

# 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 INFORMATION

Institut für Angewandte Physik  
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Website: <http://quantum-technologies.iap.uni-bonn.de/alberti/>

## SCIENTIFIC CAREER & POSITIONS

- 2016 – pres. 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, GRANTS & FUNCTIONS

- 2018 – 2021 Member of the Young Academy ([Junges Kolleg](#)) of the [North Rhine-Westphalian Academy of Sciences and the Arts](#).
- 2017 Awarded the [Rudolf Kaiser Prize 2017](#).
- 2016 – 2020 Member of steering committee of [OSCAR SFB/TR 185](#) initiative.
- 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.
- 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.

## PUBLICATIONS

- [P1] C. Robens, S. Brakhane, W. Alt, D. Meschede, J. Zopes, and [A. Alberti](#), “Fast, high-precision optical polarization synthesizer for ultracold-atom experiments,” [accepted in Phys. Rev. Applied](#), [arXiv:1611.07952 \[quant-ph\]](#) (2017).
- [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. Kleißler, 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 μm*,” [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

- [PA1] 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.

## INVITATIONS TO SEMINARS, COLLOQUIA, CONFERENCES & SCHOOLS (including latest invitations denoted by \* symbol)

1. Heraeus Workshop “Search and problem solving by random walks,” Bad Honnef, Germany (May 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, UK (Jan. 2018)
5. Seminar, National Institute of Physics, University of the Philippines Diliman, Philippines (Dec. 2017)
6. International Conference on Quantum Optics and Quantum Information, Minsk, Belarus (Nov. 2017)
7. Symposium “Quantum Information and Quantum Simulation,” Université Pierre et Marie Curie, Paris, Germany (Sep. 2017)
8. Workshop “Workshop on Foundations of Quantum Mechanics” within ICNFP 2017, Kolymbari, Crete, Greece (Aug. 2017)
9. Workshop “Quantum Simulation Models Workshop,” Marseille, France (Jun. 2017)

10. Seminar, LMU Munich, Germany (May 2017)
11. Seminar, University of the Basque Country, Bilbao, Spain (Apr. 2017)
12. Seminar, Universität Ulm, Germany (Mar. 2017)
13. IBM-Heraeus Workshop "Scalable Architectures for Quantum Simulation," Bad Honnef, Germany (Jan. 2017), [\[view slides\]](#)
14. Workshop "Quantum Simulation and Quantum Walks 2016," Prague, Czech Republic (Nov. 2016), [\[view slides\]](#)
15. Summer school "Shortcuts to Adiabaticity," University College Cork, Ireland (Jul. 2016)
16. 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), [\[view slides\]](#)
17. Seminar Universität Siegen, Germany (Mar. 2016)
18. ICFO Seminar, Barcelona, Spain (Mar. 2016)
19. Colloquium ENS Lyon, France (Feb. 2016)
20. Quantum Seminar, Universität Mainz, Germany (Nov. 2015)
21. Heraeus Workshop "Microwaves Go Quantum," Bad Honnef, Germany (Nov. 2015)
22. Physics Colloquium, Universität Bonn, Germany (Oct. 2015)
23. Seminar Imperial College, London, United Kingdom (Oct. 2015)
24. ICOLS 2015, "22<sup>nd</sup> International Conference on Laser Spectroscopy," Singapore (Jun. 2015)
25. Camel11 Workshop 2015 "Control of Quantum Dynamics of Atoms, Molecules and Ensembles by Light," Nesebar, Bulgaria (Jun. 2015)
26. COST conference "Fundamental Problems in Quantum Physics," Erice, Italy (Mar. 2015)
27. "New trends in many-particle quantum transport," Physics School, Universität Freiburg, Germany (Feb. 2015), 4 hours of lectures
28. Wigner SZFI Seminar, Wigner Research Center, Budapest, Hungary (Jan. 2015)
29. LKB Seminar, Collège de France, Paris (Oct. 2014)
30. Workshop "Quantum Simulations and Quantum Walks," Centro de Giorgi, Scuola Normale Superiore, Pisa, Italy (Nov. 2013)
31. Invited guest speaker, "23rd FoQuS SFB meeting," Vienna, Austria (Dec. 2013)
32. Fritz Haber Institute seminar, Berlin, Germany (Nov. 2013)
33. von Humboldt Award's Winner Forum: Frontiers in Quantum Optics, Bonn, Germany (Oct. 2013)
34. Heraeus Workshop "Classical and Quantum Transport in Complex Networks," Bad Honnef, Germany (Aug. 2013)
35. Seminar Freiburg Institute for Advanced Studies, Universität Freiburg, Germany (May 2013)
36. Symposium "Photons, atoms, and beyond," Pisa, Italy (Sep. 2012)
37. LENS Seminar, European Laboratory for Nonlinear Spectroscopy, Sesto Fiorentino, Italy (Sep. 2012)
38. Workshop "Dynamics and asymptotics in the Dicke model and quantum networks," Mátraháza, Hungary (May 2012)
39. Quantum Control and Simulation with Distributed Neutral Atom Systems Workshop, MPQ Garching, Germany (Nov. 2011)
40. German-French-Russian Laser Symposium 2011, Erlangen, Germany (Apr. 2011)
41. "R. G. Herb Condensed Matter Seminar," University of Wisconsin, Madison USA (Feb. 2010)
42. Seminar, Columbia University, New York, USA (Feb. 2010)
43. Seminar, Institut d'Optique, Orsay, France (Feb. 2010)
44. "Optics and Condensed Matter Seminar," Institut für Angewandte Physik, Bonn, Germany (Jan. 2010)
45. Seminar, Universidad Complutense de Madrid, Madrid, Spain (Dec. 2009)
46. Workshop "Modern Problems of Laser Metrology," Lerici, Italy (Oct. 2009)

