

Erez Zohar

Curriculum Vitae

June 2017

Personal Details

Date of birth: 31.12.1984
Country of birth: Israel
Nationality: Israeli
Address: Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, Garching 85748, Germany

Higher Education

10/2006 – 7/2009 **B.Sc., The combined Mathematics-Physics Program**
School of Physics and Astronomy, Tel Aviv University

Final grade – 91 (Magna cum laude)

During the 3rd year – a research project under the supervision of Prof. Yoram Dagan (honors program)

10/2009 – 9/2010 **M.Sc., Physics**
School of Physics and Astronomy, Tel Aviv University

Supervisor: Prof. Benni Reznik

Courses average - 94.56

- Moved to the Ph.D. Direct Track

10/2010 – 12/2013 **Ph.D. (Direct Track), Physics**
School of Physics and Astronomy, Tel Aviv University

Supervisor: Prof. Benni Reznik

Courses average: 99.5

Employment

2007 – 2010

Teaching assistant (Homework grader)

School of Physics and Astronomy, Tel Aviv University

In the courses:

1. Physics 1 for engineering students (spring 2007-8)
2. Waves, Light and Optics (fall 2008-9)
3. Quantum Mechanics 2 (fall 2009-10)
4. General Physics A1 for chemistry students (fall 2009-10)
5. Introductory Mathematics for Physicists 2 (spring 2009-10)
6. Computers for Physicists (spring 2009-10)

2010 – 2014

Teaching assistant (Tutor – exercise classes)

School of Physics and Astronomy, Tel Aviv University

In the courses:

1. Analytical Mechanics (fall 2011-12,2012-13,2013-14) – teacher: Prof. Marek Karliner
2. Classical Physics 2 (spring 2011-12,2012-13) – teacher: Prof. Yoram Dagan
3. Waves, Light and Optics (substitute teaching assistant, fall 2011-12) – teacher: Prof. Ron Lifshitz
4. General Physics B for chemistry students (fall 2010-11,2011-12) – teacher: Dr. Gideon Bella
5. General Physics 1 for engineering students (spring 2010-11,2011-12) – teacher: Prof. Roy Beck-Barkai

3/2014 –

Postdoctoral Researcher

Max-Planck-Institut für Quantenoptik

Theory Division, headed by Prof. J. Ignacio Cirac

Garching bei München, Germany

(as an Alexander-von-Humboldt fellow between 6/2014-5/2016)

Research Grants and Fellowships

- 2011-2012 **Dean's Excellence Scholarship**
Faculty of Exact Sciences, Tel-Aviv University, for the academic year 2011-12.
- 10/2012-3/2014 **Adams Fellowship**
Granted by the Israel Academy of Sciences and Humanities, from 10/2012 until the end of the PhD studies (given every year to new 10-12 second/third year PhD students, nominated by the universities, for the rest of the PhD period)
- 6/2014-5/2016 **Alexander von Humboldt fellowship for postdoctoral researchers**
Granted by the Alexander von Humboldt society, for postdoctoral research in Max Planck institute for quantum optics, 6/2014-5/2016.

Prizes and Awards

- 2011** **Shulamit Goldhaber Research Excellence Prize**
School of physics and Astronomy, Tel Aviv University
- 2012** **Anne and Maurice Cohen Teaching Excellence Prize**
School of physics and Astronomy, Tel Aviv University
- 2012** **Alix De Rothschild Fund for Scholarships in Science and
Technology**
Research prize for 2011-2012
- 2013** **The Rector's List of Best Teaching Assistants, Tel Aviv
University**
For the academic year 2011-2012
- 2013** **Anne and Maurice Cohen Research Excellence Prize**
School of physics and Astronomy, Tel Aviv University
- 2013** **The Rector's List of Best Teaching Assistants, Tel Aviv
University**
For the academic year 2012-2013
- 2014** **The Rector's Award for Excellence in Teaching, Tel Aviv
University**
For the academic year 2012-2013
- 2014** **The Rector's List of Best Teaching Assistants, Tel Aviv
University**
For the academic year 2013-2014

