Patrick M. Lenggenhager

Personal Data

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Academic Experience

11.2023–present **Postdoctoral fellow**, *Max Planck Institute for the Physics of Complex Systems*, Germany
Nonequilibrium Quantum Dynamics Group, Dr. Marin Bukov

10.2023–10.2023 **Postdoctoral researcher**, *Physics Institute, University of Zurich*, Switzerland
Theory of Topological Matter Group, Prof. Dr. Tomáš Bzdušek

2.2018–9.2023 **Teaching Assistant**, *Institute of Theoretical Physics, ETH Zürich*, Switzerland
Courses: Theory of Heat, Solid State Theory, Mechanics of Continua

Higher Education

11.2019–9.2023 **Doctor of Sciences of ETH in Physics**, *ETH Zürich and Laboratory for Theoretical and Computational Physics, Paul Scherrer Institute*, Switzerland
Thesis advisors: Prof. Dr. Tomáš Bzdušek and Prof. Dr. Manfred Sigrist
Title: *Emerging avenues in band theory: multigap topology and hyperbolic lattices*

11.2019–9.2023 **Associated PhD Student**, *Physics Institute, University of Zurich*, Switzerland
Condensed Matter Theory Group, Prof. Dr. Titus Neupert

9.2016–9.2019 **Master of Science ETH in Physics**, *ETH Zürich*, Switzerland
Thesis (at Caltech): *Quantum Control of Dynamically Induced Topology* (thesis advisors: Prof. Dr. Gil Refael, Caltech, USA and Prof. Dr. Gianni Blatter)

9.2018–4.2019 **Caltech Visiting Student**, *Institute for Quantum Information and Matter*, USA
Master thesis with by Prof. Dr. Gil Refael

9.2012–9.2015 **Bachelor of Science ETH in Physics**, *ETH Zürich*, Switzerland
Thesis: *Low Frequency Resonators on Superconducting Chips* (thesis advisors: Prof. Dr. Andreas Wallraff and Dr. Anton Potočnik)

Service to the Community

2024–present **Referee for *Nature Communications***, *Nature Portfolio*

2024–present **Referee for *Communications Physics***, *Nature Portfolio*

2023–present **Referee for *Physical Review B***, *American Physical Society*

Selected Awards, Distinctions, and Scholarships

2024 **Swiss Physical Society Award in Condensed Matter Physics**, for the PhD thesis

2023 **ETH Silver Medal for outstanding PhD thesis**, *ETH Zürich*

2012–2021 **The Swiss Study Foundation**, *Member/supported student*

2019 **Master's Degree in Physics "with distinction"**, *ETH Zürich*

2016 **International Young Physicists' Tournament**, *Ekaterinburg, Russia*, Gold medal
Teamleader and coach of the Swiss national team

2012 **International Young Physicists' Tournament**, *Bad Saulgau, Germany*, Silver medal

2011/2012 **Swiss Young Physicists' Tournament**, *Switzerland*, First place

Teaching Activities

Teaching Assistant

2022 **Solid State Theory**, *by Prof. Dr. Eugene Demler at ETH Zürich*

2021 **Mechanics of Continua**, *by Prof. Dr. Manfred Sigrist at ETH Zürich*

2020 **Solid State Theory**, *by Prof. Dr. Manfred Sigrist at ETH Zürich*

2018 **Theory of Heat**, *by Prof. Dr. Gianni Blatter at ETH Zürich*

Supervision of Students

2.2024–6.2024 **Benoît Fanton**, *Master student at École Normale Supérieure - PSL*, France, co-supervised by Dr. Marin Bukov
Title: *Scaling of excitations when crossing phase transitions in the Kitaev honeycomb model*

7.2023–6.2024 **Marcelo Looser**, *Master student at University of Zurich*, Switzerland, co-supervised by Prof. Dr. Tomáš Bzdušek
Title: *Supercell-based characterization of hyperbolic tight-binding models*

Computer Skills

Scientific	Wolfram Language / Mathematica	*Exceptional knowledge and experience*
Programming	GAP, C++, Python, Julia	*Advanced knowledge and experience*
Computing	Linux, Bash, SSH, Slurm, Git	*Knowledge and experience*
Word processing	LaTeX	*Advanced knowledge and experience*

