Alioscia Hamma

Contact Information

Università degli Studi Federico II
Department of Physics
Via Cintia
Napoli, Italy 80126
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Homepage
Website

Citizenship

Italy

Who am I

I am a quantum physicist whose main interest is Quantum Information Theory. Being this field interdisciplinary in nature my research activity involves many topics in quantum physics such as Quantum Information Processing, Black Hole Physics, Quantum Chaos, Quantum Advantage, Classical and Quantum complexity, and Statistical Mechanics. One of my main interests is the understanding of emergent complex behavior in quantum mechanics, entanglement theory, and quantum complexity.

Research Interests

My main research activity revolves around the notion of quantum complexity. Quantum complex behavior emerges from the interplay of extensive entanglement and quantum resources beyond the stabilizer formalism, which is commonly known as 'magic'.
Topics of research I have been particularly interested in are quantum phase transitions, theory of entanglement, topological quantum computing, quantum information in open systems, theory of quantum and topological orders and novel quantum materials, emergent gauge fields and quantum gravity from many-body theory, quantum statistical mechanics, the onset of quantum chaos and thermalization in many-body quantum systems, integrability and exact solvability, away from equilibrium dynamics and coherence in quantum evolutions, thermalization and equilibration, thermodynamics and information processing in black holes.

Online identifiers

ORCID
ArXiv

Education

University of Napoli Federico II, Naples, Italy

Ph.D., Theoretical Physics, January 2005

- Thesis Title: *Topological Order and Quantum Information Processing*
- Advisers: Professor Giuseppe Marmo, Professor Paolo Zanardi
- Qualification: *Excellent*

M.S., Theoretical Physics, November 2001

- Thesis Title: *Equivalent metrics and perturbations in General Relativity*
- Adviser: Professor Giuseppe Marmo
- Final Mark: 110/110 cum laude

Academic Appointments

- **Associate Professor** November 2021-current
  Università di Napoli Federico II

- **Visiting Professor** June 2022
  LPMMC - University of Grenoble Alpes
- **Visiting Professor** July 2021
  ENS Lyon
- **Visiting Scientist** June 2021
  LPMMC - University of Grenoble Alpes
- **Visiting Scientist** September-October 2020
  LPMMC - University of Grenoble Alpes
- **Visiting Scientist** June 2019
  LPMMC - University of Grenoble Alpes
- **Associate Professor** September 2016-October 2021
  University of Massachusetts Boston
- **Associate Professor** June 2015- August 2016
  IIIS, Tsinghua University, Beijing
- **Assistant Professor** August 2012-May 2015
  IIIS, Tsinghua University, Beijing
- **Distinguished Research Fellow** September 2008 to August 2013
  Perimeter Institute for Theoretical Physics
- **Visiting Scientist** January 2008 to September 2008
  Research Laboratory of Electronics at Massachusetts Institute of Technology, Cambridge MA
- **Postdoctoral Fellow** December 2005 to December 2007
  University of Southern California in Daniel Lidar's group , Los Angeles CA
- **Research Associate** January 2005 to December 2005
  Institute for Scientific Interchange in Quantum Information group, Turin, Italy
- **Visiting Student** October 2003 to February 2004 and October 2004
  Department of Mechanical Engineering at Massachusetts Institute of Technology

GRANTS

- 2020: Recipient of NSF 2014000 grant, *Transitions in Quantum Complexity* - 360,000 *USD. Announcement at* `https://www.nsf.gov/awardsearch/showAward?AWD_ID=2014000`
- *2015: Recipient of NSFC 11574176 grant (*800,000 *RMB* $\simeq$ 125,000 *USD)*

EVIDENCE OF SCIENTIFIC IMPACT

- *Citations:* Google Scholar reports h-index 29 with 2981 total citations.
- *Physical Review's Editor's Suggestion:* the article Phys. Rev. B **79**, 245122 (2009); arXiv:0812.4622 was selected as Editor's Suggestion in Phys. Rev. B

AWARDS

2014, National Scientific Abilitation (Italy) as Full Professor of Theoretical Physics and Associate Professor of Condensed Matter Theory
2009, Perimeter Institute, distinguished research fellowship.

Editorial Service

- Editor at European Physics Journal Plus
- Editor at Quantum
- Member of the Editorial Board of Journal of Physics Communications
- Member of the Editorial Board of *Entropy*

Other Service

- Member of Committee for International Prize *M. Paparo*, years 2019, 2020

Teaching Experience

June 2022 Doctorate School course *Quantum magic and complexity* at the University of Grenoble Alpes, Grenoble, France.

Spring 2022 Quantum Information IV - Quantum Science Applications (undergraduate) - University of Massachusetts Boston

Spring 2022 Quantum Information III - Physics and Information (undergraduate)) - University of Massachusetts Boston

Fall 2021 Introduction to Contemporary Physics (undergraduate) - University of Massachusetts Boston

Fall 2021 Quantum Information II - Quantum Algorithms (undergraduate) - University of Massachusetts Boston

Spring 2021 The Quantum Self(undergraduate) - University of Massachusetts Boston, Honors College

Spring 2021 Quantum Information I - Fundamentals of Quantum Physics (undergraduate) - University of Massachusetts Boston

Fall 2020 Introduction to Contemporary Physics (undergraduate) - University of Massachusetts Boston

Summer 2020 Undergraduate Summer School - Perimeter Institute - Quantum information course.

Spring 2020 Fundamentals of Physics 2 (undergraduate) - University of Massachusetts Boston

January 2019 Quantum Matter in Perimeter Scholars International at Perimeter Institute for Theoretical Physics, (lectures can be viewed online)

Fall 2019 Electromagnetic Theory (graduate) - University of Massachusetts Boston

Summer 2019 Doctorate School course *Aspects of Quantum thermalization* at the University of Grenoble Alpes, Grenoble, France.

