Emilio Cobanera

Assistant Professor of Physics
Department of Mathematics and Physics
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Education

May 2012 Ph.D. in Physics, Indiana University, Bloomington, IN

Thesis: *A New Theory of Dualities and Dimensional Reduction: Applications to Phase Transitions, Topological Quantum Order, and Quantum Information Processing*

Advisor: Prof. Gerardo Ortiz

March 2007 Master in Physics, University of La Plata, Argentina

Thesis: *Five-Dimensional Brans-Dicke Gravity for Brane-World Cosmology*

Advisor: Prof. Hector Vucetich

Professional Experience

06/18- present	**Visiting Assistant Professor** *Dartmouth*, Department of Physics and Astronomy
08/17- present	**Assistant Professor of Physics** *SUNY Polytechnic Institute*, Department of Mathematics and Physics
09/15 - 08/17	**Postdoctoral Researcher** *Dartmouth College*, Department of Physics and Astronomy Research advisor: Prof. Lorenza Viola
09/14 - 09/15	**Postdoctoral Researcher** *Institute for Theoretical Physics*, Utrecht University, The Netherlands Research advisors: Profs. Cristiane Morais Smith and Jan Zaanen
06/12 - 9/14	**Postdoctoral Researcher** *Lorentz Institute*, Leiden University, The Netherlands Research advisor: Prof. Carlo W. J. Beenakker

Professional Memberships

- Member of the *American Physical Society* since 2011.

Research Interests

• **Condensed Matter Physics:** exotic superconductivity, strongly correlated states of matter (charge fractionalization and anyonic statistics), mesoscopic transport, complex-oxide interfaces
• **Statistical Mechanics:** exact solvability, phase transitions, topological states of matter and light, nanothermodynamics, thermal dynamics and dynamics towards equilibration
• **Quantum Information Science**: superconducting qbits, quantum memories, open quantum systems and non-Hermitian quantum mechanics

Awards

2012 Indiana University: Esther L. Kinsley Ph.D. Dissertation Award
Award amount: $5,000

2011 Indiana University: Departmental Award for Outstanding Graduate Research in Theoretical Physics

2008 Indiana University: Leo M. Falicov Fellowship in Theoretical Physics
Award amount: tuition & living stipend

Honors

2018 - Present **Visiting Assistant Professor of Physics**
Dartmouth College
Department of Physics and Astronomy

Grants

2019 Air Force Research Laboratory: Extension Grant
Does non-equilibrating thermal dynamics make topological quantum memories viable?
Award amount: $4,000

2019 SUNY Polytechnic Institute Office of Research Advancement: Seed Grant
Award amount: $3,500

2019 Air Force Research Laboratory RI: Visiting Faculty Research Program
Does non-equilibrating thermal dynamics make topological quantum memories viable?
Award amount: $16,200

Faculty Service Highlights

Academic Year 2020 Faculy Senator for the College of Arst + Sciences, SUNY Poly

Academic Year 2020 Head of the Academic Quality Committee of the Utica Faculty Assembly

