Felix M. Haehl

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Professional Experience

University of Southampton — Southampton, UK
Principal Research Fellow (Associate Professor) — from 2022

Institute for Advanced Study — Princeton, USA
Postdoctoral Scientist — 2019 – 2022

University of British Columbia — Vancouver, Canada
Postdoctoral Fellow (Simons Collaboration 'It from Qubit') — 2016 – 2019

ABB Corporate Research — Baden-Dättwil, Switzerland
Intern (Theoretical Plasma Physics Research Dpt.) — 2012

Education

Durham University — Durham, UK
PhD in Mathematical Sciences (Durham Doctoral Fellow) — 2016
- Thesis advisor: Prof. Mukund Rangamani

Perimeter Institute — Waterloo, Canada
Visiting Graduate Fellow — 2015

ETH Zurich — Zurich, Switzerland
MSc ETH in Physics (distinction) — 2012
BSc ETH in Physics — 2010

Research Grants as PI

UKRI Frontier Research Guarantee Grant: £ 1.29m — 2022 – 2027
- UK funding guarantee to replace an awarded *ERC Starting Grant*

ERC Starting Grant 2021: € 1.5m — 2022
- Awarded by the European Commission
- Grant declined (to take up *UKRI Frontier Research Guarantee Grant*)

Royal Society University Research Fellowship: £ 695,000 — 2023
- Provisionally offered by the Royal Society
- Fellowship declined (to take up *UKRI Frontier Research Guarantee Grant*)

STFC Ernest Rutherford Fellowship: £ 500,000 — 2022
- Awarded by UK Research and Innovation
- Fellowship declined (to take up *UKRI Frontier Research Guarantee Grant*)

Marie Skłodowska-Curie Individual Fellowship: € 187,000 — 2019
- Awarded by the European Commission
- Fellowship declined (to join the Institute for Advanced Study)

Fellowships and Awards

Postdoctoral Fellowship at UBC Vancouver Sep. 2016 – Aug. 2019
- Fellowship by the Simons Collaboration *'It From Qubit'*

Kadanoff Center Postdoctoral Fellowship (award declined) from Sep. 2016
- Prestigious postdoctoral fellowship at the University of Chicago

Hatfield College Research Award Feb. 2014
- Grant for overseas research activities

Durham Doctoral Fellowship Sep. 2012 – Mar. 2016
- Competitive funding for PhD

Distinction Nov. 2012
- For MSc degree at ETH Zurich

Visiting Student Research Scholarship by ETH Zurich Sep. 2011 – Feb. 2012
- Funding for MSc thesis research project abroad (UC Santa Barbara)

Fellow of the German Academic Scholarship Foundation 2007 – 2012
- Funding for BSc and MSc studies (competitive; based on excellence)

Teaching Experience

Academic Supervisor, University of Southampton, UK 2023
- Supervision of self-paced tutorials *(Mathematics for Electronic and Electrical Engineering)*

Student Supervision, UBC Vancouver, Canada 2016 – 2019
- Undergraduate research project 'Partially entangled thermal states in higher dimensions' (Z. Ding)
- Master thesis research project 'The strong subadditivity of holographic entanglement entropy; from boundary to bulk' (A.I. Rad)

Teaching Assistant, Durham University, UK 2013 – 2015
- Teaching tutorials and marking for two undergraduate courses: *Calculus and Probability*, *Analysis*.

Teaching Assistant, ETH Zurich and University of Zurich, Switzerland 2013 – 2015
- Typeset and revision of detailed lecture notes for four MSc level courses: *Quantum Field Theory I*, *Quantum Field Theory II*, *General Relativity*, and *Astrophysical and Cosmological Applications of General Relativity*; available at `http://www.sns.ias.edu/~haehl/downloads`.

Teaching Assistant, ETH Zurich, Switzerland 2008 – 2010
- Teaching tutorials and marking for three courses: *Analysis I*, *Analysis II*, *Mathematics III*.

