

# Curriculum vitae: Prof. Dr. Richard Schmidt

## Personal and Professional Information

<b>Position</b>	Full Professor (W3), Chair for Theoretical Physics
<b>Date of birth</b>	23. January 1982, married, two children
<b>Address</b>	Institute for Theoretical Physics, Heidelberg University, Philosophenweg 16, 69120 Heidelberg, Germany Email: <a href="mailto:richard.schmidt@thphys.uni-heidelberg.de">richard.schmidt@thphys.uni-heidelberg.de</a> Web: <a href="http://www.quantummatter.de">www.quantummatter.de</a>

## Professional Experience and Appointments

since 09/2022	Professor for Theoretical Physics, Heidelberg University, Germany
2021-2022	Associate Professor for Theoretical Physics, Aarhus University, Denmark
2020	Offer for Endowed Chair professor position at the University of Oklahoma and the Center for Quantum Science and Research, Norman, USA (declined)
June-Oct 2020	Paternity Leave
since 2018	Independent Max Planck Research Group Leader (W2; from Nov. 2021 part-time) Max Planck Institute of Quantum Optics, Garching (Germany)
2017	Pauli Center Visiting Fellow and Research Associate ETH Zürich, Zurich (Switzerland)
2016-2017	Research Associate in the Condensed Matter Theory Group Harvard University, Cambridge (USA)
2013-2016	ITAMP Postdoctoral Fellow at the Harvard-Smithsonian Center of Astrophysics Harvard University, Cambridge (USA)

## Education

2009-2013	PhD studies in theoretical physics - Grade: "with distinction" (highest grade) Thesis title: "From few- to many-body physics with ultracold atoms" Advisor: Prof. W. Zwerger Technische Universität München (Germany)
2002-2009	Diploma studies in physics - Grade: 1.0 (highest grade) Thesis title: "Trion Formation in Ultracold Fermi Gases" Advisor: Prof. C. Wetterich Universität Heidelberg (Germany)

## Scientific Profile

<b>Publication overview</b>	Author of 59 publications and 5 preprints (29 first author or PI), including: 1 Nature, 1 Science, 1 Nature Physics, 5 Phys. Rev. X, 1 Nature Communications, 9 Phys. Rev. Lett., 1 Review in Rep. Prog. Phys., 1 popular science article in Physik in unserer Zeit, and 1 invited book contribution for the Royal Chemical Society Total citations: > 4000 — h-index: 33 ( <a href="#">Google Scholar</a> ), Average citations per publication: 65
<b>Talks and Lecture series</b>	More than 130 invited talks, seminars, and colloquia, including invited plenary talks at DAMOP, ICPEAC, DFG Spring Meeting; Invited lecture series at Tsinghua University (China); ITAMP Winterschool (USA); Graduate Days Hamburg (Germany)
<b>Scientific Interests</b>	Condensed matter theory • 2D Materials • Quantum Optical Systems Quantum Gases • Semiconductor physics • Quantum Simulation • Polarons Quantum Dynamics • Few-body and scattering physics • Quantum field theory Functional renormalization group • Functional Determinants

**Scientific Profile cont.****Main scientific achievements**

- Development of first-principle approach to exciton-electron scattering in atomically thin semiconductors (2020)
- First description of Fermi-polaron induced optical gain in 2D materials (2020)
- Theoretical model of Bose polaron dynamics at finite temperature (2019)
- Development of theory of Rydberg polarons, Rydberg excitations dressed by molecular bound states (2016-17) [observation at Rice University in 2018]
- Development of a new computational Functional Determinant Approach to predict molecular absorption line shapes for large bound complexes (2016)
- First description of rotating molecules in superfluid Helium nanodroplets in terms of quasiparticles (2015); Development of angulon theory (2016)
- First description and prediction of emergence of strong coupling Bose polarons in ultracold atoms; derivation of new many-body Hamiltonian (2013) [experimental observation at JILA, MIT, Aarhus in 2016-2019]
- First theoretical prediction of repulsive polarons in Fermi gases (2011) [experimental observation in ultracold atoms in 2012, and in 2D materials in 2017]
- First complete model of the Efimov effect close to Feshbach resonances; prediction of three-body parameter (2012) [observation at JILA in 2019]
- Development of new computational functional renormalization group tool to predict correlation functions with full frequency and momentum dependence (2011)
- First exact functional RG solution of the quantum three-body problem (2009)

