

CV of Erik Panzer

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Research interests: Feynman integrals, multiple (elliptic) polylogarithms and zeta values, motivic periods, quantum field theory, scattering amplitudes, renormalization, combinatorial Hopf algebras, iterated integrals

Studies and employment in mathematics and physics

since 10/2020	Royal Society University Research Fellow (grant URF\R1\201473) at Mathematical Institute, University of Oxford (UK)
10/2015–09/2020	Post-Doctoral Research Fellow at All Souls College, Oxford (UK)
03/2015	PhD (Dr. rer. nat.) in mathematics (HU), grade: summa cum laude Thesis “ Feynman integrals and hyperlogarithms ”
07/2014–09/2015	Institut des Hautes Études Scientifiques , Bures-sur-Yvette, France
2011–2014	Research associate and PhD student at HU under Prof. Dr. Dirk Kreimer
10/2010–07/2011	Humboldt-Universität zu Berlin (HU) Master thesis “ Hopf-algebraic renormalization of Kreimer’s toy model ”
10/2010	Degree <i>Master of Advanced Study</i> (University of Cambridge)
06/2010	<i>Certificate of Advanced Study in Mathematics</i> with Distinction
10/2009–09/2010	University of Cambridge, UK (Part III of the mathematical tripos)
10/2008–09/2009	Freie Universität Berlin
10/2006–09/2008	Brandenburgische Technische Universität (BTU) , Cottbus
1999–2006	Max-Steenbeck-Gymnasium (Cottbus), final grades (Abitur): 1.0

Practical experience

07–09/2021	supervision of a summer research project with 6 undergraduate students
2021	coeditor of Algebraic Structures in Perturbative Quantum Field Theory
10/2020–05/2021	supervision of 4 undergraduate dissertations/masters theses tutor for Differentiable Manifolds
07–08/2019	supervision of two undergraduate summer projects
since 2012	26 reviews for journals including: CNTF , CJM , CMP , JNCG , JHEP , AMS Contemporary Mathematics , Journal of Algebra , IRMA , Nuclear Physics B , Frontiers of Physics , JNT , JCA , Journal of Physics A , CPC , NMJ , Open Mathematics
10/2011–02/2012	Teaching assistant: <i>Introduction to Quantum Field Theory I</i>
08/2008–09/2008	Programming internship with Miaplaza Inc. (San Francisco, USA)
04/2008–07/2008	Teaching assistant: <i>Linear algebra</i>
03/2008–08/2008	Student research assistant, project: <i>adaptive traffic control</i>
10/2007–02/2008	Teaching assistant: <i>Discrete Mathematics</i>

Practical experience (continued)

(Co-)Organization of scientific events

05–09/09/2022	Tropical and Convex Geometry and Feynman integrals, ETH-ITS Zurich
27–28/06/2022	Special Values of L-functions, Periods, and Fundamental Groups, Oxford
16/11–20/11/2020	Algebraic Structures in Perturbative Quantum Field Theory, IHES Paris
22–23/07/2019	Arithmetic and Geometric Aspects of Modular Forms, Oxford
18–22/03/2019	The Mathematics of Linear Relations between Feynman Integrals, MITP Mainz
11/02–12/04/2019	Modular forms, periods and scattering amplitudes, ITS/ETH Zürich
19/12/2017	KMPB-Day, Adlershof Berlin

Prizes and awards

2020	Hermann Weyl Prize of the International Colloquium on Group Theoretical Methods in Physics
10/2009–08/2010	Foreign exchange scholarship from the Studienstiftung ¹
07/2010	College Prize (Peterhouse, Cambridge) „Retrospective Title of Scholar“
07/2008	Participation in the 58th Lindau Nobel Laureate meeting as a „Fellow of the Wilhelm und Else Heraeus Stiftung“
2006 and 2007	Student prize of the German Physical Society (DPG)
2006	18th IOI ² (Mexico): bronze medal, 37th IPhO (Singapore): gold medal
2005	Admission to the Studienstiftung 17th IOI (Poland): bronze medal, 36th IPhO (Spain): bronze medal BOI ³ (Lithuania): gold medal, 12nd CEOI (Hungary): bronze medal
2004	11st CEOI (Poland): silver medal, 16th IOI (Greece): bronze medal