Teaching Experience

SUNY Polytechnic Institute — Fall 2017-present

Spring 22 **PHY 201T: Calculus-based Physics I Theory**

Spring 22 **PHY 472: Electromagnetism II**

Fall 21 **PHY 202T: Calculus Based Physics II Theory**

Fall 21 **PHY 371: Electromagnetism I**

Spring 21 **PHY 202L: Calculus Based Physics I Laboratory**

Spring 21 **PHY 202L: Calculus Based Physics I Laboratory**

Spring 21 **PHY 201T: Calculus-based Physics I Theory**

Fall 20 **PHY 202L: Calculus Based Physics II Laboratory**

Fall 20 **PHY 202T: Calculus Based Physics II Theory**

Fall 20 **PHY 351T: Modern Physics Theory**

Spring 20 **PHY 201T: Calculus-based Physics I Theory**

Spring 20 **PHY 472: Electromagnetism II**

Fall 19 **PHY 202T: Calculus Based Physics II Theory**

Fall 19 **PHY 371: Electromagnetism I**

Spring 19 **PHY 201T: Calculus-based Physics I Theory**

Spring 19 **PHY 381: Introduction to Quantum Mechanics**

Fall 17 **PHY 201T: Calculus Based Physics I Theory**

Fall 17 **PHY 381: Introduction to Quantum Mechanics**

Fall 18 **PHY 202T: Calculus Based Physics II Theory**

Fall 18 **PHY 290: Special Topic, Thermal Physics**

Spring 18 **PHY 361: Intermediate Mechanics**

Spring 18 **PHY 201T: Calculus Based Physics I Theory**

Fall 17 **PHY 381: Introduction to Quantum Mechanics**

Fall 17 **PHY 201T: Calculus Based Physics I Theory**

Dartmouth — Spring 2016-present

Summer 18 **PHYS 44: Mechanics** (upper division undergraduate course)

Spring 16 **PHYS 104: Statistical Mechanics I** (core graduate course)

List of Publications

32 V. P. Flynn, **E. Cobanera**, and L. Viola, *Topology by dissipation: Majorana Bosons in metastable quadratic Markovian dynamics*, Phys. Rev. Lett. 127, 245701 (2021)

31 A. Cupo, **E. Cobanera**, J. D. Whitfield, C. Ramanathan, and L. Viola, *Floquet Graphene Antidot Lattices*, Phys. Rev. B 104, 174304 (2021)

30 Q. Xu, **E. Cobanera**, and G. Ortiz, *Bloch and Bethe ansatze for the Harper model: A butterfly with a boundary*, Phys. Rev. B 104, 165140 (2021)

29 Q. Xu, A. Alase, V. P. Flynn, E. Cobanera, L. Viola, and G. Ortiz, *Squaring the fermion: the threefold way and the fate of zero modes*, Phys. Rev. B **102**, 125127 (2020)
Editors' Suggestion

28 V. P. Flynn, E. Cobanera, and L. Viola, *Restoring number conservation in quadratic bosonic Hamiltonians with dualities*, EPL **131**, 40006 (2020).

27 V. P. Flynn, E. Cobanera, and L. Viola, *Deconstructing effective non-Hermitian dynamics in quadratic bosonic Hamiltonians*, New J. Phys. **22**, 083004 (2020)

26 Z. Weinstein, E. Cobanera, G. Ortiz, and Z. Nussinov, *Absence of finite-temperature phase transitions in the X-cube model and its $\mathbb{Z}_p$ generalization*, invited contribution to *Annals of Physics: Special Issue on Fractons*, Ann. Phys. 412, 168018 (2020)

25 G. Sun, T. Vekua, E. Cobanera, and G. Ortiz, *Phase transitions in the $\mathbb{Z}_p$ and U(1) clock models*, Phys. Rev. B 100, 094428 (2019)

24 E. Cobanera, A. Alase, G. Ortiz, and L. Viola, *Generalization of Bloch's theorem for arbitrary boundary conditions: topological surface band structure and mesoscopic applications*, Phys. Rev. B 98, 245423 (2018)

23 A. Alase, E. Cobanera, G. Ortiz, and L. Viola, *Generalization of Bloch's theorem for arbitrary boundary conditions,* PRB 96, 195133 (2017)
Editors' Suggestion and featured in Physics

22 E. Cobanera, *Modeling Electron Fractionalization with Unconventional Fock Spaces*, J. Phys.: Cond. Matt. 29, 305602 (2017) (2017)

21 E. Cobanera, A. Alase, G. Ortiz, and L. Viola, *Exact solution of corner-modified banded block-Toeplitz eigensystems*, J. Phys. A: Math. Gen. 50, 195204 (2017)

20 E. Cobanera, J. Ulrich, and F. Hassler, *Realization of $\mathbb{Z}_3$ parafermions on a critical line*, Phys. Rev. B 94, 125434 (2016)