Spring 2019 Fundamentals of Physics 2 (undergraduate) - University of Massachusetts Boston

January 2019 Condensed Matter Review Perimeter Scholars International at Perimeter Institute for Theoretical Physics, (lectures can be viewed online)

Fall 2018 Fundamentals of Physics 2 (undergraduate) - University of Massachusetts Boston

Spring 2018 Fundamentals of Physics 1 (undergraduate) - University of Massachusetts Boston

January 2018 Condensed Matter Review Perimeter Scholars International at Perimeter Institute for Theoretical Physics, (lectures can be viewed online)

Fall 2017 Electromagnetic Theory (graduate) - University of Massachusetts Boston

January 2017-June 2017 Fundamental Physics 1 (undergraduate) - University of Massachusetts Boston

February 2016-July 2016 Physics of Financial Markets (undergraduate) - Tsinghua University, Beijing, China

January 2016 Condensed Matter Review Perimeter Scholars International at Perimeter Institute for Theoretical Physics, (lectures can be viewed online)

September 2015 - January 2016 Advanced Quantum Statistical Mechanics (graduate course), Tsinghua University, Beijing, China

March 2015 - July 2015 General Physics 1, Tsinghua University, Beijing, China

January 2015 Condensed Matter Review Perimeter Scholars International at Perimeter Institute for Theoretical Physics, (lectures can be viewed online)

February 2014 - July 2014 General Physics 1, Tsinghua University, Beijing, China

January 2014 Condensed Matter Review Perimeter Scholars International at Perimeter Institute for Theoretical Physics, (lectures can be viewed online)

January 2013 Condensed Matter Review Perimeter Scholars International at Perimeter Institute for Theoretical Physics, (lectures can be viewed online)

January 2012 Condensed Matter Review Perimeter Scholars International at Perimeter Institute for Theoretical Physics, (lectures can be viewed online)

April 2010-May 2010 Topological Quantum Order (informal course taught with S. Flammia at Perimeter Institute)

April 2009 Four Lectures on Topological Order, Sherbrooke University, Quebec, Canada

October 2007 Advanced Electromagnetism University of Southern California, Los Angeles, CA

April 2005 Short course on Quantum Entanglement, Università di Napoli Federico II, Italy

May 2002 - May 2003 Teaching Assistenship, Università di Napoli Federico II, Italy

Referee Service

- *Physical Review Letters*
- *Physical Review A, B, D, E*
- *Nature Physics*
- *Quantum*
- *SciPost Physics*

- *Journal of Modern Optics*
- *New Journal of Physics*
- *Scipost*
- *Journal of Physics Communications*
- *Europhysics Letters*
- *JSTAT*
- *Journal of Physics A*
- *Europhysics Letters*
- *New Journal of Physics*

STUDENTS MENTORED

- Mohamed Sahbani **2020-2021, Umass Boston**
- Mary Fries **2020-2022, Umass Boston**
- Stefano Piemontese **2020-present, Umass Boston**
- Joseph Farah **2020-2021, Umass Boston**
- Jonathan Delgado **2020-2021, Umass Boston**
- Sarah True **2020-present, Umass Boston**
- Salvatore Francesco Emanuele Oliviero **2019-present, Umass Boston**
- Lorenzo Leone **2019-present, Umass Boston**
- Davide Rattacaso **2019-2021, University of Napoli, Italy**
- Julian Fekety **2018-2021, Umass Boston**
- Ghislaine Coulter de Witt **2016-2021, Umass Boston**
- Shan Zhou **2015-2017, Tsinghua University**
- Jun Yang **2015-2018, Tsinghua University, Dartmouth College**
- Yanbin Yang **2015-2017, Tsinghua University**
- You Zhou **2015-2017, Tsinghua University**
- Yu Zheng **2013-2015, Chinese Academy of Sciences**
- Yigit Subasi **2013, University of Maryland**
- *Siddhartha Santra* **2012-2013, University of Southern California**
- *Alexandre Vincart-Emard* **2012, Perimeter Institute**
- *Francesco Caravelli* **2009-2012, Now Oppenheimer fellow at LANL**
- *Gabor Halasz* **June 2010-September 2011**
- *Sebastian Montes Valencia* **May 2011- 2014, Perimeter Institute**
- *Dalimil Mazac* **June 2011- 2014, Perimeter Institute**
- *Juho Happola* **June-August 2011, Perimeter Institute**
- *Damian Abasto* **2007, University of Southern California**
- *Wan Jung Kuo* **2007, University of Southern California**

References Available to Contact

Dr. Paolo Zanardi (e-mail: zanardi@usc.edu; Phone: +1 (213) 740- 4649)
- Professor, Physics and Astronomy
  University of Southern California
  - ◇ Seaver Science Center, USC 920 Bloom Walk, Los Angeles, CA 90089
  - ⋆ *Dr. Zanardi was my PhD adviser.*

Dr. Seth Lloyd (e-mail: slloyd@mit.edu; Phone: +1 (617) 252 1803)
- Professor, Mechanical Engineering
  Massachusetts Institute of Technology
  - ◇ Room 3-160 77 Massachusetts Avenue Cambridge, MA 02139
  - ⋆ *Dr. Lloyd hosted me at the Research Laboratory of Electronics at MIT in 2008*

Dr. Claudio Chamon (e-mail: chamon@bu.edu; Phone: +1 (617) 353 5787)
- Professor, Physics
  Boston University
  - ◇ 590 Commonwealth Avenue, Boston, MA 02215 USA