Scientific publications

Preprints

1. Hepp’s bound for Feynman integrals and matroids
August 2019. [[arXiv:1908.09820](#)]
2. Five-loop massless propagator integrals (w. A. Georgoudis, V. Gonçalves and R. Pereira)
February 2018. [[arXiv:1802.00803](#)]

¹Studienstiftung des Deutschen Volkes (German National Academic Foundation)

²IOI = International Olympiad in Informatics, IPhO = International Physics Olympiad

³BOI = Baltic Olympiad in Informatics, CEOI = Central European Olympiad in Informatics

Scientific publications (continued)

Journal articles

3. Two-loop mixed QCD-EW corrections to $q\bar{q} \rightarrow Hg$, $qg \rightarrow Hq$, and $\bar{q}g \rightarrow H\bar{q}$ (with M. Bonetti and L. Tancredi)
JHEP **2022** (Mar., 2022) p. 115. [[arXiv:2203.17202](#)]
4. Glue-and-cut at five loops (with A. Georgoudis, V. Gonçalves, R. Pereira, A. V. Smirnov and V. A. Smirnov)
JHEP **2021** (Sept. 2021) 098. [[arXiv:2104.08272](#)]
5. Four-loop collinear anomalous dimensions in QCD and $\mathcal{N} = 4$ super Yang-Mills (with B. Agarwal, A. von Manteuffel and R. M. Schabinger)
Physics Letters B **820**, 136503, Sep. 2021. [[arXiv:2102.09725](#)]
6. Two-loop mixed QCD-EW corrections to $gg \rightarrow Hg$ (with M. Bonetti, V. A. Smirnov and L. Tancredi) *JHEP* **2020** (Nov. 2020) 45. [[arXiv:2007.09813](#)]
7. The four-loop cusp anomalous dimension from the $\mathcal{N} = 4$ Sudakov form factor (with T. Huber, A. von Manteuffel, R. M. Schabinger and G. Yang),
Physics Letters B **807**, 135543, August 2020. [[arXiv:1912.13459](#)]
8. Multiple zeta values in deformation quantization (with P. Banks and B. Pym)
Inventiones Mathematicae **222** (2020), pp. 79–159. [[arXiv:1812.11649](#)]
9. Cusp and collinear anomalous dimensions in four-loop QCD from form factors (with A. von Manteuffel and R. M. Schabinger),
Phys. Rev. Lett. **124**, 162001 – 24 April 2020. [[arXiv:2002.04617](#)]
10. Lambert-W solves the noncommutative Φ^4 -model (with R. Wulkenhaar),
Commun. Math. Phys. **374** (2020), pp. 1935–1961. [[arXiv:1807.02945](#)]
11. Manifestly dual-conformal loop integration (with J. Bourjaily and F. Dulat),
Nuclear Physics B **942** (May 2019), pp. 251–302. [[arXiv:1901.02887](#)]
12. Feynman integral relations from parametric annihilators (with T. Bitoun, C. Bogner and R. P. Klausen),
Letters in Mathematical Physics **109**(3) (2019), pp. 497–564. [[arXiv:1712.09215](#)]
13. Loopedia, a database for loop integrals (with C. Bogner, S. Borowka, T. Hahn, G. Heinrich, S. P. Jones, M. Kerner, A. von Manteuffel, M. Michel and V. Papara)
Computer Physics Communications **225** (2018), pp. 1–9. [[arXiv:1709.01266](#)]

Scientific publications (continued)

