

# Andrea Alberti, Dr.

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## PERSONAL INFORMATION

Date of birth: 21.04.1982  
Nationality: Italian  
Marital status: Single  
Researcher ID: ORCID [0000-0002-1698-3895](https://orcid.org/0000-0002-1698-3895)



## CONTACT

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Website: <http://quantum-technologies.iap.uni-bonn.de/alberti/>

## SCIENTIFIC CAREER & POSITIONS

- 2016 – Senior scientist and principal investigator
- 2012 – 2015 Junior group leader, Institut für Angewandte Physik, Universität Bonn
- 2011 – 2013 Alexander von Humboldt research fellow. Host: Prof. Dieter Meschede, Institut für Angewandte Physik, Universität Bonn
- 2010 Postdoctoral position. Host: Prof. Dieter Meschede, Institut für Angewandte Physik, Universität Bonn

## SCIENTIFIC EDUCATION

- 2007 – 2010 PhD, European Laboratory for Non-Linear Spectroscopy, Università di Firenze, Supervisor: Prof. Guglielmo Tino. Subject: “Coherent transport in driven optical lattices and applications to force measurements” defended on 19 Feb. 2010. Mark: not applicable.
- 2002 – 2006 “Diploma di Licenza” in Physics, Scuola Normale Superiore di Pisa, Supervisor: Prof. Guglielmo Tino. Subject: “Induced Wannier-Stark transitions with ultra-cold  $^{88}\text{Sr}$  atoms in vertical optical lattices” defended on 27 Nov. 2007. Mark: 70/70 *con lode*.
- 2005 – 2006 M.Sc. in Physics, Università di Pisa, Supervisor: Prof. Ennio Arimondo, Co-supervisor: Prof. Christophe Salomon. Subject: “Contributions to new generation ultra-cold Lithium experiments” defended on 26 Oct. 2006. Mark: 110/110 *con lode*.
- 2006 Study abroad, École Normale Supérieure, Paris.
- 2002 – 2004 B.Sc. in Physics, Università di Pisa, Supervisor: Prof. Ennio Arimondo. Subject: “Evaporative cooling of an admixture of  $^{87}\text{Rb}$  –  $^{133}\text{Cs}$  atoms” defended on 26 Jul. 2004. Mark: 110/110 *con lode*.
- 1997 – 2001 Scientific lyceum “Liceo Scientifico G.P. Vieusseux” in Imperia, Mark: 100/100 *con lode*.

## PRIZES & FELLOWSHIPS

- 2018 Awarded the [Rudolf Kaiser Prize 2017](#).
- 2018 – 2021 Member of the Young Academy ([Junges Kolleg](#)) of the [North Rhine-Westphalian Academy of Sciences and the Arts](#).
- 2011 – 2013 Awarded two-year [Alexander von Humboldt Research Fellowship](#).
- 2006 Awarded 10-month research stipend by [QUEDDIS](#) of the European Science Foundation.
- 2002 – 2006 Five-year honor scholarship by [Scuola Normale Superiore](#) di Pisa.

## FUNCTIONS & SERVICES

- 2016 – 2020 Member of steering committee of [OSCAR SFB/TR 185](#) initiative.
- 2009 – Referee for: Physical Review Letters, Physical Review A, Physical Review X, New Journal of Physics, Optics Letters, Europhysics Letters, International Journal of Modern Physics B, Applied Physics B, Quantum Information Processing, Annals of Physics, Scientific Reports, Physics Letters A. For more information about my review work, see also <https://publons.com/author/1290461/>.

## THIRD-PARTY RESEARCH FUNDING

- 2016 – 2020 Funded project “Topological phases in discrete-time quantum walks” within the [OSCAR SFB/TR 185](#) initiative.
- 2012 – 2014 Funded junior research group (*Nachwuchsforschergruppe*) by the [MIWF](#) of North Rhine-Westphalia.





