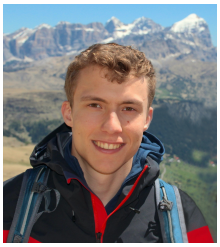
Dominik Lentrodt

Postdoctoral researcher



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Educational history & Employment

2021– **Postdoctoral researcher, Georg H. Endress Postdoctoral Fellow**, *Physikalisches Institut, Albert-Ludwigs-Universität Freiburg*, Freiburg, Germany.

2017–2021 **PhD (Dr. rer. nat.)**, *Max-Planck-Institut für Kernphysik*, Heidelberg, Germany.
Title of thesis: Ab initio approaches to x-ray cavity QED
Advisor: apl. Prof. Dr. Jörg Evers
Secondary advisors: Prof. Dr. Christoph H. Keitel, Prof. Dr. Thomas Pfeifer
Date of disputation: 13. Oktober 2021
Grade: summa cum laude

2016–2017 **4+4 Program of the Heidelberg Graduate School for Fundamental Physics**, *Max-Planck-Institut für Kernphysik and University of Heidelberg*, Heidelberg, Germany.

2012–2016 **MSc & BA Hons Physics**, *Gonville and Caius College, University of Cambridge*, Cambridge, UK.

2009–2012 **German Abitur**, *Maria-Theresia Gymnasium*, Munich, Germany.

2010–2011 **Frühstudium Informatik**, *Technical University of Munich*, Munich, Germany.

Relevant awards and funding

2021 **Georg H. Endress Postdoctoral Fellowship**, *Georg H. Endress Postdoc Cluster, Freiburg University & Basel University*.
Competitive fellowship funding three years of independent research as part of a postdoc cluster in collaboration with groups at Freiburg & Basel University.

2018 **XXV International Summer School Nicolás Cabrera scholarship**, *Instituto Nicolás Cabrera at the Universidad Autónoma de Madrid*.
Value approx. 400€.

2018 **RACIRI Summer School scholarship**, *Röntgen-Angström-Cluster (RAC), Ioffe-Röntgen-Institute (IRI) & German electron synchrotron (DESY)*.
Value approx. 1500€.

2016 **IMPRS-QD PhD Fellowship**, *International Max Planck Research School for Quantum dynamics*, Heidelberg, Germany.

2016 **Summer research project**, *University of Cambridge*, Cambridge, UK.

2013–2016 **Gonville and Caius College Scholar**, *University of Cambridge*, Cambridge, UK.
Yearly prize for continued academic excellence.

2015 **Gonville and Caius College Bell-Wade Bursary**, *University of Cambridge*, Cambridge, UK.
Financial support for students succesfully performing in academia and sports.

Leadership roles and outreach

2018–2021 **Student Representative of the International Max-Planck Research School for Quantum Dynamics in Physics, Chemistry and Biology (IMPRS-QD)**.
Representing interests of the student body (∼40 students) at board meetings and in the candidate selection process. Organized lab tours for new students, a seminar series to practice PhD defense presentations and various social events.

2018–2019 **Organising Committee of the 12th HGSFP Winterschool**.
A committee of five students elected to organise the yearly winterschool funded by the Heidelberg Graduate School for Fundemental Physics (HGSFP). Financial volume of ∼27000€.

2017–2019 **Outreach at the Max Planck Institute for Nuclear Physics**.
Jointly organised the "Girls day" and two other outreach projects at the Max Planck Institute for Nuclear Physics, which involved teaching students and children about the physics of light in interactive experiments.

2014–2015 **Cambridge University Kickboxing Society Committee: Treasurer**.
Responsible for a financial volume of ∼1000 GBP.

Teaching experience

2021 **Selected topics in modern physics, Tutor to class of 10**, *University of Freiburg*.
Novel course format for education students with emphasis on relevant topics for physics taught in highschools. Helped co-design exercises and course structure.
∼12 hours of lessons + preparation, exercise design & correction and feedback meetings.

2017 **Theoretical quantum optics, Head tutor and tutor to class of 8**, *University of Heidelberg*.
Theoretical quantum optics including advanced topics
∼12 hours of lessons + preparation, exercise correction and co-conducting oral examinations.

2017 **Experimental physics I (PEPI), Tutor to class of 22**, *University of Heidelberg*.
Mechanics and Thermodynamics
∼12 hours of lessons + preparation, exercise correction and grading exams.

2017-2019 **Various replacement teaching**, *University of Heidelberg*.
Replacement lectures and tutorials for apl. Prof. Dr. Jörg Evers. ∼4 hours of lecturing theoretical quantum optics. ∼6 hours of tutoring experimental and theoretical physics courses.

Students

2022– **Lucas Weitzel Dutra Souto**, *PhD Student at University of Freiburg*.
Role: Main supervising role (Official PhD advisor: Prof. Dr. Andreas Buchleitner)

2020–2021 **Oliver Diekmann**, *Master Student at Max Planck Institute for Nuclear Physics*.
Role: Co-supervision (Main supervisor: apl. Prof. Dr. Jörg Evers)

Languages

German Mother tongue

English Fluent; 4 years of undergraduate studies at an English university

Programming

Python, MATLAB, C++, Java

Scientific proposals and large-scale facility experiments

2019–2022 **Co-proposer and Co-investigator of Proposal No. 2628 submitted to the European XFEL (Hamburg)**, *Proposal title: "Multiphoton Collective Lambshift in Nuclear Resonant Scattering"*.
Experiment conducted May 2022.