14. The Galois coaction on ϕ^4 periods (with O. Schnetz),
Communications in Number Theory and Physics **11** (2017) no. 6, pp. 657–705.
[arXiv:1603.04289]
15. Minimally subtracted six loop renormalization of $O(n)$ -symmetric ϕ^4 theory and critical exponents (with M. V. Kompaniets), *selected as an Editors' Suggestion*,
Phys. Rev. D **96**, 036016 (2017). [arXiv:1705.06483]
16. Graphical functions in parametric space (with M. Golz and O. Schnetz),
Letters in Mathematical Physics **107**(6) (2017) no. 6, pp. 1177–1192. [arXiv:1509.07296]
17. The parity theorem for multiple polylogarithms,
Journal of Number Theory **172** (March 2017) pp. 93–113. [arXiv:1512.04482]
18. Computation of form factors in massless QCD with finite master integrals (with A. von Manteuffel and R. M. Schabinger),
Physical Review D **93**:125014, June 2016. [arXiv:1510.06758]
19. A quasi-finite basis for multi-loop Feynman integrals (with A. von Manteuffel and R. M. Schabinger),
Journal of High Energy Physics, **2015**(2):120, February 2015. [arXiv:1411.7392]
20. Algorithms for the symbolic integration of hyperlogarithms with applications to Feynman integrals,
Computer Physics Communications **188**, pp. 148–166, March 2015. [arXiv:1403.3385]
21. On hyperlogarithms and Feynman integrals with divergences and many scales,
Journal of High Energy Physics, **2014**(3):71, March 2014. [arXiv:1401.4361]
22. On the analytic computation of massless propagators in dimensional regularization,
Nuclear Physics B **874** pp. 567–593, September 2013. [arXiv:1305.2161]

Conference proceedings

23. Some open problems on Feynman periods, pp. 29–44 in *Periods in Quantum Field Theory and Arithmetic* (J. I. Burgos Gil, K. Ebrahimi-Fard and H. Gangl, eds.), vol. 314 of *Springer Proceedings in Mathematics & Statistics*, Springer, 2020. (Workshop Research Trimester on Multiple Zeta Values, Multiple Polylogarithms, and Quantum Field Theory, ICMAT, Madrid, Spain, September 15–December 19, 2014)

Scientific publications (continued)








24. Renormalization group functions of ϕ^4 theory in the MS-scheme to six loops (with M. V. Kompaniets),
in *Loops and Legs in Quantum Field Theory (Leipzig, Germany), 24–29 April 2016*.
Proceedings of Science, PoS(LL2016)038. [[arXiv:1606.09210](#)]
25. Renormalisation, Hopf algebras and Mellin transforms,
in *Feynman Amplitudes, Periods and Motives* (L. Álvarez-Cónsul, J. I. Burgos-Gil and K. Ebrahimi-Fard, eds.), vol. 648 of *Contemporary Mathematics*, (Providence, RI), pp. 169–202, Amer. Math. Soc., 2015, proceedings of the conference at ICMAT Madrid (July 2–6, 2012). [[arXiv:1407.4943](#)]
26. Feynman integrals via hyperlogarithms,
in *Loops and Legs in Quantum Field Theory (Weimar, Germany), 27 April–2 May 2014*.
Proceedings of Science, PoS(LL2014)049. [[arXiv:1407.0074](#)]
27. Renormalization and Mellin transforms (with D. Kreimer)
in *Computer Algebra in Quantum Field Theory* (C. Schneider and J. Blümlein, eds.),
vol. XII of *Texts & Monographs in Symbolic Computation*, pp. 195–223, Springer Wien,
Sept., 2013. [[arXiv:1207.6321](#)]

Other

28. Symbolic integration with hyperlogarithms,
Computeralgebra Rundbrief **56** (Mar., 2015) pp. 6–9.
29. Feynman integrals and hyperlogarithms,
PhD thesis, Humboldt-Universität zu Berlin, 2014. [[arXiv:1506.07243](#)]
30. Hopf-algebraic renormalization of Kreimer’s toy model,
Master’s thesis, Humboldt-Universität zu Berlin, July, 2011. [[arXiv:1202.3552](#)]