**Awards, Honours, and Fellowships**

- 2018 Independent Max Planck Research Group Leader  
Awarded by the Max Planck Society in an international, open-topic call with free choice of institute; yearly typically five positions are awarded across all subject areas of Chemistry, Physics and Technology
- 2017 Visiting Fellow of the Pauli Center for Theoretical Physics, ETH Zürich (Switzerland)
- 2013 Postdoctoral Fellowship of the National Science Foundation (USA)  
Institute for Theoretical Atomic, Molecular and Optical Physics (ITAMP)  
Yearly one distinguished full-time postdoctoral position is awarded in an international call
- 2005 Fellowship of the Baden-Württemberg Foundation

## Research management, service to profession, memberships

### Committee Work

- 2019-2022 Member of Executive Committee  
Munich Excellence Cluster “Munich Center of Quantum Science and Technology”
- 2019-2022 Diversity Representative of the International Max Planck Research School of  
Quantum Science and Technology (IMPRS QST)
- 2018-2021 Member of Steering Committee of the IMPRS QST
- 2014-2016 Member of the Harvard Physics Research Scholar Committee

### Organization of Conferences, Workshops, Colloquia, and related events

- 2019-2021 Organizer of Munich Excellence Cluster MCQST colloquium series (confirmed speak-  
ers include: John Preskill, Erez Berg, Claudia Felser, Mikhail Lukin, Atac Imamoglu,  
Lieven Vandersypen, Kang-Kuen Ni, Markus Aspelmeyer)
- 2019 Organisator of the ASC-CENS workshop “Many-body physics with cold atoms and  
beyond” held in Munich, Germany; 90 participants (speakers included: Anthony  
Leggett, Matthew Fisher, Gianni Blatter, Eugene Demler, Markus Greiner, Martin  
Zwierlein), September 5-6, 2019
- 2017 Co-Organisator of the “ITAMP-IST Workshop on Quantum Impurities in Atomic,  
Condensed-Matter and Chemical Systems” jointly funded by the IST Austria and  
ITAMP, Cambridge, USA; held in Klosterneuburg, Austria, August 16-18, 2017
- 2016 Organizer of Harvard Physics Department Postdoc Training Panel Discussion  
“Jobs in Academia: application, interviews, and negotiations”
- 2015-2016 Organizer of 3rd and 4th Annual Harvard Physics Department Research Scholar  
Retreat
- 2014-2015 Organizer of ITAMP Topical Discussions Seminar

### Outreach

- 2019 Public outreach lecture for visiting delegation of the Canadian Consulate:  
“Exploring universal quantum matter in cold atoms and atomically thin  
semiconductors”
- 2016 Co-Organizer of Science Day for young high school students:  
John Hopkins Center for Talented Youth, Family Academic Programs Science and  
Technology Series at ITAMP, Cambridge (USA)

**Reviewer** European Commission (ERC), Israel Science Foundation, Swiss Science Foundation,  
German Science Foundation, Poland Nat. Science Center, Dutch Research Council

**Referee** Nature, Physical Review X, Physical Review Letters, Physical Review A, Science  
Advances, New Journal of Physics, Journal of Chemical Physics, European Physical  
Journal B, Journal of Physics A, Nanomaterials, Physics Letters A, European Phys.  
Jour. Plus, njp Quantum Materials, Canadian Journal of Physics, SciPost

### Memberships

- Munich Quantum Center ([www.munich-quantum-center.de](http://www.munich-quantum-center.de))
- Munich2DMaterials Initiative ([www.munich2dmaterials.de](http://www.munich2dmaterials.de))
- German Physical Society
- American Physical Society

## Publications

### Reviews

65. R. Schmidt, M. Knap, D. A. Ivanov, J.-S. You, M. Cetina and E. Demler  
Universal many-body response of heavy impurities coupled to a Fermi sea: a review of recent progress,  
Rep. Prog. Phys. 81, 024401 (2018).
64. S. Floerchinger, S. Moroz, and R. Schmidt,  
Efimov Physics from the Functional Renormalization Group,  
Few-body Syst. 51, 153 (2011).