## SCIENTIFIC PUBLICATIONS

All my manuscripts can be downloaded in PDF format from <http://quantum-technologies.iap.uni-bonn.de/alberti/>.

### Recent submissions to the arXiv:

- [AXV1] M. Sajid, J. K. Asbóth, D. Meschede, R. Werner, and [A. Alberti](#), “Creating Floquet Chern insulators with magnetic quantum walks,” 2018, arXiv:[1808.08923](#) [[quant-ph](#)].

### Publications in peer-reviewed journals:

- [P1] C. Robens, S. Brakhane, W. Alt, D. Meschede, J. Zopes, and [A. Alberti](#), “Fast, High-Precision Optical Polarization Synthesizer for Ultracold-Atom Experiments,” [Phys. Rev. Applied](#) **9**, 034016 (2018), .
- [P2] F. Bleckmann, Z. Cherpakova, S. Linden, and [A. Alberti](#), “Spectral imaging of topological edge states in plasmonic waveguide arrays,” [Phys. Rev. B](#) **96**, 045417 (2017).
- [P3] C. F. Roos, [A. Alberti](#), D. Meschede, P. Hauke, and H. Häffner, “Revealing quantum statistics with a pair of distant atoms,” [Phys. Rev. Lett.](#) **119**, 160401 (2017), [PhysiCS](#), .
- [P4] [A. Alberti](#) and S. Wimberger, “Quantum walk of a Bose–Einstein condensate in the Brillouin zone,” [Phys. Rev. A](#) **96**, 023620 (2017), .
- [P5] J. K. Asbóth and [A. Alberti](#), “Spectral flow and global topology of the Hofstadter butterfly,” [Phys. Rev. Lett.](#) **118**, 216801 (2017).
- [P6] T. Rakovszky, J. Asbóth, and [A. Alberti](#), “Detecting topological invariants in chiral symmetric insulators via losses,” [Phys. Rev. B](#) **95**, 201407(R) (2017).
- [P7] C. Robens, J. Zopes, W. Alt, S. Brakhane, D. Meschede, and [A. Alberti](#), “Low-entropy states of neutral atoms in polarization-synthesized optical lattices,” [Phys. Rev. Lett.](#) **118**, 065302 (2017).
- [P8] C. Robens, S. Brakhane, W. Alt, F. Kleiβler, D. Meschede, G. Moon, and [A. Alberti](#), “High numerical aperture ( $NA = 0.92$ ) objective lens for imaging and addressing of cold atoms,” [Opt. Lett.](#) **42**, 1043 (2017).
- [P9] C. Robens, W. Alt, C. Emary, D. Meschede, and [A. Alberti](#), “Atomic ‘bomb testing’: the Elitzur-Vaidman experiment violates the Leggett-Garg inequality,” [Appl. Phys. B](#) **123**, 12 (2017).
- [P10] T. Groh, S. Brakhane, W. Alt, D. Meschede, J. K. Asbóth, and [A. Alberti](#), “Robustness of topologically protected edge states in quantum walk experiments with neutral atoms,” [Phys. Rev. A](#) **94**, 013620 (2016), .
- [P11] [A. Alberti](#), C. Robens, W. Alt, S. Brakhane, M. Karski, R. Reimann, A. Widera, and D. Meschede, “Super-resolution microscopy of single atoms in optical lattices,” [New J. Phys.](#) **18**, 053010 (2016).