Supervision of students

2015-2016

Daniel González Cuadra

Master Student at MPQ

Co-supervision with J. I. Cirac

Academic year 2015-2016

Thesis title: Quantum Simulation of Abelian Lattice Gauge Theories with Ultracold Atoms

Grade: 1.0 (highest)

Starting his PhD in the Lewenstein group, ICFO, Spain

2016-2017

Ilya Kull

Master Student at MPQ

Co-supervision with J. I. Cirac

Academic year 2016-2017 (currently)

2016-2017

Julian Bender

Master Student at MPQ

Co-supervision with J. I. Cirac

Academic year 2016-2017 (currently)

Other academic work

- Has served as a referee for
 - Nature
 - Physical Review Letters
 - Physical Review X
 - Physical Review A
 - New Journal of Physics
 - Journal of High Energy Physics
 - Annals of Physics
 - Physics Letters B

- Conference organization:
 - MPQ Theory Group Workshop, Lenggries, Germany, June 2017

List of Publications

- 1. Anomalous enhancement of the superconducting transition temperature of electron-doped $\text{La}_{2-x}\text{Ce}_x\text{CuO}_4$ and $\text{Pr}_{2-x}\text{Ce}_x\text{CuO}_4$ cuprate heterostructures**
K. Jin, P. Bach, X. H. Zhang, U. Grupel, E. Zohar, I. Diamant, Y. Dagan, S. Smadici, P. Abbamonte, and R. L. Greene
Phys. Rev. B **83**, 060511 (2011)
- 2. The Fermi Problem in Discrete Systems**
Erez Zohar, Benni Reznik
New J. Phys. **13** (2011) 075016
- 3. Confinement and QED electric flux-tubes simulated with ultracold Atoms**
Erez Zohar, Benni Reznik
Phys. Rev. Lett. **107**, 275301 (2011)
- 4. Simulating Compact Quantum Electrodynamics with ultracold atoms: Probing confinement and nonperturbative effects**
Erez Zohar, J. Ignacio Cirac, Benni Reznik
Phys. Rev. Lett. **109**, 125302 (2012)
- 5. Simulating 2+1d Lattice QED with dynamical matter using ultracold atoms**
Erez Zohar, J. Ignacio Cirac, Benni Reznik
Phys. Rev. Lett. **110**, 055302 (2013)
- 6. Cold-atom quantum simulator for $\text{SU}(2)$ Yang-Mills lattice gauge theory**
Erez Zohar, J. Ignacio Cirac, Benni Reznik
Phys. Rev. Lett. **110**, 125304 (2013)
- 7. Topological Wilson-loop area law manifested using a superposition of loops**
Erez Zohar, Benni Reznik
New J. Phys. **15** (2013) 043041
- 8. Quantum simulations of gauge theories with ultracold atoms: local gauge invariance from angular momentum conservation**
Erez Zohar, J. Ignacio Cirac, Benni Reznik
Phys. Rev. A **88**, 023617 (2013)
- 9. Formulation of lattice gauge theories for quantum simulations**
Erez Zohar, Michele Burrello
Phys. Rev. D **91**, 054506 (2015)

10. Non-Abelian String Breaking Phenomena with Matrix Product States

Stefan Kühn, Erez Zohar, J. Ignacio Cirac, Mari Carmen Bañuls
JHEP **07**, 130 (2015).