### Peer-Reviewed Book contributions

63. M. Lemeshko, and R. Schmidt,  
Molecular impurities interacting with a many-particle environment: from ultracold gases to helium nanodroplets,  
Chapter in "Cold Chemistry: Molecular Scattering and Reactivity Near Absolute Zero", edited by A. Osterwalder and O. Dulieu  
Royal Society of Chemistry (2017).

### Preprints

62. A. Christianen, J. I. Cirac, R. Schmidt  
Phase diagram for strong-coupling Bose polarons,  
arXiv:2306.09075 (2023).
61. M. Gievers, M. Wagner, R. Schmidt  
Probing polaron clouds by Rydberg atom spectroscopy,  
arXiv:2306.03627 (2023).
60. LB Tan, OK Diessel, A Popert, R Schmidt, A Imamoglu, M Kroner  
Bose polaron interactions in a cavity-coupled monolayer semiconductor  
arXiv:2212.11145 (2022).
59. O. K. Diessel, J. von Milczewski, A. Christianen, R. Schmidt  
Probing molecular spectral functions and unconventional pairing using Raman spectroscopy  
arXiv:2209.11758 (2022).
58. I. N. Cherepanov, G. Bighin, L. Christiansen, A. V. Jørgensen, R. Schmidt,  
H. Stapelfeldt, M. Lemeshko  
Far-from-equilibrium dynamics of angular momentum in a quantum many-particle system,  
arXiv:1906.12238 (2019).

**Publications cont.****Peer-Reviewed Articles**

57. R Li, J von Milczewski, A Imamoglu, R Ołdziejewski, R Schmidt, Impurity-induced pairing in two-dimensional Fermi gases, *Phys. Rev. B* 107, 155135 (2023).
56. M. Duda, X. Y. Chen, A. Schindewolf, R. Bause, J. von Milczewski, R. Schmidt, I. Bloch, X. Y. Luo  
Transition from a polaronic condensate to a degenerate Fermi gas of heteronuclear molecules, *Nature Physics* 19, 720 (2023).
55. Z Zeng, E Yakaboylu, M Lemeshko, T Shi, R Schmidt  
Variational theory of angulons and their rotational spectroscopy *J. Chem. Phys.* 158, 134301 (2023).
54. I. Amelio, N. Drummond, E. Demler, R. Schmidt, A. Imamoglu  
Polaron spectroscopy of a bilayer excitonic insulator, *Phys. Rev. B* 107, 155303 (2023).
53. S. Tiwari, F. Engel, M. Wagner, R. Schmidt, F. Meinert, S. Wüster  
Dynamics of atoms within atoms, *New Journal of Physics* 24, 073005 (2022).
52. R. Ołdziejewski, A. Chiocchetta, J. Knörzer, R. Schmidt  
Excitonic Tonks-Girardeau and charge-density wave phases in monolayer semiconductors, *Phys. Rev. B* 106, 081412 (2022).
51. C. Kuhlenkamp, M. Knap, M. Wagner, R. Schmidt, A. Imamoglu  
Tunable Feshbach resonances and their spectral signatures in bilayer semiconductors, *Phys. Rev. Lett.* 129, 037401 (2022).
50. R. Schmidt, T. Enss  
Self-stabilized Bose polarons, *SciPost Physics* 13, 054 (2022).
49. A. Christianen, J. I. Cirac, R. Schmidt  
Chemistry of a light impurity in a Bose-Einstein Condensate, *Phys. Rev. Lett.* 128, 183401 (2022).
48. A. Christianen, J. I. Cirac, R. Schmidt  
Bose polaron and the Efimov effect: A Gaussian-state approach, *Phys. Rev. A* 105, 053302 (2022).  
[Editor's suggestion]
47. J. von Milczewski, F. Rose, R. Schmidt  
Functional renormalization group approach to strongly-coupled Bose-Fermi mixtures in two dimensions, *Phys. Rev. A* 105, 013317 (2022).
46. F. Rose, R. Schmidt  
Disorder in order: Localization without randomness in a cold-atom system, *Phys. Rev. A* 105, 013324 (2022).
45. Y. Shimazaki, C. Kuhlenkamp, I. Schwartz, T. Smolenski, K. Watanabe, T. Taniguchi, M. Kroner, R. Schmidt, M. Knap, A. Imamoglu  
Optical Signatures of Periodic Charge Distribution in a Mott-like Correlated Insulator State, *Phys. Rev. X* 11, 021027 (2021).