In addition, 12 contributed talks, 11 poster presentations.

## ORGANIZATION OF WORKSHOPS

- 2014 Organizer of the 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

- 2015 – pres. Prof. Stefan Linden, University of Bonn (about experimental study of topological phases with surface plasmon polaritons in waveguide arrays)
- 2013 – pres. Dr. Janos K. Asbóth, Wigner Research Center, Budapest (about topological phases in discrete-time quantum walks)
- 2015 – pres. Dr. Antonio Negretti, University of Hamburg & Prof. Tommaso Calarco, Ulm University (about application of optimal control theory to quantum walks)
- 2011 – pres. Prof. Reinhard Werner, University of Hannover (about discrete-time quantum walks and artificial gauge fields)
- 2012 – 2016 Dr. Clive Emary, University of Hull, UK (about Leggett-Garg violation experiments)

## COLLABORATION IN SCIENTIFIC NETWORKS

- 2016 – 2020 Collaborative research center [OSCAR SFB/TR 185](#)
- 2013 – 2015 EU Integrated Project [SIQS](#)
- 2010 – 2012 EU Integrated Project [AQUTE](#)
- 2010 – 2012 DFG Research Unit [FOR635](#)

## TEACHING ACTIVITIES

### University courses:

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

- 2016 SS - Atome, Moleküle, Kondensierte Materie – Physik IV (Bachelor)
- 2015 WS - Advanced Atomic, Molecular and Optical Physics (Master)
- 2015 SS - Quantum optics (Master)
- 2014 WS - Laser Physics and Nonlinear Optics (Master)
- 2014 SS - Quantum optics (Master)
- 2013 SS - Atome, Moleküle, Kondensierte Materie – Physik IV (Bachelor)
- 2012 WS - Advanced Atomic, Molecular and Optical Physics (Master)
- 2011 WS - Laser Physics and Nonlinear Optics (Master)
- 2011 SS - Laser Spectroscopy (Master)
- 2010 WS - Cold atoms and many particle physics (Master, together with Prof. Achim Rosch)
- (WS: winter semester; SS: summer semester)

## SUPERVISION OF GRADUATE STUDENTS & POSTDOCTORAL FELLOWS

2010 – pres. 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

2017 The proposal to “reveal quantum statistics with two distant atoms” [P3] was covered in *Physics* magazine; see also the [press release](#) from the University of Bonn.

2017 An interview with *Forschung aktuell* of *Deutschlandfunk*, entitled “Sortiergerät für Atome: Forscher präparieren Quantenregister im Rekordtempo,” was broadcast on [March 9th, 2017](#).

2017 The “sorting machine for atoms” [P7] was featured in the general science magazine of the University of Bonn. Reference: *Forsch*, issue 1/2017, p. 13; see also the [press release](#) from the University of Bonn.

2015 The “Leggett-Garg violation experiment” [P13] 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.

2015 The “electric quantum walk” experiment [P17] were featured in *La Recherche*—a popular science magazine well known in France. Reference: P. Arrighi and S. Perdrix, “La décohérence, une alliée pour la simulation,” *La Recherche* 501, 66 (2015).

2012 The “digital single atom interferometer” [P20] was featured in the general science magazine of the University of Bonn. Reference: *Forsch*, issue 3/2012, p. 18; see also the [press release](#) from the University of Bonn.

## REVIEWER FOR SCIENTIFIC JOURNALS

Physical Review Letters, Physical Review A, New Journal of Physics, Europhysics Letters, International Journal of Modern Physics B, Applied Physics B, Quantum Information Processing, Annals of Physics, Scientific Reports.

See <https://publons.com/author/1290461/> for additional information about my review work.

## MEMBER OF SCIENTIFIC SOCIETIES

2010 – pres. European Physical Society

2010 – pres. Deutsche Physikalische Gesellschaft

2009 – pres. Società di Fisica Italiana

## LANGUAGES

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

## EXTRACURRICULAR ACTIVITIES

2010 – 2011 Design and creation of the website <http://quantum-technologies.iap.uni-bonn.de/>.

2012 – pres. Endurance sports (running, swimming). Best time in 10-km run: 38:10 (Summer 2014).