Dr. Felix Frey

Personal Details

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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

8 invited talks, 11 contributed talks at international conferences, 7 seminar talks and 16 contributed posters (01/2025)

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
2019 Invitation for a seminar talk at the *Department of Bionanoscience*, TU Delft

Contributed talks at international conferences:

2025 Selected abstract for a talk at the *DPG Spring Meeting*, Regensburg
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:

2025 Talk at *Evolunch seminar series*, IST Austria, Klosterneuburg
2025 Seminar talk at the Department of Bionanoscience, TU Delft
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
2019	Selected abstract for a poster at the *Biomembrane Days 2019,* Berlin
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

2025, summer	Lecture substitution (two lectures) at IST Austria in Soft Matter Physics (PhD course) for Prof. Anđela Šarić
2019, winter	Exercises in Electrodynamics (BSc course) at Heidelberg University
2019, summer	Lecture substitution (one lecture) at Heidelberg University in Theoretical Biophysics (MSc course) for Prof. Ulrich Schwarz
2016, winter	Exercises in Stochastic Dynamics (MSc course) at Heidelberg University
2016, winter	Exercises in Non-linear Dynamics (MSc course) at Heidelberg University
2016, summer	Exercises in Theoretical Biophysics (MSc course) at Heidelberg University
2015, winter	Exercises in Theoretical Statistical Physics (MSc 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, C*omputer simulations of SAS-6 self-assembly in two dimensions*)
2016-2018	Co-supervision of three Bachelor theses at Heidelberg University (David Outland, C*omputer 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, 07/2025): 470 citations, h-index: 11

In preparation

19. **F. Frey**, M. Amaral, A. Šarić, *Decoding membrane designs – curvature sorting reveals how membranes remodel*, ***in preparation*** (2025).

18. G. Castro Linares*, **F. Frey***, D. de Ridder*, S. Reese, M. Mavrakis, 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*** (2025). *Equal contributions.

Submitted:

17. 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*** (2025).

Published:

16. M. Muñoz-Basagoiti*, **F. Frey***, B. Meadowcroft*, M. Amaral*, A. Prada* and A. Šarić, *A tutorial for mesoscale computer simulations of lipid membranes: tether pulling, tubulation and fluctuations*, ***Soft Matter*** DOI: 10.1039/D5SM00148J (2025). *Equal contributions.

15. M. Amaral*, **F. Frey***, X. Jiang, B. Baum, A. Šarić, *Stability vs flexibility: reshaping archaeal membranes in silico*, ***eLife*** 14:RP105432 (2025). *Equal contributions.

14. **F. Frey**, U. S. Schwarz, *Coat stiffening can explain invagination of clathrin-coated membranes*, ***Phys. Rev. E*** 110, 064403 (2024).

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).