

Dr. Matthew Saul Leifer

ASSISTANT PROFESSOR OF PHYSICS



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Technology

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United States

RESEARCH INTERESTS

Quantum Foundations

Quantum Information

Foundations of Physics

Foundations of Probability

PRIZES AND AWARDS

Chapman University

Co-Teaching Award, 2019

(with Prof. K. McQueen)

FQXi Essay Contest (FQXi.org)

First Prize: 2013

Second Prize: 2018, 2015

Girton College, Cambridge

Mary Higgins Postgrad. Scholarship:

2000

C. B. West Postgrad. Prize in

Mathematics: 2000

University of Manchester

Platt Prize in Physics: 1999

Heginbottom Exhibition: 1997

PROFESSIONAL

Member American Physical Society

Member International Quantum

Structures Association

Member Foundational Questions Institute

Member Philosophy of Physics Society

PROFILE

My goal is to understand what quantum theory tells us about the nature of reality.

I study quantum foundations and quantum information, especially topics at the intersection of these two areas. I work at the boundary between physics, mathematics, and philosophy, collaborating with colleagues in all three

WORK EXPERIENCE

August 2022 – Present: PROGRAM DIRECTOR OF PHYSICS

Schmid College of Science and Technology, Chapman University, USA

June 2019 – August 2021: CO-DIRECTOR, INSTITUTE FOR QUANTUM STUDIES

Chapman University, USA

June 2018 – June 2019: ASSOCIATE PROGRAM DIRECTOR OF PHYSICS

Schmid College of Science and Technology, Chapman University, USA

January 2016 – Present: ASSISTANT PROFESSOR OF PHYSICS

December 2016 – Present: VISITING RESEARCH FELLOW

Perimeter Institute for Theoretical Physics, Canada

August 2013 – December 2015: LONG TERM VISITOR

Perimeter Institute for Theoretical Physics, Canada

December 2010 – December 2011: PART TIME RESEARCH ASSOCIATE

Department of Physics and Astronomy, University College London, UK

January 2007 – April 2008: POSTDOCTORAL FELLOW

Institute for Quantum Computing/Department of Applied Math, University of Waterloo, Canada

January 2007 – April 2008: ASSOCIATE POSTDOCTORAL FELLOW

Perimeter Institute for Theoretical Physics, Canada

October 2006 – January 2007: RESEARCH ASSOCIATE

Centre for Quantum Computing/DAMTP, University of Cambridge, UK

January 2004 – September 2006: POSTDOCTORAL FELLOW

Perimeter Institute for Theoretical Physics, Canada

November 2003 – December 2003: RESEARCH ASSISTANT

School of Mathematics, University of Bristol, UK

EDUCATION

Ph.D. in Applied Mathematics

University of Bristol, UK

October 2003

Research Area: Quantum Information Theory

Thesis Title: Entangled Quantum Dynamics

Masters of Advanced Studies in

Mathematics (Maths Tripos Part III)

University of Cambridge, UK

July 2000

Passed with distinction

B.Sc. in Physics with Theoretical Physics

University of Manchester, UK

July 1999

Passed with 1st class hon.

RESEARCH EXPERIENCE

Four Top Cited Publications

Searches performed on May 28, 2024.

with H. Barnum, J. Barrett, A. Wilce, **Generalized no-broadcasting theorem**, *Phys. Rev. Lett.* 99 (24) 240501 (2007)

Published Version: <https://doi.org/10.1103/PhysRevLett.99.240501>

Preprint: <https://arxiv.org/abs/0707.0620>

Google Scholar: 332 citations. Web of Science: 194 citations. Dimensions: 228 citations.

with R. Spekkens, **Towards a formulation of quantum theory as a causally neutral theory of Bayesian inference**, *Phys. Rev. A* 88 (5) 052130 (2013)

Published Version: <https://doi.org/10.1103/PhysRevA.88.052130>

Preprint: <https://arxiv.org/abs/1107.5849>

Google Scholar: 333 citations. Web of Science: 166 citations. Dimensions: 199 citations.

with H. Barnum, J. Barrett, L. Clark, R. Spekkens, N. Stepanik, A. Wilce, R. Wilke, **Entropy and Information Causality in General Probabilistic Theories**, *New J. Phys.* 12 033024

Published Version: <https://doi.org/10.1088/1367-2630/12/3/033024>

Preprint: <https://arxiv.org/abs/0909.5075>

Google Scholar: 177 citations. Web of Science: 94 citations. Dimensions: 100 citations.

Is the quantum state real? An extended review of ψ -ontology theorems, *Quanta* 3 67-155 (2014)

Published Version: <http://dx.doi.org/10.12743/quanta.v3i1.22>

Preprint <https://arxiv.org/abs/1409.1570>

Google Scholar: 351 citations. Dimensions: 208 citations. (Journal not indexed by Web of Science)

Research Metrics

Searches performed on May 28, 2024 (- indicates that service does not compute this index)

METRIC	GOOGLE SCHOLAR	WEB OF SCIENCE	DIMENSIONS	SCOPUS
Number of Publications	60	33	37	34
Citations	2775	1,190	1,162	1,362
h-index	23	17	-	17
i10-index	30	-	-	-

Research Grants

START DATE	END DATE	AMOUNT	ROLE	AWARDING AGENCY	PROJECT TITLE
Sept. 2024	Aug. 2027	\$2,441,268	Co-Principal Investigator	Templeton Foundation	SoCal Quantum Foundations Hub: Knowledge and Agency in Quantum Physics
Sept. 2019	Aug. 2022	\$130,853	Principal Investigator	Foundational Questions Institute	Reasoning in a Quantum World
Jan. 2018	Sept. 2020	\$249,950	Principal Investigator	Fetzer Franklin Fund	Fine Tunings and the Nature of Quantum Reality
Jan. 2018	Aug. 2018	\$4,600	Principal Investigator	Foundational Questions Institute	California Quantum Interpretation Network (CQIN)

Sept. 2016	Aug. 2018	\$9,775	Principal Investigator	Foundational Questions Institute	Institute for Quantum Studies Visitor Program
Sept. 2015	Aug. 2017	\$52,601	Principal Investigator	Foundational Questions Institute	Quantum Theory in the Block Universe
Sept. 2013	Aug. 2015	\$119,888	Co-Investigator (with PI J. Barrett, University of Oxford)	Foundational Questions Institute	Thermodynamic vs. Information Theoretic Entropies in Probabilistic Theories
Jan. 2011	Aug. 2011	\$1,500	Principal Investigator	Foundational Questions Institute	London Foundations Connection
Jan. 2008	Aug. 2008	\$7,500	Principal Investigator	Foundational Questions Institute	APS Invited Session: Quantum Information Meets Gravitation
Sept. 2007	Aug. 2011	\$70,000	Principal Investigator	Foundational Questions Institute	Abstract Quantum Probability

Graduate Research Student Advising

January 2008 – April 2008: Thomas Waterhouse, Ph.D. student visiting Perimeter Institute from University of British Columbia
Project: Temporal Joint Measurements

July 2007 – September 2007: Oscar Dahlsten, Ph.D. student visiting Perimeter Institute from Imperial College
Project: Unentangled Bit Commitment in Generic Probabilistic Models

Undergraduate Research Student Advising

June 2021 – August 2021: Pablo Labbate, Chapman software engineering major, IQS Summer Research Fellowship.
Project: Experimental Bounds on the Reality of the Quantum State using the IBM Quantum Computer

September 2020 – August 2021: Jacob Anabi, Chapman physics major, PHYS 491 Student-Faculty Research/Creative activity and Schmid Summer Research Fellowship.
Projects: Compatibility of Quantum Channels, Theory Independent Benchmarking of the IBM Quantum Computer

September 2019 – May 2019: Tucker Arrants, Chapman physics major, PHYS 491 Student-Faculty Research/Creative activity.
Project: Applications of Quantum Conditional States

January 2019 – December 2019 Conner Carnahan, Chapman physics major, PHYS 491 Student-Faculty Research/Creative activity.
Project: Compatibility of Observables in Quantum Darwinism

June 2018 – August 2018: Aaron Grisez, Chapman physics major visiting Perimeter Institute with me and 2 Fall 2018 research credits at Chapman.
Project: Reverse distinguishability theory

June 2007 – August 2007: Ryan Morris, University of Waterloo Undergraduate Research Student
Project: Distinguishability as a resource theory

TEACHING EXPERIENCE

Graduate Courses

Epistricted Classical Theories As Foils for Quantum Theory, ETH Zurich, Switzerland, June 2022
Summer School Course, 2 lectures, URL: <https://foundations.ethz.ch/>

Interpretations of Quantum Theory: Solstice of Foundations, ETH Zurich, Switzerland, June 2019
Summer School Course, 3 lectures, URL: <https://foundations.ethz.ch/2019-edition-of-solstice-of-foundations/>

Quantum Foundations: Perimeter Scholars International, Perimeter Institute, Canada, January 2019
Review Course, 15 lectures, videos at <http://pirsa.org/C19002>

No Go Theorems In Quantum Theory: Solstice of Foundations, ETH Zurich, Switzerland, June 2017
Summer School Course, 2 lectures, videos at <http://www.video.ethz.ch/conferences/2017/quantum.html>

Quantum Foundations: Perimeter Scholars International, Perimeter Institute, Canada, January 2017
Review Course, 14 lectures, videos at <http://pirsa.org/C16043>

Undergraduate Courses at Chapman

PHYS 102 General Physics II: Fall 2023, Fall 2019, Fall 2018, Fall 2017, Spring 2016 (Spring 2019 as reading and conference)

Electromagnetism: Coulomb's law, Biot Savart law, electric and magnetic fields, Maxwell's equations in integral form, electric potential, DC and AC circuits.

