

CURRICULUM VITAE

PERSONAL INFORMATION

Name: Arthur Christianen

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Date & Place of birth: 4 February 1996, Nijmegen, the Netherlands



EMPLOYMENT

Nov. 2026: Junior Group Leader at IQOQI Innsbruck,
Austrian Academy of Sciences (ÖAW), Few & Many-Body Quantum Theory Group

April 2024- Oct.2026: Postdoctoral fellow, ETH Zürich
*Institute for Theoretical Physics and Institute for Quantum Electronics,
Groups of prof. Eugene Demler and Ataç İmamoğlu*

Dec. 2023 – March 2024: Postdoctoral researcher, Max Planck Institute of Quantum Optics Theory Division, led by prof. J. Ignacio Cirac

EDUCATION

Oct. 2019- Nov. 2023: PhD in Physics, Max Planck Institute of Quantum Optics
Degree awarding institution: Technical University of Munich, *summa cum laude*
Supervisors: prof. J. Ignacio Cirac and prof. Richard Schmidt

Sep. 2017- July 2019: Master in physics, Radboud University (Nijmegen, the Netherlands)
Specialization: Physics of Molecules and Materials (GPA 9.7/10)
Thesis in the Theoretical Chemistry group, supervisor: prof. Gerrit C. Groenenboom

Aug. 2015- Sep. 2017: Honours Program of the Faculty of Science, Radboud University
Thesis in the Theoretical Chemistry group, supervisor: prof. Gerrit C. Groenenboom

Sep. 2014- Aug. 2017: Bachelor Physics and Astronomy, Radboud University (GPA 9.5/10)

Sep. 2014- Aug. 2017: Bachelor Chemistry, Radboud University (GPA 9.2/10)

RESEARCH VISITS

6 June 2022 – 15 July 2022: Visitor at JILA (Boulder, Colorado, United States)
Groups of prof. John Bohn and prof. Ana Maria Rey

6 April- 9 June 2017: Visiting Research Student, University of British Columbia (Vancouver, Canada)
Group of prof. Roman V. Krems, Department of Chemistry

RESEARCH INTERESTS

My research bridges **atomic and molecular physics, condensed matter, quantum optics, and theoretical chemistry**. Taking an interdisciplinary approach, I combine concepts from these fields to gain new insights. As a theorist, I focus on controlled quantum many-body systems, including **ultracold gases and two-dimensional semiconductors**. My work explores the **interplay between few- and many-body quantum physics**, seeking to understand complex phenomena from the fundamental principles of **scattering theory**.

A natural step in the progression from few- to many-body physics is the **polaron problem** of an impurity particle immersed in a quantum bath. Polarons represent the density imbalanced limit of **complex quantum mixtures**, providing key insights into their phase diagram. Moreover, polarons can serve as powerful sensors of the bath properties; for example, in two-dimensional semiconductors **excitons polarons** are used as **optical probes for strongly correlated electronic states**. To describe these systems, I predominantly employ **variational techniques**, drawing inspiration from quantum chemistry.

For full publication list, see Google Scholar: <https://scholar.google.nl/citations?user=-H7OL98AAAAJ&hl=nl>

Identifying the photoinduced loss mechanism of ultracold molecules

The field of ultracold molecules was long hindered by an unexplained collisional loss of supposedly non-reactive species. In our work, we identified a key mechanism responsible for this loss: photoexcitation of long-lived collision complexes by the trapping laser [1]. This conclusion was based on detailed modeling of molecular interaction potentials, calculations of the lifetimes of the collision-complexes, and estimates of their photoexcitation rates [1]. Within a year of our theoretical prediction, this mechanism was confirmed experimentally (*Nat. Phys.* 16 (2020) 1132; *Phys. Rev. Lett.* 124 (2020) 163402). I co-authored a review [2] summarizing these developments, including our further experimental and theoretical progress, and highlighting remaining open questions.

[1] [A. Christianen](#), M. W. Zwierlein, G. C. Groenenboom, T. Karman, *Photoinduced Two-Body Loss of Ultracold Molecules*, *Phys. Rev. Lett.* 123, 123402(2019)

[2] R. Bause, [A. Christianen](#), A. Schindewolf, I. Bloch, X.-Y. Luo, *Ultracold Sticky collisions: Theoretical and Experimental Status*, *J. Phys. Chem. A* 127, 729 (2023)

Phase diagram for Bose polarons and discovery of halo trimer in Bose Fermi mixtures

Many-body dressing of impurities in a Bose-Einstein condensate, or Bose polarons, leads to interesting higher-order correlations. Earlier theoretical works gave conflicting predictions for the polaronic ground-state properties at strong coupling. We achieved a unified theoretical understanding of this problem [3], by developing a novel variational approach that allowed us to determine the ground-state character of the Bose as a function of the relevant parameters. We further predicted a qualitatively novel phenomenon: the local collapse of the BEC due to impurity-mediated interactions originating from the Efimov effect [4].

