

Dr. Felix Frey

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**Summary statement**

I am a theoretical physicist by training and I work primarily in the area of biophysics and soft matter. In particular, I study self-assembly, transport and remodeling processes at biomembranes with the ambition to develop a physical understanding of biological systems. I am trained in continuum modeling and I am working with particle-based mesoscale computer simulations in my current independent postdoc position. Therefore, I have acquired a unique skill-set that allows me to bridge scales.

Academic positions

- 2022 – present Independent NOMIS Postdoctoral fellow at the Institute of Science and Technology Austria (ISTA) with Anđela Šarić
- 2020 – 2022 Postdoc at the Department of Bionanoscience, Kavli Institute of Nanoscience, Delft University of Technology (TU Delft), in the group of Timon Idema
- 2019 – 2020 Postdoc at the Institute for Theoretical Physics, Heidelberg University, in the group of Ulrich Schwarz
- 2015 – 2019 PhD researcher at the Institute for Theoretical Physics, Heidelberg University, in the group of Ulrich Schwarz

Education

- 06/2019 PhD at the Institute for Theoretical Physics, Heidelberg University
Thesis title: *Physical models for uptake processes at the cell membrane*
Advisor: Ulrich Schwarz.
- 07/2015 Master of Science in Physics at Heidelberg University.
- 07/2012 Bachelor of Science in Physics at Heidelberg University.
- 06/2009 Abitur (A-level) at the Ludwig-Uhland-Gymnasium in Kirchheim unter Teck.

Fellowships and awards

- 2022 Independent NOMIS fellowship (fully funded independent 3-year Postdoc position, worth 242.000€)
- 2022 IST-BRIDGE fellowship (fully funded independent 2-year Postdoc position), funded from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 101034413 (declined)
- 2021 Kavli Synergy Grant (worth 50.000€)
- 2020 Among the six best dissertations at the Heidelberger Wilhelm-und-Else Heraeus dissertation prize for physics and astronomy
- 2018 Travel grant for the Biophysical Society Annual Meeting in San Francisco funded through the Excellence Initiative at Heidelberg University
- 2015 Full 3-year PhD fellowship of the Heidelberg Graduate School for Physics (HGSFP)
- 2009 School award of the German Physical Society (DPG)

Talks and posters at international conferences and seminars

7 invited talks, 10 contributed talks at international conferences, 5 seminar talks and 15 contributed posters (11/2024)

Invited talks at international conferences and seminars:

- 2024 Invitation for a talk at the *International Symposium on Membrane/Protein Interactions*, University of Chicago International Institute for Research in Paris
- 2024 Invitation for a talk at the *Young Investigator Mini Symposium at the Department of Biology at University of Erlangen-Nuremberg*, Erlangen
- 2023 Invitation for a talk at the symposium *Septins: biology meets physics* at TU Delft, Delft
- 2023 Invitation for a talk at the *DGZ Focus Workshop: Workgroup Membrane Trafficking and Molecular Motors*, online
- 2023 Invitation for a talk at the symposium *Theoretical Physics - Theory of Condensed Matter* at Johannes Gutenberg University, Mainz
- 2023 Invitation for a seminar talk at the *Max-Planck-Institute of Biophysics*, Frankfurt am Main
- 2022 Invitation for a talk at the *Statistical Physics and low dimensional systems conference*, Pont-à-Mousson

Contributed talks at international conferences:

- 2024 Selected abstract for a talk at the *German Biophysical Society Meeting*, Leipzig
- 2024 Selected abstract for a talk at the *DPG Spring Meeting*, Berlin
- 2023 Selected abstract for a talk at the *EMBO | EMBL Symposium Life at the periphery: mechanobiology of the cell surface*, Heidelberg
- 2023 Selected abstract for a talk at the *DPG Spring Meeting*, Dresden
- 2022 Selected abstract for a talk at the *DPG Spring Meeting*, Regensburg
- 2022 Contributed flash talk at *Dutch Soft Matter Meeting*, Delft
- 2022 Selected abstract for a talk at *SynCell2022*, The Hague
- 2021 Selected abstract for a talk at *Dutch Biophysics*, online
- 2019 Selected abstracts for two talks at the *DPG Spring Meeting*, Regensburg
- 2018 Selected abstract for a talk at the *DPG Spring Meeting*, Berlin

Seminar talks:

