Dr. rer. nat. David Maibach

Institute for Theoretical Physics
Philosophenweg 12
69120 Heidelberg, Germany

Email: d.maibach@web.de
Nationality: German
Website: davidmaibach.com

About me

My postdoctoral research at the University of Heidelberg focuses on **gravitational memory, analog models for gravity and cosmology**, as well as **black hole soft hairs**. Previously, I studied **modified gravity**, **mathematical aspects of gravitational waves, quantum properties of black holes, Dark matter, the LISA instrument**, and **cosmic (super-)strings.**

Experience

08/2025 - present
University of Heidelberg, Heidelberg, Germany
Independent Postdoctoral Researcher at the Institute for Theoretical Physics

Education

10/2021 - 07/2025
University of Heidelberg, Heidelberg, Germany
PhD student in Theoretical Physics (Summa Cum Laude)
Thesis: Across the Horizon: On Gravitational Wave Flux Laws and Tests of Gravity
Supervisor: Prof. Lavinia Heisenberg

02/2019 - 06/2021
Swiss Federal Institute of Technology (ETH Zurich), Zurich, Switzerland
Master of Science in Physics (with distinction)
Thesis: 21cm signatures of Cosmic (super-)strings
Supervisor: Prof. Robert Brandenberger

10/2015 - 10/2018
Karlsruhe Institute of Technology, Karlsruhe, Germany
Bachelor of Science in Physics (with distinction)
Thesis: Baryogenesis in singlet extensions of the standard model
Supervisor: Prof. Milada M. Mühlleitner

10/2014 - 04/2018
Karlsruhe Institute of Technology, Karlsruhe, Germany
Bachelor of Science in Industrial Engineering and Management
Thesis: How intraday hedging affects option returns
Supervisor: Prof. Marliese Uhrig-Homburg

Grants & Awards

2024
Exploratory Project - Modelling Dark Matter with Cold Atoms, Structures Cluster of Excellence (~154.000 Euros) - Postdoctoral fellowship for independent research on analog models of Dark Matter and beyond.

2023
Exploratory Project - Exploring Structure Formation through Gravitational Waves, Structures Cluster of Excellence (~154.000 Euros) - Project funding for research on the interplay between gravitational waves and early structures of the universe.

2022 – 2023
Travel Grant, Structures Cluster of Excellence (~10.000 Euros)

02/2019 – 02/2021
Full scholarship of the German Academic Exchange Service DAAD (~35.000 Euros) - Additional half-year extension because of exceptional academic performance

Publications

in preparation
Covariant Phase Space Approach Beyond General Relativity
D. Maibach, J. Zosso (ongoing project) **[project lead, main author]** - Derivation of a general formula for balance flux laws, i.e., conserved quantities at null infinity, for beyond-GR theories.

05/2025
Across the Horizon: On Gravitational Wave Flux Laws and Tests of Gravity
D. Maibach (PhD thesis, arXiv:2506.06783)

02/2025
Signatures of Quantum Gravity in Gravitational Wave Memory
N. Deppe, L. Heisenberg, L. E. Kidder, **D. Maibach**, *et al.* (Phys.Rev.D 112 (2025), 024016, arXiv:2502.20584) **[project lead, main author]** - Computation of (semi-)analytical corrections to the gravitational memory based on area quantization arguments.