2018–2019 **Co-proposer and Co-investigator of Proposal I-20180786 at PETRA III (Hamburg)**, *Proposal title: "Optimizing resonant photon flux enhancement with yoctosecond phase stability in mechanically controlled nuclear resonance scattering"*.
Experiment conducted May 2019.

2016–2022 **Co-investigator of 7 experiments at PETRA III (Hamburg) and ESRF (Grenoble)**.
Resulting in two refereed publications (publication 1 & 4) and articles in preparation.

Peer reviewing

Reviewer for Physics Reports, Nanophotonics, New Journal of Physics, Scientific Reports

Publications

Published in refereed journals

1. K. P. Heeg, A. Kaldun, C. Strohm, P. Reiser, C. Ott, R. Subramanian, D. Lentrodt, J. Haber, H.-C. Wille, S. Goerttler, R. Rüffer, C. H. Keitel, R. Röhlsberger, T. Pfeifer and J. Evers, "Spectral narrowing of x-ray pulses for precision spectroscopy with nuclear resonances", *Science* **357**, 375-378 (2017).
2. D. Lentrodt and J. Evers, "Ab Initio Few-Mode Theory for Quantum Potential Scattering Problems", *Phys. Rev. X* **10**, 011008 (2020).
3. D. Lentrodt, K. P. Heeg, C. H. Keitel and J. Evers, "Ab initio quantum models for thin-film X-ray cavity QED with Mössbauer nuclei", *Phys. Rev. Research* **2**, 023396 (2020).

4. K. P. Heeg, A. Kaldun, C. Strohm, P. Reiser, C. Ott, R. Subramanian, D. Lentrodt, J. Haber, H.-C. Wille, S. Goerttler, R. Rüffer, C. H. Keitel, R. Röhlsberger, T. Pfeifer and J. Evers, "Coherent x-ray-optical control of nuclear excitons with zeptosecond phase-stability", *Nature* **590**, 401–404 (2021).
5. O. Diekmann, D. Lentrodt and J. Evers, "Inverse design approach to x-ray quantum optics with Mössbauer nuclei in thin-film cavities", *Phys. Rev. A* **105**, 013715 (2022).

Theses

t1 D. Lentrodt, "Ab initio approaches to x-ray cavity QED – From multi-mode theory to nonlinear dynamics of Mössbauer nuclei", *PhD Thesis*, Heidelberg University (2021).

Preprints/Submitted

p1 D. Lentrodt, O. Diekmann, C. H. Keitel, S. Rotter, and J. Evers, "Certifying multi-mode light-matter interaction in lossy resonators", *arXiv:2107.11775 [quant-ph]*.

p2 O. Diekmann, D. Lentrodt and J. Evers, "Inverse design in nuclear quantum optics: From artificial x-ray multi-level schemes to spectral observables", *arXiv:2205.06586 [quant-ph]*.

In Preparation

p3 D. Lentrodt, C. H. Keitel, J. Evers et al., "Nonlinear excitation of Mössbauer nuclei in thin-film cavities by focussed x-ray pulses", *in preparation*.

p4 M. Gerharz, D. Lentrodt et al., "Fast resonant adaptive x-ray optics via mechanically-induced refractive-index control", *in preparation*.

Presentations

Invited Conference Talks

Sep. 2022 **FRIAS Junior Researcher Conference - Quantum Control of Complex Systems**, Freiburg, Germany,
Multi-mode quantum optics in lossy resonators
Invited by: Dr. Edoardo Carion, Andreas Woitzik, Frieder Lindel

Apr. 2022 **14th Annual Meeting Photonic Devices (AMPD2022)**, Berlin, Germany,
Multi-mode quantum optics in lossy resonators
Invited by: Prof. Dr. Sven Burger, Dr. Felix Binkowski

Sep. 2021 **ICAME 2021 - International Conference on the Applications of the Mössbauer Effect**, Brasov, Romania,
Progress in the Theory of X-ray Quantum Optics with Mössbauer Nuclei
Invited by: Prof. Dr. Victor Kuncser

Jan. 2020 **41st Extreme Atomic Systems (EAS) conference**, Rietzlern, Kleinwalsertal, Austria,
Ab initio few-mode theory
Invited by: Prof. Dr. Thomas Pfeifer

Sep. 2019 **QSEC 2019**, Heidelberg, Germany,
Ab initio few-mode theory for quantum potential scattering problems
Invited by: Conference committee

July 2019 **LPHYS'19 - 28th annual International Laser Physics Workshop**, Gyeongju, South Korea
Coherent X-Ray-Optical Control of Nuclear Dynamics with Zeptosecond Phase-Stability
Invited by: Prof. Dr. Olga Kocharovskaya