11. Fermionic Projected Entangled Pair States and Local U(1) Gauge Theories

Erez Zohar, Michele Burrello, Thorsten B. Wahl, J. Ignacio Cirac
Ann. Phys. **363**, 385 (2015)

12. Quantum Simulations of Lattice Gauge Theories using Ultracold Atoms in Optical Lattices (A review paper)

Erez Zohar, J. Ignacio Cirac, Benni Reznik
Rep. Prog. Phys. **79** 014401 (2016)

13. Remote state preparation for quantum fields

Ran Ber, Erez Zohar
Found. Phys. **46** 7 804 (2016)

14. Building Projected Entangled Pair States with a Local Gauge Symmetry

Erez Zohar, Michele Burrello
New J. Phys. **18** 043008 (2016)

15. Quantum Simulation of fundamental physics

Erez Zohar
Nature (News and Views) **534** 480 (2016)

16. Projected Entangled Pair States with non-Abelian gauge symmetries: an SU(2) study

Erez Zohar, Thorsten B. Wahl, Michele Burrello, J. Ignacio Cirac
Ann. Phys. **374**, 84 (2016)

17. Half a state, half an operator: a general formulation of stators

Erez Zohar
J. Phys. A: Math. Theor. **50**, 085301 (2017)

18. Digital lattice gauge theories

Erez Zohar, Alessandro Farace, Benni Reznik, J. Ignacio Cirac
Phys. Rev. A **95**, 023604 (2017)

19. Digital quantum simulation of Z_2 lattice gauge theories with dynamical fermionic matter

Erez Zohar, Alessandro Farace, Benni Reznik, J. Ignacio Cirac
Phys. Rev. Lett. **118**, 070501 (2017)

20. Quantum Simulation of the Abelian-Higgs Lattice Gauge Theory with Ultracold Atoms

Daniel González-Cuadra, Erez Zohar, J. Ignacio Cirac
Preprint arXiv:1702.05492, accepted to New J. Phys.

Talks in Conferences

- 10/2012 **Workshop on Quantum Simulations**
UPV/EHU, Bilbao, Spain
- Talk: **Simulation of Dynamic Abelian and Non-Abelian Gauge Theories with Ultracold Atoms**
- 6/2013 **Relativistic Quantum Information 2013 North**
University of Nottingham, UK
- 3/2014 **COST action MP1006 on Fundamental Problems in Quantum Physics**
Weizmann Institute, Israel
- Invited Talk: **Simulation of Dynamic Abelian and Non-Abelian Gauge Theories with Ultracold Atoms**
- 11/2014 **MPQ Theory Group Workshop**
Passau, Germany
- Talk: **Formulating Lattice Gauge Theories for Tensor Networks and Quantum Simulations**
- 5/2015 **New Trends in Complex Quantum Dynamics**
Cartagena, Spain
- Talk: **Formulating Lattice Gauge Theories for Quantum Simulations**
- 6/2015 **Cold Atoms meet High Energy Physics**
ECT*, Trento, Italy
- Invited Talk: **Quantum Simulation of Lattice Gauge Theories using Ultracold Atoms**
- 7/2015 **Central European Workshop on Quantum Optics 2015**
Warsaw, Poland
- 5/2016 **MPQ Theory Group Workshop**
Oetz, Austria
- Talk: **Gauge Symmetries with Cold Atoms and PEPS**

- 6-7/2016 **Humboldt Kolleg: From the Vacuum to the Universe**
Kitzbühel, Austria

Invited Talk: **Projected entangled pair states (PEPS) and local (gauge) symmetries**
- 7/2016 **Quantum Science: Implementations 2016**
Centro de Ciencias de Benasque Pedro Pascual, Benasque, Spain

Tutorial: **Quantum Simulation of Lattice Gauge Theories: an introduction**
- 8-9/2016 **Quantum Gases and Quantum Coherence: BEC2016**
Salerno, Italy

Invited Talk: **Quantum Simulation of Lattice Gauge Theories with Ultracold Atoms in Optical Lattices**
- 9/2016 **Humboldt Colloquium – Bridges to the Future: German-Israeli Scientific Relations**
Tel Aviv University, Israel

Talk: **Gauge Theories with Tensor Networks and Ultracold Atoms**
- 12/2016 **632 Heraeus-Seminar – Gauge Field Dynamics with Ultracold Gas Systems**
Physikzentrum Bad Honnef, Germany