- [P12] S. Brakhane, W. Alt, D. Meschede, C. Robens, and [A. Alberti](#), “Note: Ultra-low birefringence dodecagonal vacuum glass cell,” *Rev. Sci. Instrum.* **86**, 126108 (2015).
- [P13] C. Robens, W. Alt, D. Meschede, C. Emary, and [A. Alberti](#), “Ideal Negative Measurements in Quantum Walks Disprove Theories Based on Classical Trajectories,” *Phys. Rev. X* **5**, 011003 (2015), [Physics](#).
- [P14] [A. Alberti](#), W. Alt, R. Werner, and D. Meschede, “Decoherence models for discrete-time quantum walks and their application to neutral atom experiments,” *New J. Phys.* **16**, 123052 (2014).
- [P15] A. Steffen, W. Alt, M. Genske, D. Meschede, C. Robens, and [A. Alberti](#), “Note: In situ measurement of vacuum window birefringence by atomic spectroscopy,” *Rev. Sci. Instrum.* **84**, 126103 (2013).
- [P16] C. Cedzich, T. Rybár, A. H. Werner, [A. Alberti](#), M. Genske, and R. F. Werner, “Propagation of Quantum Walks in Electric Fields,” *Phys. Rev. Lett.* **111**, 160601 (2013).
- [P17] M. Genske, W. Alt, A. Steffen, A. H. Werner, R. F. Werner, D. Meschede, and [A. Alberti](#), “Electric Quantum Walks with Individual Atoms,” *Phys. Rev. Lett.* **110**, 190601 (2013).
- [P18] N. Belmechri, L. Förster, W. Alt, A. Widera, D. Meschede, and [A. Alberti](#), “Microwave control of atomic motional states in a spin-dependent optical lattice,” *J. Phys. B: At. Mol. Phys.* **46**, 104006 (2013).
- [P19] A. Ahlbrecht, [A. Alberti](#), D. Meschede, V. B. Scholz, A. H. Werner, and R. F. Werner, “Molecular binding in interacting quantum walks,” *New J. Phys.* **14**, 073050 (2012).
- [P20] A. Steffen, [A. Alberti](#), W. Alt, N. Belmechri, S. Hild, M. Karski, A. Widera, and D. Meschede, “Digital atom interferometer with single particle control on a discretized space-time geometry,” *Proc. Natl. Acad. Sci. U.S.A.* **109**, 9770 (2012).
- [P21] M. G. Tarallo, [A. Alberti](#), N. Poli, M. L. Chiofalo, F.-Y. Wang, and G. M. Tino, “Delocalization-enhanced Bloch oscillations and driven resonant tunneling in optical lattices for precision force measurements,” *Phys. Rev. A* **86**, 033615 (2012).
- [P22] M. Karski, L. Förster, J.-M. Choi, [A. Alberti](#), W. Alt, A. Widera, and D. Meschede, “Direct Observation and Analysis of Spin Dependent Transport of Single Atoms in a 1D Optical Lattice,” *J. Korean Phys.Soc.* **59**, 2947 (2011).
- [P23] N. Poli, F.-Y. Wang, M. G. Tarallo, [A. Alberti](#), M. Prevedelli, and G. M. Tino, “Precision Measurement of Gravity with Cold Atoms in an Optical Lattice and Comparison with a Classical Gravimeter,” *Phys. Rev. Lett.* **106**, 038501 (2011).
- [P24] [A. Alberti](#), G. Ferrari, V. V. Ivanov, M. L. Chiofalo, and G. M. Tino, “Atomic wave packets in amplitude-modulated vertical optical lattices,” *New J. Phys.* **12**, 065037 (2010).
- [P25] [A. Alberti](#), V. V. Ivanov, G. M. Tino, and G. Ferrari, “Engineering the quantum transport of atomic wavefunctions over macroscopic distances,” *Nature Phys.* **5**, 547 (2009).
- [P26] F. Sorrentino, [A. Alberti](#), G. Ferrari, V. V. Ivanov, N. Poli, M. Schioppo, and G. M. Tino, “Quantum sensor for atom-surface interactions below  $10\mu\text{m}$ ,” *Phys. Rev. A* **79**, 013409 (2009).
- [P27] V. V. Ivanov, [A. Alberti](#), M. Schioppo, G. Ferrari, M. Artoni, M. L. Chiofalo, and G. M. Tino, “Coherent Delocalization of Atomic Wave Packets in Driven Lattice Potentials,” *Phys. Rev. Lett.* **100**, 043602 (2008).