Professional Services and Engagement

Referee for journal submissions. Regularly: *Journal of High Energy Physics (JHEP)*, *SciPost Physics*. Occasionally: *Annals of Physics (AOP)*, *Mathematical Reviews*, *Entropy*, *European Physics Journal C*.

Referee for grant proposals: *EPSRC*, *UK Research and Innovation*, and *Israel Science Foundation*.

Referee for conference submissions: *It from Qubit 2023 (Perimeter Institute)*.

Organization of scientific events:

- Regional holography initiative *HoloUK*
  - Meetings organized: Sep. 2023 & Feb. 2024 (LIMS, Royal Society)
- Workshop *Gravity from Chaotic Quantum Dynamics* (University of Oxford, July 2023)
  - Successful application for funding (£ 15,000) from the *Gravity Theory Trust*
- Seminar series of the *String Theory Group* at UBC Vancouver (2017 – 2019)
- *'It from Qubit'* postdoc workshop (New Orleans, Feb. 2018)
- PhD student conference *Young Theorists' Forum* (Durham University, Dec. 2014)

Outreach:

- Masterclass on algorithmic thinking and computing (University of Southampton, Oct. 2023)
- Scientific representative at public event *Solar Eclipse* (UBC Vancouver, Aug. 2017)
- Organizer of *College Induction Fortnight* for about 150 new postgraduate students at Hatfield College (Durham University, Sep. 2014)
- Organizer of *Research Workshop on Succeeding in Science* (Durham University, 2014)
- Public lecture on gauge/gravity duality (Durham University, 2013)

Extensive experience performing classical piano in concert

Publications

[1] F. M. Haehl, W. Reeves, and M. Rozali, *Euclidean wormholes in two-dimensional CFTs from quantum chaos and number theory,* Phys. Rev. D **108**, L101902 (2023) [arXiv:2309.02533].

[2] F. M. Haehl, W. Reeves, and M. Rozali, *Symmetries and spectral statistics in chaotic conformal field theories II: arithmetic chaos and Maass cusp forms,* JHEP **2023**, 161 (2023) [arXiv:2309.00611].

[3] F. M. Haehl, and Y. Zhao, *Operator growth and black hole formation,* JHEP **2023**, 184 (2023) [arXiv:2304.14351].

[4] F. M. Haehl, C. Marteau, W. Reeves, and M. Rozali, *Symmetries and spectral statistics in chaotic conformal field theories,* JHEP **2023**, 196 (2023) [arXiv:2302.14482].

[5] C. Choi, F. M. Haehl, M. Mezei, and G. Sarosi, *Effective description of sub-maximal chaos: stringy effects for SYK scrambling,* JHEP **2023**, 142 (2023) [arXiv:2301.05698].

[6] F. M. Haehl, and Y. Zhao, *Collisions of localized shocks and quantum circuits,* JHEP **2022**, 2 (2022) [arXiv:2202.04661].

[7] M. Christos, F. M. Haehl, and S. Sachdev, *Spin liquid to spin glass crossover in the random quantum Heisenberg magnet,* Phys. Rev. B **105**, 085120 (2022) [arXiv:2110.00007].

[8] T. Anous, and F. M. Haehl, *The quantum p-spin glass model: a user manual for holographers,* J. Stat. Mech. (2021) 113101 [arXiv:2106.03838].

[9] F. M. Haehl, A. Streicher, and Y. Zhao, *Six-point functions and collisions in the black hole interior,* JHEP **2021** 134 (2021) [arXiv:2105.12755].

[10] F. M. Haehl, and Y. Zhao, *Diagnosing collisions in the interior of a wormhole,* Phys. Rev. D **104** (2021) 2, L021901 [arXiv:2104.02736].

[11] F. M. Haehl, and Y. Zhao, *Size and momentum of an infalling particle in the black hole interior,* JHEP **2106**, 056 (2021) [arXiv:2102.05697].