**Publications cont.**

44. A. Imamoglu, O. Cotlet, R. Schmidt  
Exciton-polarons in two-dimensional semiconductors and the Tavis-Cummings model,  
Comptes Rendus. Physique 22, 1 (2021).
43. G. E. Astrakharchik, L. A. Peña Ardila, R. Schmidt, K. Jachymski, A. Negretti  
Ionic polaron in a Bose-Einstein condensate,  
Communications Physics 4, 94 (2021).
42. N. E. Guenther, R. Schmidt, G. M. Bruun, V. Gurarie, P. Massignan  
Mobile impurity in a Bose-Einstein condensate and the orthogonality catastrophe,  
Phys. Rev. A 103, 013317 (2021).
41. T. Wasak, R. Schmidt, F. Piazza  
Quantum-Zeno Fermi polaron in the strong dissipation limit,  
Phys. Rev. Research 3, 013086 (2021).
40. G. Ness, C. Shkedrov, Y. Florshaim, O. K. Diessel, J. von Milczewski, R. Schmidt, Y. Sagi  
Observation of a smooth polaron-molecule transition in a degenerate Fermi gas,  
Phys. Rev. X 10, 041019 (2020).
39. P. P. Mazza, R. Schmidt, I. Lesanovsky  
Vibrational dressing in kinetically constrained spin systems,  
Phys. Rev. Lett. 125, 033602 (2020).
38. L. B. Tan, O. Cotlet, A. Bergschneider, R. Schmidt, P. Back, Y. Shimazaki, M. Kroner,  
A. Imamoglu,  
Interacting Polaron-Polaritons,  
Phys. Rev. X 10, 021011 (2020).
37. C. Fey, P. Schmelcher, A. Imamoglu, R. Schmidt,  
Theory of exciton-electron scattering in atomically thin semiconductors,  
Phys. Rev. B 101, 195417 (2020).  
[Editor's suggestion]
36. D. Dzotjan, R. Schmidt, M. Fleischhauer,  
Dynamical variational approach to Bose polarons at finite temperatures,  
Phys. Rev. Lett. 124, 223401(2020).
35. J. Sous, H. R. Sadeghpour, T. C. Killian, E. Demler, R. Schmidt,  
Rydberg impurity in a Fermi gas: Quantum statistics and rotational blockade,  
Phys. Rev. Research 2, 023021 (2020).
34. X. Li, E. Yakaboylu, G. Bighin, R. Schmidt, M. Lemeshko, A. Deuchert  
Intermolecular forces and correlations mediated by a phonon bath,  
J. Chem. Phys. 152, 164302 (2020).
33. J. Knörzer, M. J. A. Schuetz, G. Giedke, D. S. Wild, K. De Greve, R. Schmidt, M. D. Lukin,  
J. I. Cirac,  
Wigner Crystals in Two-Dimensional Transition-Metal Dichalcogenides: Spin Physics  
and Readout,  
Phys. Rev. B 101, 125101 (2020).  
[Editor's suggestion]
32. Y. Ashida, T. Shi, R. Schmidt, H. R. Sadeghpour, J. I. Cirac, E. Demler,  
Quantum Rydberg Central Spin Model,  
Phys. Phys. Lett. 123, 183001 (2019).  
[Editor's suggestion]

## Publications cont.

31. J. Klein, M. Lorke, M. Florian, F. Sigger, J. Wierzbowski, J. Cerne, K. Müller, T. Taniguchi, K. Watanabe, U. Wurstbauer, M. Kaniber, M. Knap, R. Schmidt, J. J. Finley, A. W. Holleitner, Atomistic defect states as quantum emitters in monolayer MoS<sub>2</sub>, Nature Communications 10, 2755 (2019).