Dr. Stephen Arnason (e-mail: stephen.arnason@umb.edu; Phone: +1 617.287.5408)
- Associate Professor, Physics Department
  University of Massachusetts Boston
  - ◇ 100 William T. Morrissey Blvd. Boston, MA 02125-3393
  - ⋆ *Dr. Arnason is the Physics Department chair at UMass Boston*

Dr. Daniel Lidar (e-mail: lidar@usc.edu; Phone: +1 (213) 740-0198)
- Professor, Electrical Engineering
  University of Southern California
  - ◇ Seaver Science Center, USC 920 Bloom Walk, Los Angeles, CA 90089
  - ⋆ *Dr. Lidar hired me for my first Postdoc*

Dr. James Forrest (e-mail: jforrest@perimeterinstitute.ca;
Phone: +1 (519) 569-7600 ext 5190)
- Professor, Perimeter Institute for Theoretical Physics
  - ◇ 31 Caroline St N, Waterloo ON, Canada N2L 2Y5
  University of Waterloo, Canada ON
  - ⋆ *Dr. Forrest is the academic program director of PSI and can be contacted regarding my teaching skills.*

Dr. John Berlinsky (e-mail: jberlinsky@pitp.ca; Phone: +1 (519) 569-7600x5190
- Professor, Perimeter Institute for Theoretical Physics
  - ◇ 31 Caroline St N, Waterloo ON, Canada N2L 2Y5
  - ⋆ *Dr. Berlinsky was the Academic Programs Director at PI and can be contacted as reference regarding my teaching skills.*

Dr. Stephan Haas (e-mail: shaas@usc.edu; Phone: +1 (213) 740-4528)
- Professor, Physics
  University of Southern California
  - ◇ Seaver Science Center, USC 920 Bloom Walk, Los Angeles, CA 90089
  - ⋆ *Dr. Haas is a collaborator since my postdoc at USC*

Dr. Massimiliano Di Ventra (e-mail: diventra@physics.ucsd.edu; Phone: +1-(858) 822-6447)
- Professor, Physics
  UC San Diego
  - ◇ Department of Physics University of California, San Diego
  4631 Mayer Hall 9500 Gilman Drive La Jolla, CA 92093-0319, USA

Conference Organization

1. Co-organized (with Alexander Seidel) in summer 2021 the virtual conference Thermalization and Equilibration Dynamics in Quantum and Classical Many-Body Systems, August 2021.

2. I was the chair of the organizing committee for the workshop held in dates May 25-29 2010 at the Perimeter Institute, with title **Emergence and Entanglement**. The abstract for the workshop is the following:

   In recent years, there has been considerable interest in quantum systems which show novel behaviour of the whole system emerging from the collective behaviour and interaction of the constituent local degrees of freedom. The novel phenomena include fractional quantum number, fractional statistics, topologically protected gapless bulk/edge excitations, etc. It appears that the long-range quantum entanglement in those systems plays a critical role in generating those novel phenomena. The goal of this workshop is the study of the emergent and entanglement properties of quantum many-body systems. Possible topics of the workshop will be the emergence of gauge fields, fractionalized particles and symmetries as low energy properties of condensed matter systems, the study of entanglement in many body systems and its relationships with novel quantum phase transitions, the study of the AdS/CFT correspondence to understand properties of systems of strongly interacting fermions, the study of topological order, topological insulators, and quantum spin liquids.

   Organizers:

   - Alioscia Hamma (Chair)
   - Hector Bombin
   - Daniel Gottesman
   - Subir Sadchev
   - Neil Turok

   Invited Speakers:

   - Ian Affleck, University of British Columbia
   - Sougato Bose, University College of London
   - Claudio Chamon, Boston University
   - Xie Chen, Massachusetts Institute of Technology
   - Ignacio Cirac, Max Planck Institute
   - Jens Eisert, University of Potsdam
   - Paul Fendley, University of Virginia
   - Matthew Fisher, California Institute of Technology
   - Eduardo Fradkin, University of Illinois at Urbana-Champaign
   - Michel Gingras, University of Waterloo
   - Taylor Hughes, University of Illinois at Urbana-Champaign
   - Shamit Kachru, KITP/Stanford
   - Andreas Karch, University of Washington
   - Yong Baek Kim, University of Toronto
   - Israel Klich, University of Virginia
   - Karyn Le Hur, Yale University
   - Sung-Sik Lee, McMaster University

- Anthony Leggett, University of Illinois at Urbana-Champaign
- John McGreevy, Massachusetts Institute of Technology
- Roger Melko, University of Waterloo
- Max Metlitski, Harvard University
- Chetan Nayak, Microsoft Station Q and University of California, Santa Barbara
- Gil Refael, California Institute of Technology
- Subir Sachdev, Harvard University
- Omid Saremi, McGill University
- Barbara Terhal, IBM
- Frank Verstraete, Universitat Wien
- Guifre Vidal, University of Queensland
- Xiao-Gang Wen, Massachusetts Institute of Technology
- Cenke Xu, Harvard University
- Paolo Zanardi, University of Southern California

All the talks can be viewed online at PIRSA: http://pirsa.org/C10012/3

Recent Outreach

1. Summer Undergraduate Research Program - Perimeter Institute, Summer 2019
2. Starbase at Hanscom, MA - outreach to elementary schools of inner cities
3. Panelist at symposium on *The soul in the age of sciences*, Spring 2019, Napoli, Italy
4. Panelist at Career Day, Perimeter Institute, May 2019 - *The road to Academia*
5. Organizer and lecturer for the Seminar *Science as Humanistic Discipline*, UMass Boston, 2019.
6. Collaboration with UTeach program at UMass Boston. This activity constitutes the basis for a proposal of incorporating quantum physics in Junior High/High Schools curricula. This effort resulted also in outreach in the form of a podcast, that can be listened here.

