Dennis Wörthmüller

Curriculum Vitae

Institut Curie
Physics of Cells and Cancer (UMR168)
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Research interests

membrane physics, finite element methods, continuum mechanics, cell mechanics, optogenetics, fluid mechanics, numerics of partial differential equations, stochastic and non-linear dynamics, coarse grained Brownian dynamics simulations, reaction-diffusion systems, protein assembly

Education

2018 – 2022 **PhD in physics**, *Ruprecht-Karls-Universität Heidelberg*, Germany
Specialization: Theoretical biophysics (cell mechanics, optogenetics)

2015 – 2018 **Master of science in physics**, *Ruprecht-Karls-Universität Heidelberg*, Germany
Specialization: Theoretical biophysics (Brownian dynamics of protein self-assembly)

2012 – 2015 **Bachelor of science in physics**, *Ruprecht-Karls-Universität Heidelberg*, Germany
Specialization: Experimental particle physics (Bunch-crossing identification for ATLAS at the Large Hadron Collider (LHC, CERN))

Publications and Preprints

(*These authors contributed equally.)

Publications

Artur Ruppel*, Dennis Wörthmüller*, Vladimir Misiak, Manasi Kelkar, Irène Wang, Philippe Moreau, Adrien Méry, Jean Révilloud, Guillaume Charras, Giovanni Cappello, Thomas Boudou, Ulrich S. Schwarz, Martial Balland
Force propagation between epithelial cells depends on active coupling and mechano-structural polarization
PDF
https://doi.org/10.7554/eLife.83588

Santiago Gomez Melo*, Dennis Wörthmüller*, Pierre Gönczy, Niccolo Banterle and Ulrich S. Schwarz
Grand canonical Brownian dynamics simulations of adsorption and self-assembly of SAS-6 rings on a surface
PDF
https://doi.org/10.1063/5.0135349

Tomas Andersen*, Dennis Wörthmüller*, Dimitri Probst, Irène Wang, Philippe Moreau, V Fitzpatrick, Thomas Boudou, Ulrich S. Schwarz, Martial Balland
Cell size and actin architecture determine force generation in optogenetically activated cells
PDF
https://doi.org/10.1016/j.bpj.2023.01.011

Preprints

Dennis Wörthmüller, Falko Ziebert and Ulrich S. Schwarz
Modelling mechanochemical coupling in optogenetically activated cell layers
PDF
https://doi.org/10.1101/2025.06.30.662367

Dennis Wörthmüller, Gaetano Ferraro, Pierre Sens, Michele Castellana
IRENE: a fluId layeR finitE-elemeNt softwarE
https://doi.org/10.48550/arXiv.2506.17827

Research experience

2023- present **Postdoc**, *Institut Curie (PCC), UMR168 Physics of Cells and Cancer*, Paris, France
Research Advisors: Prof. Pierre Sens
Project: Pushing from within: control of cell shape, integrity and motility by cytoskeletal pushing forces
- Developing analytical and numerical models to investigate how cell-generated pushing forces shape adhesion-independent control of cell morphology, substrate interactions, and motility.

2022-2023 **Transition Postdoc**, *Institute for theoretical physics* , Heidelberg University, Germany
- Finalised and published open research projects

2018-2022 **PhD student**, *Institute for theoretical physics* , Heidelberg University, Germany
Research Advisors: Prof. Ulrich Schwarz and Dr. Falko Ziebert
Project: Finite Element Modeling of Optogenetic Control of Cell Contractility
- Developed research questions in collaboration with experimentalists to study force generation and force propagation in adherent adherent cells
- Developed and extended finite element approaches to simulate adherent cells as active elastic materials
- Analyzed experimental data and performed basic image processing
- Implemented discontinuous Galerkin methods to study interacting cell systems

2015-2018 **MSc student**, *Institute for theoretical physics* , Heidelberg University, Germany
Research Advisors: Prof. Ulrich Schwarz and Dr. Felix Frey
Project: Computer Simulations of SAS-6 Self-Assembly in Two Dimensions
- Developed research questions to study the self-assembly properties of SAS-6 proteins with focus on malformed structures
- Developed and implemented a force-based Brownian dynamics patchy particles simulation in two dimensions
- Implemented a rare-event (forward flux sampling) to quantify protein dissociation rates
- Conducted a statistical analysis of the simulation results

2012-2015 **BSc student**, *Kirchhoff institute for physics*, Heidelberg University, Germany
Research Advisors: Prof. Hans-Christian Schultz-Coulon, Dr. Rainer Stamen and Dr. Jan Jongmanns
Project: Kalibration eines verbesserten Algorithmus zur Identifikation der Strahlkreuzung saturierter Signale für den ATLAS Level-1 Kalorimeter-Trigger
- Analysed oscilloscope pulses to calibrate an algorithm used for Bunch-crossing identification of saturated signals in the PreProcessor of the ATLAS Level-1 Calorimeter Trigger at the Large Hadron Collider (LHC, CERN)

Conferences, Workshops, Talks and Posters

05/2025 **Active Matter: the synergy between Maths and Physics**, *Institut Poincaré, Paris*, France
- Poster title: *Active Gel on a Wavy Surface, Stresses and Instabilities*

10/2024 **Theory Group Seminar at Institut Curie**, *Paris*, France
- Talk: *Optogenetic control of cell contractility and force propagation in epithelial tissue*

04/2024 **Morphodynamics of Living Systems**, *Grande salle des séances of Institut de France, Paris*, France

11/2023 **Unraveling the Complexity: Decoding Cellular and Molecular Organization on Engineered Micropatterns and 3D Structures**, *Paris*, France

09/2022 **European Conference on Mathematical and Theoretical Biology**, *Heidelberg*, Germany
- Invited speaker at minisymposium on "Bridging scales between the cytoskeleton and tissue mechanics"
- Talk: Modeling optogenetic control of cell contractility and force propagation in epithelial tissue.

