FABIAN RENNECKE

Curriculum Vitae

(Updated: July 5, 2026)

Institute for Theoretical Physics
Justus Liebig University Giessen
Heinrich-Buff-Ring 16
35392 Giessen, Germany

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Research Interests

- **Phase structure of Quantum Chromodynamics**
  QCD at high density – moat regime and pattern formation – confinement and chiral symmetry breaking – thermodynamics and transport phenomena
- **Phenomenology of heavy-ion collisions**
  particle correlations – signatures of exotic phases at high density – dilepton spectra
- **Topological aspects of strongly interacting matter**
  axial anomaly – higher topological charge effects – axion dark matter – anomalous correlations
- **Nonperturbative methods in quantum field theory**
  functional renormalization group techniques – effective field theories – semi-classical path integral methods – large-N and mean-field approximations
- **Critical phenomena**
  Yang-Lee edge singularities – critical physics of QCD and QCD-like theories

Research Experience

since 09/2021 — **Habilitation Position** (6 years, non-tenured)
Institute for Theoretical Physics, University of Giessen, Germany
Group: Lorenz von Smekal

10/2017 – 08/2021 — **Research Associate**
Physics Department, Brookhaven National Laboratory, USA
Group: Nuclear Theory Group
Until 9/2019: *Research Fellow of the German Research Foundation (DFG)*
Host: Robert D. Pisarski

9/2016 – 9/2017 — **Postdoctoral Researcher**
Institute for Theoretical Physics, Heidelberg University, Germany
Groups: Jan M. Pawlowski and Stefan Floerchinger

8/2015 – 8/2016 — **Postdoctoral Researcher**
Institute for Theoretical Physics, University of Giessen, Germany
Group: Bernd-Jochen Schaefer

6/2014 – 9/2014 — **Visiting Researcher**
Physics Department, Brookhaven National Laboratory, USA
Host: Robert D. Pisarski

Education

2012 – 2015 **Dr. rer. nat. (Ph.D.) in Physics,** Heidelberg University, Germany
Thesis: *The Chiral Phase Transition of QCD*
Advisor: Jan M. Pawlowski

2006 – 2012 **Diplom (M.Sc.) in Physics,** Heidelberg University, Germany
Thesis: *Renormalization Group Study of the Chiral Phase Transition in QCD*
Advisor: Jan M. Pawlowski

Funding and Grants

1/2026 – 6/2029 **Project leader**
Collaborative Research Center TransRegio CRC-TR 211 "Strong-interaction matter under extreme conditions" [Link]
Project: *Inhomogeneous phases at high density (A03)*

10/2017 – 9/2019 **Research Fellowship** (“Forschungsstipendium”)
German Research Foundation (DFG)
Project: *Signatures of the QCD Phase Diagram* [Link]

5/2014 – 8/2014 **Research Grant** “HGS-HIRe Abroad”
Helmholtz Graduate School for Hadron and Ion Research (HGS-HIRe)

2/2012 – 7/2015 **Ph.D. Scholarship**
Helmholtz Graduate School for Hadron and Ion Research (HGS-HIRe)

Publications

44 publications, 2517 citations, h-index: 27 (as of July 5, 2026; source: [INSPIRE])

Selected publications:

- *Dilepton production from moaton quasiparticles*
  Z. Nussinov, M. C. Ogilvie, L. Pannullo, R. D. Pisarski, **F. Rennecke**, S. T. Schindler and M. Winstel
  Phys. Rev. Letters 135, 101904, arXiv:2410.22418 (2024)
- *Conjectures about the Chiral Phase Transition in QCD from Anomalous Multi-Instanton Interactions*
  R. D. Pisarski and **F. Rennecke**
  Phys. Rev. Letters 132, 251903, arXiv:2401.06130 (2024)
- *Particle Interferometry in a Moat Regime*
  F. Rennecke, R. D. Pisarski and D. H. Rischke
  Phys. Rev. D 107, 116011, arXiv:2301.11484 (2023)
- *Signatures of Moat Regimes in Heavy-Ion Collisions*
  R. D. Pisarski and **F. Rennecke**
  Phys. Rev. Letters 127, 152302, arXiv:2103.06890 (2021)
- *Universal location of the Yang-Lee edge singularity in O(N) theories*
  A. Connelly, G. Johnson, **F. Rennecke** and V. Skokov
  Phys. Rev. Letters 125, 191602, arXiv:2006.12541 (2020)