Past Outreach

I have participated in several panel discussions aimed at reaching out general public to stimulate interest in physics. See, e.g., Science in the Club at Starlight. I have taught at the International Summer School for Young Physicists, a two-week program for Canadian and international high school students who have a keen interest in theoretical physics and intend to pursue physics studies at the university level. I have written several pieces about the connections between art, literature and science. One, entitled πολύτροπον was presented at the conference *The Crossroads Between Sciences and Humanities* - University of Waterloo, Canada, 2012. Recently, I have been featured in a video about the relationship between Art and Science, *Converging Streams: Art and Science*. I am conducting outreach to the *Starbase Academy* to introduce STEM topics to fifth-grade students from disadvantaged economical environments and the Uteach at UMass Boston program for the formation of teachers and instructors of Science and Technology subjects.

PUBLICATIONS **My top publications are marked with an asterisk (*)**

1. Lorenzo Leone, Salvatore F.E. Oliviero, Stefano Piemontese, Sarah True, Alioscia Hamma
To Learn a Mocking-Black Hole
https://arxiv.org/abs/2206.06385

2. Lorenzo Leone, Salvatore F.E. Oliviero, Alioscia Hamma
Magic hinders quantum certification
https://arxiv.org/abs/2204.02995

3. Salvatore F.E. Oliviero, Lorenzo Leone, Alioscia Hamma
Magic of the ground state of the transverse field Ising model
https://arxiv.org/abs/2205.02247

4. **(*)** Salvatore F.E. Oliviero, Lorenzo Leone, Alioscia Hamma, Seth Lloyd
Measuring magic on a quantum processor
https://arxiv.org/abs/2204.00015

5. Sarah True, Alioscia Hamma
Transitions in Entanglement Complexity in Random Circuits
https://arxiv.org/abs/2202.02648

6. Luigi Amico, Vladimir Korepin, Alioscia Hamma, Salvatore Marco Giampaolo, Fabio Franchini
Local Convertibility in quantum spin systems
Chapter for the Springer Volume "Entanglement in Spin Chains - Theory and Quantum Technology Applications"; https://arxiv.org/abs/2201.10625

7. You Zhou, Alioscia Hamma
Entanglement of random hypergraph states
accepted in Phys Rev A, Phys. Rev. A 106, 012410 (2022) https://arxiv.org/abs/2110.07158

8. Davide Rattacaso, Alioscia Hamma, Patrizia Vitale
Towards a geometrization of quantum complexity and chaos
Nielsen F., Barbaresco F. (eds) Geometric Science of Information. GSI 2021. Lecture Notes in Computer Science, vol 12829. Springer. (2021)
link; https://arxiv.org/abs/2107.06557

9. Luis Pedro Garcia-Pintos, Alioscia Hamma, Adolfo del Campo
Reply
Phys. Rev. Lett. 127, 028902 (2021)

10. **(*)** Lorenzo Leone, Salvatore F. E. Oliviero, Alioscia Hamma
Stabilizer Rényi Entropy
Phys. Rev. Lett. 128, 050402 (2022).; https://arxiv.org/abs/2106.12587

11. Salvatore F.E. Oliviero, Lorenzo Leone, Alioscia Hamma
Stability of topological purity under random local unitaries
https://arxiv.org/abs/2106.04600

12. Lorenzo Leone, Salvatore F.E. Oliviero, Alioscia Hamma
Transitions in entanglement complexity in random quantum circuits by measurements
Physics Letters A, Volume 418, 127721; https://arxiv.org/abs/2103.07481

13. **(*)** Lorenzo Leone, Salvatore F.E. Oliviero, Y. Zhou, Alioscia Hamma
Quantum Chaos is Quantum
Quantum, volume 5, page 453 (2021); https://arxiv.org/abs/2102.08406

14. Yu Zeng, Alioscia Hamma, Yu-Ran Zhang, Jun-Peng Cao, Heng Fan, Wu-Ming Liu
Protecting topological order by dynamical localization
https://arxiv.org/abs/2102.03046

15. Francesco Caravelli, Bin Yan, Luis Pedro Garcia-Pintos, and Alioscia Hamma
Energy storage and coherence in closed and open quantum batteries
Quantum 5, 505 (2021); https://arxiv.org/abs/2012.15026

16. Salvatore F.E. Oliviero, Lorenzo Leone, Alioscia Hamma
Random Matrix Theory of the Isospectral Twirling
SciPost Phys. 10, 076 (2021) ; https://arxiv.org/abs/2012.07681

17. **(*)** Lorenzo Leone, Salvatore F.E. Oliviero, Alioscia Hamma
Isospectral twirling and quantum chaos
Entropy, 2021, 23(8), 1073; https://arxiv.org/abs/2011.06011

18. Alioscia Hamma, Georgios Styliaris, Paolo Zanardi
Localizable quantum coherence
Physics Letters A 397 (2021), 127264; https://arxiv.org/abs/2005.02988

19. Sayandip Dhara, Alioscia Hamma, Eduardo R. Mucciolo
Quantum Coherence in Ergodic and Many-Body Localized Systems
Phys. Rev. B 102, 045140 (2020); https://arxiv.org/abs/2002.09447

20. Davide Rattacaso, Alioscia Hamma, Patrizia Vitale
Quantum geometric tensor away from Equilibrium
J. Phys. Commun. 4 (2020) 055017; arxiv.:1912.02677

21. Luis Pedro Garcia-Pintos, Alioscia Hamma, Adolfo del Campo
Fluctuations in stored work bound the charging power of quantum batteries
Phys. Rev. Lett. 125, 040601 (2020); https://arxiv.org/abs/1909.03558