[12] T. Anous, and F. M. Haehl, *On the Virasoro six-point identity block and chaos,* JHEP **2008**, 002 (2020) [arXiv:2005.06440].

[13] F. M. Haehl, W. Reeves, and M. Rozali, *Reparametrization modes, shadow operators, and quantum chaos in higher-dimensional CFTs,* JHEP **1911**, 102 (2019) [arXiv:1909.05847].

[14] F. M. Haehl, E. Mintun, J. Pollack, A. Speranza, and M. Van Raamsdonk, *Nonlocal multi-trace sources and bulk entanglement in holographic conformal field theories,* JHEP **1906**, 005 (2019) [arXiv:1904.01584].

[15] F. M. Haehl and M. Rozali, *Effective Field Theory for Chaotic CFTs,* JHEP **1810**, 118 (2018) [arXiv:1808.02898].

[16] F. M. Haehl, R. Loganayagam and M. Rangamani, *Effective Action for Relativistic Hydrodynamics: Fluctuations, Dissipation, and Entropy Inflow,* JHEP **1810**, 194 (2018) [arXiv:1803.11155].

[17] F. M. Haehl, R. Loganayagam and M. Rangamani, *Inflow Mechanism for Hydrodynamic Entropy,* Phys. Rev. Lett. **121**, 051602 (2018) [arXiv:1803.08490].

[18] F. M. Haehl, E. Hijano, O. Parrikar and C. Rabideau, *Higher Curvature Gravity from Entanglement in Conformal Field Theories,* Phys. Rev. Lett. **120**, 201602 (2018) [arXiv:1712.06620].

[19] F. M. Haehl and M. Rozali, *Fine Grained Chaos in AdS_2 Gravity,* Phys. Rev. Lett. **120**, 121601 (2018) [arXiv:1712.04963].

[20] M. Geracie, F. M. Haehl, R. Loganayagam, P. Narayan, D. M. Ramirez and M. Rangamani, *Schwinger-Keldysh superspace in quantum mechanics,* Phys. Rev. D **97**, 105023 (2018) [arXiv:1712.04459].

[21] F. M. Haehl, R. Loganayagam, P. Narayan, A. A. Nizami and M. Rangamani, *Thermal out-of-time-order correlators, KMS relations, and spectral functions,* JHEP **1712**, 154 (2017) [arXiv:1706.08956].

[22] T. Faulkner, F. M. Haehl, E. Hijano, O. Parrikar, C. Rabideau and M. Van Raamsdonk, *Nonlinear Gravity from Entanglement in Conformal Field Theories,* JHEP **1708**, 057 (2017) [arXiv:1705.03026].

[23] F. M. Haehl, R. Loganayagam and M. Rangamani, *Two roads to hydrodynamic effective actions: a comparison, unpublished comments* [arXiv:1701.07896].

[24] F. M. Haehl, R. Loganayagam, P. Narayan and M. Rangamani, *Classification of out-of-time-order correlators,* SciPost Phys. **5**, 067 (2018) [arXiv:1701.02820].

[25] S. Bhattacharyya, F. M. Haehl, N. Kundu, R. Loganayagam and M. Rangamani, *Towards a second law for Lovelock theories,* JHEP **1703**, 065 (2017) [arXiv:1612.04024].

[26] F. M. Haehl, R. Loganayagam and M. Rangamani, *Schwinger-Keldysh formalism. Part II: thermal equivariant cohomology,* JHEP **1706**, 070 (2017) [arXiv:1610.01941].

[27] F. M. Haehl, R. Loganayagam and M. Rangamani, *Schwinger-Keldysh formalism. Part I: BRST symmetries and superspace,* JHEP **1706**, 069 (2017) [arXiv:1610.01940].

[28] J. de Boer, F. M. Haehl, M. P. Heller and R. C. Myers, *Entanglement, holography and causal diamonds,* JHEP **1608**, 162 (2016) [arXiv:1606.03307].