- 2024 Talk at *Membrane Club seminar series*, Institute of Molecular Biotechnology (IMBA), Vienna
- 2024 Talk at *Soft Hour seminar series*, IST Austria, Klosterneuburg
- 2022 Talk at *Soft Hour seminar series*, IST Austria, Klosterneuburg
- 2022 Talk at the *BN Forum*, seminar of the Department of Bionanoscience, TU Delft (online)
- 2018 Talk at *BioQuant Internal Seminar*, Heidelberg University

Contributed posters at international conferences:

- 2024 Selected abstract for a poster at *The Vienna Soft Matter Day*, Technical University of Vienna
- 2024 Selected abstract for a poster at the *EMBO | EMBL Symposium The mechanics of life: from development to disease*, Heidelberg
- 2023 Selected abstract for a poster at the *ISMC 2023 | 7th International Soft Matter Conference*, Osaka
- 2022 Poster at *The Vienna Soft Matter Day*, IST Austria, Klosterneuburg
- 2022 Selected abstract for a poster at the *Biophysical Society Annual Meeting*, San Francisco
- 2022 Selected abstract for a poster at *NWO Physics@Veldhoven*, online
- 2021 Selected abstract for a poster at *Dutch Biophysics*, online
- 2021 Selected abstract for a poster at *EMBO Workshop Molecular and Cell Biology of Septins*, Berlin
- 2021 Selected abstract for a poster at *EMBO Workshop Physics of living systems: From molecules to tissues*, online

- 2021 Selected abstract for a poster at the *BaSyC (Building a Synthetic Cell) Spring Meeting*, online
- 2021 Selected abstract for a poster at the *DPG Spring Meeting*, online
- 2018 Selected abstract for a poster at the *Venice Meeting on Fluctuations in Small Complex Systems IV*, Venice
- 2018 Selected abstract for a poster and flash talk at the *BDBDB4 Meeting*, Heidelberg
- 2018 Selected abstract for a poster at the *Biophysical Society Annual Meeting*, San Francisco
- 2017 Selected abstract for a poster at the *DPG Spring Meeting*, Dresden

Teaching experience and supervision

- 2019, winter Exercises in Electrodynamics (Bachelor course) at Heidelberg University
- 2019, summer Lecture substitution (one lecture) at Heidelberg University in Theoretical Biophysics (Master course) for Prof. Ulrich Schwarz
- 2016, winter Exercises in Stochastic Dynamics (Master course) at Heidelberg University
- 2016, winter Exercises in Non-linear Dynamics (Master course) at Heidelberg University
- 2016, summer Exercises in Theoretical Biophysics (Master course) at Heidelberg University
- 2015, winter Exercises in Theoretical Statistical Physics (Master course) at Heidelberg University
- 2022 Co-supervision of two Bachelor End Projects at TU Delft (Leó Szücs, *Modeling and analysis of cytoskeletal septin filament growth* and Léo Simon, *Modeling of spherical virus particle motion and uptake at the cell membrane*)
- 2018 Co-supervision of one Master thesis at Heidelberg University (Dennis Wörthmüller, *Computer simulations of SAS-6 self-assembly in two dimensions*)
- 2016-2018 Co-supervision of three Bachelor theses at Heidelberg University (David Outland, *Computer simulations of growing clusters*; Vanessa Scheller, *Modeling polymers as random walks* and Markus Miltner, *Computer simulations of cluster growth*)

Reviewing activities

Physical Review Letters (APS), PRX Life (APS), Physical Review E (APS), New Journal of Physics (IOPscience), The Journal of Applied Physics, The Journal of Chemical Physics, The Proceedings of the National Academy of Sciences (PNAS), eLife, Biology of the Cell, Nature Cell Biology, Nature Communications

Administration and organization

- 2022 Organization of the theory journal club of the Department of Bionanoscience at TU Delft
- 2022 Co-organization of the scientific retreat for the theory division of the Department of Bionanoscience at TU Delft involving the groups of three principal investigators
- 2021 Participation at the EMBO Lab Leadership course for postdocs (online)

List of publications

Summary of bibliometric information (Google Scholar, 11/2024): 409 citations, h-index: 10

In preparation

18. **F. Frey**, M. Amaral, A. Šarić, *Decoding membrane designs – curvature sorting reveals how membranes remodel, in preparation* (2024).
17. G. Castro Linares*, **F. Frey***, D. de Ridder*, S. Reese, M. Mavrakakis, R. P. Richter, T. Idema, and G. H. Koenderink, *Human septin binding and polymerization on lipid membranes depends on oligomer species, lipid composition and GTP, in preparation* (2024). *Equal contributions.