22. Francesco Caravelli, Ghislaine Coulter-De Wit, Luis Pedro Garcia-Pintos, Alioscia Hamma
Random Quantum Batteries
Phys. Rev. Research 2, 023095 (2020); https://arxiv.org/abs/1908.08064

23. **(*)** Shiyu Zhou, Zhi-Cheng Yang, Alioscia Hamma, Claudio Chamon
Single T gate in a Clifford circuit drives transition to universal entanglement spectrum statistics
SciPost Phys. 9, 087 (2020); https://arxiv.org/abs/1906.01079

24. Yu Zeng, Alioscia Hamma, Heng Fan
Disorder-protected topological entropy after a quantum quench
https://arxiv.org/abs/1704.08819

25. **(*)** Zhi-Cheng Yang, Alioscia Hamma, Salvatore M. Giampaolo, Eduardo R. Mucciolo, Claudio Chamon
Entanglement Complexity in Quantum Many-Body Dynamics, Thermalization and Localization
Phys. Rev. B **96**, 020408(R) (2017) ; https://arxiv.org/abs/1703.03420

26. Jun Yang, Alioscia Hamma
Many-Body Localization Transition, Temporal Fluctuations of the Loschmidt Echo, and Scrambling
https://arxiv.org/abs/1702.00445

27. Yu Zeng, Alioscia Hamma, Heng Fan
Thermalization of Topological Entropy after a Quantum Quench
Phys. Rev. B 94, 125104 (2016); http://arxiv.org/abs/1509.08613

28. **(*)** Zhi-Cheng Yang,Claudio Chamon, Alioscia Hamma, and Eduardo R. Mucciolo
Two-Component Structure in the Entanglement Spectrum of Highly Excited States
Phys. Rev. Lett, **115**, 267206 (2016); http://arxiv.org/abs/1506.01714

29. Alioscia Hamma, Ling-Yan Hung, Antonino Marciano, Mingyi Zhang
Area Law from Loop Quantum Gravity
Phys. Rev. D **97**, 064040 (2018); http://arxiv.org/abs/1506.01623

30. A. Hamma, S.M. Giampaolo, F. Illuminati
Spontaneous symmetry breaking and macroscopic entanglement
Phys. Rev. A **93**, 012303 (2016); http://arxiv.org/abs/1501.06961

31. D. Shaffer, C. Chamon, A. Hamma, E. Mucciolo
Irreversibility and Entanglement Spectrum Statistics in Quantum Circuits
J. Stat. Mech. (2014) P12007; http://arxiv.org/abs/1407.4419

32. Alioscia Hamma
Topological order away from equilibrium
http://arxiv.org/abs/1312.2811

33. Francesco Caravelli, Alioscia Hamma, Massimiliano Di Ventra
Scale-free networks as an epiphenomenon of memory
EPL, 109 (2015) 28006; http://arxiv.org/abs/1312.2289

34. S. Santra, A. Hamma, L. Cincio, Y. Subasi, P. Zanardi, L. Amico
Local convertibility of the ground state of the perturbed Toric code
Phys. Rev. B **90**, 245128 (2014); http://arxiv.org/abs/1310.6490

35. **(*)**C. Chamon, A. Hamma, E.R. Mucciolo
Emergent irreversibility and entanglement spectrum statistics
Phys. Rev. Lett. **112**, 240501 (2014); http://arxiv.org/abs/1310.2702

36. Jian Cui, Luigi Amico, Heng Fan, Mile Gu, Alioscia Hamma, Vlatko Vedral
Local characterization of 1d topologically ordered states
Phys. Rev. B **88**, 125117 (2013); http://arxiv.org/abs/1304.2279

37. **(*)** Gábor Hàlasz, Alioscia Hamma
Topological Rényi entropy after a quantum quench
Phys. Rev. Lett. **110**, 170605 (2013); http://arxiv.org/abs/1211.5381

38. Alioscia Hamma, Lukasz Cincio, Siddhartha Santra, Paolo Zanardi, Luigi Amico
Local response of topological order to an external perturbation
Phys. Rev. Lett. **110**, 210602 (2013); http://arxiv.org/abs/1211.4538

39. Gabor Halasz and A.Hamma
Probing topological order with Rényi entropy
Phys. Rev. A **86**, 062330 (2012) ; http://arxiv.org/abs/1206.4223

40. Alioscia Hamma, S. Santra, and P. Zanardi
Ensembles of physical states and random quantum circuits on graphs
Phys. Rev. A **86**, 052324 (2012); http://arxiv.org/abs/1204.0288

41. Sebastian Valencia and Alioscia Hamma
Phase diagram and quench dynamics of the Cluster-XY spin chain
Phys. Rev. E **86**, 021101 (2012); http://arxiv.org/abs/1112.4414

42. Luigi Amico, Davide Rossini, Alioscia Hamma, Vladimir E. Korepin
Optimal correlations in many-body quantum systems
Phys. Rev. Lett. **108**, 240503 (2012); http://arxiv.org/abs/1112.3280

43. Dalimil Mazáč, and Alioscia Hamma
Topological order, entanglement, and quantum memory at finite temperature
Annals of Physics, **327**, 2096 (2012); http://arxiv.org/abs/1112.0947

44. Bruno Tomasello, Davide Rossini, Alioscia Hamma, Luigi Amico
Quantum discord in a spin system with symmetry breaking
Int. J. Mod. Phys. B **26**, 1243002 (2012)
http://arxiv.org/abs/1112.0361