Invited Talk: **Quantum Simulation of Lattice Gauge Theories with Ultracold Atoms in Optical Lattices**
- 2/2017 **Quantum methods of lattice gauge theories calculations**
Schloss Waldthausen (organized by Mainz institute of theoretical physics), Germany

Talk: **Projected entangled pair states (PEPS) and local (gauge) symmetries**
- 5/2017 **New Trends in Complex Quantum Dynamics**
Cartagena, Spain

Talk: **Projected entangled pair states (PEPS) and local (gauge) symmetries**

5-6/2017 **From Static to Dynamical Gauge Fields with Ultracold Atoms**
Galileo Galilei Institute, Florence, Italy

Invited Talk: **Quantum Simulation of Lattice Gauge Theories with Ultracold Atoms in Optical Lattices**

6/2017 **MPQ Theory Group Workshop**
Lenggries, Germany

Talk: **Quantum Methods for Lattice Gauge Theories: What, When, Where, Why and Who**

Talks in Seminars, Research visits

7/2011 **Research visit to the MPQ Theory Group**
Max Planck Institute for Quantum Optics, Garching, Germany
Hosted by Prof. J. Ignacio Cirac

9/2011 **Particle Physics Seminar, Tel Aviv University**
Talk: **Confinement and Lattice QED Electric Flux Tubes Simulated with Ultracold Atoms**

6/2012 **Research visit to the MPQ Theory Group**
Max Planck Institute for Quantum Optics, Garching, Germany
Hosted by Prof. J. Ignacio Cirac

9/2012 **Research visit to the MPQ Theory Group**
Max Planck Institute for Quantum Optics, Garching, Germany
Hosted by Prof. J. Ignacio Cirac

12/2012 **Theoretical / Mathematical Physics Seminar, Technion**
Talk: **Confinement and Lattice QED Electric Flux Tubes Simulated with Ultracold Atoms**

1-2/2013 **Research visit to the MPQ Theory Group**
Max Planck Institute for Quantum Optics, Garching, Germany
Hosted by Prof. J. Ignacio Cirac

5/2013 **Particle Physics Seminar, Ben-Gurion University**
Talk: **Simulation of Dynamic Abelian and Non-Abelian Gauge Theories with Ultracold Atoms**

- 9/2013 **Research visit to the MPQ Theory Group**
Max Planck Institute for Quantum Optics, Garching, Germany
Hosted by Prof. J. Ignacio Cirac
- 11/2013 **Particle Physics Seminar, Tel Aviv University**

 Talk: Quantum simulation of Abelian and Non-Abelian Lattice Gauge Theories using Ultracold Atoms
- 1/2014 **Research visit to the MPQ Theory Group**
Max Planck Institute for Quantum Optics, Garching, Germany
Hosted by Prof. J. Ignacio Cirac
- 4/2014 **Quantum Optics Theory Seminar, MPQ Garching**

 Talk: Topological Wilson-loop area law manifested using a superposition of loops
- 4/2014 **Theory Seminar, MPQ Garching**

 Talk: Simulation of Dynamic Abelian and Non-Abelian Gauge Theories with Ultracold Atoms
- 5/2014 **Quantum Optics Theory Seminar, MPQ Garching**

 Talk: Supersymmetric Quantum Mechanics
- 9/2014 **Quantum Seminar, Hebrew University, Jerusalem**

 Talk: Ultracold Atoms as Quantum Simulators for Dynamic Abelian and Non-Abelian Gauge Theories
- 11-12/2014 **Quantum Optics Theory Seminar, MPQ Garching**

 Three talks: The Vacuum Polarization and QED Renormalization
- 12/2014 **Particle Physics Seminar, Tel Aviv University**

 Talk: Formulating Lattice Gauge Theories for Tensor Networks and Quantum Simulations
- 1/2015 **Theoretical / Mathematical Physics Seminar, Technion**