Scientific activities

*Invited seminar talks and research stays*⁴

01–14/05/2022	<i>Research in Pairs</i> “Motives in Deformation Quantization” with Clément Dupont and Brent Pym, MFO Oberwolfach	
20/12/2021 (S)	Humboldt-Universität zu Berlin (online)	
01/06/2021 (S)	Japan Europe Number Theory Exchange Seminar (online)	
07/05/2021 (S)	IPPP Seminar, Durham (online)	
10/03/2021 (S)	Arithmetic Geometry and Quantum Field Theory, Warwick (online)	
27/10/2020 (S)	Calgary Algebra & Number Theory Seminar (online)	
19/10/2020 (S)	Matroid Union, Waterloo (online)	













Scientific activities (continued)

12/06/2020	(S) Mathematical Physics Seminar, Lyon (online)	
28/05/2020	(S) NIKHEF, Amsterdam (online)	
27/04/2020	(S) ETH Zürich (online)	
09–12/12/2019	Humboldt-Universität zu Berlin	
28/11/2019	(S) Dalitz Seminar in Fundamental Physics, Oxford	
01/11/2019	(S) Maths HEP Lunchtime Seminars, Durham	
29/10/2019	(S) Relativity Seminar, University of Oxford	
17–24/09/2019	Spacetime and quantum mechanics, total positivity and motives, CSMA Harvard	
02–06/09/2019	Valeurs zêta multiples en quantification par déformation, IMAG Mont- pellier	
29–30/07/2019	(S) Max-Planck-Institut für Physik, München	
18–19/06/2019	(S) Felix Klein Kolloquium, TU Kaiserslautern	
04/04/2019	(S) Talks in mathematical physics, ETH Zürich	
25/03–12/04/2019	Modular forms, periods and scattering amplitudes, ITS Zürich	
11–15/03/2019	Modular forms, periods and scattering amplitudes, ITS Zürich	
18–21/02/2019	(S) Niels Bohr Institute, Copenhagen	
24/01/2019	(S) Mathematical Physics Seminar, The University of York	
19/12/2018	(S) QFT and String Theory seminar, Humboldt-Universität zu Berlin	
17–21/12/2018	(S) Humboldt-Universität zu Berlin	
13/12/2018	(S) Séminaire de Mathématique, IHÉS, Bures-sur-Yvette	
	(S) Séminaire Darboux, LPTHE, Paris	
07/12/2018	(S) Southampton High Energy Physics Seminar	
26–30/11/2018	(S) Séminaire AGATA, Institut Montpellierain A. Grothendieck	
15/10/2018	(S) String Theory Seminar, University of Oxford	
24–30/05/2018	University of Waterloo	
18–20/04/2018	(S) Niels Bohr Institute, Copenhagen	
26–30/03/2018	University of Edinburgh	
26/02–02/03/2018	(S) Amplitudes and Periods, HIM, Bonn	
18–22/12/2017	(S) Humboldt-Universität zu Berlin	
07/12/2017	(S) String Theory Seminar, DESY, Hamburg	
06–30/11/2017	(S) Kyushu University, Fukuoka	
26/05/2017	(S) North meets South Colloquium, Oxford	
08/03/2017	(S) Edinburgh Mathematical Physics Group, Edinburgh	
26–27/01/2017	LPTHE, Paris	
01–02/12/2016	(S) DAMTP, Cambridge	
29–30/11/2016	(S) University of Liverpool	
23–25/11/2016	CERN, Geneva	
02–04/10/2016	(S) NIKHEF, Amsterdam	
18–19/07/2016	(S) Particle Physics Seminar, ETH Zürich	
17/06/2016	(S) University of Warwick	
13–15/06/2016	(S) Humboldt-Universität zu Berlin	

Scientific activities (continued)