Languages

German	Native language	*Matura (Grade 6)*
English	European Language Level C2	*Bilingual Matura, Cambridge Certificate of Advanced English (Grade A)*
Italian	European Language Level B2	*Matura (Grade 5.5)*

Outreach

Swiss/International Young Physicists' Tournament (SYPT/IYPT)

1.2013–3.2024 **Board Member, Coach and Juror at the SYPT**, *Pro IYPT-CH*, Switzerland

4.2016–7.2016 **Teamleader and Coach of the Swiss IYPT Team and Juror at the IYPT 2016**, *Pro IYPT-CH*, Zurich, Switzerland / Ekaterinburg, Russia

7.2016–9.2016 **Webdeveloper and -designer**, *Pro IYPT-CH*, Switzerland

Publications

[1] **P. M. Lenggenhager**, S. Dey, T. Bzdušek, and J. Maciejko. *Hyperbolic spin liquids*. preprint arXiv:2407.09601 (2024). DOI:10.48550/arXiv.2407.09601.

[2] S. Dey, A. Chen, P. Basteiro, A. Fritzsche, M. Greiter, M. Kaminski, **P. M. Lenggenhager**, R. Meyer, R. Sorbello, A. Stegmaier, R. Thomale, J. Erdmenger, and I. Boettcher. *Simulating holographic conformal field theories on hyperbolic lattices*. Phys. Rev. Lett. **133**, 061603 (2024). (Editors' Suggestion) DOI:10.1103/PhysRevLett.133.061603.

[3] T. Tummuru*, A. Chen*, **P. M. Lenggenhager***, T. Neupert, J. Maciejko, and T. Bzdušek. *Hyperbolic non-Abelian semimetal*. Phys. Rev. Lett. **132**, 206601 (2024). DOI:10.1103/PhysRevLett.132.206601.

[4] **P. M. Lenggenhager**, J. Maciejko, and T. Bzdušek. *Non-Abelian hyperbolic band theory from supercells*. Phys. Rev. Lett. **131**, 226401 (2023). DOI:10.1103/PhysRevLett.131.226401.

[5] A. Chen, Y. Guan, **P. M. Lenggenhager**, J. Maciejko, I. Boettcher, and T. c. v. Bzdušek. *Symmetry and topology of hyperbolic haldane models*. Phys. Rev. B **108**, 085114 (2023). DOI:10.1103/PhysRevB.108.085114.

[6] **P. M. Lenggenhager**, X. Liu, T. Neupert, and T. Bzdušek. *Triple nodal points characterized by their nodal-line structure in all magnetic space groups*. Phys. Rev. B **106**, 085128 (2022). (Editors' Suggestion) DOI:10.1103/PhysRevB.106.085128.

[7] **P. M. Lenggenhager**, X. Liu, T. Neupert, and T. Bzdušek. *Universal higher-order bulk-boundary correspondence of triple nodal points*. Phys. Rev. B **106**, 085129 (2022). DOI:10.1103/PhysRevB.106.085129.

[8] D. M. Urwyler, **P. M. Lenggenhager**, I. Boettcher, R. Thomale, T. Neupert, and T. Bzdušek. *Hyperbolic topological band insulators*. Phys. Rev. Lett. **129**, 246402 (2022). DOI:10.1103/PhysRevLett.129.246402.

[9] **P. M. Lenggenhager**, A. Stegmaier, L. K. Upreti, T. Hofmann, T. Helbig, A. Vollhardt, M. Greiter, C. H. Lee, S. Imhof, H. Brand, T. Kießling, I. Boettcher, T. Neupert, R. Thomale, and T. Bzdušek. *Simulating hyperbolic space on a circuit board*. Nat. Commun. **13**(1), 4373 (2022). DOI:10.1038/s41467-022-32042-4.

[10] **P. M. Lenggenhager**, X. Liu, S. S. Tsirkin, T. Neupert, and T. Bzdušek. *From triple-point materials to multiband nodal links*. Phys. Rev. B **103**, L121101 (2021). DOI:10.1103/PhysRevB.103.L121101.

[11] **P. M. Lenggenhager**, D. E. Gökmen, Z. Ringel, S. D. Huber, and M. Koch-Janusz. *Optimal renormalization group transformation from information theory*. Phys. Rev. X **10**, 011037 (2020). DOI:10.1103/PhysRevX.10.011037.