10/2024	**Echos from Beyond: Detecting Gravitational Wave Quantum Imprints with LISA** N. Deppe, L. Heisenberg, H. Inchauspé, L. E. Kidder, **D. Maibach**, *et al.* (Phys.Rev.D 111 (2025), 124035, arXiv:2411.05645) **[project lead, main author]** - Evaluation of LISA's potential to detect the black hole echoes using a ready-to-use numerical analysis pipeline based on Bayesian inference.
02/2024	**Testing gravitational waveforms in full General Relativity** F. D'Ambrosio, F. Gozzini, L. Heisenberg, H. Inchauspé, **D. Maibach**, J. Zosso (JCAP 02 (2025) 060, arXiv:2402.19397) **[project lead, main author]** - Mode-by-mode assessment of numerical gravitational waveforms based on analytical constraint equations derived in full, nonlinear General Relativity.
02/2024	**Observing Kinematic Anisotropies of the Stochastic Background with LISA** L. Heisenberg, H. Inchauspé, **D. Maibach** (JCAP 01 (2025) 044, arXiv:2401.14849) **[co-author]** - Numerical evaluation of LISA's capabilities to detect the Stochastic Gravitational wave background using a real-data-suitable 3-year time domain LISA data analysis pipeline with an integrated Markov-Chain-Monte-Carlo approach.
09/2023	**Searching for Topological Dark Matter in LIGO data** L. Heisenberg, **D. Maibach**, D. Vesk (Phys.Rev.D 110 (2024) 5, 055037, arXiv:2309.05093) **[co-author]** - Analysis of Dark Matter features in gravitational wave interferometer data and comparison to existing non-allocated signals.
01/2022	**Gravitational Waves in Full, Non-Linear General Relativity** F. D'Ambrosio, S. Fell, L. Heisenberg, **D. Maibach**, S. Zentarra, J. Zosso (arXiv:2201.11634, Review) **[project lead, main author of chapters 5-8 & exercises]** - Review on analytical constraint equations for General Relativity asymptotically flat spacetimes, the BMS group, and radiative degrees of freedom at null infinity.
07/2021	**Extracting the signal of cosmic string wakes from 21-cm observations** **D.Maibach**, R. Brandenberger, D. Crichton, A. Refregier (Phys.Rev.D 104 (2021), 123535, arXiv:2107.07289) **[main author]** - Development of new detection methods of cosmic (super-)string features in 21-cm data, setting new benchmark on constraints on cosmic strings.

Research visits

06/2024	**ETH Zurich, Switzerland (Group of Prof. Defenu)**
11/2023	**Caltech, United States (Group of Prof. Vallisneri)**
10/2023 - 12/2023	**KITP at University of Santa Barbara, United States (multiple groups)**

Invited talks

05/2025	**LISA Community Call (online)**
02/2025	**Black Hole Mimickers: From Theory to Observation, Princeton Center for Theoretical Science, Princeton University (in person)**
07/2024	**15th International LISA Symposium, University of Dublin (in person)**
04/2024	**SXS Collaboration Webinar (online)**
11/2023	**CMB Constellation Seminar, KIPAC, Stanford (in person)**
11/2023	**INPA Seminar, LBNL, University of California Berkeley (in person)**
07/2023	**Quantum Gravity 2023, University of Nijmegen (in person)**

Outreach & extracurricular activities

2027	**"Analog Models: New Experimental Windows into Fundamental Theory" program at the Kavli Institute for Theoretical Physics, Santa Barbara** - Initiator and main coordinator of a large-scale 3-month international program
01/2025 - present	**Intellectual Pottery - Blog & Podcast** - Host and producer of a science-based interdisciplinary blog for curious explorers, https://intellectual-pottery.com/
01/2024 - present	**Reviewer for Progress in Physics, JCAP, PRD, CQG**
10/2023	**51st Graduate Days, Heidelberg Graduate School for Physics** - Organizer of a week-long workshop hosting various professional lectures
09/2023 - present	**LISA Cosmology Working Group Member, LISA Consortium**
07/2023	**Speaker for "Academic lunch break", organized by the STRUCTURES Excellence Cluster** - On fractal dimensions and their appearance
07/2023	**STRUCTURES Cluster of Excellence, STRUCTURES Day** - Organizer of a 3-day interdisciplinary conference

02/2023 - present	**Spokesperson for the Young Researcher Convent (YRC) of the STRUCTURES Excellence Cluster** - Representative for junior scientists within the Excellence Cluster, allocating traveling and conference budgets
2022 - 2023	**Joint Cosmology Seminar at the Institute for Theoretical Physics, University of Heidelberg** - Coordinator of talks and seminars held at the Institute
2019 – 2023	**Teaching assistant at ETH Zurich and University of Heidelberg** - General Relativity, Electrodynamics, Cosmology, and Astrophysics

Reference

Prof. Lavinia Heisenberg	email: l.heisenberg@thphys.uni-heidelberg.de
Prof. Robert Brandenberger	email: rhb@physics.mcgill.ca
Prof. Nicolo Defenu	email: ndefenu@phys.ethz.ch
Prof. Matthias Bartelmann	email: bartelmann@uni-heidelberg.de
Prof. Markus Oberthaler	email: oberthaler@kip.uni-heidelberg.de