02–03/05/2016	(S) Albert-Ludwigs-Universität, Freiburg	
07/04/2016	(S) 5th Itzykson seminar, IHES, Bures-sur-Yvette	
14–27/03/2016	(S) Simon Fraser University, Vancouver	
29/02–04/03/2016	Max-Planck-Institut für Mathematik, Bonn	
15–17/02/2016	(S) School of Mathematics, Trinity College Dublin	
01–05/02/2016	(S) Emmy-Noether-Seminar, FAU Erlangen	
26/01/2016	(S) University of Oxford	
30/11–02/12/2015	(S) Humboldt-Universität zu Berlin	
14/09–18/09/2015	Johannes-Gutenberg-Universität (THEP), Mainz	
30/04–01/05/2015	(S) Higgs Centre for Theoretical Physics, Edinburgh	
21–24/04/2015	(S) Humboldt-Universität zu Berlin	
19–20/01/2015	NCSR Demokritos, Athens	
09–12/12/2014	(S) Johannes-Gutenberg-Universität (THEP), Mainz	
05–09/12/2014	(S) KIT (TTP), Karlsruhe	
21/11/2014	(S) Insitute for Theoretical Studies, Zürich	
17/11–28/11/2014	ICMAT, Madrid	
22/09–03/10/2014	(S) ICMAT, Madrid	
18–29/08/2014	NIKHEF, Amsterdam	
05–07/05/2014	(S) Max-Planck-Institut für Physik, München	
17–19/03/2014	(S) ITP, ETH Zürich	
08/01/2014	(S) Research seminar “Quantum Fields and Strings” (HU Berlin)	
12/12/2013	(S) DESY Theory Seminar Zeuthen	
25–29/03/2013	Institut des Hautes Études Scientifiques, Bures-sur-Yvette	

Workshops and conferences







28/03–01/04/2022	Graph Complexes and Quantum Field Theory, HU Berlin (online participation)	
15–18/11/2021	(S) Higher Structures Emerging from Renormalisation, ESI Vienna	
18–22/10/2021	(S) Elliptics '21, Uppsala	
09–13/08/2021	(S) GEOQUANT 2021, Freiburg (online participation)	
16/06/2021	(S) StringMath, IMPA (online)	
05–09/10/2020	(S) Antidifferentiation and the Calculation of Feynman Amplitudes, Zeuthen (online participation)	
18–20/12/2019	Intersection theory and Feynman integrals, Padova	
09–13/09/2019	Graph complexes in algebraic geometry and topology, Manchester	
22–23/07/2019	Arithmetic and Geometric Aspects of Modular Forms, Oxford	
02–04/07/2019	Amplitudes, Dublin	
31/05–04/06/2019	(S) Supergravity Divergences and Modular Graph Forms, Uppsala	
18–22/03/2019	(S) The Mathematics of Linear Relations between Feynman Integrals, MITP Mainz	

⁴Speaker (S) indicates that I gave a talk.















Scientific activities (continued)