Scientific Software Development

2023–present **HyperCells**, *A GAP package for constructing primitive cells and supercells of hyperbolic lattices based on triangle groups and quotients with normal subgroups*, `https://github.com/patrick-lenggenhager/HyperCells`

2023–present **HyperBloch**, *A Mathematica package for constructing tight-binding models on hyperbolic lattices and calculating their band structures using the supercell method*, `https://github.com/patrick-lenggenhager/HyperBloch`

Talks and Posters

Seminars

03.02.2023 Theoretical Physics Institute, University of Alberta, Edmonton, Canada
Host: Prof. Dr. Joseph Maciejko
Title: *Classification and higher-order topology of triple nodal points*

04.11.2022 Theoretical Solid State Physics, Technische Universität Dresden, Dresden, Germany
Host: Prof. Dr. Matthias Vojta
Title: *From a hyperbolic drum towards hyperbolic topological insulators*

27.10.2022 Max Planck Institute for the Physics of Complex Systems, Dresden, Germany
Host: Dr. Marin Bukov
Title: *From a hyperbolic drum towards hyperbolic topological insulators*

11.10.2022 The Cavendish Laboratory, University of Cambridge, Cambridg, United Kingdom
Host: Dr. Robert-Jan Slager
Title: *From a hyperbolic drum towards hyperbolic topological insulators*

17.11.2021 Institute for Theoretical Physics, Julius-Maximilians-University of Wurzburg, Würzburg, Germany
Host: Prof. Dr. Ronny Thomale
Title: *Classification and higher-order topology of triple nodal points*

25.06.2019 Institute of Physics, University of Zurich, Zurich, Switzerland
Host: Prof. Dr. Titus Neupert
Title: *Optimal Renormalization Group from Information Theory*

04.06.2019 Laboratory for Scientific Computing and Modelling, Paul Scherrer Institute, Villigen, Switzerland
Host: Prof. Dr. Christopher Mudry
Title: *Optimal Renormalization Group from Information Theory*

30.01.2019 Institute for Quantum Information and Matter, Caltech, Pasadena, USA
Host: Dr. Evert van Nieuwenburg
Title: *Optimal Renormalization Group from Information Theory*

Contributions to Conferences/Workshops

21.03.2024 Workshop on Topological Quantum Matter in Magnetic and Synthetic Platforms, Dresden, Germany, poster
Title: *Unraveling the effect of non-Abelian hyperbolic Bloch states on spectrum and topology*

21.03.2024 CT.QMAT Retreat, Weimar, Germany, poster
Title: *Non-Abelian Hyperbolic Band Theory from Supercells*

21.03.2024 DPG Meeting, Berlin, Germany, contributed talk
Title: *HyperCells and HyperBloch: open-source software packages for studying hyperbolic lattices based on triangle groups*

06.03.2024 APS March Meeting, Minneapolis, USA, contributed talk
Title: *HyperCells and HyperBloch: open-source software packages for studying hyperbolic lattices based on triangle groups*

16.03.2023 APS March Meeting, Las Vegas, USA, contributed talk
Title: *Supercell construction and non-Abelian Bloch states in hyperbolic lattices*

30.08.2022 Swiss Workshop on Materials with Novel Electronic Properties SWM 22, Les Diablerets, Switzerland, poster
Title: *Classification and higher-order topology of triple points*

29.07.2022 International Conference on Complexity and Topology in Quantum Matter CT.QMAT 22, Würzburg, Germany, contributed talk
Title: *From a hyperbolic drum towards hyperbolic topological insulators*

16.03.2022 APS March Meeting, Chicago, USA, contributed talk
Title: *Simulating hyperbolic space on a circuit board*

11.03.2021 TopCor 22 Workshop on Topological Materials: From Weak to Strong Correlations, Dresden, Germany, poster
Title: *Classification and higher-order topology of triple points*

29.09.2021 Condensed Matter Theory Symposium ETH Zürich, Zurich, Switzerland, poster
Title: *Classification and higher-order topology of triple points*

02.09.2021 SPS Annual Meeting, Innsbruck, Austria, contributed talk
Title: *Classification and higher-order topology of triple points*

15.03.2021 APS March Meeting, online, contributed talk
Title: *Classification and higher-order topology of triple points*

25.01.2021 Waiting for the conference on Highly Frustrated Magnetism, online, poster
Title: *From triple points to multi-band nodal links with monopole charges and higher-order topology*