Core course. This is taught as a standard lecture course with in-class activities consisting of multi-choice conceptual questions.

PHYS 201 General Physics III: Fall 2016 (Interterm 2018, Summer 2018 as reading and conference).

Periodic motion, waves, fluids, thermal physics, optics, introduction to quantum mechanics.

Core course. This is taught as a "flipped classroom" using pre-class readings and quizzes. Class is mostly problem solving in groups with a small amount of lecturing based on student difficulties identified in the pre-class assignments.

PHYS 320 Mechanics I: Fall 2021 and Interterm 2024 as reading and conference:

Students deepen their understanding of Newtonian mechanics and its applications by using more advanced mathematical formulations of the physical principles studied in PHYS 101. Students learn general concepts, methods, analytic tools and advanced problem-solving skills. Topics include Newton's laws, conservation of momentum, angular momentum, and energy, oscillations, many-body dynamics, and non-inertial frames.

Core course.

PHYS/PHIL 329 Experimental Course (Philosophy and Foundations of Quantum Mechanics, co taught with Prof. K. McQueen): Spring 2020.

Quantum superposition, the formalism of quantum mechanics, multiple particles and properties, two path interference, qubits, the no-cloning theorem, quantum entanglement, quantum teleportation, ψ -epistemic modes (models in which the quantum state is a state of knowledge), the Einstein-Podolsky-Rosen (EPR) paradox, the measurement problem, nonlocality, contextuality, decoherence, and interpretations of quantum mechanics (spontaneous collapse theories, de Broglie-Bohm theory, many-worlds, and Copenhagenish interpretations).

Elective. This is a standard lecture course aimed at physics and philosophy students, but accessible to a general audience. It is an attempt to make the material covered in PHYS 453 (see below) accessible to a wider audience and is intended as a replacement for that course. Jointly taught with Prof. McQueen in philosophy as a result of winning the co-teaching award.

PHYS/PHIL 351 Philosophy and Foundations of Quantum Mechanics: Spring 2024.

This is the same as the above experimental course, which has now been added to the catalogue as a regular lecture course with a single instructor.

PHYS 451 Quantum Mechanics 1: Fall 2022, Spring 2021, Spring 2019, Spring 2018, Spring 2016 (Summer 2019, Summer 2018, Summer 2020 as reading and conference).

Modern physics (black body radiation, Compton effect, wave-particle duality, Bohr atom, etc.), mathematics of quantum theory (including Dirac notation), postulates of quantum mechanics, one-dimensional systems (step potentials, wells, harmonic oscillator, etc.), angular momentum (orbital and spin), three-dimensional systems including the hydrogen atom.

Core course. This is taught as a standard lecture course with breaks in class for activities, usually consisting of a short derivation or calculation.

PHYS 452 Quantum Mechanics II: Fall 2017, Fall 2021 (Fall 2018, Summer 2020, Fall 2020 as reading and conference).

Rotation group and angular momentum, addition of angular momentum, identical particles, approximation techniques (perturbation theory, variational method, WKB approximation), interaction of atoms with radiation, scattering theory, relativistic quantum mechanics.

Core course. This is taught as a "flipped classroom" using pre-class readings. Class starts with a conceptual quiz based on student misconceptions identified in the research literature, followed by solving one or two in depth problems as a group.

PHYS 453 Foundations of Quantum Mechanics: Spring 2018

Realism vs. anti-realism debate, generalized probabilistic theories, key quantum phenomena (quantum interference, EPR experiment, teleportation, etc.), the generalized formalism (density operators, completely-positive maps, etc.), quantum state distinguishability, ontological models and no-go theorems (Bell, Kochen-Specker, etc.), Interpretations of quantum theory (Copenhagen, many-worlds, Bohm, spontaneous collapse), writing popular science articles.

Elective. This is a standard lecture course except for a semester-long assignment to produce popular science media (article, video, podcast, game, etc.) about a topic in the foundations of quantum mechanics. Features peer evaluation and guest lecture from a popular science writer.

Undergraduate Courses Pre-Chapman

MATH137 Intro. Calculus for Math Hons.: University of Waterloo, Canada, September 2007 — December 2007

Advanced Quantum Mechanics: University of Waterloo, Canada, September 2006

Two lectures covering for instructor's absence.

Interpretations of Quantum Mechanics: Current Status and Future Directions, University of Waterloo, Canada, March 2005

Guest lecture on Quantum Logic.

IS304 Is the quantum state real? University of Waterloo, Canada, January 2015 — April 2015

Supervisor for independent studies student Ding Jia.

Undergraduate Tutoring

Mathematics 1A: University of Bristol, UK, October 2000 — June 2003

Mathematics for 1st year Physics, Chemistry and Economics Students.

Undergraduate Computer Lab Demonstration

Mathematics 1A: University of Bristol, UK, October 2001 — June 2003

MATLAB and MAPLE.

ACADEMIC SERVICE

Service at Chapman University

August 2023 – April 2024: Member, Search Committee for Director of Jewish Life

August 2022 – Present: Program Director of Physics

February 2021 – December 2021: Chair, Hiring Committee for NTT Professor of Physics

Fall 2021: Thesis Committee member for Shiva Lotfallahzadeh Barzili, Computational and Data Science (CADs) Ph.D. student.

August 2020 – May 2021: Member, Faculty Governance Council

Summer 2020: Faculty subcommittee of the COVID19 taskforce

June 2019- August 2021: Co-Director, Institute for Quantum Studies

May 2019 – May 2021: Faculty Senator

September 2018 – September 2020: Faculty Advisor, Physics Club

June 2018 – June 2019: Associate Program Director of Physics

2017, 2020, 2023 – Refereeing undergraduate research proposals for the Center for Undergraduate Excellence (CUE, formerly OURCA).

Pre-Chapman Committees

November 2004 – June 2005: Postdoc Representative on the Postdoc Hiring Committee, Perimeter Institute, Canada

November 2004 – June 2005: Postdoc Representative on the Quantum Information Faculty Hiring Committee, Perimeter Institute, Canada

External Thesis Committees

November 2022: External Ph.D. thesis examiner: Oskari Kerppo, Mathematics, University of Turku, Finland, Adviser: Dr. Teiko Heinosaari. Thesis title: *Quantum communication tasks*

October 2019: External Ph.D. thesis examiner: Angela Karanjai, Physics, University of Sydney, Australia. Advisers: Prof. S. Bartlett. Thesis title: *Statistical Modelling of Quantum Data*

October 2017: External Ph.D. thesis examiner: Christina Giarmatz, Physics, University of Queensland, Australia. Advisers: Prof. G. Milburn and Prof. A. White. Thesis title: *Quantum Correlations with No Causal Order – In Theory and Experiments*

Editorial Work

November 2022 - Present: Editorial board member, *Philosophy of Physics*: Open access peer-reviewed journal published by LSE press.