29/10–09/11/2018	Amplitudes in the LHC era, Galileo Galilei Institute for Theoretical Physics, Florence	
05–08/09/2018 (S)	Elliptic integrals in Mathematics and Physics, ETZ Zürich, Ascona	
13–17/08/2018 (S)	International Workshop on Arithmetic Geometry and Quantum Field Theory, KIAS Seoul	
18–22/06/2018 (S)	Amplitudes, SLAC	
25/05/2018 (S)	Combinatorial structures in perturbative QFT 2: transforms and graph counting, University of Waterloo	
29/04–04/05/2018 (S)	Loops & Legs in Quantum Field Theory, St Goar	
03–26/01/2018	Periods in Number Theory, Algebraic Geometry and Physics, HIM, Bonn	
11–12/11/2017 (S)	Polylogs, multiple zetas, and related topics, Tohoku University, Sendai	
04–15/09/2017 (S)	Mathematics and Physics of Scattering Amplitudes, MIAPP Munich	
28/08–01/09/2017 (S)	Motives for Periods, Berlin	
11–12/07/2017	Amplitudes, Edinburgh	
26–30/06/2017	Algebraic Combinatorics, Resurgence, Moulds and Applications (CARMA), CIRM, Luminy	
07/06/2017 (S)	Workshop on multi-loop calculations, Paris	
06–09/06/2017 (S)	The elliptic/missing Feynman integrals, ETH Zürich	
10–14/04/2017 (S)	Iterated integrals and the Regge limit, Higgs Centre, Edinburgh	
27–31/03/2017	Galois Theory of Periods and Applications, MSRI Berkeley	
06–10/02/2017	Amplitudes: Practical and Theoretical Developments, MITP Mainz	
13–14/07/2016 (S)	ICMS 2016, ZIB Berlin	
04–08/07/2016	Amplitudes, NORDITA, Stockholm	
23/06–02/07/2016	Aspects of Amplitudes, NORDITA, Stockholm	
24–25/05/2016	Number Theory and Physics, Institut Henri Poincaré, Paris	
25–29/04/2016 (S)	Loops & Legs in Quantum Field Theory, Leipzig	
21/03/2016 (S)	CombStructPQFT, SFU Vancouver	
08–12/02/2016 (S)	Paths to, from and in renormalization, Potsdam	
20–23/07/2015 (S)	Applications of Computer Algebra (ACA), Kalamata	
06–10/07/2015 (S)	Amplitudes, Zürich	
22–26/06/2015	International Conference in Number Theory and Physics, IMPA, Rio de Janeiro	
15–19/06/2015 (S)	RADCOR/LoopFest, Los Angeles	
01–04/06/2015 (S)	CanaDAM, Saskatoon	
02–13/03/2015	The interrelation between mathematical physics, number theory and noncommutative geometry, ESI Vienna	
18/01/2015 (S)	HOCTOOLS NNLO meeting, Athens	
01–04/12/2014	Workshop on Multiple Zeta Values, Modular Forms and Elliptic Motives II, Madrid	

Scientific activities (continued)

- 15–19/09/2014 (S) Numbers and Physics, Madrid 
- 27/04–02/05/2014 (S) Loops & Legs in Quantum Field Theory, Weimar 
- 27/03/2014 (S) DPG-Frühjahrstagung, Mainz 
- 07–09/11/2013 (S) Renormalisation from Quantum Field Theory to Random and Dynamical Systems, Potsdam 
- 02–06/07/2012 Periods and Motives, A Modern Perspective on Renormalization, Madrid 
- 25–29/06/2012 Quantum Field Theory, Periods and Polylogarithms III, dedicated to David Broadhurst's 65th birthday, Berlin 

Schools

- 19–23/07/2021 (S) The Amplitude Games, MITP Mainz (online) 
- 17–20/02/2020 (S) 2nd SAGEX training school, HU Berlin 
- 20–24/05/2019 (S) Masterclass: Elliptic Motives, KTH and University of Stockholm 
- 11–15/02/2019 (S) Modular forms, periods and scattering amplitudes, ETH Zürich 
- 04–15/06/2018 (S) Summer school on structures in local quantum field theory, Les Houches 
- 25–29/05/2015 (S) Applied combinatorics graduate summer school, Saskatoon 
- 09–20/06/2014 (S) Summer school on structures in local quantum field theory, Les Houches 
- 01–05/10/2013 (S) Multiple Zeta Values in Mathematics and Physics, KOSMOS Summer University, Berlin 
- 03–12/07/2013 Polylogarithms as a Bridge between Number Theory and Particle Physics, London Mathematical Society - EPSRC Durham Symposium 
- 18–22/03/2013 (S) Feynman Graphs and motives, Bingen 
- 10–14/09/2012 New Methods for Field Theory Amplitudes, Arnold Sommerfeld School, LMU München 
- 11–16/09/2011 Symmetries, Fundamental Interactions and Cosmology, Frauenchiemsee 
- 09/2010 (S) Summer academy of the *Studienstiftung*, San Giovanni
Project: *The direct method of the calculus of variations* 
- 07 – 09/2009 (S) DESY Summer student programme, Zeuthen 
- 08/2007 (S) Summer academy of the *Studienstiftung*, Schloß Neubeuern
Project: *Billiards and Veech-groups of origamis* 