 Talk: Formulating Lattice Gauge Theories for Tensor Networks and Quantum Simulations

- 1/2015 **Condensed Matter Theory Seminar, MPQ Garching**
 Talk: **Introduction to Lattice Gauge Theory**
- 1-3/2015 **Quantum Field Theory Course, MPQ**
 A series of weekly introductory lectures on Quantum Field Theory for
 the Theory Group at MPQ.
- 5/2015 **Condensed Matter Seminar, Harvard University**
 Talk: **Formulating Lattice Gauge Theories for Quantum
 Simulations**
- 10/2015 **Quantum Optics Theory Seminar, MPQ Garching**
 Talk: **Particle Oscillations and Symmetry Violation in the Weak
 Interactions**
- 12/2015 **Quantum Optics Theory Seminar, MPQ Garching**
 Talk: **PEPS and Local (Gauge) Symmetries**
- 12/2015 **Condensed Matter Seminar, Weizmann Institute**
 Talk: **PEPS and Local (Gauge) Symmetries**
- 1/2016 **Condensed Matter Seminar, Hebrew University, Jerusalem**
 Talk: **PEPS and Local (Gauge) Symmetries**
- 9/2016 **Condensed Matter Theory Seminar, MPQ Garching**
 Talk: **A Group Theory Approach to Lattice Gauge Theories**
- 11/2016 **Condensed Matter Seminar, Tel Aviv University**
 Talk: **Gauge Theories with Cold Atoms and Tensor Networks**
- 11/2016 **Condensed Matter Seminar, Hebrew University, Jerusalem**
 Talk: **Gauge Theories with Cold Atoms and Tensor Networks**
- 11/2016 **Quantum Optics Seminar, IQOQI, Innsbruck**
 Talk: **Digital Lattice Gauge Theories**
- 11/2016 **Colloquium, MPQ Garching**
 Talk: **PEPS with Local (Gauge) Symmetries**

- 3/2017 **Research visit to ICFO, Barcelona**
Hosted by Prof. Maciej Lewenstein
 Talk: **PEPS with Local (Gauge) Symmetries**
- 5/2017 **Research visit to the university of Ghent, Belgium**
Hosted by Prof. Frank Verstraete
 Talk: **Gauging PEPS**
- 6/2017 **String Theory Journal Club, LMU**
Munich, Germany
 Talk: **PEPS with Local (Gauge) Symmetries**

Participation in Other Conferences and Workshops

- 10/2009 **50 Years of the Aharonov-Bohm Effect**
Tel Aviv University, Israel
- 12/2009 **Physical Implementations of Quantum Computing**
Yad Hashmona, Israel
- 4/2010 **QION 10 – Workshop on Quantum Information and Quantum Dynamics in Ion Traps**
Tel Aviv, Israel
- 11/2010 **Minerva-Weizmann Workshop on Entanglement in Atomic Systems**
Weizmann Institute, Israel
- 9/2011 **Workshop on Quantum Field Theory Aspects of Condensed Matter Physics**
LNF, Frascati, Italy
- 3/2012 **QION 12 – Workshop on Quantum Information and Quantum Dynamics in Ion Traps**
Tel Aviv, Israel
- 5/2013 **Workshop on Quantum Simulations and Related Topics on the Occasion of the Award of the Wolf Prize to Peter Zoller and**

Ignacio Cirac

Technion, Israel

7/2013

Summer Programme on Synthetic Gauge Fields for Photons and Atoms

BEC center, Trento, Italy

6/2014

Second Kavli-MPQ workshop

Max Planck Institute for Quantum Optics, Garching, Germany

7/2014

Quantum Science: Implementations 2014

Centro de Ciencias de Benasque Pedro Pascual, Benasque, Spain

2/2016

Quantum Simulation with Cold Matter and Photons

Solvay Institute, Brussels, Belgium