Curriculum Vitae

General information

Name	Philipp Schindler
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Education

2008–2013	**PhD (Dr. rer. nat.)**, *Universität Innsbruck*, Innsbruck
2000–2008	**Masters (Mag. rer. nat.)**, *Universität Innsbruck*, Innsbruck
1995–2000	**Matura**, *HTL für Nachrichtentechnik*, Innsbruck

Master thesis

Title	**Frequency synthesis and pulse shaping for quantum information processing with trapped ions**
Supervisor	Prof. Rainer Blatt

Doctoral thesis

Title	**Quantum computation and simulation with trapped ions using dissipation**
Supervisor	Prof. Rainer Blatt

Research interest

Quantum control and characterization of single molecular ions

Quantum information processing with trapped ions

Quantum simulation of open and closed systems

Quantum error detection and correction

Quantum process characterization and validation

Precision spectroscopy with trapped ions

Scalable ion trap technologies

Selected publications

Ultrafast infrared spectroscopy with single molecular ions. *New Journal of Physics* 21(8) 083025 (2019)
This publication is is a theoretical analysis of the planned experiments with molecular ions. It highlights my ability to conduct research on molecular systems.

Engineering Vibrationally Assisted Energy Transfer in a Trapped-Ion Quantum Simulator. *Phys. Rev. X* 8, 011038, (2018)
This publication represents the first quantum simulation of vibrational assisted energy transfer in molecular and mesoscopic systems resulted from my postdoctoral stay. I have initiated the project and designed the experiment.

A quantum information processor with trapped ions. *New. J. Phys.* 15, 123012 (2013).
This was the final publication of my PhD thesis and presents the experimental system that I designed during my PhD. It has been cited 272 (Google scholar) times, which underlines its impact on the quantum information processing community.

Quantum simulation of dynamical maps with trapped ions. Nature Physics 9, 361 (2013)
This publications shows advanced quantum simulation with open quantum systems. It includes multiple innovative experimental and theoretical techniques, such as quantum error reduction with little overhead. It highlights my ability to collaborate with excellent theoretical researchers on a complex topic.

Experimental repetitive quantum error correction. *Science* 332,1059-1061 (2011),
This publications presents the first repetitive implementation of quantum error correction procedures in any physical system. It is thus a major milestone towards a large-scale quantum information processor.

Research experience

2008 – 2013	Graduate student at the Institute of Experimental Physics, University of Innsbruck
2013 – 2014	Postdoctoral scholar at the University of Berkeley
2014 – 2015	Erwin Schrödinger fellow at the University of Berkeley
2016 – 2021	Postdoctoral researcher at the Institute of Experimental Physics, University of Innsbruck
since 2022	Tenure track position at the Institute of Experimental Physics, University of Innsbruck

Teaching experience

since 2015	Co-supervision of 9 doctoral students
since 2015	Co-supervision of 6 Masters students
since 2015	Occasional substitutions of the courses "Physik 3 Proseminar", "Physik 2", and basic lab courses ("Grundpraktikum", "Fortgeschrittenen Praktikum")
since 2015	Four summer schools on the doctoral and Masters level
since 2022	Teaching of basic and advanced lab-courses.

Publications

47 publications in peer reviewed journals

1 book chapter

Prizes and awards

2012 Annerkennungspreis: Best students paper Universitaet Innsbruck
2013 Anerkennungspreis: Award of Excellence
2013 Wissenschaftspreis der Stadt Innsbruck
2014 Dissertationspreis des Institus für Quantenoptik und Quanteninformation
2014 Erwin Schrödinger Stipendium
2019 Eduard Wallnöfer Preis
2020 ERC starting grant