<https://philosophyofphysics.org/journal/>

August 2021 – Present: Steering board member, *Quantum*: Open access peer-reviewed journal of quantum science

<https://quantum-journal.org/>

September 2016 – August 2021: Coordinating editor, *Quantum*: Open access peer-reviewed journal of quantum science

<https://quantum-journal.org/>

January 2008 – June 2018: Book reviews editor and editorial board member, *The Quantum Times: Newsletter of the APS Division of Quantum Information*

<https://engage.aps.org/dqi/resources/newsletters/archived-newsletters>

Refereeing for Research Grant Panels

European Research Council (ERC), Foundational Questions Institute ([FQXi.org](https://fqxi.org)), National Science Center (Poland), NWO (Netherlands)

Refereeing for Academic Book Publishers

Cambridge University Press, Springer

Refereeing for Journals

British Journal for the Philosophy of Science, Foundations of Physics, Foundations of Science, Information, Journal of Physics A, Nature Physics, New Journal of Physics, Philosophy of Science, Philosophy of Physics, Physical Review A, Physical Review D, Physical Review Letters, Physical Review X, Physics Essays, Proceeding of the National Academy of Science, Quanta, Quantum, Quantum Information and Computation, Quantum Studies: Mathematics and Foundations, Royal Society Open Science, Studies in the History and Philosophy of Modern Physics, Synthese

Conferences, Workshops, and Summer Schools Organized

September 2022: California Quantum Interpretation Network Meeting, Chapman University, USA. Co organized with A. Jordan, K. McQueen and M. Waegel

<https://sites.google.com/site/californiaquantum/home/september-2022-meeting>

March 2022: Focus sessions on Quantum Foundations, APS March Meeting, Chicago, USA

<https://meetings.aps.org/Meeting/MAR22/Content/4178>

June 2021: Program Committee Member for Quantum Physics and Logic 2021, Gdansk, Poland

<https://qpl2021.eu/>

March 2021: Focus sessions on Quantum Foundations (co organized with R. Spekkens), APS March Meeting, Online

<http://meetings.aps.org/Meeting/MAR21/Content/3990>

July 2020: First Online IQS Workshop, Chapman University, USA/Zoom

<https://iqs.mattleifer.info/doku.php?id=workshop>

March 2020: Second PI-man Meeting on Quantum Foundations (co organized with R. Spekkens), Chapman University, USA
Cancelled due to COVID 19 pandemic.

March 2020: Focus sessions on Quantum Foundations (co organized with I. Durham and R. Spekkens), APS March Meeting, Denver, USA
Cancelled due to COVID19 pandemic.

June 2019: Quantum Physics and Logic (co organized with J. Dressel, L. Catani and A. Moshier – I was lead local organizer and program committee chair), Chapman University, USA

<https://qpl2019.org>

March 2019: Encapsulated Agents in Quantum Theory: Re-examining Wigner's Friend (co organized with C. Fuchs), Boston, USA

<https://wigner.mattleifer.info>

March 2019: First PI-man Meeting on Quantum Foundations (co organized with R. Spekkens), Chapman University, USA

<https://piman.mattleifer.info>

June 2018: Program Committee Member for Quantum Physics and Logic 2018, Halifax, Canada

<https://www.mathstat.dal.ca/qpl2018/>

March 2018: Invited and focus sessions on Quantum Foundations (co organized with J. Dressel and K. Murch), APS March Meeting, Los Angeles, USA

<https://meetings.aps.org/Meeting/MAR18/Content/3475>

March 2018: AAV Anniversary Conference – Celebrating 30 Years of Weak Values (co organized with J. Dressel and J. Tollaksen), Chapman University, USA

<https://www.chapman.edu/research/institutes-and-centers/quantum-studies/aav.aspx>

March 2017: Focus session on Gamification and other novel approaches in quantum physics outreach, APS March Meeting, New Orleans, USA, Mar. 2017

<https://meetings.aps.org/Meeting/MAR17/Content/3284>

July 2016: Program Committee Member for 18th UK and European Conference on Foundations of Physics, London, UK

<http://www.lse.ac.uk/philosophy/blog/2015/10/01/foundations-2016/>

June 2016: Program Committee Member for Quantum Physics and Logic 2016, Strathclyde, UK

<http://qpl2016.cis.strath.ac.uk/>

June 2016: Making Sense of Quantum Mechanics & Concepts and Paradoxes in a Quantum Universe (co-organized with Y. Aharonov, J. Dressel, L. Hardy, and J. Tollaksen), Perimeter Institute, Canada

<https://www.perimeterinstitute.ca/conferences/concepts-and-paradoxes-quantum-universe>

July 2015: Program Committee Member for Quantum Physics and Logic 2015, Oxford, UK

<http://www.cs.ox.ac.uk/qpl2015/>

May 2014: Advisory Committee Member for London Foundations Connection, London School of Economics, UK

<https://lfc.mattleifer.info/>

May 2013: Advisory Committee Member for London Foundations Connection, Imperial College, London, UK

April 2012: London Foundations Connection (co-organized with A. Caulton), University of London, UK

<https://www.youtube.com/playlist?list=PL81DgADB1DE007827>

March 2008: Invited Session on Quantum Information Meets Gravitation (co organized with L. Viola), APS March Meeting, New Orleans, USA

<https://meetings.aps.org/Meeting/MAR08/Content/1017>

August 2007: Quantum Foundations Summer School (co organized with H. Burton and L. Hardy), Perimeter Institute, Canada

<https://www.perimeterinstitute.ca/conferences/quantum-foundations-summer-school>

July 2005: Workshop on Quantum Information, Computation and Logic: Exploring New Connections (co organized with H. Barnum), Perimeter Institute, Canada

<https://www.perimeterinstitute.ca/conferences/quantum-information-computation-and-logic-exploring-new-connections>

Seminar Series Organized

August 2021 – August 2022: Institute for Quantum Studies Seminars, Chapman University

<https://www.chapman.edu/research/institutes-and-centers/quantum-studies/iqs-seminar-series.aspx>

August 2011 – January 2016: Q+ Hangouts (co organized with D. Burgarth), Online seminars on quantum information and quantum foundations

<https://sites.google.com/site/plusquant/>

Discussion Groups Organized

2004 – 2005: Contextuality Workgroup of Perimeter Institute Experts (CoWPIE), Perimeter Institute, Canada

Updated: August 9, 2024

PUBLICATIONS

Articles in Refereed Journals

2024

With M. Khoshbin, L. Catani, **Alternative robust ways of witnessing nonclassicality in the simplest scenario**, *Phys. Rev. A* 109(3) 032212

Published Version: <https://doi.org/10.1103/PhysRevA.109.032212>

Preprint: <https://arxiv.org/abs/2311.13474>

2023

with L. Catani, G. Scala, D. Schmid, R. Spekkens, **Aspects of the phenomenology of interference that are genuinely nonclassical**, *Phys. Rev. A* 108 022207

Editors' Suggestion

Published Version: <https://doi.org/10.1103/PhysRevA.108.022207>

Preprint: <https://arxiv.org/abs/2211.09850>

With L. Catani, D. Schmid, R. Spekkens, **Why interference phenomena do not capture the essence of quantum theory**, *Quantum* 7 1119.

Published Version: <https://doi.org/10.22331/q-2023-09-25-1119>

Preprint: <https://arxiv.org/abs/2111.13727>

Uncertainty from the Aharonov–Vaidman identity, *Quantum Studies: Mathematics and Foundations* 10 373–397

Published Version: <https://doi.org/10.1007/s40509-023-00301-8>

Preprint: <https://arxiv.org/abs/2301.08679>

with L. Catani, **A mathematical framework for operational fine tunings**, *Quantum* 7 948

Published Version: <https://doi.org/10.22331/q-2023-03-16-948>

Preprint: <https://arxiv.org/abs/2003.10050>

2022

with L. Catani, G. Scala, D. Schmid, R. Spekkens, **What is Nonclassical about Uncertainty Relations?**, *Phys. Rev. Lett.* 129 240401

Published Version: <https://doi.org/10.1103/PhysRevLett.129.240401>

Preprint: <https://arxiv.org/abs/2207.11779>

2020

with C. Duarte, **Noncontextuality inequalities from antidistinguishability**, *Phys. Rev. A*, 101 062113

Editors' Suggestion

Published Version: <https://doi.org/10.1103/PhysRevA.101.062113>

Preprint: <https://arxiv.org/abs/2001.11485>

2018

with J. Combes, C. Ferrie, M. Pusey, **Why protective measurement does not establish the reality of the quantum state**, *Quantum Studies: Mathematics and Foundations* 5 (2) 189–211

Published Version: <https://doi.org/10.1007/s40509-017-0111-4>

Preprint: <https://arxiv.org/abs/1509.08893>

2017

with M. Pusey, **Is a time symmetric interpretation of quantum theory possible without retrocausality?** *Proc. Roy. Soc. A*, 473 (2202) 20160607

Published Version: <https://dx.doi.org/10.1098/rspa.2016.0607>

Preprint: <https://arxiv.org/abs/1607.07871>

2016

with D. Jennings, **No Return to Classical Reality**, *Contemporary Physics* 57 60-82 (2016)

Published Version: <https://doi.org/10.1080/00107514.2015.1063233>

Preprint: <https://arxiv.org/abs/1501.03202>

2014

Is the quantum state real? An extended review of ψ -ontology theorems, *Quanta* 3 67-155 (2014)

Published Version: <http://dx.doi.org/10.12743/quanta.v3i1.22>

Preprint <https://arxiv.org/abs/1409.1570>

ψ -epistemic models are exponentially bad at explaining the distinguishability of quantum states, *Phys. Rev. Lett.* 112 160404 (2014)

Published Version: <https://doi.org/10.1103/PhysRevLett.112.160404>

Preprint: <https://arxiv.org/abs/1401.7996>

with R. Spekkens, **A Bayesian approach to compatibility, improvement, and pooling of quantum states**, *J.Phys. A* 47 275301 (2014)

Selected by the editors for inclusion in the "Highlights of 2014" collection.