45. **(*)**Alioscia Hamma, S. Santra, and P. Zanardi
Quantum entanglement in random physical states
Phys. Rev. Lett. **109**, 040502 (2012); http://arxiv.org/abs/1109.4391

46. Francesco Caravelli, Alioscia Hamma, Fotini Markopoulou, Arnau Riera
Trapped surfaces and emergent curved space in the Bose-Hubbard model
Phys. Rev. D **85**, 044046 (2012); http://arxiv.org/abs/1108.2013

47. Wonmin Son, Luigi Amico, Rosario Fazio, Alioscia Hamma, Saverio Pascazio, Vlatko Vedral
Quantum phase transition between cluster and antiferromagnetic states
Europhys. Lett. vol. **95**, 50001 (2011); http://arxiv.org/abs/1103.0251

48. B. Tomasello, L. Amico, Alioscia Hamma, D. Rossini
Ground state factorization and correlations with broken symmetry
Europhys. Lett. vol. **96**, 27002 (2011); http://arxiv.org/abs/1012.4270

49. Alioscia Hamma, Fotini Markopoulou
Background independent condensed matter models for quantum gravity
New Journal of Physics vol. **13**, 095006 (2011); http://arxiv.org/abs/1011.5754

50. Juho Häppölä, Gábor B. Halász, Alioscia Hamma
Universality and robustness of revivals in the transverse field XY model
Phys. Rev. A **85**, 032114; http://arxiv.org/abs/1011.0380

51. I. Prémont-Schwartz, Alioscia Hamma, I. Klich, F. Markopoulou-Kalamara
Lieb-Robinson bounds for commutator-bounded operators
Phys. Rev. A **81**, 040102(R) (2010); http://arxiv.org/abs/0912.4544

52. A.H, Fotini Markopoulou, Seth Lloyd, Francesco Caravelli, Simone Severini, Klas Markstrom
A quantum Bose-Hubbard model with evolving graph as toy model for emergent spacetime
Phys. Rev. D **81**, 104032 (2010); http://arxiv.org/abs/0911.5075

53. **(*)** S. Flammia, Alioscia Hamma, T. Hughes, X.-G. Wen
Topological Entanglement Rényi Entropy and Reduced Density Matrix Structure
Phys. Rev. Lett. **103**, 261601 (2009); http://arxiv.org/abs/0909.3305

54. D.I. Tsomokos, A. H., W. Zhang, S. Haas, R. Fazio
Title: Topological Order Following a Quantum Quench
Phys. Rev. A **80**, 060302(R) (2009); http://arxiv.org/abs/0909.0752

55. A.T. Rezakhani, W.-J. Kuo, A. H., D.A. Lidar, P. Zanardi
Quantum Adiabatic Brachistochrone
Phys. Rev. Lett. **103**, 080502 (2009), http://arxiv.org/abs/0905.2376

56. Alioscia Hamma, D. A. Lidar, S. Severini
Entanglement and area law with a fractal boundary
Phys. Rev. A **81**, 010102 (R) (2010) , http://arxiv.org/abs/0903.4444

57. **(*)**Alioscia Hamma, C. Castelnovo, and C. Chamon
The toric-boson model: Toward a topological quantum memory at finite temperature
Phys. Rev. B **79** (Physical Review Editor's Suggestions), 245122 (2009);
http://arxiv.org/abs/0812.4622

58. D. Lidar, A. Rezakhani, Alioscia Hamma
Adiabatic approximation with better than exponential accuracy for many-body systems and quantum computation
J. Math. Phys **50**, 102106 (2009); http://arxiv.org/abs/0808.2697

59. A.H, I. Prémont-Schwartz, S. Severini, F. Markopoulou-Kalamara
Lieb-Robinson Bounds and the speed of light from topological order
Phys. Rev. Lett. **102** , 017204 (2009); http://arxiv.org/abs/0808.2495

60. G. Campagnano, Alioscia Hamma, U. Weiss
Entanglement dynamics of coupled qubits and a semi-decoherence free subspace
Physics Letters A **374** (2010) pp. 416-423; http://arxiv.org/abs/0807.1987

61. Alioscia Hamma, T. Mansour and S. Severini
Diffusion on an Ising Chain with Kinks
Physics Letters A **373**, 2622 (2009); http://arxiv.org/abs/0806.4812

62. M. Arzano, Alioscia Hamma, and S. Severini
Hidden entanglement at the Planck scale: loss of unitarity and the information paradox
Modern Physics Letters A **25**, 437 (2010) http://arxiv.org/abs/0806.2145

63. D. Abasto, Alioscia Hamma and P. Zanardi
Fidelity analysis of topological phase transitions
Phys. Rev. A **78**, 010301(R), (2008); http://arxiv.org/abs/0803.2243

64. Alioscia Hamma, W. Zhang, S. Haas, D. Lidar
Entanglement, fidelity and topological entropy in a quantum phase transition to topological order
Phys. Rev. B **77**, 155111 (2008); http://arxiv.org/abs/0705.0026

65. Alioscia Hamma
Berry Phases and Quantum Phase Transitions
http://arxiv.org/abs/quant-ph/0602091

66. Alioscia Hamma, R. Ionicioiu, P. Zanardi
Quantum entanglement in states generated by bilocal group algebras
Phys. Rev. A **72**, 012324 (2005); http://arxiv.org/abs/quant-ph/0504049

67. Alioscia Hamma, P. Zanardi, X.-G. Wen
String and Membrane condensation on 3D lattices
Phys. Rev. B **72**, 035307 (2005); http://arxiv.org/abs/cond-mat/0411752

68. **(*)** Alioscia Hamma, R. Ionicioiu, P. Zanardi
Bipartite entanglement and entropic boundary law in lattice spin systems
Phys. Rev. A **71**, 022315 (2005); http://arxiv.org/abs/quant-ph/0409073