#### Patents:

- [PAT1] S. Brakhane, W. Alt, D. Meschede, C. Robens, and [A. Alberti](#), “Polarisationserhaltende Vakuum-Zelle zur Anwendung oder Messung elektromagnetischer Wellen im Vakuum,” [Patent pending](#) (German and PCT international application), Oct. 2015.

#### Proceedings:

- [PR1] C. Robens, S. Brakhane, D. Meschede, and [A. Alberti](#), “Quantum Walks With Neutral Atoms: Quantum Interference Effects of One and Two Particles,” in [Proceedings of the XXII International Conference ICOLS 2015](#), 2016, p. 1, arXiv:1511.03569 [quant-ph].
- [PR2] G. M. Tino, [A. Alberti](#), A. Bertoldi, L. Cacciapuoti, M. de Angelis, G. Ferrari, A. Giorgini, V. Ivanov, G. Lamporesi, N. Poli, M. Prevedelli, and F. Sorrentino, “Precision Gravity Tests by Atom Interferometry,” in [Proceedings of the XVIII International Conference ICOLS 2007](#), 2008, p. 89.

## ORGANIZATION OF WORKSHOPS

- 2017 Minisymposium "Discrete quantum simulators," 22–23 Mar. 2017, Bonn, Germany
- 2014 Heraeus workshop "*Discrete and Analogue Quantum Simulators*," 10–12 Feb. 2014, <http://www.weh553.iap.uni-bonn.de/>, Bad Honnef, Germany
- 2012 Symposium "*Quantum Walks, Quantum Simulators, and Quantum Networks*," 30–31 Jul. 2012, <http://for635.iap.uni-bonn.de/workshop2012/workshop2012.html>, Bonn, Germany

## SCIENTIFIC COLLABORATIONS

- Prof. Enrique Solano, University of the Basque Country (boson sampling with ultracold atoms)
- Prof. Stefan Linden, University of Bonn (about experimental study of topological phases with surface plasmon polaritons in waveguide arrays)
- Dr. Janos K. Asbóth, Wigner Research Center, Budapest (about topological phases in discrete-time quantum walks)
- Dr. Antonio Negretti, University of Hamburg & Prof. Tommaso Calarco, Ulm University (about application of optimal control theory to quantum walks)
- Prof. Reinhard Werner, University of Hannover (about discrete-time quantum walks and artificial gauge fields)
- Dr. Clive Emary, University of Hull, UK (about Leggett-Garg violation experiments)

## LIST OF INVITED ACADEMIC TALKS

### Conferences:

1. Humboldt Kolleg "Controlling quantum matter: From ultracold atoms to solids," Vilnius, Lithuania (Jul. 2018)
2. Conference "Is quantum theory exact? The quest for the spin-statistics connection violation and related items," Rome, Italy (Jul. 2018)
3. International Conference on Quantum Optics and Quantum Information, Minsk, Belarus (Nov. 2017)
4. COST conference "Fundamental Problems in Quantum Physics," Erice, Italy (Mar. 2015)
5. ICOLS 2015, "22<sup>nd</sup> International Conference on Laser Spectroscopy," Singapore (Jun. 2015)
6. von Humboldt Award Winners' Forum: "Frontiers in Quantum Optics," Bonn, Germany (Oct. 2013)