Published Version: <https://doi.org/10.1088/1751-8113/47/27/275301>

Preprint: <https://arxiv.org/abs/1110.1085>

2013

with R. Spekkens, **Towards a Formulation of Quantum Theory as a Causally Neutral Theory of Bayesian Inference**, *Phys. Rev. A* 88 052130

Published Version: <https://doi.org/10.1103/PhysRevA.88.052130>

Preprint: <https://arxiv.org/abs/1107.5849>

with O. Maroney, **Maximally epistemic interpretations of the quantum state and contextuality**, *Phys. Rev. Lett.* 110 120401

Published Version: <https://doi.org/10.1103/PhysRevLett.110.120401>

Preprint: <https://arxiv.org/abs/1208.5132>

2012

with H. Barnum, J. Barrett, L. Clark, R. Spekkens, N. Stepanik, A. Wilce, R. Wilke, **Entropy and Information Causality in General Probabilistic Theories (addendum)**, *New J. Phys.* 14 129401

Published Version: <https://doi.org/10.1088/1367-2630/14/12/129401>

2010

with H. Barnum, J. Barrett, L. Clark, R. Spekkens, N. Stepanik, A. Wilce, R. Wilke, **Entropy and Information Causality in General Probabilistic Theories**, *New J. Phys.* 12 033024

Published Version: <https://doi.org/10.1088/1367-2630/12/3/033024>

Preprint: <https://arxiv.org/abs/0909.5075>

2009

with J. Barrett, **The de Finetti Theorem for Test Spaces**, *New J. Phys.* 11 033024

Published Version: <https://doi.org/10.1088/1367-2630/11/3/033024>

Preprint: <https://arxiv.org/abs/0712.2265>

2008

with D. Poulin, **Quantum Graphical Models and Belief Propagation**, *Ann. Phys.* 323 1899

Published Version: <https://doi.org/10.1016/j.aop.2007.10.001>

Preprint: <https://arxiv.org/abs/0708.1337>

2007

with H. Barnum, J. Barrett, A. Wilce, **Generalized No-Broadcasting Theorem**, *Phys. Rev. Lett.*, 2007 99 240501

Published Version: <https://doi.org/10.1103/PhysRevLett.99.240501>

Preprint: <https://arxiv.org/abs/0707.0620>

2006

Quantum Dynamics as an Analog of Conditional Probability, *Phys. Rev. A* 74 042310

Published Version: <https://doi.org/10.1103/PhysRevA.74.042310>

Preprint: <https://arxiv.org/abs/quant-ph/0606022>

2005

with J. Barrett, R. Tumulka, **Bell's Jump Process in Discrete Time**, *Europhysics Letters*, 72 685-690

Published Version: <https://doi.org/10.1209/epl/i2005-10297-5>

Preprint: <https://arxiv.org/abs/quant-ph/0506066>

with R. Spekkens, **Pre- and Post-Selection Paradoxes and Contextuality in Quantum Mechanics**, *Phys. Rev. Lett.* 95 200405

Published Version: <https://doi.org/10.1103/PhysRevLett.95.200405>

Preprint: <https://arxiv.org/abs/quant-ph/0412178>

2004

with N. Linden, A. Winter, **Measuring Polynomial Invariants of Multi-Party Quantum States**, *Phys. Rev. A* 69 052304

Published Version: <https://doi.org/10.1103/PhysRevA.69.052304>

Preprint: <https://arxiv.org/abs/quant-ph/0308008>

2003

with L. Henerson, N. Linden, **Optimal Entanglement Generation from Quantum Operations**, *Phys. Rev. A* 67 012306

Published Version: <https://doi.org/10.1103/PhysRevA.67.012306>

Preprint: <https://arxiv.org/abs/quant-ph/0205055>

2002

with C. Bennett, J. Cirac, D. Leung, N. Linden, S. Popescu, G. Vidal, **Optimal Simulation of Two-Qubit Hamiltonians using General Local Operations**, *Phys. Rev. A* 66 012305

Published Version: <https://doi.org/10.1103/PhysRevA.66.012305>

Preprint <https://arxiv.org/abs/quant-ph/0107035>

Articles in Conference Proceedings

2015

with M. Pusey, **Logical pre- and post-selection paradoxes are proofs of contextuality**, in Proc. 12th International Workshop on Quantum Physics and Logic (QPL2015), Electronic Proceedings in Theoretical Computer Science 195, C. Heunen, P. Selinger, J. Vicary (eds.) 295-306

Published Version: <https://cgi.cse.unsw.edu.au/~eptcs/paper.cgi?QPL2015.22>

Preprint <https://arxiv.org/abs/1506.07850>

2012

with H. Barnum, J. Barrett, A. Wilce, **Teleportation in General Probabilistic Theories**, in Mathematical Foundations of Information Flow: Proceedings of the Clifford Lectures 2008, Proceedings of Symposia in Applied Mathematics 71, S. Abramsky, M. Mislove (eds.) 25-47 (AMS)

Published Version: <https://bookstore.ams.org/view?ProductCode=PSAPM/71>

Preprint: <https://arxiv.org/abs/0805.3553>

2008

with H. Barnum, O. Dahlsten, B. Toner, **Nonclassicality without Entanglement Enables Bit Commitment**, in Proceedings of IEEE Information Theory Workshop 2008 386-390

Published Version: <https://doi.org/10.1109/ITW.2008.4578692>

Preprint <https://arxiv.org/abs/0803.1264>

2007

Conditional Density Operators and the Subjectivity of Quantum Operations, in Foundations of Probability and Physics 4, AIP Conference Proceedings 889, G. Adenier, C. Fuchs and A. Khrennikov (eds.), 172-186

Published Version: <https://doi.org/10.1063/1.2713456>
Preprint: <https://arxiv.org/abs/quant-ph/0611233>

2005

with R. Spekkens, **Logical Pre- and Post-Selection Paradoxes, Measurement-Disturbance and Contextuality**, in Proceedings of Quantum Structures 2004, *Int. J. Theor. Phys.* 44 1977-1987
Published Version: <https://doi.org/10.1007/s10773-005-8975-1>
Preprint: <https://arxiv.org/abs/quant-ph/0412179>

Book Chapters

2021

Quantum entanglement, In *World Book Student* (World Book, 2021).
Published Version: <https://worldbookonline.com/student-new/#/article/home/757992>

2019

Against Fundamentalism, in *What is Fundamental?*, A. Aguirre, B. Foster, Z. Merali (eds.), 13-25 (Springer)
Second Prize winner in 2017 FQXi Essay Contest
Published Version: https://doi.org/10.1007/978-3-030-11301-8_3
Preprint: https://fqxi.org/data/essay-contest-files/Leifer_FQXi2017.pdf

2016

Mathematics Is Physics, in *Trick or Truth? The Mysterious Connection Between Physics and Mathematics*, A. Aguirre, B. Foster, Z. Merali (eds.), 21-40 (Springer)
Second prize winner in 2015 FQXi Essay Contest
Published Version: https://doi.org/10.1007/978-3-319-27495-9_3
Preprint: <https://arxiv.org/abs/1508.02770>

2015

"It from bit" and the quantum probability rule, in *It From Bit or Bit From It? On Physics and Information*, A. Aguirre, B. Foster, Z. Merali (eds.) 5-22 (Springer)
First prize winner in 2013 FQXi Essay Contest
Published Version: <https://doi.org/10.1007/978-3-319-12946-4>
Preprint: <https://arxiv.org/abs/1311.0857>

Preprints

2023

With D. Schmid, Y. Ying, **A review and analysis of six extended Wigner's friend arguments**. Submitted to *Quantum*.
Preprint: <https://arxiv.org/abs/2308.16220>

2022

With C. Duarte, **Generalizing Aumann's Agreement Theorem**.
Preprint: <https://arxiv.org/abs/2202.02156>
With L. Catani, D. Schmid, R. Spekkens, **Reply to "Comment on 'Why interference phenomena do not capture the essence of quantum theory' "**.
Preprint: <https://arxiv.org/abs/2207.11791>

2020

With C. Duarte, B. Amaral, M. Terra Cunha, **Investigating Coarse-Grainings and Emergent Quantum Dynamics with Four Mathematical Perspectives**
Preprint: <https://arxiv.org/abs/2011.10349>