69. **(*)** Alioscia Hamma, R. Ionicioiu, P. Zanardi
Ground state entanglement and geometric entropy in the Kitaev's model
Phys. Lett. A **337**, 22 (2005); http://arxiv.org/abs/quant-ph/0406202

70. Alioscia Hamma, P. Zanardi
Quantum entangling power of adiabatically connected Hamiltonians
Phys. Rev. A **69**, 062319 (2004); http://arxiv.org/abs/quant-ph/0308131

Books

L. Amico, A. Hamma, V. Vedral, *Quantum Phases of Matter: Non-local Correlations in Many-Body Systems*, Cambridge University Press (accepted for publication)

Conference Publications

1. A. Hamma
Topological order and entanglement
Advances in Quantum Computation, Edited by Kazem Mahdavi and Deborah Koslover
American Mathematical Society Contemporary Mathematics, Vol. 482 , p. 221-226 (2009)

2. R. Ionicioiu, A. Hamma, and P. Zanardi
Entanglement, area law and group theory
Proceedings of the NATO Advanced Study Institute, Quantum Computation and Quantum Information, 2-13 May 2005 Chania, Crete, Greece

Invited Talks

- July 2021 - Colloquium, ENS Lyon, France
Looking into the Abyss

- April 2021 - Colloquium, Washington University, St Louis, MI
Quantum Chaos is Quantum

- November 25th 2019 - Colloquium, University of Southern California, Los Angeles CA
What are quantum phases?

- August 2018 - Invited speaker at Emergent Topological Order in Classical Systems" (ETOCS-2018), Santa Fe, NM
Topological Order, Equilibrium, Memory

- August 2015 - Invited talk at Workshop on Strongly Coupled Field Theories for Condensed Matter and Quantum Information Theory, IIP, Natal, Brazil
Entanglement is not a number

- Invited talk at Workshop on Quantum Metrology, Interaction, and Causal Structure, December 1-5, 2014, Tsinghua University, Beijing, China
A toy model for quantum space-time

- August 2013 - Invited talk at International Conference on Nanomaterials 2013, Western University, London ON Canada
Topological Entropy after a Quantum Quench

- Invited talk given at the Peyresq Meeting 2012, France
Local thermalization and fast scramblers in quantum mechanical models of Black Holes

- November 7th 2011, Colloquium, Institute for Quantum Computing, Waterloo ON Canada
  Quantum Entanglement in Random Physical States
- 26-28 October 2011 Invited speaker at Emergence and Effective Field Theories, Perimeter Institute for Theoretical Physics, Waterloo On Canada
  Entanglement and the Emergence of Thermalization
- 18-21October 2011 Invited speaker at Workshop on Quantum Information in Quantum Many-body Physics, Centre de Recherches Mathématiques, Montreal QC Canada
  Entanglement in physical states
- 16-17 May 2011 Invited speaker at workshop *Topological Quantum Information*, Scuola Normale Superiore, Pisa, Italy
  Topological order at finite temperature and the quest for quantum memory
- 9-11 March 2011 Invited speaker at International Conference on Frontier Topics in Nanostructures and Condensed Matter Theory, London Ontario, Canada
  Topological order at finite temperature and the quest for quantum memory
- 5-10 June 2010 Invited speaker at Quantum Engineering of States and Devices: Theory and Experiments, Universitatszentrum Obergurgl, Obergurgl, Austria
  Topological Renyi Entropy
- 06/05/2009 Invited speaker at Theory Canada 5, University of New Brunswick, Fredericton NB, Canada.
  Quantum Adiabatic Brachistochrone
- 09/19/2008 Invited speaker at the conference GRAVTUM II, Amorgos, Greece September 15-20, 2008.
  Quantum evolution of space and matter
- 08/25/2008 Invited speaker at conference on Emergent Gravity, Massachusetts Institute of Technology, Center for Theoretical Physics
  Lieb-Robinson bounds and the speed of light from topological order
- 09/2007 Invited speaker at Conference on Representation Theory, Quantum Field Theory, Category Theory, Mathematical Physics and Quantum Information Theory, September 20 - 23, 2007, Tyler, TX
  Topological order and entanglement

Other selected Presentations and Talks

- November 2021- Center for Theoretical Physics of Complex Systems, IBS, Korea
  What is quantum complexity?
- July 2021 - ENS Lyon, France
  Six lectures on quantum chaos and information scrambling
- July 2021- Geometric Science of Information: 5th International Conference, GSI 2021, Paris, France
  Towards a Geometrization of Quantum Complexity and Chaos
- June 2021 - Quantum Information Day Inria Grenoble-Lyon *Entanglement, operator spreading and quantum chaos in random quantum circuits*
- June 2021 - CNRS Grenoble, France
  Quantum chaos and complexity