19 A. Alase, E. Cobanera, G. Ortiz, and L. Viola, *Exact solution of quadratic fermionic Hamiltonians for arbitrary boundary conditions*, Phys. Rev. Lett. 117, 076804 (2016)

18 A. Quelle, E. Cobanera, and C. Morais Smith, *Thermodynamic signatures of topological insulators*, Phys. Rev. B 94, 075133 (2016)

17 G. Ortiz and E. Cobanera, *What is a topological superfluid? The fate of Majorana fermions beyond mean field*, Ann. Phys. 372, 357 (2016)

16 E. Cobanera, P. Kristel, and C. Morais Smith, *Quantum Brownian motion in a Landau level*, Phys. Rev. B 93, 245422 (2016)

15 E. Cobanera and G. Ortiz, *Equivalence of topological insulators and superconductors*, Phys. Rev. B 92, 155125 (2015)

14 A. Milsted, L. Seabra, I. C. Fulga, C. W. J. Beenakker, and E. Cobanera, *Statistical translation invariance protects a topological insulator from interactions*, Phys. Rev. B 92, 085139 (2015)

13 M. Diez, A.M.R.V.L. Monteiro, G. Mattoni, E. Cobanera, T. Hyart, E. Mulazimoglu, N. Bovenzi, C.W.J. Beenakker, and A.D. Caviglia, *Giant negative magnetoresistance driven by spin-orbit coupling at the LAO/STO interface*, Phys. Rev. Lett. 115, 016803 (2015)

12 G. Ortiz, J. Dukelsky, E. Cobanera, C. Essebag, and C. W. J. Beenakker, *Many-Body Characterization of Particle-Conserving Topological Superfluids*, Phys. Rev. Lett. 113, 267002 (2014)

11 A. Milsted, E. Cobanera, M. Burello, and G. Ortiz, *Commensurate and incommensurate phases of topological quantum matter*, Phys. Rev. B 90, 195101 (2014)

10 B. van Heck, E. Cobanera, J. Ulrich, and F. Hassler *Thermal conductance as a probe of the non-local order parameter for a topological superconductor with gauge fluctuations*, Phys. Rev. B 89, 165416 (2014)

9 E. Cobanera and G. Ortiz, *Fock parafermions and self-dual representations of the braid group*, Phys. Rev. A 89, 012328 (2014)

8 E. Cobanera, G. Ortiz, and E. Knill, *A Solution of the non-Abelian duality problem*, Nuc. Phys. B 877, 574 (2013)

7 E. Cobanera, G. Ortiz, and Z. Nussinov, *Holographic symmetries and generalized order parameters for topological matter*, Phys. Rev. B 87, 041105(R) (2013)

6 M. Burrello, B. van Heck, and E. Cobanera, *Topological phases in two-dimensional arrays of parafermionic zero modes*, Phys. Rev. B 87, 195422 (2013)

5 Z. Nussinov, G. Ortiz, and E. Cobanera, Arbitrary dimensional Majorana dualities and network architectures for topological matter, Phys. Rev. B 86, 085415 (2012)

4 Z. Nussinov, G. Ortiz and E. Cobanera, *Effective and exact holographies from symmetries and dualities*, Ann. Phys. 327, 2491 (2012)

3 G. Ortiz, E. Cobanera and Z. Nussinov, *Dualities and the phase diagram of the p-clock model*, Nucl. Phys. B 854, 780-814 (2011)

2 E. Cobanera, G. Ortiz and Z. Nussinov, *The bond-algebraic approach to dualities*, Adv. Phys. 60, 679-798 (2011)

1 E. Cobanera, G. Ortiz and Z. Nussinov, *Unified approach to quantum and classical dualities*, Phys. Rev. Lett. 104, 020402 (2010)

	NASA ADS Labs	Google Scholar
Total times cited	**709**	**936**
Number of citing papers	478	–
Average # citations per paper	21.5	–
h-index	16	18

Table 1: Citation Statistics (last updated: December 2019)

Book chapters

- G. Ortiz, E. Cobanera, and Z. Nussinov, *The Berezinskii-Kosterlitz-Thouless transition through the eyes of dualities*, in *40 Years of the Berezinskii-Kosterlitz-Thouless Theory*, edited by Jorge V. José, World Scientific (2012).