2017

Time Symmetric Quantum Theory Without Retrocausality? A Reply to Tim Maudlin

Preprint: <https://arxiv.org/abs/1708.04364>

2015

with T. Fritz, **Plausibility measures on test spaces**

Preprint <https://arxiv.org/abs/1505.01151>

2006

with H. Barnum, J. Barrett, A. Wilce, **Cloning and Broadcasting in Generic Probabilistic Theories**

Preprint <https://arxiv.org/abs/quant-ph/0611295>

2005

Nondeterministic Testing of Sequential Quantum Logic Propositions on a Quantum Computer

Preprint <https://arxiv.org/abs/quant-ph/0509193>

Book Reviews

2019

Something Deeply Hidden: Quantum Worlds and the Emergence of Spacetime by Sean Carroll, *Physics Today* 72 (12) 56

Published Version: <https://doi.org/10.1063/PT.3.4366>

2017

QBism: The Future of Quantum Physics by Hans Christian von Baeyer, *Physics in Perspective* 19 76-83

Published Version: <https://doi.org/10.1007/s00016-017-0196-5>

Chapman Digital Commons: https://digitalcommons.chapman.edu/scs_articles/561/

2016

Einstein and the Quantum: The Quest of the Valiant Swabian by A. Douglas Stone, *Spontaneous Generations* 8 (1) 105-108

Published Version: <https://doi.org/10.4245/sponge.v8i1.20940>

2013

Computing With Quantum Cats: From Colossus To Qubits by John Gribbin and Schrödinger's Killer App: Race To Build The World's First Quantum Computer by Jonathan Dowling, *The Quantum Times (Newsletter of the APS Topical Group on Quantum Information)* 7 (2) 8-10

Published Version: <https://www.aps.org/units/dqi/newsletters/upload/vol7num2.pdf>

2012

The Mathematical Language of Quantum Theory: From Uncertainty to Entanglement by Teiko Heinosaari and Mario Ziman, *The Quantum Times (Newsletter of the APS Topical Group on Quantum Information)* 7 (1) 11-13

Published Version: <https://www.aps.org/units/dqi/newsletters/upload/vol7num1.pdf>

Elegance and Enigma: The Quantum Interviews by Maximilian Schlosshauer, *American Journal of Physics* 80 (3) 266

Published Version: <https://doi.org/10.1119/1.3663268>

Chapman Digital Commons: https://digitalcommons.chapman.edu/scs_articles/560/

Newsletter Articles

2017

Gamifying Quantum Theory, *The Quantum Times (Newsletter of the APS Topical Group on Quantum Information)*

Published Version: <http://thequantumtimes.org/2017/03/gamifying-quantum-theory/>

2013

Point-Counterpoint: Can anything be learned from surveys on the interpretations of quantum mechanics? *The Quantum Times* (Newsletter of the APS Topical Group on Quantum Information) 7 (2) 4-6

Published Version: <https://www.aps.org/units/dqi/newsletters/upload/vol7num2.pdf>

2012

Response to Griffiths, *The Quantum Times* (Newsletter of the APS Topical Group on Quantum Information) 6 (4) 6

Published Version: <https://www.aps.org/units/dqi/newsletters/upload/vol6num4.pdf>

PBR, EPR, and all that jazz, *The Quantum Times* (Newsletter of the APS Topical Group on Quantum Information) 6 (3) 1-3

Published Version: <https://www.aps.org/units/dqi/newsletters/upload/vol6num3.pdf>

MEDIA AND OUTREACH

Public Lecture Series Organized

Institute for Quantum Studies Public Lectures – January 2019 – August 2021

URL: <https://www.chapman.edu/research/institutes-and-centers/quantum-studies/conferences-and-events.aspx>

Public Lectures

2022

October 13: Does Quantum Mechanics Violate Einstein's Speed Limit?, Institute for Quantum Studies Public Lecture, Chapman University, USA

Video: https://youtu.be/Rdl_7zL7KHs

2018

September 17: Quantum Entanglement: Does Physics Have a Speed Limit?, Science on Tab, Chapman University, USA

Video: <https://youtu.be/ERaF-MDDL4A>

Media Appearances

2024

July 2024: Guest on Debates in Science podcast. Interviewed by Ding Jia and debated with Markus Müller on the nature of reality described by quantum theory

URL: <https://youtube.com/playlist?list=PLXVxuzPeY8z6PPBOfg1qRXC2Nz04sf47a&si=A3bPKjdV-Wo7OKAg>

2021

March 24: The Disordered Cosmos, Institute for Quantum Studies Online Discussion, me interviewing Chanda Prescod Weinstein

URL: <https://youtu.be/yRBFzll8Nbo>

February 17: Quantum Cause and Effect, Institute for Quantum Studies Online Discussion, me interviewing Rob Spekkens

URL: <https://youtu.be/xHGgxGouccE>

2020

October 21: Quantum Mechanics and Nonlocality, Institute for Quantum Studies Online Discussion, me interviewing Travis Norsen

URL: https://youtu.be/5L_kJH9v5v4

September 16: The Many Worlds of Quantum Mechanics, Institute for Quantum Studies Online Discussion, me interviewing Sean Carroll

URL: <https://youtu.be/vZc1YQ19GSA>

May 6: Quantum Mechanics, Quantum Theory and Embracing Uncertainty, The Bus Driver Experience podcast hosted by Brandon Reese

URL: <https://shows.acast.com/the-bus-driver-experience/episodes/matt-leifer-quantum-mechanics-ep-25>

2017

November 24: Emergent Quantum Mechanics – Special Edition, FQXi podcast hosted by Zeeya Merali and Brandan Foster
URL: <https://fqxi.org/community/podcast/2017.11.24>

2016

August 20: Dirty Secrets of Quantum Foundations, FQXi podcast hosted by Zeeya Merali and Brendan Foster
URL: <https://fqxi.org/community/podcast/2016.08.20.1>

2015

June 17: Talking About How To Talk About Physics, FQXi Podcast presented by Brendan Foster
URL: <http://fqxi.org/community/podcast/2015.06.17>

2014

June 30: Why Is Nature Quantum?, FQXi Podcast interview with Colin Stuart
URL: <http://fqxi.org/community/podcast/2014.06.30>

Articles About My Work

2023

April 29: The nature of a proof, Views Column in New Scientist by Chanda Prescod-Weinstein
URL: <https://www.newscientist.com/article/mg25834360-700-how-can-we-prove-the-world-is-really-quantum-mechanical/>

2018

February 17: When the Future Comes Before the Past, cover story of New Scientist by Adam Becker
URL: <https://www.newscientist.com/article/mg23731652-800-quantum-time-machine-how-the-future-can-change-what-happens-now/>

2017

July 10: Basic Assumptions of Physics Might Require the Future to Influence the Past, Gizmodo article by Ryan F. Mandelbaum
URL: <https://gizmodo.com/basic-assumptions-of-physics-might-require-the-future-t-1796730487>

July 5: Physicists provide support for retrocausal quantum theory, in which the future influences the past, phys.org article by Lisa Zyga
URL: <https://phys.org/news/2017-07-physicists-retrocausal-quantum-theory-future.html>

2014

June 17: Why Quantum?, FQXi article by Colin Stuart
URL: <https://fqxi.org/community/articles/display/190>

2007

October 5: Talking Heads, FQXi article by Kate Becker
URL: http://fqxi.org/data/articles/Leifer_Matthew.pdf

Articles In Which I Am Quoted

2019

July 31: To understand reality, we first need to find our place in it, New Scientist article by Richard Webb
URL: <https://www.newscientist.com/article/mg24332412-700-to-understand-reality-we-first-need-to-find-our-place-in-it/>

2018

December 3: New Quantum Paradox Clarifies Where Our Views of Reality Go Wrong, Quanta article by Anil Ananthaswamy
URL: <https://www.quantamagazine.org/frauchiger-renner-paradox-clarifies-where-our-views-of-reality-go-wrong-20181203/>

September 18: Reimagining of Schrödinger's cat breaks quantum mechanics – and stumps physicists, Nature News article by Davide Castelvecchi

URL: <https://www.nature.com/articles/d41586-018-06749-8>

2017

July 11: Scientists 'Teleport' a Particle Hundreds of Miles – But What Does That Mean?, Gizmodo article by Ryan F. Mandelbaum

URL: <https://gizmodo.com/scientists-teleport-a-particle-hundreds-of-miles-but-w-1796818859>

2016

September 29: There may be more than one of you, Plus Magazine article by Marianne Freiberger

URL: <https://plus.maths.org/content/more-than-one>

July 13: Collapse: Has quantum theory's greatest mystery been solved?, New Scientist article by John Cartwright

URL: <https://www.newscientist.com/article/mg23130820-200-collapse-has-quantum-theorys-greatest-mystery-been-solved/>

2015

August 29: The Race to Prove 'Spooky' Quantum Connection May Have a Winner, Popular Science article by Devin Powell