- *Higher Topological Charge and the QCD Vacuum*
  F. Rennecke
  Phys. Rev. Research, 2, 033359, arXiv:2003.13876 (2020)
- *Multi-Instanton Contributions to Anomalous Quark Interactions*
  R. D. Pisarski and **F. Rennecke**
  Phys. Rev. D 101, 114019, arXiv:1910.14052 (2019)
- *The QCD Phase Structure at Finite Temperature and Density*
  W.-j. Fu, J. M. Pawlowski and **F. Rennecke**
  Phys. Rev. D 101, 054032, arXiv:1909.02991 (2019)
- *Strangeness Neutrality and Baryon-Strangeness Correlations*
  W.-j. Fu, J. M. Pawlowski and **F. Rennecke**
  Phys. Rev. D 100, 111501(R), arXiv:1809.01594 (2018)
- *In-Medium Spectral Functions of Vector- and Axial-Vector Mesons*
  C. Jung, **F. Rennecke**, R.-A. Tripolt, L. von Smekal and J. Wambach
  Phys. Rev. D 95, 036020, arXiv:1610.08754 (2016)
- *Vacuum Structure of Vector Mesons in QCD*
  F. Rennecke
  Phys. Rev. D 92, 076012, arXiv:1504.03585 (2015)
- *From Quarks and Gluons to Hadrons: Chiral Symmetry Breaking in Dynamical QCD*
  J. Braun, L. Fister, J. M. Pawlowski and **F. Rennecke**
  Phys. Rev. D 94, 034016, arXiv:1412.1045 (2014)

A complete list of publications can be found under:
http://inspirehep.net/author/profile/Fabian.Rennecke.1

Talks and Seminars

66 talks in total, 24 invited/plenary talks at conferences and workshops, 15 invited seminar talks and colloquia

Invited/plenary talks at workshops and conferences (since 2020):

22/05/2026	*Fluctuation signals of the CEP (and beyond)* 18th Workshop on Particle Correlations and Femtoscopy (WPCF2026) Budapest, Hungary
19/09/2025	*Hot and dense QCD from functional methods* International School of Nuclear Physics Erice, Italy
09/09/2025	*Universality of the Yang-Lee edge singularity and its applications* Analytic structure of QCD and Yang-Lee edge singularity ECT* Trento, Italy
11/04/2025	*QCD phase diagram & equation of state: a functional perspective* XXXI International Conference on Ultra-relativistic Nucleus-Nucleus Collisions (Quark Matter 2025) Frankfurt, Germany
14/03/2025	*New insights into the QCD phase diagram* Spring Meeting of the German Physical Society (DPG) Cologne, Germany

16/08/2024 *The QCD phase structure and its signatures from functional approaches*
Strong and Electro-Weak Matter 2024 (SEWM 2024)
Frankfurt, Germany

19/08/2024 *The QCD phase structure and its signatures from functional approaches*
The XVIth Quark Confinement and the Hadron Spectrum Conference (QCHSC 2024)
Cairns, Australia

17/07/2024 *Mixing, moats and modulations in dense QCD matter*
The 20th International Conference on QCD in Extreme Conditions (XQCD 2024)
Lanzhou, China

15/07/2024 *Mixing, moats and modulations in dense QCD matter*
2nd Symposium on Intermediate-energy Heavy Ion Collisions (iHIC 2024)
Tsinghua University, Beijing, China

30/05/2024 *Topological Effects & their Phenomenology*
Non-Perturbative and Topological Aspects of QCD
CERN, Switzerland

24/04/2024 *Mixing, Moats and Modulations in Dense QCD Matter*
ELEMENTS Annual Conference 2024
Frankfurt, Germany

21/02/2024 *Nuclear Matter Properties at High muB*
Probing Dense Baryonic Matter with Hadrons II: FAIR Phase-0
GSI, Darmstadt, Germany

22/05/2023 *Correlations in a Moat Regime*
From First-Principles QCD to Experiments
ECT* Trento, Italy

08/11/2021 *Moat Regimes & their Signatures in Heavy-Ion Collisions*
XXXIII International Workshop on High Energy Physics
Kurchatov Institute, Protvino, Russia (online)

09/09/2021 *Higher Topological Charge Effects in QCD and Beyond*
Topological Aspects of Strong Correlations and Gauge Theories
International Centre for Theoretical Sciences, Bengaluru, India (online)

16/11/2020 *The Functional RG: Universality and Emergence*
Renormalization Group Approaches to the Many-Body Problem,
Institute for Nuclear Theory, Seattle, USA (online)

03/11/2020 *QCD from an FRG Perspective*
10th International Conference on the Exact Renormalization Group (ERG 2020)
Kyoto University, Japan (online)

Supervision and Teaching

Supervision of students:

8/2026 – present PhD thesis supervision of **Michael Sacks**,
University of Giessen, Germany,
Thesis (preliminary title): *Analytic structure of Lifshitz points*

8/2026 – present	PhD thesis supervision of **Shant Baghouzian**, University of Giessen, Germany, Thesis (preliminary title): *Exotic phases in dense QCD matter*
2/2026 – present	Master's thesis supervision of **Domenico Artese**, University of Giessen, Germany, Thesis (preliminary title): *Real time properties of the moat regime*
3/2025 – present	Master's thesis co-supervision (with C. Höhne) of **Johanna Scharf**, University of Giessen, Germany, Thesis (preliminary title): *The moat regime in heavy-ion collisions*
3/2025 – 7/2026	Master's thesis supervision of **Simon Schute**, University of Giessen, Germany, Thesis: *Universality of the chiral phase transition*
6/2020 – 6/2023	Ph.D. co-supervision (with V. Skokov) of **Gregory Johnson**, North Carolina State University, USA, Thesis: *The Universal Location of The Yang Lee Edge Singularity for $O(N)$ Universality Classes*
3/2023 – 4/2023	Research internship supervision of **Timothy Herl**, University of Giessen, Germany Topic: *Yang-Lee edge singularities and the Columbia plot*
3/2022 – 9/2022	Bachelor's thesis supervision of **Maximilian Hänsch**, University of Giessen, Germany, Thesis: *Analytic Structure of Effective Low-Energy Models of QCD*
8/2015 – 7/2016	Master's thesis co-supervision (with B.-J. Schaefer) of **Simon Resch**, University of Giessen, Germany, Thesis: *Mass Sensitivity of the QCD Phase Structure*

Postdocs:

4/2024 – 6/2026	**Shi Yin**, Humboldt Research Fellow

Lectures:

Summer term 2026	*Quantum Field Theory*, University of Giessen, Germany
Winter term 25/26	*Advanced Quantum Mechanics*, University of Giessen, Germany
Summer term 2025	*Quantum Field Theory*, University of Giessen, Germany
Winter term 24/25	*Advanced Quantum Mechanics*, University of Giessen, Germany
Winter term 23/24	*Advanced Quantum Field Theory*, University of Giessen, Germany
10/2023	*The Functional Renormalization Group, Critical Phenomena & QCD*, Joint CRC-TR 211 & HGS-HIRe Lecture Week (invited lecture), Rauischholzhausen, Germany
09/2023	*The Functional Renormalization Group and Critical Phenomena*, CRC 1225 IsoQuant YRC Retreat (invited lecture), Baiersbronn, Germany

04/2022	*Dense Strongly Interacting Matter*, HGSFP Graduate Days (invited lecture), Heidelberg University, Germany
Summer term 2016	*The Theory of Electrodynamics and Thermodynamics* (substitute), University of Giessen, Germany
Winter term 15/16	*The Theory of Thermodynamics* (substitute), University of Giessen, Germany

Collaborations

since 09/2021	**Member and project leader** (since 01/2026) Collaborative Research Center TransRegio CRC-TR 211 "Strong-interaction matter under extreme conditions" [Link], German Research Foundation (DFG)
since 2016	**Co-founder and board member** *Functional QCD Collaboration (fQCD)* [Link],

Academic Service

- **Organizer:** *12th International Conference on the Exact Renormalization Group (ERG2024)*, Conference in Les Diablerets, Switzerland (∼130 participants), co-organized with L. Classen, N. Defenu and L. Zambelli (22 – 27/09/2024)
- **Organizer:** *Functional Methods in Strongly Correlated Systems (FunSCS)*, Workshop in Hirschegg, Austria (38 participants), co-organized with M. Buballa and N. Wink
(22 – 26/05/2023)
- **Organizer:** *FunQCD*, Hybrid Workshop in Valencia, Spain (97 participants), co-organized with C. Aguilar, D. Ibanez, J. Papavassiliou, J. M. Pawlowski and R. D. Pisarski (13– 17/04/2022)
- **Organizer:** Weekly seminar *Lunch Club*, Institute for Theoretical Physics, University of Giessen, Germany (09/2021 – present)
- **Organizer:** *FunQCD: from first principles to effective theories*, Online Workshop (156 participants), co-organized with C. Aguilar, J. Papavassiliou, J. M. Pawlowski and R. D. Pisarski
(29/03 – 01/04/2021)
- **Organizer:** Weekly seminar *Cold Quantum Coffee*, Institute for Theoretical Physics, Heidelberg University, Germany (2012 – 2014)
- **Peer review:** Referee for Phys. Rev. Letters, Phys. Rev. C, Phys. Rev. D and Phys. Lett. B