Funding

2013 Co-lead: CETO - Certified encoded topological quantum computation
2014 Co-lead: Rose Hill Innovator Award: Parametric coupling of trapped ions to superconducting electronics for quantum computing
2014 Personal award: Erwin Schrödinger Stipendium
2015 Co-lead: Equal - Encoded qubit alive
2017 Co-lead: QLECTOR - Qubit loss error correction
2018 PI: AUTOMATIQ - Automated quantum computing with variational algorithms
2018 Co-lead: BeyondC - Quantum Information Systems Beyond Classical Capabilities
2018 Co-lead: AQTION - Advanced quantum computing with trapped ions
2020 Co-lead: VEQTOR - Verification and Certification of Quantum Fault-Tolerance
2020 Co-lead: ALF - Agile laser feedback for quantum computing
2020 PI: PIEDMONS - Portable ion entangling devices
2021 PI: ERC starting grant QCOSMO - Quantum control and characterization of single molecules

Memberships

since 2006 German Physical Society (DPG)
since 2012 American Physical Society (APS)
since 2021 Young academy of the Austrian academy of sciences (ÖAW)

Selected invited talks

2011 CLEO Conference, Baltimore, USA
2012 Workshop: New Directions in quantum statistics, Nottingham, UK
2013 APS March meeting, Baltimore, USA
2015 Workshop: Quantum noise and Model reduction, Laurel, USA
2016 APS March meeting, Baltimore, USA
2016 Conference for Advances in Quantum Algorithms and Computation Aspen, USA
2017 ICE-4, Madrid, ESP
2017 QUSENC: Quantum Sensing with Quantum Correlated Systems, Dresden, GER

2019 QSC: Quantum Simulation & Computation, Madrid, ESP
2021 CIQC colloqium, Berkeley, USA (virtual)

Selected referee and panel activity

since 2013 New Journal of Physics
since 2015 Physical Review Letters
since 2015 Science
since 2016 Nature
since 2021 Selection panel: Joint excellence in sciences and humanities (ÖAW)
since 2021 Technical steering committee of OpenQasm
since 2022 Editor with the Jonnral "Quantum"

International collaborations

Prof. Markus Müller; RWTH Aachen, Germany
Prof. Jonathan Home; ETH Zürich, Switzerland
Dr. Florentin Reiter; ETH Zürich, Switzerland
Prof. Simon Benjamin,; University of Oxford, UK
Prof. David Lucas; University of Oxford, UK
Prof. Michael Biercuk; University of Sydney, Australia
Prof. Stephen Bartlett; University of Sydney, Australia
Prof. Alejandro Bermudez; Universidad Comlutense Madrid, Spain
Prof. Miguel-Angel Martin-Delgado; Universidad Comlutense Madrid, Spain
Prof. Joseph Emerson; IQC Waterloo, Canada
Prof. Christine Muschik; IQC Waterloo, Canada
Prof. Ferdinand Schmidt-Kaler; University of Mainz, Germany
Prof. Hartmut Häffner; University of California, Berkeley, USA
Prof. Juan-Jose Garcia-Ripoll; CSIC Madrid, Spain

Selected national collaborations

Dr. Nicolai Friis; IQOQI Vienna
Prof. Peter Zoller; University of Innsbruck
Dr. Rick van Bijnen; University of Innsbruck
Dr. Pietro Silvi; University of Innsbruck
Dr. Lukas Sieberer; University of Innsbruck
Dr. Hendrik Poulsen-Nautrup; University of Innsbruck

Industrial collaborations

Infineon Austria
Alpine Quantum Technologies

Toptica Photonics

Bull - Atos

Selected outreach activities

2016 Pint of Science festival

since 2017 Active twitter account

2019 Innovation days of the Forum Alpach

2020 Interview for Deutschlandfunk

2020 Youtube video with the University press office

2021 Presentation for the Rotary club Seefeld

Software development

since 2018 Lead developer for experimental control software in collaboration with Alpine Quantum Technologies

2018 – 2020 Contributor to Cirq software package

2021 Contributor to Qutip software package

Publications

[1] A. K. Pal, P. Schindler, A. Erhard, Á. Rivas, M.-A. Martin-Delgado, R. Blatt, T. Monz, and M. Müller, "Relaxation times do not capture logical qubit dynamics," *Quantum*, vol. 6, p. 632, 2022. DOI: 10.22331/q-2022-01-24-632.