In collaboration with the world-leading Zwierlein group at MIT, we revealed that their Bose polaron spectra show evidence for the formation of BEC-induced coherent dimer-trimer superpositions [5]. Trimers of this type had not been observed before, and our theoretical work directly prompted the subsequent experimental discovery of this novel halo trimer state in a Bose-Fermi mixture [6].

[3] [A. Christianen](#), J. I. Cirac, R. Schmidt, *Phase diagram for strong-coupling Bose polarons*, *SciPost Physics* 16, 067 (2024)

[4] [A. Christianen](#), J. I. Cirac, R. Schmidt, *Chemistry of a light impurity in a Bose-Einstein condensate*, *Phys. Rev. Lett.* 128, 183401 (2022)

[5] A.Y. Chuang*, H. Q. Bui*, [A. Christianen*](#), Y. Zhang, Y. Ni, D. Ahmed-Braun, C. Robens, M. Zwierlein, *Observation of a Halo Trimer in an Ultracold Bose-Fermi Mixture*, *Phys. Rev. X* 15, 021098 (2025)

[6] C. Robens*, [A. Christianen*](#), A. Y. Chuang*, H. Q. Bui, Y. Zhang, R. Schmidt, M. Zwierlein, *Polaronic hybridization of atoms, dimers and trimers in a Bose-Einstein condensate*, *arXiv:2606.20440* (2026)

Exciton-electron interactions in 2D semiconductors

Exciton spectroscopy provides a powerful probe for correlated electronic states in 2D semiconductors. One such correlated state is a Wigner crystal, where electrons spontaneously crystallize. In our experimental [7] and theoretical [8] works, we show that excitons cannot only probe the existence of Wigner crystals, but also probe their vibrational excitations. Aside from addressing many-body signatures in exciton spectra, I also elucidated the nature of exciton-electron bound states, showing that they have a previously unexpected internal structure, both for ground-state [9] and Rydberg excitons [10].

[7] L. Zhang, L. Gu, H.S. Adlong, [A. Christianen](#), E. Dizer, R. Ni, R. Ma, S. Park, H. Jang, T. Taniguchi, K. Watanabe, I. Esterlis, R. Schmidt, A. Imamoglu, Y. Zhou, *Wigner polarons probe the dynamics of a Wigner crystal in a monolayer semiconductor*, *Nat. Phys.* (2026)

[8] H.S. Adlong, E. Dizer, R. Schmidt, A. Imamoglu, [A. Christianen](#), *Microscopic Model of Exciton Polarons in 2D Wigner Crystals*, *Phys. Rev. Lett.* 137, 076503 (2026)

[9] [A. Christianen](#), A. İmamoğlu, *Asymmetric trions in monolayer transition metal dichalcogenides*, *arXiv:2507.16643* (2025)

[10] [A. Christianen](#), A. M. Seiler, A. Tüngen, A. İmamoğlu, *Interactions of electrons and Rydberg excitons in two-dimensional semiconductors*, *arXiv:2512.06893* (2025)

AWARDS

2024: MCQST PhD Award

The MCQST (Munich Center for Quantum Science and Technology) PhD Award annually honours two outstanding PhD theses from the MCQST community, highlighting excellence in research at an early career stage and encouraging awardees to pursue a further career in science.

2023: ETH Zurich Postdoctoral Fellowship, amount: CHF 235,300 ≈ €240,000

Fellowship program by ETH Zurich to foster young researchers who have already demonstrated scientific excellence in the early stages of their careers. Duration: 2 years, starting date: 01.04.2024.

2022: Quantum Alliance PhD conference Presentation Award

Awarded by public vote for the best presentation at the Quantum Alliance PhD conference 2022.

2019: Shell Graduation Prize for Physics

Awarded by the Royal Dutch Society of Science (KHMW)s for the best 3 Master theses in physics in the Netherlands.

2018: Institute of Molecules and Materials (IMM) Presentation Award

Awarded by the Institute of Molecules and Materials (IMM) at the Radboud University for the best presentation in the theme ‘Structure and Dynamics of Molecules’ at its yearly sIMMposium.

2016: Young Talent Award, for the best first year physics student of the Radboud University

Awarded by the Royal Dutch Society of Sciences (KHMW).

2014: Socrates Award, for the best high school student in the Netherlands

Awarded by the Socrates association for excellent students.

