spain, July 18, 2016.
31. Johannes Guttenberg University, Mainz, Germany, May 18 to 20, 2016.
30. ICFO, Castelldefels, Barcelona, Catalonia, Spain, April 11 to 15, 2016.
29. University of Innsbruck, November 16, 2015.
28. Institute for complex quantum systems, Ulm University, Germany, November 5 to 6, 2015.
27. UAB and ICFO, September 28 to 29, 2015.
26. ICFO, Barcelona, August 17 to 21, 2015.
25. ITP Hannover, Germany, July 14 to 17, 2015.
24. University of Innsbruck, Austria, July 17, 2015.
23. University of Innsbruck, Austria, March 27, 2015.
22. University of Sydney, Australia, 8 to 9 and 19 to 20 January 2015.
21. Center for Mathematical Sciences, University of Cambridge, UK, October 6 to 10, 2014.
20. Simons Institute for the Theory of Computing, UC Berkeley, California, USA, April 20 to May 1, 2014.
19. Universidad Complutense de Madrid, Madrid, Spain, April 7 to 11, 2014.
18. IQOQI and Universität Innsbruck, Austria, March 3 to 5, 2014.
17. CWI Amsterdam, Netherlands, February 10 to 12, 2014.
16. Perimeter Institute, Waterloo, Canada, November 11 to 17, 2013.
15. ICFO, Castelldefels, Catalonia, Spain, October 31, 2013.
14. Universitat Autònoma de Barcelona, Bellaterra, Catalonia, Spain, October 28 to 30, 2013.
13. IQOQI and Universität Innsbruck, Austria, June 11 to 12, 2013.
12. Perimeter Institute, Waterloo, Canada, February 25 to March 1, 2013.
11. Physikzentrum der RWTH Aachen, Germany, November 5 to 7, 2012.
10. Universidad Complutense de Madrid, Madrid, Spain, October 15 to 19, 2012.
9. Scuola Internazionale Superiore di Studi Avanzati (SISSA), Trieste, Italy, May 23 to 26, 2012.
8. Institut de Ciències Fotòniques (ICFO), Barcelona, Catalonia, Spain, April 16 to 17, 2012.

7. Universidad Complutense de Madrid, Madrid, Spain, February 13 to 24, 2012.
6. Scuola Internazionale Superiore di Studi Avanzati (SISSA), Trieste, Italy, February 21 to 25, 2011.
5. Max Planck Institut für Quantenoptik, Garching, Germany, October 11 to 15, 2010.
4. Gravity group, University of British Columbia, Vancouver, Canada, 17 to July 31, 2010.
3. Max Planck Institut für Quantenoptik, Garching, Germany, August 23 to 26, 2009.
2. Universidad Complutense de Madrid, Madrid, Spain, 28 July to August 1, 2008.
1. Institute for Quantum Optics and Quantum Information, Innsbruck, Austria, March 10 to 13, 2007.

TEACHING EXPERIENCE

All lectures have been held at the University of Innsbruck.

- Theoretical Quantum Information, Winter term 2017 (in English).
- Exercises of Theoretical Physics I (Classical Mechanics), Winter term 2010 (in German).
- Exercises of Theoretical Physics II (Quantum Physics), Summer term 2009 (in German).
- Exercises of Theoretical Physics I (Classical Mechanics), Winter term 2008 (in German).

SUPERVISION

- Supervisor of Master Thesis of Maria Balanzo-Juando (February 2017 - April 2018)
- Supervisor of trainee David Martin (Spring 2014) and Sven Wasmus (Summer 2015).

OTHERS

- Referee for PRX, New Journal of Physics, Scientific Reports, Journal of Physics A, Quantum Information Processing.
- Program Committees
 - QIP'15 Program Committee member, held in Sydney from January 12 to 16, 2015.
 - Program Committee member of "Quantum Computation, Quantum Information and the Exact sciences", held in Munich on January 30 to 31, 2015.
- Organisation

- Organizer of MPQ Workshop 2013 in Kitzbühel (Austria), December 11 to 14, 2013, and the MPQ Workshop 2014 in Passau (Germany), November 26 to 29, 2014 (with Carlos Navarrete-Benlloch).
- Experience in administration: Responsible for managing the activities of the MPQ Theory Group for the European integrated project SIQS during 2013 - 2016. This involved writing reports on the activities of the entire group, attending European meetings and presenting the results of the group.

LANGUAGES

Catalan and Spanish (mother tongues), English (Cambridge Advanced Exam, 2001), German (Zertifikat Mittelstufe Prüfung, 2005).

Last update: July 8, 2018