### Workshops and symposia:

1. Workshop "Workshop on Foundations of Quantum Mechanics" within ICNFP 2018, Kolymbari, Crete, Greece (Jul. 2017)
2. Heraeus Workshop "Search and problem solving by random walks," Bad Honnef, Germany (May 2018)
3. German-French-Russian Laser Symposium 2018, Kazan, Russia (Apr. 2018)
4. Symposium "Quantum Information and Quantum Simulation," Université Pierre et Marie Curie, Paris, France (Sep. 2017)
5. Workshop "Workshop on Foundations of Quantum Mechanics" within ICNFP 2017, Kolymbari, Crete, Greece (Aug. 2017)
6. Workshop "Quantum Simulation Models Workshop," Marseille, France (Jun. 2017)
7. IBM-Heraeus Workshop "Scalable Architectures for Quantum Simulation," Bad Honnef, Germany (Jan. 2017), [\[view slides\]](#)
8. Workshop "Quantum Simulation and Quantum Walks 2016," Prague, Czech Republic (Nov. 2016), [\[view slides\]](#)
9. Heraeus Workshop "Microwaves Go Quantum," Bad Honnef, Germany (Nov. 2015)
10. Camel11 Workshop 2015 "Control of Quantum Dynamics of Atoms, Molecules and Ensembles by Light," Nesebar, Bulgaria (Jun. 2015)
11. Workshop "Quantum Simulations and Quantum Walks," Centro de Giorgi, Scuola Normale Superiore, Pisa, Italy (Nov. 2013)

12. Guest speaker, "23rd FoQuS SFB meeting," Vienna, Austria (Dec. 2013)
13. Heraeus Workshop "Classical and Quantum Transport in Complex Networks," Bad Honnef, Germany (Aug. 2013)
14. Symposium "Photons, atoms, and beyond," Pisa, Italy (Sep. 2012)
15. Workshop "Dynamics and asymptotics in the Dicke model and quantum networks," Mátraháza, Hungary (May 2012)
16. Quantum Control and Simulation with Distributed Neutral Atom Systems Workshop, MPQ Garching, Germany (Nov. 2011)
17. German-French-Russian Laser Symposium 2011, Erlangen, Germany (Apr. 2011)
18. Workshop "Modern Problems of Laser Metrology," Lerici, Italy (Oct. 2009)

### Seminars and colloquia:

1. Quantum optics colloquium, ZOQ & Institute of Laser Physics, Hamburg, Germany (Jun. 2018)
2. Seminar, Okinawa Institute of Science and Technology, Okinawa, Japan (Feb. 2018)
3. Seminar, University of Vienna, Austria (Feb. 2018)
4. Seminar, University of Nottingham, Nottingham, United Kingdom (Jan. 2018)
5. Seminar, National Institute of Physics, University of the Philippines Diliman, Philippines (Dec. 2017)
6. Seminar, LMU Munich, Germany (May 2017)
7. Seminar, University of the Basque Country, Bilbao, Spain (Apr. 2017)
8. Seminar, Universität Ulm, Germany (Mar. 2017)
9. Public lecture on "Twisted quantum states: From the Möbius strip to dissipationless currents" at kick-off meeting of SFB/TR 185 OSCAR, Bonn, Germany (Jul. 2016), [\[view slides\]](#)
10. Seminar Universität Siegen, Germany (Mar. 2016)
11. ICFO Seminar, Barcelona, Spain (Mar. 2016)
12. Colloquium ENS Lyon, France (Feb. 2016)
13. Quantum Seminar, Universität Mainz, Germany (Nov. 2015)
14. Wigner SZFI Seminar, Wigner Research Center, Budapest, Hungary (Jan. 2015)
15. Physics Colloquium, Universität Bonn, Germany (Oct. 2015)
16. Seminar Imperial College, London, United Kingdom (Oct. 2015)
17. LKB Seminar, Collège de France, Paris, France (Oct. 2014)
18. Fritz Haber Institute seminar, Berlin, Germany (Nov. 2013)
19. Seminar, Freiburg Institute for Advanced Studies, Universität Freiburg, Germany (May 2013)
20. LENS Seminar, European Laboratory for Nonlinear Spectroscopy, Sesto Fiorentino, Italy (Sep. 2012)
21. "R. G. Herb Condensed Matter Seminar," University of Wisconsin, Madison USA (Feb. 2010)
22. Seminar, Columbia University, New York, USA (Feb. 2010)
23. Seminar, Institut d'Optique, Orsay, France (Feb. 2010)
24. Optics and Condensed Matter Seminar, Institut für Angewandte Physik, Bonn, Germany (Jan. 2010)
25. Seminar, Universidad Complutense de Madrid, Madrid, Spain (Dec. 2009)