OLYMPIAD RESULTS

International

International University Physics Olympiad (PLANCKS)

12th place (Bucharest, 2016), 1st place (Zagreb, 2018) and 5th place (Odense, 2019)

International Physics Olympiad (IPHO)

2x Bronze medallist (Copenhagen, 2013 and Astana, 2014)

National (the Netherlands)

Dutch University Physics Olympiad (PION)

3rd place (2015), 1st place (2016), 1st place (2018), and 1st place (2019)

Dutch National Physics Olympiad

10th place (2012), 2nd place (2013) and 1st place (2014)

SUPERVISION

Co-supervision of PhD students:

Haydn Adlong (ETH Zürich, ongoing). Eugen Dizer (Heidelberg University, ongoing)

Co-supervision of Master students:

Friederike Bartels (ETH Zürich, 2025-2026), Zheng Liu (ETH Zürich, 2025-2026), Qi Hu (ETH Zürich, 2024), Sandra Coll-Vinent (MPI of Quantum Optics, 2020-2021)

Co-supervision of Bachelor students:

Zied Jaber (MPI of Quantum Optics, 2023), David van 't Wout (Radboud University, 2018), Youp Caris (Radboud University, 2018), Rudo Brus (Radboud University, 2018)

PRESENTATIONS

In reverse chronological order, internal group seminars are not mentioned

1. *Understanding and probing correlated matter using polarons (invited talk)*
Collaboration Meeting on slow dynamics in heavy-light mixtures of cold atoms, (06.03.2026, Tübingen)
2. *Sticky collisions of ultracold molecules (Winter school lectures)*
Haikou Winter School on Fundamentals and Frontiers of Ultracold Atoms and Molecules (08.12.2025)
3. *Halo trimers and dimer-trimer superpositions in ultracold Bose-Fermi mixtures (invited talk)*
Haikou Winter School on Fundamentals and Frontiers of Ultracold Atoms and Molecules (08.12.2025)
4. *From few-to many-body physics in ultracold gases (Winter school lecture series)*
HGSFP Winter School for Heidelberg graduate students (23-27.11.2025, Obergurgl)
5. *Excitons in 2D Semiconductors: Probing Complex Phases with Few-Body Physics (invited talk)*
ETH Quantum Center Retreat (10.07.2025, Davos)
6. *BCS-to-BEC crossover with ultracold fermionic molecules: a polaron perspective*
(contributed talk)
Workshop on Ultracold Molecules, Warsaw (26.06.2025)
7. *Trimers and polarons in ultracold mixtures (invited seminar)*
Atominstitut, Technical University of Vienna (26.10.2024)
8. *Chemistry in a quantum medium: Bose polarons and the Efimov effect (invited talk)*
Future of ultracold an ultrafast dynamics workshop (Dresden, 22.10.2024)
9. *Spectroscopy of trimers and polarons in ultracold mixtures (invited talk)*
IMAMPC'2024, (09.07.24, Warsaw)
10. *Chemistry in a quantum medium (prize talk)*
MCQST conference (17.05.24, Sonthofen)
11. *Chemistry in a quantum medium, Bose polaron in ultracold gases (invited seminar)*
Theory of Quantum systems and Complex systems group seminar, University of Antwerp (12.02.24)
12. *Scattering in a quantum medium: A Gaussian-state approach (invited seminar)*
Centre for Theoretical Physics seminar, Polish Academy of Sciences (26.04.23, Warsaw)
13. *The birth and death of ultracold molecules (invited seminar)*
Quantum Molecular Systems group seminar, University of Warsaw (26.04.23)
14. *The Bose polaron and the Efimov effect (Seminar)*
Quantum Monte Carlo group seminar, Universitat Politècnica de Catalunya (24.04.2023, Barcelona)
15. *The strong-coupling Bose polaron (Contributed talk),*
ICFO-IMPRS joint workshop, (20.04.23, Castelldefells)
16. *Chemistry in a quantum medium: the Bose polaron and the Efimov effect, (invited seminar)*
Coherence and Quantum Technology group seminar, Technical University of Eindhoven (28.10.2022)
17. *Chemistry in a quantum medium (seminar)*
Theoretical Chemistry and Spectroscopy of Cold Molecules, Radboud University (25.10.2022, Nijmegen)
18. *Crossover from few- to many-body physics: The Efimov effect and the Bose polaron (seminar)*
JILA Science seminar (23.06.22, Boulder)
19. *From a polaron into a cluster: The fate of an impurity in a BEC (contributed talk)*
DAMOP Annual meeting, (01.06.2022, Orlando)
20. *Quantum physics and chemistry with ultracold atoms (broad audience talk),*
Quantum Alliance PhD conference (25.04.2022, Munich)
21. *Chemistry of a light impurity in a BEC (invited talk),*
DPG SAMOP Spring meeting (17.03.2022, online)
22. *Crossover from few-to many-body physics: The Efimov effect and the Bose polaron (Invited colloquium)*
Center of Complex Quantum Systems, Aarhus University (27.01.2022, online)
23. *A QWIZ quiz: chemistry of polarons in cold gases (Contributed talk & Poster)*
IMPRS-ETH workshop QWIZ, special talk in the form of a quiz (14.09.2021, online)
24. *Chemistry of the light Bose polaron (Contributed talk & Poster)*
IMPRS-Harvard summer school (13.07.2021, online)
25. *Crossover from few-to many-body physics: Efimov physics and the Bose polaron (Contributed talk)*
DAMOP Annual meeting (2.06.2021, online)
26. *Crossover from few-to many-body physics: Efimov physics and the Bose polaron (Contributed talk)*
ICFO-IMPRS online workshop (24.03.2021, online)