News Coverage:

[Science Daily](#), [chemie.de](#), [Inovacao Technologica](#), [phys.org](#), [Electronics Weekly](#)

30. J. D. Whalen, S. K. Kanungo, R. Ding, M. Wagner, R. Schmidt, H. R. Sadeghpour, S. Yoshida, J. Burgdörfer, F. B. Dunning, and T. C. Killian, Probing nonlocal spatial correlations in quantum gases with ultra-long-range Rydberg molecules, Phys. Rev. A 100, 011402(R) (2019).
29. Y. Ashida, T. Shi, R. Schmidt, H. R. Sadeghpour, J. I. Cirac, E. Demler, Efficient variational approach to dynamics of a spatially extended bosonic Kondo model, Phys. Phys. A 100, 043618 (2019). [Editor's suggestion]
28. J.-S. You, R. Schmidt, D. A. Ivanov, M. Knap, E. Demler, Atomtronics with a spin: statistics of spin transport and non-equilibrium orthogonality catastrophe in cold quantum gases, Phys. Phys. B 99, 214505 (2019).
27. O. Cotlet, F. Pientka, R. Schmidt, G. Zarand, E. Demler, A. Imamoglu, Transport of neutral optical excitations using electric fields Phys. Rev. X 9, 041019 (2019).
26. R. Schmidt, F. Camargo, J. D. Whalen, R. Ding, G. Woehl Junior, S. Yoshida, J. Burgdörfer, F. B. Dunning, E. Demler, H. R. Sadeghpour, and T.C. Killian, Theory of excitation of Rydberg polarons in an atomic quantum gas, Phys. Rev. A 97, 022707 (2018).
- Wikipedia article: [Rydberg polarons](#)
25. Y. Ashida, R. Schmidt, L. Tarruell, and E. Demler, Many-body interferometry of magnetic polaron dynamics, Phys. Rev. B 97, 060302 (Rapid Communication) (2018).
- News Coverage:  
Research highlight in Nature Physics: [Nature.com](#)
24. F. Camargo, R. Schmidt, J. D. Whalen, R. Ding, G. Woehl Junior, S. Yoshida, J. Burgdörfer, F. B. Dunning, H. R. Sadeghpour, E. Demler, and T.C. Killian, Creation of Rydberg Polarons in a Bose Gas, Phys. Rev. Lett. 120, 083401 (2018).
- News Coverage:  
[National Geographic](#), [Forbes Magazine](#), [Pro Physik](#), [Ars Technica](#), [Space Daily](#), [International Business Times](#), [Chem Views](#), [Yahoo News](#), [Science Daily](#), [Eurek Alert](#), [The Independent UK](#), [Life Science](#), [News Week](#), [chemie.de](#), [ChemEurope.com](#), [APA](#), [Der Standard](#), [Austria](#), [Gizmodo](#), [phys.org](#)  
For an overview see: [altmetric.com](#)
- Altmetric Attention Score:  
- [Top 64 of 27920](#) of all articles ever published by the Physical Review Letters  
- In the [top 1% of all research outputs](#) ever tracked by Altmetric (January 13, 2019)