### Physics schools:

1. Summer school "Shortcuts to Adiabaticity," University College Cork, Ireland (Jul. 2016)
2. "New trends in many-particle quantum transport," Universität Freiburg, Germany (Feb. 2015)

## TEACHING ACTIVITIES

### University courses:

- 2017 SS - Intensive Week Course: "[Introduction to topological insulators and their implementations in artificial matter setups](#)" (Universität Bonn, Master)
- 2016 WS - Advanced Topics in Quantum Optics (Universität Bonn, Master)

## Exercise classes, and other teaching experiences:

Since 2010, I have been regularly involved in preparing exercise sheets, written examinations, and holding several hours of lectures per semester in university courses of the University of Bonn. These include at the Master's level "Seminar on Quantum Technology," "Advanced Atomic, Molecular and Optical Physics," "Quantum optics," "Laser Physics and Nonlinear Optics," "Cold atoms and many particle physics," and at the Bachelor's level "Atome, Moleküle, Kondensierte Materie."

## SUPERVISION OF GRADUATE STUDENTS & POSTDOCTORAL FELLOWS

- 2010 – 10 PhD students, 1 Postdoc, 19 Master students and 7 Bachelor students at the Institut für Angewandte Physik, Universität Bonn
- 2007 – 2008 1 Master Student, European Laboratory for Non-Linear Spectroscopy, Firenze

## MEDIA COVERAGE & OUTREACH

- 2018 The Rudolf Kaiser Prize was covered by the daily newspaper "General Anzeiger Bonn" with an [interviewed](#) appeared on May 8th, 2018; see also the press releases by the [Deutsches Stiftungszentrum](#) and by the [University of Bonn](#), and the related article on the [Forsch](#), issue 2/2018, p. 20.
- 2017 The proposal about revealing quantum statistics with two distant atoms was covered in [Physics](#) magazine; see also the [press release](#) from the University of Bonn. Scientific publication: [Phys. Rev. Lett. 119, 160401 \(2017\)](#).
- 2017 An interview with *Forschung aktuell* of *Deutschlandfunk* entitled "Sortiergerät für Atome: Forscher präparieren Quantenregister im Rekordtempo," was broadcast on [March 9th, 2017](#). The "sorting machine for atoms" was also featured in a press release [press release](#) and in the general science magazine of the University of Bonn, [Forsch](#), issue 1/2017, p. 13. Scientific publication: [Phys. Rev. Lett. 118, 065302 \(2017\)](#).
- 2015 The "Leggett-Garg violation experiment" was featured in a *Viewpoint* article by G. Knee, "[Do Quantum Superpositions Have a Size Limit?](#)" [Physics 8, 6 \(2015\)](#), as well as in a *Brennpunkt* article by K. Hornberger, "[Cäsium mag es unrealistisch](#)" [Physik Journal 14, 24 \(2015\)](#); see also the [press release](#) from the University of Bonn. Scientific publication: [Phys. Rev. X 5, 011003 \(2015\)](#).
- 2015 The "electric quantum walk" experiment were featured in *La Recherche*—a popular science magazine well known in France. Reference: P. Arrighi and S. Perdrrix, "[La décohérence, une alliée pour la simulation](#)," [La Recherche 501, 66 \(2015\)](#). Scientific publication: [Phys. Rev. Lett. 110, 190601 \(2013\)](#).
- 2012 The "digital single atom interferometer" was featured in the general science magazine of the University of Bonn; see also the [press release](#) from the University of Bonn. Scientific publication: [PNAS 109, 9770 \(2012\)](#).

## LANGUAGES

Fluent in **English, German, French, Italian** (mother tongue).

## OTHER ACTIVITIES

- 2010 – 2011 Design and creation of the website <http://quantum-technologies.iap.uni-bonn.de/>
- 2012 – Endurance sports (running, swimming). Best time in 10-km run: 38:10 (Summer 2014)