URL: <http://www.popsoci.com/race-prove-spooky-quantum-connection-may-have-winner>

August 28: New experiment verifies quantum spookiness, Science News article by Andrew Grant

URL: <https://www.sciencenews.org/article/new-experiment-verifies-quantum-spookiness>

August 27: Quantum 'spookiness' passes toughest test yet, Nature News article by Zeeya Merali

URL: <http://www.nature.com/news/quantum-spookiness-passes-toughest-test-yet-1.18255>

May 20: The Quantum Thermodynamic Revolution, FQXi article by Colin Stuart

URL: <http://fqxi.org/community/articles/display/202>

February 7: Wave function gets real in quantum experiment, New Scientist article by Michael Slezak

URL: <https://www.newscientist.com/article/mg22530075-000-wave-function-gets-real-in-quantum-experiment/>

2014

January 30: The Quantum Mechanics of Fate, Nautilus article by George Musser

URL: <http://nautil.us/issue/9/time/the-quantum-mechanics-of-fate>

January 25: From I to u: Searching for the quantum master bit, New Scientist article by Matthew Chalmers

URL: <https://www.newscientist.com/article/mg22129530-700-from-i-to-u-searching-for-the-quantum-master-bit/>

2012

November: Preprint policies sow confusion, APS News article by Brian Jacobsmeier

URL: <http://www.aps.org/publications/apsnews/201211/preprint.cfm>

October 16: Cheating the Causal Game, FQXi article by Sophie Hebden

URL: <http://fqxi.org/community/articles/display/173>

August 6: Time to go Retro, FQXi article by Graeme Stemp-Morlock

URL: <http://fqxi.org/community/articles/display/170>

May 8: A boost for quantum reality, Nature article by Eugenie Samuel Reich

URL: <http://www.nature.com/news/a-boost-for-quantum-reality-1.10602>

Social Media

Twitter: @mattleifer Joined April 2008, 2,600 followers on August 9, 2024

I blog at <https://mattleifer.info> Although mostly defunct, some previous posts still generate a lot of views. Most popular blog posts:

November 20, 2011: Can the quantum state be interpreted statistically?

URL: <https://mattleifer.info/2011/11/20/can-the-quantum-state-be-interpreted-statistically/>

August 1, 2011: The Choi-Jamiolkowski Isomorphism: You're Doing It Wrong!

URL: <https://mattleifer.info/2011/08/01/the-choi-jamiolkowski-isomorphism-youre-doing-it-wrong/>

TALKS AND POSTER PRESENTATIONS

Panel Discussions

2019

July 23: Can Quantum Theory Consistently Describe Itself?, FQXi Conference: Mind Matters: Intelligence and Agency in the Physical World, Castelvecchio Pascoli, Italy

Meeting URL: <https://fqxi.org/conference/home/2019>

2018

June 1: Is quantum mechanics or general relativity more fundamental. California Quantum Interpretation Network (CQIN) Meeting, Lake Arrowhead, California, USA

Meeting URL: <https://sites.google.com/site/californiaquantum/home/may-2018-meeting>

Video: <https://youtu.be/gOGfvwt3H74>

2016

November 14: Creativity in Art and Science. Chapman University, USA. Nov. 14

Meeting URL: <http://www1.chapman.edu/library/aboutus/events%2020161108%20Creativity%20in%20Art%20and%20Science.pdf>

2015

May 16: Prospects and limitations of information theoretic approaches. Information Theoretic Foundations for Physics, Perimeter Institute, Canada

Meeting URL: <https://perimeterinstitute.ca/conferences/information-theoretic-foundations-physics>

April 25: Seeing Without Looking: How to Teach Physics Foundations. New Directions in the Foundations of Physics. Washington DC, USA

Meeting URL: <http://carnap.umd.edu/philphysics/newdirections15.html>

Audio: <https://fqxi.org/community/podcast/2015.06.17>

Invited Talks at Conferences and Workshops

2024

February 16: The Second Quantum Physics Revolution. UM6P Science Week, Polytechnic University Mohammed 6, Benguerir, Morocco

Video: <https://www.youtube.com/live/aUke2GmSwwA?si=giekSiQNNUX7gP28&t=7571>

February 2: On the Utility of Philosophy in Quantum Mechanics. Is Philosophy Useful for Science and/or Vice Versa?, Chapman University, California, USA

Meeting URL: <https://www.chapman.edu/scst/conferences-and-events/conferences/philosophy-science-conference.aspx>

Video: https://youtu.be/VioEoIVCDUU?si=ay9m1tao4PXx_s1o

2023

April 29: What Is Nonclassical About Quantum Interference (and Interaction Free Measurement)?, 30 Years of Interaction Free Measurement, Chapman University, California, USA

Video: <https://youtu.be/NTgDuMC62Yo?si=vUYBIHgulOEc-ik1>

2021

September 25: A "Natural" Ψ -Epistemic Explanation of Quantum Interference. California Quantum Interpretations Network Meeting, Lake Arrowhead, California, USA

September 9: What is Nonclassical About Quantum Interference?, Vienna Quantum Foundations Conference, Vienna, Austria

Meeting URL: <https://vqf.iqoqi.oeaw.ac.at/>

2020

October 22: Block Universe Ontological Models: A Framework for Realist Theories Incorporating Retrocausality, Mini-Workshop on Causation, Harvard/Online, USA
Meeting URL: <https://harvardfop.jacobbarandes.com/20201022c>

July 23: Uncertainty from the Aharonov-Vaidman Identity, First IQS Online Workshop, Chapman University/Online, USA
Meeting URL: <https://iqs.mattleifer.info>

2019

March 9: What Are Copenhagenish Interpretations and Should they be Perspectival?, Encapsulated Agents in Quantum Theory: Re-examining Wigner's Friend, Boston, Massachusetts, USA
Meeting URL: <https://wigner.mattleifer.info/>

2018

August 1: Measures of Preparation Contextuality, Foundations of Quantum Mechanics, Perimeter Institute, Canada
Meeting URL: <https://perimeterinstitute.ca/conferences/foundations-quantum-mechanics>
Video: <http://pirsa.org/18080032/>

February 18: What's Weird About Quantum Mechanics? Renaissance Weekend, Santa Monica, California, USA
Meeting URL: <https://www.renaissanceweekend.org/>

January 8: On the Role of the Reversible Observer in Thermodynamics, Hong Kong Workshop on Quantum Information and Foundations, Hong Kong, China
Meeting URL: <http://qsit2.weebly.com/>

2017

October 26: The Problem of Fine-Tuning in Quantum Theory, Emergent Quantum Mechanics 2017, London, UK
Meeting URL: <http://emqm17.org>
Video: <http://emqm17.org/presentations/matthew-leifer/>

September 23: The Ironic Many-Worlds Interpretation of Quantum Theory, California Quantum Interpretation Network (CQIN)
Meeting, Lake Arrowhead, California, USA
Meeting URL: <https://sites.google.com/site/californiaquantum/home/september-2017-meeting>

July 25: Aharonov vs. Spekkens Round II: Contextuality in Pre- and Post-Selection Paradoxes, Contextuality: Conceptual Issues, Operational Signatures, and Applications, Perimeter Institute, Canada
Meeting URL: **Error! Hyperlink reference not valid.**
Video: <http://pirsa.org/17070041/>

2016

August 18: Dirty secrets of quantum foundations, 5th International FQXi Conference, Banff, Canada
Meeting URL: <https://fqxi.org/conference/2016>
Video: <https://youtu.be/MaRiP5HovR4>
Audio: <https://fqxi.org/community/podcast/2016.08.20.1>
Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2009/04/FQXi20160818.pdf>

June 22: Does time-symmetry in quantum theory imply retrocausality? Concepts and Paradoxes in a Quantum Universe, Perimeter Institute, Canada
Meeting URL: <http://perimeterinstitute.ca/conferences/concepts-and-paradoxes-quantum-universe>
Video: <http://pirsa.org/16060059/>
Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2016/08/ConceptsParadoxes20160622.pdf>

2015

November 9 – November 13: Informal talks on Spekkens contextuality, interpretations of quantum theory, and the reality of the quantum state, Workshop on Quantum Correlations, Contextuality and All That, Natal, Brazil
Meeting URL: <http://personal.us.es/adan/natal15.htm>

October 23: The reality of the quantum state from Kochen-Specker contextuality, Emergent Quantum Mechanics, Vienna, Austria

Meeting URL: <http://www.emqm15.org/>

Video: <https://www.fetzer-franklin-fund.org/media/emqm15-reality-quantum-state-kochen-specker-contextuality-3/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/12/EmQM15.pdf>

June 24: Aharonov meets Spekkens: What do quantum paradoxes tell us about the nature of reality?, Convergence (Quantum Foundations Workshop), Perimeter Institute, Canada