Submitted and forthcoming publications

F1 E. Cobanera, *Thermal dynamics of topological quantum field theories: the Abelian Chern-Simons theory*, in preparation for *Nuclear Physics B*

F2 A. Alase, E. Cobanera, G. Ortiz, and L. Viola, *Matrix factorization approach to the bulk-boundary correspondence and stability of zero modes*, in preparation for *Annals of Physics*

F3 A. Milsted, E. Cobanera, M. Burrello, G. Ortiz, *Frustrated Quantum Clock Chains*, in preparation for *Physical Review B*

F4 E. Cobanera, *Conserved currents of quantum dynamical semigroups and the thermodynamic limit of steady states*, in preparation for *Journal of Physics A: Mathematical and General.*

Talks and Seminars

Invited Seminars

2022 *The Majorana Boson*, Department of Physics, the University at Buffalo, (Spring)

2018 *Quantum Brownian motion in the integer quantum Hall regime*, Center for Coherence and Quantum Optics, University of Rochester, Rochester NY (December)

2018 *First steps towards a theory of stochastically-driven topological quantum orders,* Department of Physics and Astronomy, Indiana University, Bloomington IN (November)

2018 *Bulk-Boundary Correspondence: What is the role of boundary conditions? Part II*, Department of Physics, Rensselaer Polytechnic Institute, Troy NY (March)

2018 *Topological order in interacting one-dimensional superconductors: thermodynamic signatures*, Department of Physics, Colgate University, Hamilton NY (April)

2018 *Bulk-Boundary Correspondence: What is the role of boundary conditions? Part I*, Department of Physics, Rensselaer Polytechnic Institute, Troy NY (February)

2017 *An introduction to topological superconductivity: From Ohm's law to complex oxide interfaces*, Center for Nanoscale Science and Technology, SUNY Polytechnic, Albany NY (August)

2017 *An introduction to topological superconductivity*, Department of Mathematics and Physics, SUNY Polytechnic Institute, Utica NY (April)

2015 *Fermion-root quasiparticles: fractionalized electrons in second quantization*, Department of Physics and Astronomy, Dartmouth College, Hanover NH (January)

2014 *Fractionalized electrons in second quantization*, Institut für Quanteninformation, RWTH Aachen University, Aachen, Germany (December)

2013 *Anyons in Second Quantization and the Fractional Josephson Effect*, Department of Physics and Astronomy, University of Leeds, Leeds, UK, (November)

2013 *Anyons in Second Quantization*, Max-Planck-Institut für Quantenoptik, Garching, Germany (October)

2013 *The Problem of Anyons in Second Quantization*, Utrecht University, Utrecht, The Netherlands (October)

2013 *Fock Parafermions and Self-Dual Representations of the Braid Group*, Department of Physics, University of Virginia, Charlottesville VA (August)

2013 *A New Theory of Dualities, Holographic Symmetries, and the Search of Generalized Order Parameters for Topological Quantum Order*, Institute for Theoretical Physics, Hannover, Germany (April)

2013 *A New Theory of Dualities, Holographic Symmetries, and the Search of Generalized Order Parameters for Topological Matter*, Institute for Theoretical Physics, Utrecht University, Utrecht, The Netherlands (February)

2013 *A new theory of dualities, holographic symmetries, and the search of generalized order parameters for topological order*, Institute of Physics, University of Amsterdam, Amsterdam, The Netherlands (January)

2012 *Dualities and Dimensional Reduction in Topological Quantum Order and Processing of Quantum Information*, Department of Physics, Cornell, Ithaca NY (March)