[2] C. Greganti, T. Demarie, M. Ringbauer, J. Jones, V. Saggio, I. A. Calafell, L. Rozema, A. Erhard, M. Meth, L. Postler, R. Stricker, **P. Schindler**, R. Blatt, T. Monz, P. Walther, and J. Fitzsimons, "Cross-verification of independent quantum devices," *Physical Review X*, vol. 11, no. 3, 2021. DOI: 10.1103/physrevx.11.031049.

[3] P. C. Holz, K. Lakhmanskiy, D. Rathje, **P. Schindler**, Y. Colombe, and R. Blatt, "Electric-field noise in a high-temperature superconducting surface ion trap," *Physical Review B*, vol. 104, no. 6, 2021. DOI: 10.1103/physrevb.104.064513.

[4] I. Pogorelov, T. Feldker, C. D. Marciniak, L. Postler, G. Jacob, O. Krieglsteiner, V. Podlesnic, M. Meth, V. Negnevitsky, M. Stadler, B. Höfer, C. Wächter, K. Lakhmanskiy, R. Blatt, **P. Schindler**, and T. Monz, "Compact ion-trap quantum computing demonstrator," *PRX Quantum*, vol. 2, no. 2, 2021. DOI: 10.1103/prxquantum.2.020343.

[5] M. Teller, D. A. Fioretto, P. C. Holz, P. Schindler, V. Messerer, K. Schüppert, Y. Zou, R. Blatt, J. Chiaverini, J. Sage, and T. E. Northup, "Heating of a trapped ion induced by dielectric materials," *Physical Review Letters*, vol. 126, no. 23, 2021. DOI: 10.1103/physrevlett.126.230505.

[6] A. Erhard, H. P. Nautrup, M. Meth, L. Postler, R. Stricker, M. Stadler, V. Negnevitsky, M. Ringbauer, P. Schindler, H. J. Briegel, R. Blatt, N. Friis, and T. Monz, "Entangling logical qubits with lattice surgery," *Nature*, vol. 589, no. 7841, pp. 220–224, 2021. DOI: 10.1038/s41586-020-03079-6.

[7] T. Olsacher, L. Postler, P. Schindler, T. Monz, P. Zoller, and L. M. Sieberer, "Scalable and parallel tweezer gates for quantum computing with long ion strings," *PRX Quantum*, vol. 1, no. 2, 2020. DOI: 10.1103/prxquantum.1.020316.

[8] R. Stricker, D. Vodola, A. Erhard, L. Postler, M. Meth, M. Ringbauer, P. Schindler, T. Monz, M. Müller, and R. Blatt, "Experimental deterministic correction of qubit loss," *Nature*, vol. 585, no. 7824, pp. 207–210, 2020. DOI: 10.1038/s41586-020-2667-0.

[9] M. W. van Mourik, E. A. Martinez, L. Gerster, P. Hrmo, T. Monz, P. Schindler, and R. Blatt, "Coherent rotations of qubits within a surface ion-trap quantum computer," *Physical Review A*, vol. 102, no. 2, 2020. DOI: 10.1103/physreva.102.022611.

[10] A. Erhard, J. J. Wallman, L. Postler, M. Meth, R. Stricker, E. A. Martinez, P. Schindler, T. Monz, J. Emerson, and R. Blatt, "Characterizing large-scale quantum computers via cycle benchmarking," *Nature Communications*, vol. 10, no. 1, 2019. DOI: 10.1038/s41467-019-13068-7.

[11] P. Schindler, "Ultrafast infrared spectroscopy with single molecular ions," *New Journal of Physics*, 2019. DOI: 10.1088/1367-2630/ab3549.

[12] ——, *Verification of independent quantum devices*, 2019.

[13] ——, "Experimental quantification of spatial correlations in quantum dynamics," *Quantum*, 2018. DOI: 10.22331/q-2018-09-03-90.

[14] D. J. Gorman, B. Hemmerling, E. Megidish, S. A. Moeller, P. Schindler, M. Sarovar, and H. Haeffner, "Engineering vibrationally assisted energy transfer in a trapped-ion quantum simulator," *Physical Review X*, vol. 8, no. 1, 2018.