Meeting URL: <https://perimeterinstitute.ca/research/conferences/convergence>

Video: <http://pirsa.org/15060036/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/08/Convergence2015.pdf>

2014

July 3: Ontological Models in the Block Universe, Free Will and Retrocausality in the Quantum World, Cambridge, UK. July 3

Meeting URL: http://prce.hu/centre_for_time/itf/retro.html

Video: <https://youtu.be/tp-jNOKbl4>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/CambridgeRetro2014.pdf>

June 24: Is the Quantum State Real? 12th Biennial IQSA Meeting, Olomouc, Czech Republic

Meeting URL: <http://ameql.math.muni.cz/iqsa2014/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/IQSA2014Talk.pdf>

March 22: Ontic versus Epistemic Interpretations of the Wave Function, Information and Interaction: Eddington, Wheeler, and the Limits of Knowledge, Cambridge, UK

Meeting URL: <https://informationandinteraction.wordpress.com/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/EddingtonFest2014.pdf>

March 6: Bounds on Epistemic Interpretations of the Quantum State from Contextuality, APS March Meeting, Denver, USA

Meeting URL: <http://meetings.aps.org/Meeting/MAR14/>

Slides: <https://absuploads.aps.org/presentation.cfm?pid=10881>

2011

June 23: Formulating Quantum Theory as a Causally Neutral Theory of Bayesian Inference, ColLoQul (Colleges of London Quantum Information Meeting), Royal Holloway, University of London, UK

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/ColloQui20110623.pdf>

2010

August 18: The Two Churches of Quantum Theory, Pictures, Quanta, Probability, Oxford, UK

Meeting URL: <http://www.cs.ox.ac.uk/people/bob.coecke/PQP.html>

2007

December 18: Unentangled Bit Commitment and the Clifton-Bub-Halvorson (CBH) Theorem, Mini-Workshop on Quantum Foils, Pavia, Italy

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/PaviaDec2007.pdf>

December 10: Quantum Causal Networks: A Quantum Informationish Approach to Causality in Quantum Theory, Quantum Information Theory in Quantum Gravity, Perimeter Institute, Canada

Meeting URL: <http://www.perimeterinstitute.ca/conferences/quantum-information-quantum-gravity>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/PIQIQGDec07.pdf>

July 6: Open Questions in Ontological Models, Operational Probabilistic Theories as Foils to Quantum Theory, Cambridge, UK

June 4: Separations of Generalized Probabilistic Theories via their Information Processing Capabilities, Operational Quantum Physics and the Quantum-Classical Contrast, Perimeter Institute, Canada

Meeting URL: <https://www.perimeterinstitute.ca/video-library/collection/operational-quantum-physics-and-quantum-classical-contrast-2007>

Video: <http://pirsa.org/07060033/>

Slides: <https://www.perimeterinstitute.ca/video-library/collection/operational-quantum-physics-and-quantum-classical-contrast-2007>

2006

June 8: Quantum Dynamics as Generalized Conditional Probabilities, Foundations of Physics and Probability 4, Växjö, Sweden
Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/Vaxjo200606.pdf>

2005

August: Quantum Analogs of Bayes' Rule, Being Bayesian in a Quantum World, Konstanz, Germany

July 19: Nondeterministic Testing of Sequential Quantum Logic Propositions on a Quantum Computer, Quantum Information, Computation and Logic: Exploring New Connections, Perimeter Institute, Canada

Meeting URL: <http://www.perimeterinstitute.ca/conferences/quantum-information-computation-and-logic-exploring-new-connections>

Video: <http://pirsa.org/05070102/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/SQLQICL.pdf.pdf>

2003

July 2003: Measuring Polynomial Invariants of Multi-Party Quantum States, QuICT Network Meeting, Abingdon, UK

Invited Commentaries at Conferences and Workshops

2016

June 11: Commentary on Jeffrey Bub: Yes! We have no bananas, Information-Theoretic Interpretations of Quantum Mechanics, University of Western Ontario, Canada

Meeting URL: <http://www.rotman.uwo.ca/event/information-theoretic-interpretations-quantum-mechanics-2016-annual-philosophy-physics-conference/>

Video: <https://youtu.be/x2HYO86a1gQ>

Contributed Talks at Conferences, Workshops and Summer Schools

2021

March 19: Block Universe Ontological Models: A Framework for Realist Accounts of Quantum Theory That Allows for Retrocausality, APS March Meeting, Online

Meeting URL: <http://meetings.aps.org/Meeting/MAR21/Session/X33.3>

2019

March 7: Noncontextuality Inequalities from Antidistinguishability, APS March Meeting, Boston, Massachusetts, USA

Meeting URL: <http://meetings.aps.org/Meeting/MAR19/Session/V27>

2018

March 7: The Ironic Many-Worlds Interpretation of Quantum Theory, APS March Meeting, Los Angeles, California, USA

Meeting URL: <https://meetings.aps.org/Meeting/MAR18/Session/L26.4>

2016

July 17: Does time-symmetry in quantum theory imply retrocausality?, The 18th UK and European Conference on Foundations of Physics, London School of Economics, UK

Meeting URL: <http://www.lse.ac.uk/philosophy/blog/2015/10/01/foundations-2016/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2016/08/Foundations20160717.pdf>

July 13: Plausibility Measures on Test Spaces, 13th Biennial IQSA Meeting, University of Leicester, UK

Meeting URL: <http://physics.le.ac.uk/iqsa2016/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2016/08/IQSA20160713.pdf>

2015

August 21: Logical pre- and post-selection paradoxes are proofs of contextuality, Conference on Quantum Information and Quantum Control, Fields Institute, Toronto, Canada

Meeting URL: <http://www.fields.utoronto.ca/programs/scientific/15-16/CQIQCVI/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2016/08/CQIQ2015.pdf>

March 4: Does protective measurement imply the reality of the quantum state? APS March Meeting, San Antonio, USA

Meeting URL: <http://meetings.aps.org/Meeting/MAR15/Session/M38.7>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/08/APS2015.pdf>

2007

March 5: Cloning, Broadcasting and the de Finetti theorem in Generalized Probabilistic Theories, APS March Meeting, Denver, USA

Meeting URL: <http://meetings.aps.org/Meeting/MAR07/Session/B33.2>

February 12: Conditional Density Operators in Quantum Information, Operator Structures in Quantum Information, Banff, Canada

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/Banff200702.pdf>

2006

July 21: Quantum Causal Networks, Cats, Kets and Cloisters. Oxford, UK

Meeting URL: <http://www.cs.ox.ac.uk/people/bob.coecke/CKC.html>

July 13: Quantum Dynamics as Generalized Conditional Probabilities, 8th Biennial IQSA Meeting, Malta

Meeting URL: <http://www.mat.savba.sk/qs06/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/QS200607.pdf>

March 13: Entanglement of Overlapping Systems and the Breakdown of the Tensor Product, APS March Meeting, Baltimore, USA

Meeting URL: <http://meetings.aps.org/Meeting/MAR06/Content/346>

2005

August: Quantum Analogs of Bayes' Rule, Summer School on Philosophy, Probability and Physics, Konstanz, Germany

2004

July: Logical Pre- and Post-Selection Paradoxes, Measurement-Disturbance, and Contextuality, 7th Biennial

IQSA Meeting, Denver, USA

2003

July 17: Measuring Polynomial Invariants of Multi-Party Quantum States, 4th European QIPC Workshop, Oxford, UK

Meeting URL: http://www.quiprocone.org/Oxford/4th_Keble.htm

2002

September: Optimal Entanglement Generation from Quantum Operations, Informal Quantum Information Gathering, Imperial College, London, UK

2001

March: Multi-particle Entanglement in Quantum States and Evolutions, Winter School on "QuEnt" Quantum Entanglement and Quantum Information, Les Houches, France

Poster Presentations at Conferences and Workshops

2015

July 15: Plausibility Measures on Test Spaces, Quantum Physics and Logic, Oxford, UK

Meeting URL: <http://www.cs.ox.ac.uk/qpl2015/>

Poster: <http://mattleifer.info/wordpress/wp-content/uploads/2015/08/QPL2015Poster.pdf>

2014

June 19: Psi-Epistemic Models are Exponentially Bad at Explaining the Distinguishability of Quantum States, Quantum Unspeakeables II: 50 Years of Bell's Theorem, Vienna, Austria

Meeting URL: <https://bellconference2014.univie.ac.at/>

Poster: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/exp-epistemic-poster.pdf>

2004

July: Pre- and Post-Selection Paradoxes and Contextuality in Quantum Mechanics, The 7th International Conference on Quantum Communication, Measurement and Computing, Glasgow, UK