Feb. 2019 **40th Extreme Atomic Systems (EAS) conference**, Rietzlern, Kleinwalsertal, Austria,
X-ray Quantum Optics with Mössbauer Nuclei
Invited by: Prof. Dr. Thomas Pfeifer

Invited Seminar Talks/Colloquia

Jan. 2022 **Kaffeepalaver**, Seminar talk at Max Planck Institute for Nuclear Physics, Heidelberg, Germany
X-ray cavity QED with Mössbauer nuclei

Nov. 2021 **Haverkort Group Seminar**, University of Heidelberg, Germany
X-ray cavity QED with Mössbauer nuclei
Hosts: Prof. Dr. Maurits W. Haverkort

Okt. 2019 **Seminarium Fizyki Materii Skondensowanej**, University of Warsaw, Warsaw, Poland
Ab initio few-mode theories for quantum potential scattering problems
Hosts: Dr. habil. Magdalena Stobińska, Dr. Thomas Sturges

May 2019 **MPSD Theory Seminar**, Max-Planck-Institut für Struktur und Dynamik der Materie, Center for Free-Electron Laser Science, Hamburg, Germany
Ab initio few-mode theories for quantum potential scattering problems
Hosts: Prof. Dr. Angel Rubio, Dr. Michael Ruggenthaler

Feb. 2019 **Quantum Optics and Statistics Colloquium**, Albert-Ludwigs-Universität Freiburg, Freiburg, Germany,
Ab initio few-mode theories for quantum potential scattering problems
Hosts: Prof. Dr. Andreas Buchleitner, Dr. Stefan Buhmann

Nov. 2018 **ITP Seminar**, Institute for Theoretical Physics, Vienna University of Technology, Vienna, Austria
Effective few-mode theories for ab initio cavity QED
Hosts: Prof. Dr. Stefan Rotter, Dr. Himadri Shekhar Dhar

Contributed Talks/Other Talks

July 2022 **CCPQ Windsor 2022**, Cumberland Lodge, Windsor, UK
Quantum optical few-mode models for lossy resonators

July 2019 **LPHYS'19 - 28th annual International Laser Physics Workshop**, Gyeongju, South Korea
Ab Initio Few-Mode Theories for Quantum Potential Scattering Problems

Mar. 2019 **DPG Spring Meeting for Atomic, Molecular, Quantum Optical and Plasma Physics**, Rostock, Germany
Ab initio few-mode Hamiltonians for cavity QED

Nov. 2018 **CQD Colloquium - IMPRS-QD Pretalk**, Center for Quantum Dynamics, Heidelberg University, Heidelberg, Germany
Effective few-mode theories for resonant quantum scattering problems

May 2018 **Evaluation of the International Max Planck Research School for Quantum Dynamics in Physics, Chemistry and Biology - Student Talk**, MPI für Kernphysik, Heidelberg, Germany
X-ray quantum optics with Mössbauer nuclei

Mar. 2018 **DPG Spring Meeting for Atomic, Molecular, Quantum Optical and Plasma Physics**, Erlangen, Germany
Linking ab initio theory and phenomenological models in cavity QED

Jan. 2018 **Seminar Theoretical Quantum Dynamics**, MPI für Kernphysik, Heidelberg, Germany
Effective few-mode theories for quantum scattering problems in X-ray cavity QED

Posters

Sep. 2019 **QSEC 2019**, Heidelberg, Germany
Ab initio few-mode theory for quantum potential scattering problems

Mar. 2019 **DPG Spring Meeting for Atomic, Molecular, Quantum Optical and Plasma Physics**, Rostock, Germany
Beyond input-output models in X-ray cavity QED with overlapping modes

Sep. 2018 **XXV International Summer School Nicolás Cabrera**, Miraflores de la Sierra, Madrid, Spain
X-ray cavity QED in the overlapping modes regime

Aug. 2018 **RACIRI Summer School**, Sellin, Rügen, Germany
X-ray cavity QED with Mössbauer nuclei in the overlapping modes regime

May 2018 **SFB 1225 ISOQUANT Workshop**, Heidelberg, Germany
Effective few-mode theories for quantum potential scattering in X-ray cavity QED

Mar. 2018 **DPG Spring Meeting for Atomic, Molecular, Quantum Optical and Plasma Physics**, Erlangen, Germany
X-ray cavity QED beyond the input-output formalism

Jan. 2018 **11th Winterschool of the Heidelberg Graduate School for Fundamental Physics**, Obergurgl, Austria
Effective few-mode theories for quantum scattering problems in X-ray cavity QED

Dez. 2017 **Center for Quantum Dynamics Colloquium**, Ruprecht-Karls University, Heidelberg, Germany
Cavity QED beyond the input-output formalism

Mar. 2017 **DPG Spring Meeting for Atomic, Molecular, Quantum Optical and Plasma Physics**, Mainz, Germany
Collective sensing at x-ray energies

Feb. 2017 **SFB 1225 ISOQUANT Kick-Off Workshop**, Obergurgl, Austria
Many-body dynamics of large ensembles of nuclei