27. *Photoinduced Two-Body Loss of Ultracold Molecules (Invited talk)*
Online workshop on collisions of ultracold molecules (10.12.2020, online)
28. *Photoinduced Two-Body Loss of Ultracold Molecules (Contributed talk)*
Workshop: Towards Dipolar Physics with Ultracold Molecules (19.11.2019, Durham)
29. *Unraveling the trap loss mechanism in ultracold diatomic gases (Contributed talk)*
Symposium of the Institute of Molecules and Materials, Radboud University (30.10.2018, Nijmegen)

POSTER PRESENTATIONS

1. *Halo trimers and dimer-trimer superpositions in ultracold mixtures*
BEC conference (09.09.2025, Sant Feliu de Guixols)
2. *Asymmetric trions in TMDs,*
Correlations and Topology in Moiré Materials (28.07.2025, Ascona)
3. *Asymmetric trions in TMDs,*
GRC: Topological and Correlated Matter (12.05.2025, Castelldefels)
4. *Halo trimers and dimer-trimer superpositions in ultracold mixtures*
ICAP conference (15.07.24, London)
5. *Strong-coupling Bose polarons: Molecule formation in a BEC*
Workshop on Ultracold mixtures: polarons and beyond (19.09.2023, Oxford)
6. *Strong-coupling Bose polarons: Molecule formation in a BEC*
BEC conference 2023 (11.09.2023, Sant Feliu de Guixols)
7. *Strong-coupling Bose polarons: Molecule formation in a BEC*
Workshop on Ultracold Molecules (06.09.2023, Warsaw)
8. *Simulating prethermalization using near-term quantum computers*
Workshop on Fermionic Quantum Simulation (14.08.2023, Obermarchtal)
9. *From a polaron into a cluster: The fate of an impurity in a BEC*
MCQST conference (20.06.2023, Sonthofen)
10. *From a polaron into a cluster: The fate of an impurity in a BEC*
EMMI Workshop on Long-Range Ultracold Interactions 2022 (07.09.2022, Innsbruck)
11. *From a polaron into a cluster: The fate of an impurity in a BEC*
ICAP conference (18.07.2022, Toronto)
12. *Chemistry of the light Bose polaron*
Munich Center for Quantum Science and Technology conference (19-23.07.2021, online)
13. *Crossover from few-to many-body physics: Efimov physics and the Bose polaron*
Munich Center for Quantum Science and Technology conference (6-8.07.2020, online)

ADDITIONAL ACTIVITIES

- Spring 2026:** Teaching assistant (Dissipative Quantum systems (Master level))
- Fall 2025** Teaching assistant (Classical simulation of quantum computing (Master level))
- 2025:** Member of the organization committee for the 2025 BEC conference
- 2023 -now:** Reviewer for Nature, Phys. Rev. Lett., Phys. Rev. A, Phys. Rev. Res.
- 2023:** Participant in MCQST Diversity in Leadership program
- 2023 &2024:** Jury member at German Young Physicists' Tournament, Regional Championship
- 2020-2022:** MPQ theory seminar organizer
- July 2021:** Mentor at MCQST Summer Student Program
- Spring 2021:** Teaching assistant (Quantum Mechanics (bachelor level))
- 2017-2019:** Board member of the Honours program of the Faculty of Science of Radboud University
- 2017-2019:** Chairman of NSBC Stuban

NSBC Stuban is the Nijmegen student badminton association, with circa 90 members

2016-2018: Trainer for NSBC Stuban

Dec. 2017: Volunteer at the International Junior Science Olympiad (IJSO)

2016-2017: Member of the organization committee of the PION

PION is the Dutch university physics Olympiad

2015-2016: Mentor for first year students and teaching assistant (Mechanics)