Angelo Lucia

Curriculum vitæ

California Institute of Technology
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Personal information

Place of birth Scafati (SA) - Italy Nationality Italian

Employment

09/2018 – present **Sherman Fairchild Fellow**, *California Institute of Technology*, U.S.A.
Walter Burke Institute for Theoretical Physics and Institute for Quantum Information and Matter

12/2016 – 08/2018 **Postdoc**, *University of Copenhagen*, Denmark.
Jointly held at the Center for the Mathematics of Quantum Theory (QMATH), Department of Mathematical Sciences, and at the Niels Bohr International Academy, Niels Bohr Institute

Education

2011 – 2016 **PhD in Mathematics**, *Universidad Complutense de Madrid*, Spain.
Title: Stability and area law for rapidly mixing quantum dissipative systems
Advisors: David Pérez García, Toby S. Cubitt
Sobresaliente cum laude. Defense date: July 7th, 2016
Distinction: Special PhD Thesis Award (Premio Extraordinario de Doctorado) 2015/2016

2009 – 2011 **Master degree in Mathematics**, *Università di Pisa*, Italy, 110/110 cum laude.
Advisor: Alberto Abbondandolo

2006 – 2009 **Bachelor degree in Mathematics**, *Università di Pisa*, Italy, 110/110 cum laude.
Advisor: Paolo Acquistapace

Grants and awards

Research awards

⋆ 2018 **Premio de Investigación "José Luis Rubio de Francia"**, *Real Sociedad Matemática Española*, Spain.
The highest distinction given by the Spanish Royal Mathematical Society, and one of the most important prizes in Mathematics in Spain. Awarded yearly to one mathematician who is either a spanish citizen or has completed their PhD in Spain.

2017 **Premio de Investigación Matemática "Vicent Caselles"**, *Real Sociedad Matemática Española and Fundación BBVA*, Spain.
One out of six yearly awarded prizes for young mathematicians in Spain.

Research grants

2018 – 2021 **Start-up Grant J. L. Rubio de Francia**, *Fundación BBVA*, Spain.
PI: A. Lucia

PhD fellowships

2012 – 2016 **FPI Fellowship**, *Ministero de Economia y Competitividad, Spain*.
PhD fellowship

2016 **Estancias Breves FPI 2015**, *Ministerio de Economia y Competividad, Spain*.
Personal travel funds for visiting NBIA, Denmark, 10 weeks

2014 **Estancias Breves FPI 2013**, *Ministerio de Economia y Competividad, Spain*.
Personal travel funds for visiting Caltech, US, 4 months

Teaching and mentoring

Teaching experience

2017 – 2018 **University of Copenhagen**, *Teaching assistant*.
Quantum Information Theory (14h): graduate course (in English),
~12 students in Mathematics, Physics, and Computer Science.

2015 – 2016 **Universidad Complutense de Madrid**, *Teaching assistant*.
Groups of ~30 undergraduate students (in Spanish):

- Análisis de variable real (50h): 1st year Calculus for Mathematics students
- Calculo integral (15h): 2nd year Calculus for Mathematics and Physics students (joint degree program)
- Métodos matemáticos para la ingeniería (15h): 1st year Calculus and Linear Algebra for Computer Science and Engineering students

PhD Students

2019 **Ángela Capel Cuevas**, *Universidad Autónoma de Madrid, Spain*, co-supervisor.
Jointly with David Pérez García. Thesis title: "Quantum logarithmic Sobolev inequalities for quantum many-body systems: an approach via quasi-factorization of the relative entropy". Defense date: December 16th 2019.

Undergraduate students

2019 **John Martyn**, *University of Maryland*, co-mentor.
Jointly with Kohtaro Kato and John Preskill. WAVE fellow for SURF (Summer Undergraduate Research Fellowship), a 10 weeks undergraduate summer research program at Caltech.

Pedagogy courses

2019 **Certificate of Interest in Undergraduate Research Mentoring**, *(in progress)*.
Participation in seminar series on mentoring of undergraduate researchers.