- February 2021 - University of Southern California, Los Angeles CA
  Quantum Chaos is Quantum
- December 2019, Fudan University, Shanghai
  Equilibration in quantum many-body physics
- October 2019, UMass Lowell, MA
  What is Quantum Complexity?
- October 2019, Perimeter Institute, Waterloo ON, Canada
  Quantum complexity, irreversibility, learnability and fluctuations.
- June 2019, ENS Lyon, France
  Entanglement complexity and irreversibility
- June 2019, LPMMC, Grenoble, France
  Quantum Complexity and the emergence of Irreversibility - a quantum KAM theorem?
- August 2018, LANL, Los Alamos, NM
  Entanglement Complexity
- August 2015, Colloquium, Natal, Brazil
  Locality in quantum Many - Body Physics
- May 2015, Fudan University, Shanghai China
  What is special about thermalization in quantum systems?
- January 2015, McMaster University, Ontario, Canada
  Colloquium: Thermalization and Entanglement in Quantum Systems
- December 2014, Fudan University, Shanghai China
  Colloquium: Equilibration, Thermalization, and Entanglement in Quantum Many-Body Systems
- February 2014, Western University, London Ontario
  Colloquium: Equilibration and Thermalization in Quantum Many-Body Systems
- January 2014, University of Virginia
  Equilibration and Thermalization in Quantum Many-Body Systems
- May 2013, Boston University
  Topological Order after a Quantum Quench
- November 2012, Washington University, St. Louis, Missouri
  Can we Build a Quantum Hard Drive?
- November 2012, University of Guelph, Ontario
  Lieb-Robinson Bounds and the Structure of Correlations in Many-Body Quantum Systems
- October 2012, USC
  Renyi Entropies for Exotic States
- October 2012, UCSD
  Can we build a quantum Hard Drive?
- January 25th, 2012, SISSA, Trieste, Italy
  Quantum Entanglement in Random Physical States
- October 2012, Beijing Normal University
  Quantum Phase Transitions and Exotic States Entanglement in Physical States

- December 28th, 2011 Tsinghua University, Beijing, China
  Topological order, Entanglement, and Quantum Memory

- May 2011 Scuola Normale Superiore di Pisa, Italy
  Short course on topological order

- 04/2011 University of Illinois Urbana Champaign
  Lieb-Robinson bounds and the structure of correlations in quantum many body systems

- 18/11/2010 Stony Brook, NY
  Simons Conference on New Trends in Quantum Computation
  Topological entanglement Renyi entropy and reduced density matrix structure

- 6/10/2010 Santa Fe Institute, Santa Fe NM
  Revivals of a closed quantum system and Lieb-Robinson speed

- 29/09/2010 Boston University, MA
  Revivals of a closed quantum system and Lieb-Robinson speed

- 11/03/2010 University of Toronto, Canada
  Lieb-Robinson bounds and the structure of correlations in quantum many body systems

- 02/2010 Albert Einstein Institute -Potsdam, Germany
  Short course about quantum phase transitions, entanglement, and topological order.

- 23/10/2009 Quantum Information and Condensed Matter Physics Seminars series at the University of Southern California
  How sound can protect quantum memory: The Toric-Boson model

- 17/09/2009 University of Virginia
  The Toric-Boson model and quantum memory at finite temperature

- 04/29/2009 Colloquium at Sherbrooke University, Quebec, Canada.
  Topological Quantum Memory at Finite Temperature

- 12/16/2008 Università di Perugia, Italy.
  Stable quantum memory at finite temperature

- 10/31/2008 Talk at Boston University.
  Lieb-Robinson Bounds and The Speed of Light

- 12/19/2007 Contributed Talk at the First International Conference on Quantum Error Correction QEC07, USC Los Angeles CA
  A new error estimate for Adiabatic Quantum Computation

- 11/13/2007 IQI, California Institute of Technology, Pasadena, CA
  Topological entropy and the entanglement description of Topological Order

- 11/02/2007 USC Quantum Information and Condensed Matter Physics Seminars
  Entanglement description of topological order

- 10/30/2007 UC Berkeley
  Entanglement in topologically order

- 03/2007 Talk at APS March meeting, Denver USA
  Quantum phase transition from magnetic to topological order

- 03/2007 Talk at APS March meeting, Denver USA
  Adiabatic Preparation of Topological Order

- 03/2007 Talk at APS March meeting, Denver USA
  Adiabaticity in Open Quantum Systems
- 11/2006: Lectures at Università di Napoli Federico II
  Three lectures on Quantum phase transitions, lattice gauge theories, and quantum order
- 10/2006: Perimeter Institute, Waterloo, Canada
  The transition from magnetic to topological order
- 9/2006: StationQ at university of Santa Barbara, USA.
  Topological adiabatic quantum computation
- 9/2005: Max Planck Institute for Quantum Optics, Munich, Germany
  String/Membrane condensed states and Topological Order
- 8/2005: Contributed talk at Quantum computing 2005, Algorithms, Physical Realizations and Beyond, Kinki University, Osaka, Japan
  Topological order with membrane condensation
- 8/2005: Contributed talk at EQIS 2005, ERATO conference on Quantum Information Science, Tokyo, Japan
  Group theoretic methods, entanglement, area law
- 7/2005: Università di Napoli Federico II
  Group Theoretic Methods, Entanglement and Area Law
- 6/2005: University of Innsbruck, Institute for Theoretical Physics, quantum information group *Group Theoretic Methods, Entanglement and Area Law*
- 5/2005: Workshop on: Quantum Measurements and operations for cryptography and information processing, University of Pavia, Italy
  Bipartite entanglement and area law with group-theoretic methods
- 3/2005: TU Delft, Holland
  Bipartite entanglement and area law
- 3/2005: University of Barcelona, Spain
  Bipartite entanglement and entropic boundary law in lattice spin systems
- 11/2004: Perimeter Institute, Waterloo, Canada
  Topological order, string/membrane condensation, and entanglement
- 06/2004: TOPQIP workshop, Institute for Scientific Interchange, Torino, Italy
  Ground state entanglement in Kitaev's model
- 04/2004: Poster session XXIII Meeting of theoretical physics and structure of matter, Fai della Paganella, Italy
  String and membrane condensation on 2D and 3D lattices
- 12/2003: Talk at MIT Quantum reading
  Entangling Power in adiabatically connected hamiltonians

Programming Skills	Mathematica, Matlab, LaTeX
Other Interests	Drawing, Photography, Running, Writing