Submitted:

16. M. Amaral*, **F. Frey***, X. Jiang, B. Baum, A. Šarić, *Stability vs flexibility: reshaping of archaeal bilayer and monolayer membranes in silico*, doi.org/10.1101/2024.10.18.619072, **preprint** (2024). *Equal contributions.
15. **F. Frey**, U. S. Schwarz, *Coat stiffening explains the consensus pathway of clathrin-mediated endocytosis*, arXiv:2405.02820, **preprint** (2024).
14. L. Baldauf, **F. Frey**, M. Arribas Perez, M. Vladenov, M. Way, T. Idema, G. H. Koenderink, *Biomimetic actin cortices shape cell-sized lipid vesicles*, doi.org/10.1101/2023.01.15.524117, **preprint, in revision** (2023).

Published:

13. E. Weiner*, E. Berryman*, **F. Frey***, A. González Solís*, A. Leier, T. Marquez Lago, A. Šarić and M. S. Otegui, *Endosomal Membrane Budding Patterns in Plants*, **Proc. Natl. Acad. Sci. U.S.A.** 121.44: e2409407121 (2024). *Equal contributions.
12. L. Baldauf*, **F. Frey***, M. Arribas Perez, T. Idema, G. H. Koenderink, *Branched actin cortices reconstituted in vesicles sense membrane curvature*, **Biophys. J.** 122.11: 2311-2324 (2023). *Equal contributions.
11. M. Mund, A. Tschanz, Y.-L. Wu, **F. Frey**, J. L. Mehl, M. Kaksonen, O. Avinoam, U. S. Schwarz, and J. Ries, *Clathrin coats partially preassemble and subsequently bend during endocytosis*, **J. Cell Biol.** 222 (3): e202206038 (2023).
10. J. J. de Vries, D. M. Laan, **F. Frey**, G. H. Koenderink, M. P. M. de Maat, *A systematic review and comparison of automated tools for quantification of fibrous networks*, **Acta Biomater.** 157, 263-274 (2022).
9. **F. Frey**, and T. Idema, *Membrane area gain and loss during cytokinesis*, **Phys. Rev. E** 106, 024401 (2022).
8. **F. Frey**, and T. Idema, *More than just a barrier: using physical models to couple membrane shape to cell function*, **Soft Matter**, 17, 3533 – 3549 (2021).
7. **F. Frey**, and U. S. Schwarz, *Competing pathways for the invagination of clathrin-coated membranes*, **Soft Matter** 16, 10723-10733 (2020).
6. **F. Frey**, D. Bucher, K. A. Sochacki, J. W. Taraska, S. Boulant, and U. S. Schwarz, *Eden growth models for flat clathrin lattices with vacancies*, **New J. of Phys.** 22, 073043 (2020).
5. T. Wiegand, M. Fratini, **F. Frey**, K. Yserentant, Y. Liu, E. Weber, K. Galior, J. Ohmes, F. Braun, DP. Herten, S. Boulant, U. S. Schwarz, K. Salaita, E. A. Cavalcanti-Adam, and J. P. Spatz, *Forces during cellular uptake of viruses and nanoparticles at the ventral side*, **Nat. Commun.** 11, 32 (2020).
4. **F. Frey**, F. Ziebert, and U. S. Schwarz, *Dynamics of particle uptake at cell membranes*, **Phys. Rev. E** 100, 052403 (2019).
3. **F. Frey**, F. Ziebert, and U. S. Schwarz, *Stochastic dynamics of nanoparticle and virus uptake*, **Phys. Rev. Lett.** 122, 088102 (2019).
2. D. Bucher*, **F. Frey***, K. A. Sochacki, S. Kummer, JP. Bergeest, W. J. Godinez, HG. Kräusslich, K. Rohr, J. W. Taraska, U. S. Schwarz, and S. Boulant, *Clathrin-adaptor ratio and membrane tension regulate the flat-to-curved transition of the clathrin coat during endocytosis*, **Nat. Commun.** 9, 1109 (2018). *Equal contributions.
1. P. Kumberger, **F. Frey**, U. S. Schwarz, and F. Graw, *Multiscale modeling of virus replication and spread*, **FEBS Lett.** 590, 1972-1986 (2016).