July: Quantum Contextuality and the ABL rule for pre- and post-selected systems, Reference Frames and Superselection Rules in Quantum Information Theory. Perimeter Institute, Canada
Meeting URL: <https://www.perimeterinstitute.ca/conferences/workshop-reference-frames-and-superselection-rules-quantum-information-theory>

2003

August: Measuring Polynomial Invariants of Multi-Party Quantum States, MaPhySto/QUANTOP Workshop on Quantum Measurements and Quantum Stochastics, Aarhus, Denmark
Meeting URL: <http://www.maphysto.dk/events2/QPFA2003/>

2002

July: Optimal Entanglement Generation from Quantum Operations, The Sixth International Conference on Quantum Communication, Measurement and Computing, MIT, Cambridge, USA

July: Optimal Entanglement Generation from Quantum Operations, Quantum Information: Conceptual Foundations, Developments and Perspectives, Oviedo, Spain

2001

September: Simulation of 2-qubit Hamiltonians using General Local Operations, London Mathematical Society Regional Meeting, University of Bristol, UK

Seminars

2024

February 28: Contextuality in Quantum Interferometry, Institute for Quantum Studies Seminar, Chapman University, USA
Video: https://youtu.be/TNhBJUBGk9c?si=ZjL_6b29J1GnDj_U

2023

November 8: Who's Afraid of Quantum Interference? Schmid College Science Forum, Chapman University, USA

October 13: What do Extended Wigner's Friend arguments tell us about Copenhagenish Interpretations of Quantum Mechanics? Math, Physics, Philosophy Seminar, Chapman University, USA

2021

August 11: An Update on Ψ -ontology, Quantum Seminar, University of Sao Paulo, Brazil

2020

October 12: Block Universe Ontological Models: A Framework for Realist Theories Incorporating Retrocausality, Quantum Group Meeting, Chapman University/Online, USA

2018

September 27: Fine Tunings and the Nature of Quantum Reality, Math, Physics, and Computation Seminar, Chapman University, USA

2016

November 10: Plausibility Measures on Test Spaces, Math, Physics, and Computation Seminar, Chapman University, USA

June 17: Everything you wanted to know about the reality of the quantum state, but were afraid to ask Matt Pusey, Quantum Foundations Seminar, Perimeter Institute, Canada
Video: <http://pirsa.org/16060104/>

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2016/08/PIQF20160617.pdf>

March 5: Does time-symmetry in quantum theory imply retrocausality?, Southern California Philosophy of Physics Reading Group, UC Irvine, USA

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2016/08/SoCalPhil20160305.pdf>

February 4: Does time-symmetry in quantum theory imply retrocausality?, Quantum Group Meeting, Chapman University, USA

2015

October 29: Bounds on psi-epistemic explanations of quantum indistinguishability from noncontextuality inequalities.

Quantum Seminar, University of Oxford, UK

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/12/Oxford20151029.pdf>

October 22: Plausibility Measures on Test Spaces. Quantum Foundations Seminar, University of Vienna, Austria

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/12/Vienna20151022.pdf>

October 19: Bounds on psi-epistemic explanations of quantum indistinguishability from noncontextuality inequalities.

Quantum Information Seminar, University College London, UK

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/12/UCL20151019.pdf>

October 15: Aharonov Meets Spekkens: What do quantum paradoxes tell us about the nature of reality?, Quantum Information and Foundations Seminar, University of Cambridge, UK

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/12/Cambridge20151015.pdf>

October 14: Probabilities in quantum theory and beyond. Quantum Information group meeting, Imperial College, London, UK

January 28: What Are Quantum States?, Math, Physics and Computation Seminar, Chapman University, USA

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/08/chapman-research.pdf>

2014

December 10: 2 out of 3 Roads to Quantum Foundations. Quantum Foundations Seminar, IQOQI Vienna, Austria

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2015/08/Vienna-talk.pdf>

June 4: A Survey of Quantum Conditional States and their Applications. Applied Mathematics Seminar, University of Western Ontario, Canada

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/UWO-math-talk.pdf>

June 3: Is the Wavefunction Real?, Philosophy of Physics Seminar, University of Western Ontario, Canada

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/UWO-philo-talk1.pdf>

April 3: ψ -Epistemic Models are Exponentially Bad at Explaining the Distinguishability of Quantum States. Theoretical Physics Seminar, Imperial College, UK

April 2: Is the Wavefunction Real?, Philosophy of Physics Seminar, University of Bristol, UK

February 18: Psi-Epistemic Models are Exponentially Bad at Explaining the Distinguishability of Quantum States. Quantum Foundations Seminar, Perimeter Institute, Canada

Video: <http://pirsa.org/14020145/>

2011

October 20: Quantum Theory as a Causally Neutral Theory of Bayesian Inference. Philosophy of Physics Seminar, Oxford University, UK

May 26: Quantum Conditional States, Bayes' Rule and Quantum Pooling. Quantum Foundations Seminar, University of Toronto, Canada

May 17: Quantum Conditional States, Bayes' Rule and Quantum Pooling. Quantum Foundations Seminar, Perimeter Institute, Canada

Video: <http://pirsa.org/11050023/>

May 6: Quantum Conditional States, Bayes' Rule, and State Compatibility. Quantum Information Seminar, University of Sherbrooke, Canada

April 5: Quantum Conditional States, Bayes' Rule, and State Compatibility, Institute for Quantum Computing Seminar, University of Waterloo, Canada

March 3: Quantum Conditional States, Bayes' Rule, and State Compatibility, Centre for Quantum Information and Foundations Seminar, University of Cambridge, UK

February 3: Quantum Conditional States, Bayes' Rule, and State Compatibility, Quantum Dynamics Seminar, Royal Holloway, UK

2010

December 14: Quantum Conditional States, Bayes' Rule, and State Compatibility, Quantum Information Seminar, Imperial College, UK

2007

February 20: Cloning and Broadcasting in Generalized Probabilistic Theories, Quantum Information Seminar, CalTech, USA

2006

November: Cloning and Broadcasting in Generalized Probabilistic Theories, Quantum Information Seminar, University of Cambridge, UK

November: Cloning and Broadcasting in Generalized Probabilistic Theories, Quantum Information Seminar, University of Bristol, UK

November: Cloning and Broadcasting in Generalized Probabilistic Theories, Quantum Information Seminar, Imperial College, UK

November: Cloning and Broadcasting in Generalized Probabilistic Theories, Quantum Information Seminar, Royal Holloway, UK

October: Cloning and Broadcasting in Generalized Probabilistic Theories, Quantum Information Seminar, University of Leeds, UK

September 19: Quantum Dynamics as Generalized Conditional Probabilities, Quantum Information and Geometric Statistics Seminar, University of Guelph, Canada

Slides: <http://mattleifer.info/wordpress/wp-content/uploads/2014/07/Guelph200609.pdf>

June 28: Quantum Causal Networks, PiQuDos Seminar, Perimeter Institute, Canada

Video: <http://pirsa.org/06060063/>

April: Quantum Causal Networks, Quantum Information Seminar, Los Alamos National Laboratory, USA

April: Quantum Causal Networks, Quantum Information Seminar, University of New Mexico, USA

April: Quantum Causal Networks, Institute for Quantum Computing Seminar, University of Waterloo, Canada

February: Noncommuting Subsystems and the Breakdown of the Tensor Product, Quantum Information Seminar, ERATO Tokyo, Japan

January: Is Quantum Computing Quantum Logical?, Quantum Information Seminar, Technical University of Innsbruck, Austria

January: Entanglement of Overlapping Systems and the Breakdown of the Tensor Product, Quantum Information Seminar, Imperial College, UK

January 9: Entanglement of Overlapping Systems and the Breakdown of the Tensor Product, Mathematical Physics Seminar, University of York

2005

November: What's Wrong with these Quantum Computations?, Quantum Information Seminar, University of Sydney, Australia

October: Do we Need a Logic of Quantum Computation?, Quantum Information Seminar, Griffith University, Australia

October: Do we Need a Logic of Quantum Computation?, Quantum Information Seminar, University of Queensland, Australia

April: Pre- and Post-Selection Paradoxes, Measurement-Disturbance and Contextuality in Quantum Mechanics, Quantum Information Seminar, Bell Labs, USA

2004

November 10: Pre- and Post-Selection Paradoxes, Measurement-Disturbance and Contextuality in Quantum Mechanics",
PiQuDos Seminar, Perimeter Institute, Canada
Video: <http://pirsa.org/04110008/>

2003

January: Measuring Polynomial Invariants of Multi-Party Quantum States, PiQuDos Seminar, Perimeter Institute, Canada

2002

August: Optimal Entanglement Generation from Quantum Operations, Quantum Information Seminar, University of Bristol, UK

2001

January: Multi-particle Entanglement in Quantum States and Evolutions, Applied Mathematics Seminar, University of Bristol, UK