2011 *Dualities and Dimensional Reduction in Topological Quantum Order and Processing of Quantum Information*, Institute of Condensed Matter Theory of the University of Illinois, Urbana-Champaign IL (March)

2011 *Dualities and Dimensional Reduction in Topological Quantum Order and Processing of Quantum Information*, Department of Physics, Rutgers, New Brunswick NJ (December)

2011 *Dualities and Dimensional Reduction in Topological Quantum Order and Processing of Quantum Information,* Perimeter Institute for Theoretical Physics, Waterloo, Canada (November)

2011 *Dualities, Exact and Effective Dimensional Reduction, and Quantum Information Processing,* Department of Physics, University of Southern California, Los Angeles CA (November)

Talks at Meetings and Workshops

2020 *Modeling electron fractionalization with unconventional Fock spaces*, APS March Meeting, Denver, Colorado (March 2-6)

2020 *Supercurrents in junctions of non-fermionic SPT phases*, Planning Workshop for NSF QLCI on the Identification and Control of Fundamental Properties of Quantum Systems, Brown, Providence, Rhode Island (January 20-24)

2016 *Analytical characterization of bulk/boundary separation.*
APS March Meeting, Baltimore, Maryland (March)

2014 *Phase slips and the Higgs mechanism in Majorana chains*,

Bypassing Elitzur's theorem with non-Abelian dualities: order parameters of non-Abelian topological quantum matter,

"EUBET 2014: Applications of effective field theories to particle physics, condensed matter and quantum optics," Technical University of Munich, Munich, Germany (October)

2011 *Unified approach to quantum and classical dualities*,
APS March Meeting, Dallas, Texas (March)

2010 *An algebraic approach to quantum and classical dualities*,
DESY theory workshop "Quantum field theory: Developments and Perspectives," DESY Hamburg, Germany (September)

Schools and Workshops

2021 *Topology meets Quantum Optics*, Workshop, Centro de Ciencies de Benasque Pedro Pascual, virtual, June 2-4

2019 *Quantum Information Science,* 1st International Workshop, SUNY Polytechnic Institute, Utica NY, July 9-11

2018 *Gravity in the Quantum Regime,* Workshop, Wilder Laboratory, Dartmouth College, Hanover NH, June 28-29

2015 *Frontiers of Quantum Information and Computer Science,* Workshop, QuICS, University of Maryland, MD, September 28- October 2

2015 *Superconductivity on the verge,* Workshop, Lorentz Center, Leiden University, The Netherlands, July 27-31

2014 *Nanothermodynamics: For Equilibrium and Non-Equilibrium,* Workshop, Lorentz Center, Leiden University, The Netherlands, December 1-5

2014 *Topological matter out of equilibrium,* Focus Workshop, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, March 27-29

2013 *Hidden Order, Superconductivity, and Magnetism in URu2Si2,* Workshop, Lorentz Center, Leiden University, The Netherlands, November 4-8

2013 *Quantum Information Processing,* The 44th IFF Spring School in Jüllich, Germany, February 25 - March 8

2010 *Quantum Field Theory: Developments and Perspectives,* Annual DESY Theory Workshop, DESY Hamburg, Germany, 21-24 September

2004 *Segunda Escuela Chilena de Astrofísica, Cosmología y Gravitación,* Universidad de Concepción, Chile, 18-22 October

Service and Outreach

- **Internship host** for the Regional Program for Excellence, Boards of Cooperative Educational Services (BOCES) of New York. Fall 2018 Intern: Bianca Nunes of Holland Patent High School.
- **Referee** since 2012 for *Physical Review Letters*, *Physical Review X*, *Physical Review A*, *Physical Review B*, *Journal of High Energy Physics*, *Annals of Physics*, *New Journal of Physics*, *Journal of Physics A: Mathematical and General*, *European Physics Journal B*, *Journal of Physics Communications*.
- **Invited Reviewer** for *Mathematical Reviews* since 2017.
- **Organizer** of the condensed matter meetings of the Delta Institute for Theoretical Physics (Leiden University, 2014).