[29] F. M. Haehl, R. Loganayagam and M. Rangamani, *Topological sigma models & dissipative hydrodynamics,* JHEP **1604**, 039 (2016) [arXiv:1511.07809].

[30] F. M. Haehl, R. Loganayagam and M. Rangamani, *The Fluid Manifesto: Emergent symmetries, hydrodynamics, and black holes,* JHEP **1601**, 184 (2016) [arXiv:1510.02494].

[31] F. M. Haehl, *Comments on universal properties of entanglement entropy and bulk reconstruction,* JHEP **1510**, 159 (2015) [arXiv:1508.00766].

[32] F. M. Haehl, R. Loganayagam and M. Rangamani, *Adiabatic hydrodynamics: The eightfold way to dissipation,* JHEP **1505**, 060 (2015) [arXiv:1502.00636].

[33] F. M. Haehl, T. Hartman, D. Marolf, H. Maxfield and M. Rangamani, *Topological aspects of generalized gravitational entropy,* JHEP **1505**, 023 (2015) [arXiv:1412.7561].

[34] F. M. Haehl and M. Rangamani, *Permutation orbifolds and holography,* JHEP **1503**, 163 (2015) [arXiv:1412.2759].

[35] F. M. Haehl, R. Loganayagam and M. Rangamani, *The eightfold way to dissipation,* Phys. Rev. Lett. **114**, 201601 (2015) [arXiv:1412.1090].

[36] F. M. Haehl, R. Loganayagam and M. Rangamani, *Effective actions for anomalous hydrodynamics,* JHEP **1403**, 034 (2014) [arXiv:1312.0610].

[37] F. M. Haehl and M. Rangamani, *Comments on Hall transport from effective actions,* JHEP **1310**, 074 (2013) [arXiv:1305.6968].

[38] F. M. Haehl, *The Schwarzschild-Black String AdS Soliton: Instability and Holographic Heat Transport,* Class. Quant. Grav. **30**, 055002 (2013) [arXiv:1210.5763].

Conference Presentations

YITP Kyoto (conference *Quantum Information, Matter and Gravity*)	Sep. 2023
Perimeter Institute, Waterloo (conference *It from Qubit 2023*)	July 2023
Centro de Ciencias de Benasque (workshop *Gravity – New perspectives...*)	July 2023
International Solvay Institutes, Brussels (conference on *SYK Models*)	June 2023
IIT Madras, Chennai (conference *Black Holes and Gauge Theories*)	Jan. 2023
Okinawa IST (virtual workshop *Informational Architecture of Spacetime*)	Jun. 2022
Aruba (conference *Qubits on the Horizon 2*)	Apr. 2022
IAS Princeton (conference *Quantum Information and Spacetime*)	Dec. 2021
UC Davis (conference *Quantum Information in Quantum Gravity*)	Aug. 2019
Centro de Ciencias de Benasque (workshop *Gravity – New perspectives...*)	July 2019
YITP Kyoto (conference *Quantum Information and String Theory*)	Jun. 2019
UBC Vancouver (conference *Theory Canada XIV*)	May 2019
IAS Princeton (conference *QI and the Structure of Spacetime*)	Dec. 2018
IQOQI, Vienna (conference *Quantum Information and Gravity*)	May 2018
MITP, Mainz (workshop *Modern Techniques for CFT and AdS*)	May 2018
UT Austin (conference *Southwest Holography Meeting*)	Mar. 2018
Centro de Ciencias de Benasque (workshop *Gravity – New perspectives...*)	July 2017

Simons Foundation, Manhattan (conference *It from Qubit Annual Meeting*)	Dec. 2016
YITP Kyoto (conference *Quantum Information in String Theory*)	June 2016
Centro de Ciencias de Benasque (workshop *Gravity – New perspectives...*)	July 2015
ICTS Bangalore (poster, conference *Strings*)	June 2015
ICTS Bangalore (gong show talk *Advanced Summer School*)	June 2015
University of Cambridge (poster, conference *Eurostrings*)	Mar. 2015
UBC Vancouver (gong show talk *Quantum Info in Quantum Gravity*)	Aug. 2014
University of Madrid (conference *Postgrad. Meeting on Th. Physics*)	Oct. 2013