09/2019 **IWR School 2019, A Crash Course in Machine Learning with Applications in Natural- and Life Sciences** , *Heidelberg*, Germany

04/2019 **DPG Spring Meeting of the Condensed Matter Section (SKM)**, *Regensburg*, Germany
- Poster title: *Computer Simulations of SAS-6 Assembly on Surfaces*

03/2018 **DPG Spring Meeting of the Condensed Matter Section (SKM)**, *Berlin*, Germany

03/2018 **IFF Spring School: "Physics of Life"**, *Jülich*, Germany

Student supervision

Dec 2023 - present **Co-supervising PhD student**, *Institut Curie*,
Instructor: Prof. Pierre Sens
Student: Kristiana Mihali
Project: Actin-driven membrane instabilities
- Supported the student in developing the research question
- Assisted in solving problems related to programming
- Supervised and supported the student in preparing the manuscript

Dec 2020 - Dec 2021 **Supervising master's student**, *Heidelberg University*,
Instructor: Prof. Ulrich Schwarz
Student: Santiago Gomez Melo
Project: Grand Canonical Brownian Dynamics of SAS-6 Self-Assembly
- Introduced the student to my custom written simulation software.
- Assisted in solving problems related to the programming
- Supported the student in the development of a research question
- Published results in Journal of Chemical Physics together

Teaching experience

Oct 2022 - Mar 2023 **Teaching assistant**, *Heidelberg University*, *Theoretical physics V,* ***Statistical Physics***,
Instructor: Prof. Ulrich Schwarz, Heidelberg University
- Conducted tutorial sessions (ca. 90min) on different topics of theoretical statistical physics
- Corrected and evaluated assignments of ca. 10-20 people

Oct 2020 - Mar 2021 **Teaching assistant**, *Heidelberg University*, *Theoretical physics V,* ***Statistical Physics***,
Instructor: Prof. Ulrich Schwarz, Heidelberg University
- Conducted online tutorial sessions (ca. 90min) on different topics of theoretical statistical physics
- Corrected and evaluated assignments of ca. 10-20 people

Oct 2019 - Mar 2020 **Teaching assistant**, *Heidelberg University*, *Theoretical physics III,* ***Classical electrodynamics***,
Instructor: Prof. Ulrich Schwarz, Heidelberg University
- Conducted tutorial sessions (ca. 90min) on different topics of classical electrodynamics
- Corrected and evaluated assignments of ca. 10-20 people

Oct 2018 - Mar 2019 **Teaching assistant**, *Heidelberg University*, ***Continuum mechanics***,
Instructor: Prof. Ulrich Schwarz, Heidelberg University
- Created exercises for weekly problem sheets
- Conducted tutorial sessions (ca. 90min) on different topics of continuum mechanics
- Corrected and evaluated assignments of ca. 10-20 people

Oct 2017 - Mar 2018 **Teaching assistant**, *Heidelberg University*, *Theoretical physics I,* ***Classical mechanics and mathematical methods***,
Instructor: Prof. Luca Amendola, Heidelberg University
- Conducted tutorial sessions (ca. 90min) on different topics of classical mechanics and fundamental mathematical concepts
- Corrected and evaluated assignments of ca. 10-20 people

Apr - Oct 2017 **Teaching assistant**, *Heidelberg University*, *Theoretical physics IV,* ***Quantum mechanics***, Instructor: Prof. Matthias Bartelmann, Heidelberg University
- Conducted tutorial sessions (ca. 90min) on different topics of quantum mechanics
- Corrected and evaluated assignments of ca. 10-20 people

Oct 2016-Mar 2017 **Teaching assistant**, *Heidelberg University*, *Theoretical physics III,* ***Classical electrodynamics***, Instructor: Prof. Carlo Ewerz, Heidelberg University
- Conducted tutorial sessions (ca. 90min) on different topics of classical electrodynamics
- Corrected and evaluated assignments of ca. 10-20 people

2014,2015 **Teaching assistant**, *Ruprecht-Karls-Universität Heidelberg*, *Teaching for the beginner's physics labs*, Instructor: Dr. Jens Wagner, Heidelberg University
- Assisted students in learning physical measurement techniques and data evaluation of experiments.
- Corrected and evaluated lab protocols

Academic service

Peer-review Co-reviewer for Physical Review X (with Prof. Francois Graner)

Additional skills

programming *Python 3*, *C++*, *R*, *MATLAB*// Skilled in using the open-source cytoskeleton simulation suite **Cytosim** and advanced in finite element modeling with **FEniCS**; experienced in high-performance **computing on clusters** for large-scale simulations.

Languages German (native), english (fluent)

References

Prof. Dr. Pierre Sens,
Physics of Cells and Cancer UMR 168, Institut Curie
Postdoctoral Advisor
Email: pierre.sens@curie.fr

Prof. Dr. Ulrich Schwarz,
Institute for theoretical physics, Heidelberg University
PhD Supervisor
Email: schwarz@thphys.uni-heidelberg.de

Dr. Falko Ziebert,
Institute for theoretical physics, Heidelberg University
PhD Supervisor
Email: f.ziebert@thphys.uni-heidelberg.de

Prof. Dr. Martial Balland, Laboratoire Interdisciplinaire de Physique, Grenobles Alpes
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