**Publications cont.**

23. C. Langmack, R. Schmidt, and W. Zwerger,  
Efimov states near a Feshbach resonance and the limits of van der Waals universality at finite background scattering length,  
*Phys. Rev. A* 97, 033623 (2018).
22. A. Mazurenko, C. S. Chiu, G. J. Ji, M. F. Parsons, M. Kanasz-Nagy, R. Schmidt, F. Grusdt, E. Demler, D. Greif, and M. Greiner  
A cold-atom Fermi–Hubbard antiferromagnet,  
*Nature* 545, 462 (2017).  
News Coverage:  
[PhysicsWorld](#), [The Science Times](#), [phys.org](#), [The Harvard Gazette](#)  
News and Views by Thierry Giamarchi: [Nature.com](#)
21. K. Agarwal, R. Schmidt, B. Halperin, V. Oganesyan, G. Zarand, M. D. Lukin, E. Demler,  
Magnetic noise spectroscopy as a probe of local electronic correlations in two-dimensional systems,  
*Phys. Rev. B* 95, 155107 (2017).
20. J. M. Pawłowski, M. M. Scherer, R. Schmidt, and S. J. Wetzel,  
Functional Renormalization Group Flows and the Physics of Regulator Choice,  
*Ann. Phys.* 384, 165 (2017).
19. F. Grusdt, R. Schmidt, Y. Shchadilova, and E. Demler,  
Strong coupling Bose polarons in a BEC,  
*Phys. Rev. A* 96, 013607 (2017).
18. M. Cetina, M. Jag, R. S. Lous, I. Fritsche, J. T. M. Walraven, R. Grimm, J. Levinsen, M. M. Parish, R. Schmidt, M. Knap, and E. Demler,  
Ultrafast many-body interferometry of impurities coupled to a Fermi sea,  
*Science* 354, 96 (2016).  
News Coverage:  
[Phys.org](#), [Asian Scientist](#), [Space Daily](#), [Labo Online](#), [Chemie.de](#), [Le Scienze](#), [APA Austria](#), [R&D Mag](#), [News Week](#)
17. Y. Shchadilova, R. Schmidt, F. Grusdt, and E. Demler,  
Quantum dynamics of ultracold Bose polarons,  
*Phys. Rev. Lett.* 117, 113002 (2016).
16. R. Schmidt, H. Sadeghpour, and E. Demler,  
A mesoscopic Rydberg impurity in an atomic quantum gas,  
*Phys. Rev. Lett.* 116, 105302 (2016).
15. S. Markson, S. T. Rittenhouse, R. Schmidt, J. P. Shaffer, and H. R. Sadeghpour,  
Theory of ultralong-range Rydberg molecule formation incorporating spin-dependent relativistic effects: Cs(6s)–Cs(np) as case study,  
*ChemPhysChem* 17, 3683 (2016).
14. R. Schmidt, and M. Leshko,  
Deformation of a quantum many-particle system by a rotating impurity,  
*Phys. Rev. X* 6, 011012 (2016).  
News coverage:  
[EurekAlert](#), [Phys.org](#), [SpaceDaily.com](#), [ScienceDaily.com](#), [APA Austria](#)  
See also viewpoint in Physics: [A new angle on Quantum Impurities](#)



**Publications cont.**

13. B. Midya, M. Tomza, R. Schmidt, and M. Lemeshko,  
Rotation of cold molecular ions inside a Bose-Einstein condensate,  
Phys. Rev. A 94, 041601 (Rapid Communication) (2016).
12. R. Schmidt, and M. Lemeshko,  
Rotation of Quantum Impurities in the Presence of a Many-Body Environment,  
Phys. Rev. Lett. 114, 203001 (2015).  
[Editor's suggestion]  
  
Article on Wikipedia: [Quasiparticles](#)
11. S. P. Rath, and R. Schmidt,  
Field-theoretical study of the Bose polaron,  
Phys. Rev. A 88, 053632 (2013).
10. R. Schmidt, S. P. Rath, and W. Zwerger,  
Efimov physics beyond universality,  
Eur. Phys. J. B 85, 386 (2012).
9. R. Schmidt, T. Enss, V. Pietilä, and E. Demler,  
Fermi polarons in two dimensions,  
Phys. Rev. A 85, 021602 (Rapid Communication) (2012).
8. R. Schmidt, and T. Enss,  
Excitation spectra and rf response near the polaron-to-molecule transition from the  
functional renormalization group,  
Phys. Rev. A 83, 063620 (2011).
7. R. Schmidt, and S. Moroz,  
Renormalization-group study of the four-body problem,  
Phys. Rev. A 81, 052709 (2010).
6. S. Moroz, and R. Schmidt,  
Nonrelativistic inverse square potential, scale anomaly, and complex extension,  
Ann. Phys. 325, 491 (2010).
5. R. Schmidt, and S. Moroz,  
Functional renormalization-group approach to the four-body problem,  
EPJ Web of Conf. 3, 19th International IUPAP Conference on Few-Body Problems in  
Physics (2010).
4. S. Floerchinger, R. Schmidt, and C. Wetterich,  
Three-body loss in lithium from functional renormalization,  
Phys. Rev. A 79, 053633 (2009).
3. S. Moroz, S. Floerchinger, R. Schmidt, and C. Wetterich,  
Efimov effect from functional renormalization,  
Phys. Rev. A 79, 042705 (2009).
2. S. Floerchinger, R. Schmidt, S. Moroz, and C. Wetterich,  
Functional renormalization for trion formation in ultracold fermion gases,  
Phys. Rev. A 79, 013603 (2009).

**Popular Science Articles**

1. R. Schmidt, and M. Knap,  
Quasiteilchen in Zeitlupe,  
Physik in unserer Zeit 48, 6 (2017).