2017 **Introduction to University Pedagogy**, *Participant*.
77 working hours/3 ECTS course at University of Copenhagen

Professional services

Organization

2020 **15th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2020)**, *Online*.
Program committee

2019 – present **IQIM Seminar Series**, *Caltech*.
Organizing committee. Weekly seminar aimed at bridging and connecting the different groups of the Institute for Quantum Information and Matter (both theory and experiments)

2019 **V Congreso Jóvenes Investigadores RSME – Castelló 2020**, *Spain*.
Scientific committee. Young Researchers Conference of the Spanish Royal Mathematical Society

2017 **Master Class on Exotic Phases of Matter**, *University of Copenhagen*.
Local organizing committee

Referee for journals and conferences

- Communications in Mathematical Physics
- International Journal of Quantum Information
- Quantum Information and Computation
- Journal of Mathematical Physics
- Proceeding of the Royal Society A
- Revista Matemática Complutense
- Mathematical Reviews/MathSciNet
- zbMath
- Workshop on Quantum Information and Processing (QIP)

Talks

Invited talks

2019 Sep. **Boundary Hamiltonians and spectral gaps for 2D PEPS**.
Quantum Information Theory research term, ICMAT Madrid

June **Quantum log-Sobolev inequalities and conditional relative entropy**.
Operator Algebras, Groups and Applications to Quantum Information, ICMAT Madrid

⋆ Feb. **Rapid mixing in dissipative many-body quantum systems**, *Plenary lecture*.
Biennial Conference of the Spanish Royal Mathematical Society, Santander, Spain

2018 Oct. **Undecidability of spectral gap in 1D**.
Mathematical Challenges in Many-Body Physics and Quantum Information, Montreal

Rapid mixing in dissipative many-body quantum systems.
Rubio de Francia Award Seminar, UAM, Madrid

Jun. **Rapid mixing in dissipative many-body quantum systems**.
Workshop on quantum functional inequalities, Toulouse

Contributed talks

2018 Jul. **Locality at the boundary implies gap in the bulk for 2D PEPS**.
XIX International Congress on Mathematical Physics, Montreal

A limitation on the asymptotic decay of vanishing spectral gaps.
Young Researchers Symposium ICMP 2018, Montreal

Locality at the boundary implies gap in the bulk for 2D PEPS.
Theory of Quantum Computation, Communication and Cryptography (TQC), Sydney

2015 May **Area law for fixed points of rapidly mixing dissipative quantum systems**.
Theory of Quantum Computation, Communication and Cryptography (TQC), Brussels

⋆ 2014 Feb. **Stability of local quantum dissipative systems**.
17th Workshop on Quantum Information Processing (QIP2014), Barcelona

2013 Oct. **Stability of local quantum dissipative systems**.
Noise Information & Complexity @ Quantum Scale, Erice (Sicily)

Jul. **Stability of local quantum dissipative systems**.
Quantum Information Processing and Communications (QIPC 2013), Florence

Jun. **Stability of local quantum dissipative systems**.
Intensive Month on Operator Algebra and Quantum Information, ICMAT Madrid

Seminar talks

2018 Oct. **Perimeter Institute for Theoretical Physics**, Waterloo, Canada.

2017 Dec. **University of California, Davis**, *Department of Mathematics*, Davis, USA.

Mar. **ICFO**, *Prof. Antonio Acín's group*, Castelldefels, Barcelona, Spain.

2016 May **Universidad Carlos III Madrid**, *Q-Math Seminar*, Madrid, Spain.

2015 Oct. **Max Planck Institute of Quantum Optics**, *Theory seminar*, Garching, Germany.

Technical University of Munich, *Prof. Michael Wolf's group*, Garching, Germany.

Sep. **Universitat Autònoma de Barcelona**, *Andreas Winter's group*, Barcelona, Spain.

2014 July **Google**, *Quantum A.I.*, Venice, Los Angeles, USA.

Jun. **University of Southern California**, *Dept. of Physics & Astronomy*, Los Angeles, USA.

May **Caltech**, *IQIM*, Pasadena, USA.

University of California, Davis, *Department of Mathematics*, Davis, USA.

2013 May **University of Cambridge**, *DAMPT*, Cambridge, UK.

Outreach talks

2019 April **La complejidad de las teselaciones**, *Fundación BBVA*, Madrid, Spain.
English blog post:
`https://quantumfrontiers.com/2019/05/08/the-complexity-of-mosaics/`
Interview on Radio 5 (Spanish National Radio)
Media coverage in Spanish Newspapers: Europapress, El Mundo, El Economista.