Invited Seminar Presentations

University of Jena (seminar)	Feb. 2024
University of Edinburgh & Heriot-Watt (EMPG seminar)	Jan. 2024
University of Amsterdam (seminar)	Jan. 2024
Oxford University (informal seminar)	Nov. 2023
University of Victoria (virtual seminar)	Sep. 2023
McGill University (virtual seminar)	Apr. 2023
University of Warsaw (seminar)	Mar. 2023
University of Warsaw (pedagogical lectures)	Mar. 2023
University of Sussex (seminar)	Feb. 2023
UBC Vancouver (virtual seminar)	Feb. 2023
Neve Shalom (joint seminar for institutions in Israel)	Jan. 2023
Weizmann Institute of Science (seminar)	Jan. 2023
King's College London (seminar)	Dec. 2022
Oxford University (seminar)	Nov. 2022
University of Plymouth (seminar)	Nov. 2022
University of Southampton (gravity seminar)	Oct. 2022
University of Southampton (string theory seminar)	Oct. 2022
IAS Princeton (seminar)	Apr. 2022
GQFI online seminar series (virtual seminar)	Nov. 2021
EPFL Lausanne (virtual seminar)	Nov. 2021
McGill University (virtual seminar)	Nov. 2021
IAS Princeton (seminar)	July 2021
'Holotube' webinar network (virtual seminar)	July 2021
ICTS Bangalore (virtual seminar)	July 2021
King's College London (virtual seminar)	Apr. 2021
University of Warsaw (virtual seminar)	Mar. 2021
UBC Vancouver (virtual seminar)	Mar. 2021
Purdue University (virtual seminar)	Nov. 2020
Brown University (virtual seminar)	Apr. 2020
Caltech (virtual seminar)	Apr. 2020
Simons Center for Geometry and Physics (virtual seminar)	Mar. 2020
Massachusetts Institute of Technology (seminar)	Mar. 2020

IAS Princeton (seminar)	Feb. 2020
KIAS Seoul (pedagogical lectures)	Nov. 2019
KIAS Seoul (seminar)	Nov. 2019
Stanford University (SITP Theory Colloquium)	Oct. 2018
University of Kentucky (seminar)	Sep. 2018
University of Kentucky (seminar)	Sep. 2018
UC Davis (seminar)	Apr. 2018
Albert Einstein Institute, Potsdam (seminar)	Dec. 2017
Albert Einstein Institute, Potsdam (seminar)	Dec. 2017
University of Victoria (seminar)	Nov. 2017
TRIUMF Accelerator, Vancouver (seminar)	Nov. 2017
UC Santa Barbara (seminar)	Oct. 2017
Durham University (seminar)	Aug. 2017
University College London (seminar)	July 2017
McGill University (seminar)	May 2017
McGill University (seminar)	May 2017
UC Davis (seminar)	May 2016
KU Leuven (joint seminar with VUB, KUL, UMONS, Solvay)	Feb. 2016
Université Libre de Bruxelles (seminar)	Feb. 2016
University of Amsterdam (seminar)	Dec. 2015
Perimeter Institute, Waterloo (seminar)	Nov. 2015
Perimeter Institute, Waterloo (seminar)	Nov. 2015
University of Chicago (seminar)	Oct. 2015
UC Berkeley (seminar)	Oct. 2015
Massachusetts Institute of Technology (seminar)	Oct. 2015
University of Crete (seminar)	Apr. 2015
University of Crete (seminar)	Apr. 2015
Utrecht University (seminar)	Feb. 2015
Durham University (seminar)	Feb. 2015
Durham University (graduate seminar)	Oct. 2013

Languages

German (native)
English (professional)
French (advanced)
Latin (days of yore...)