[15] A. Bermudez, X. Xu, R. Nigmatullin, J. O'Gorman, V. Negnevitsky, **P. Schindler**, T. Monz, U. G. Poschinger, C. Hempel, J. Home, F. Schmidt-Kaler, M. Biercuk, R. Blatt, S. Benjamin, and M. Mueller, "Assessing the progress of trapped-ion processors towards fault-tolerant quantum computation," *Physical Review X*, vol. 7, no. 4, 2017.

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[17] A. Bermudez, P. Schindler, T. Monz, R. Blatt, and M. Mueller, "Micromotion-enabled improvement of quantum logic gates with trapped ions," *New Journal of Physics*, 2017.

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[19] E. A. Martinez, T. Monz, D. Nigg, P. Schindler, and R. Blatt, "Compiling quantum algorithms for architectures with multi-qubit gates," *New Journal of Physics*, vol. 18, 2016.

[20] M. F. Brandl, **P. Schindler**, T. Monz, and R. Blatt, "Cryogenic resonator design for trapped ion experiments in paul traps," *Applied Physics B*, vol. 122, no. 6, p. 157, 2016.

[21] M. F. Brandl, M. W. van Mourik, L. Postler, A. Nolf, K. Lakhmanskiy, R. R. Paiva, S. Moller, N. Daniilidis, H. Haffner, V. Kaushal, T. Ruster, C. Warschburger, H. Kaufmann, U. G. Poschinger, F. Schmidt-Kaler, **P. Schindler**, T. Monz, and R. Blatt, "Cryogenic setup for trapped ion quantum computing," *Review of Scientific Instruments*, vol. 87, no. 11, 2016.

[22] I. Talukdar, D. J. Gorman, N. Daniilidis, **P. Schindler**, S. Ebadi, H. Kaufmann, T. Zhang, and H. Haffner, "Implications of surface noise for the motional coherence of trapped ions," *Physical Review a*, vol. 93, no. 4, 2016.

[23] M. Muller, A. Rivas, E. A. Martinez, D. Nigg, **P. Schindler**, T. Monz, R. Blatt, and M. A. Martin-Delgado, "Iterative phase optimization of elementary quantum error correcting codes," *Physical Review X*, vol. 6, no. 3, 2016.

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[27] P. Schindler, D. J. Gorman, N. Daniilidis, and H. Haeffner, "Polarization of electric-field noise near metallic surfaces," *Physical Review a*, vol. 92, no. 1, 2015.

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[36] **P. Schindler**, M. Mueller, D. Nigg, J. T. Barreiro, E. A. Martinez, M. Hennrich, T. Monz, S. Diehl, P. Zoller, and R. Blatt, "Quantum simulation of dynamical maps with trapped ions," *Nature Physics*, vol. 9, no. 6, pp. 361–367, 2013.

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[44] B. P. Lanyon, C. Hempel, D. Nigg, M. Mueller, R. Gerritsma, F. Zaehringer, **P. Schindler**, J. T. Barreiro, M. Rambach, G. Kirchmair, M. Hennrich, P. Zoller, R. Blatt, and C. F. Roos, "Universal digital quantum simulation with trapped ions," *Science*, vol. 334, no. 6052, pp. 57–61, 2011.

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[48] T. Monz, K. Kim, A. S. Villar, **P. Schindler**, M. Chwalla, M. Riebe, C. F. Roos, H. Haeffner, W. Haensel, M. Hennrich, and R. Blatt, "Realization of universal ion-trap quantum computation with decoherence-free qubits," *Physical Review Letters*, vol. 103, no. 20, 2009.

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[52] M. Riebe, K. Kim, **P. Schindler**, T. Monz, P. O. Schmidt, T. K. Koerber, W. Haensel, H. Haeffner, C. F. Roos, and R. Blatt, "Process tomography of ion trap quantum gates," *Physical Review Letters*, vol. 97, no. 22, 2006.

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