Poster presentations

2019 Sep. **Undecidability of the spectral gap in one dimension**, *Poster Award*.
12th Italian Quantum Information Science Conference

2018 Jul. **A limitation on the asymptotic decay of vanishing spectral gaps**.
4th Seefeld workshop on Quantum Information, Seefeld, Austria

Jan. **A limitation on the asymptotic decay of vanishing spectral gaps**.
Quantum Information Processing (QIP) 2018

Long visits and research programs participation

2017 **UC Santa Barbara**, *Kavli Intitute for Theoretical Physics*, Santa Barbara, USA.
November 13th – December 16th, Quantum Physics of Information program

2017 **Intitut Henri Poincaré**, Paris, France.
October 9th – October 29th, Analysis in Quantum Information Theory program

2016 **University of Copenhagen**, *Niels Bohr International Academy*, Copenhagen, Denmark.
September – November

2014 **California Institute of Technology**, *IQIM*, Pasadena, USA.
April – July

2013 **University of Cambridge**, *Newton Institute and DAMPT*, Cambridge, UK.
September – December, Mathematical challenges in quantum information program

Publication list

Published

[1] J. Bausch, T. Cubitt, A. Lucia, and D. Perez-Garcia. "Undecidability of the Spectral Gap in One Dimension". In: *Physical Review X* 10 (3), p. 031038. arXiv: 1810.01858 [quant-ph].

[2] J. Martyn, K. Kato, and A. Lucia. "Deformations of the boundary theory of the square-lattice AKLT model". In: *Physical Review B* 102.3 (July 2020). arXiv: 1912.10327 [quant-ph].

[3] H. Abdul-Rahman, M. Lemm, A. Lucia, B. Nachtergaele, and A. Young. "A class of two-dimensional AKLT models with a gap". In: *Analytic Trends in Mathematical Physics*. Ed. by H. Abdul-Rahman, R. Sims, and A. Young. Contemporary Mathematics 741. American Mathematical Society, Jan. 2020, pp. 1–21. arXiv: 1901.09297 [math-ph].

[4] B. Durhuus and A. Lucia. "Recursion relations for chromatic coefficients for graphs and hypergraphs". In: *Discussiones Mathematicae Graph Theory* (Dec. 2019). arXiv: 1901.00899 [math.CO].

[5] M. J. Kastoryano, A. Lucia, and D. Perez-Garcia. "Locality at the Boundary Implies Gap in the Bulk for 2D PEPS". In: *Comm. Math. Phys.* 366 (Mar. 2019), p. 895. arXiv: 1709.07691 [quant-ph].

[6] A. Capel, A. Lucia, and D. Pérez-García. "Quantum conditional relative entropy and quasi-factorization of the relative entropy". In: *J. Phys. A* 51.48 (Nov. 2018). arXiv: 1804.09525 [quant-ph].

[7] M. J. Kastoryano and A. Lucia. "Divide and conquer method for proving gaps of frustration free Hamiltonians". In: *J. Stat. Mech.: Theory Exp.* 2018.3 (Mar. 2018), p. 033105. arXiv: 1705.09491 [math-ph].

[8] J. Bausch, T. S. Cubitt, A. Lucia, D. Pérez-García, and M. M. Wolf. "Size-Driven Quantum Phase Transitions". In: *Proc. Natl. Acad. Sci. U.S.A.* 115.1 (Dec. 2017), pp. 19–23. arXiv: 1512.05687 [quant-ph].

[9] Á. Capel, A. Lucia, and D. Pérez-García. "Superadditivity of quantum relative entropy for general states". In: *IEEE Trans. Inf. Theory* 64.7 (Nov. 2017), p. 4758. arXiv: 1705.03521 [quant-ph].

[10] F. G. Brandao, T. S. Cubitt, A. Lucia, S. Michalakis, and D. Perez-Garcia. "Area law for fixed points of rapidly mixing dissipative quantum systems". In: *J. Math. Phys.* 56 (Sept. 2015), p. 102202. arXiv: 1505.02776 [quant-ph].

[11] A. Lucia, T. S. Cubitt, S. Michalakis, and D. Pérez-García. "Rapid mixing and stability of quantum dissipative systems". In: *Phys. Rev. A* 91 (4 Apr. 2015). Rapid Communication, p. 040302. arXiv: 1409.7809 [quant-ph].

[12] T. S. Cubitt, A. Lucia, S. Michalakis, and D. Perez-Garcia. "Stability of Local Quantum Dissipative Systems". In: *Comm. Math. Phys.* 337.3 (Apr. 2015), pp. 1275–1315. arXiv: 1303.4744 [quant-ph].

Pre-prints

[13] I. Bardet, A. Capel, A. Lucia, and D. Pérez-García. *On the modified logarithmic Sobolev inequality for the heat-bath dynamics for 1D systems*. Aug. 2019. arXiv: 1908.09004 [quant-ph].

[14] M. Christandl, A. Lucia, P. Vrana, and A. H. Werner. *Tensor network representations from the geometry of entangled states*. Sept. 2018. arXiv: 1809.08185 [quant-ph].