

CV of Erik Panzer

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

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 ”
10/2009–09/2010	University of Cambridge, UK (Part III of the mathematical tripos), degree <i>Certificate of Advanced Study in Mathematics</i> with Distinction
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

01–03/2023	16 hour lecture course: Electromagnetism
10/2022–02/2023	supervision of a masters thesis (Jean-Luc Portner)
07–09/2022	supervision of a summer research project with 2 undergraduate students
since 2021	co-supervision of PhD student Simone Hu
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 tutor for Differentiable Manifolds
07–08/2019	supervision of two undergraduate summer projects
2018–2022	co-supervision of PhD student Matija Tapušković
since 2012	30 reviews for journals including: AIHPD , AMS Contemp. Math. , CJM , CMP , CNTF , CPC , E-JC , Front. Phys. , IRMA Lect. , J. Algebra , JCA , JHEP , JMP , JNCG , JNT , J. Phys. A , Nagoya Math. J. , Nucl. Phys. B , Open Math. , SIGMA
10/2011–02/2012	Teaching assistant: Introduction to Quantum Field Theory I
08/2008–09/2008	Programming internship with Miaplaza Inc. (San Francisco, USA)

Practical experience (continued)

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>

(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. Regularized integrals and manifolds with log corners (with C. Dupont and B. Pym)
December 2023. [[arXiv:2312.17720](#)]

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)

2. Feynman symmetries of the Martin and c_2 invariants of regular graphs (with K. Yeats)
April 2023. [[arXiv:2304.05299](#)]
3. Hierarchies in relative Picard-Lefschetz theory (with M. Berghoff)
December 2022. [[arXiv:2212.06661](#)]
4. Five-loop massless propagator integrals (w. A. Georgoudis, V. Gonçalves and R. Pereira)
February 2018. [[arXiv:1802.00803](#)]

Journal articles

5. Hepp's bound for Feynman graphs and matroids
Ann. Inst. H. Poincaré D **10** (2023), no. 1 pp. 31–119. [[arXiv:1908.09820](#)]
6. 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](#)]
7. 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](#)]
8. 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](#)]
9. 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](#)]
10. 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](#)]
11. Multiple zeta values in deformation quantization (with P. Banks and B. Pym)
Inventiones Mathematicae **222** (2020), pp. 79–159. [[arXiv:1812.11649](#)]
12. 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](#)]

Scientific publications (continued)

13. Lambert-W solves the noncommutative Φ^4 -model (with R. Wulkenhaar),
Commun. Math. Phys. **374** (2020), pp. 1935–1961. [[arXiv:1807.02945](#)]
14. Manifestly dual-conformal loop integration (with J. Bourjaily and F. Dulat),
Nuclear Physics B **942** (May 2019), pp. 251–302. [[arXiv:1901.02887](#)]
15. 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](#)]
16. 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](#)]
17. 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](#)]
18. 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](#)]
19. 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](#)]
20. The parity theorem for multiple polylogarithms,
Journal of Number Theory **172** (March 2017) pp. 93–113. [[arXiv:1512.04482](#)]
21. 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](#)]
22. 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](#)]
23. Algorithms for the symbolic integration of hyperlogarithms with applications to Feynman integrals,
Computer Physics Communications **188**, pp. 148–166, March 2015. [[arXiv:1403.3385](#)]

Scientific publications (continued)

24. On hyperlogarithms and Feynman integrals with divergences and many scales,
Journal of High Energy Physics, **2014(3)**:71, March 2014. [[arXiv:1401.4361](#)]
25. On the analytic computation of massless propagators in dimensional regularization,
Nuclear Physics B **874** pp. 567–593, September 2013. [[arXiv:1305.2161](#)]

Conference proceedings

26. 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)
27. 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](#)]
28. 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](#)]
29. 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](#)]
30. 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









31. Symbolic integration with hyperlogarithms,
Computeralgebra Rundbrief **56** (Mar., 2015) pp. 6–9.
32. Feynman integrals and hyperlogarithms,
PhD thesis, Humboldt-Universität zu Berlin, 2014. [[arXiv:1506.07243](#)]
33. 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

21/12/2023	(S) Online seminar on periods and motives, Tsinghua University	
30/11/2023	(S) Niels Bohr Institute, Copenhagen	
19–21/06/2023	(S) DESY Theory Seminar, Hamburg	
10/05/2023	(S) Seminar on motives and period integrals in Quantum field theory and String theory, Oxford	
26/04–05/05/2023	McGill University, Montréal	
17–21/04/2023	(S) Institute for Advanced Study, Princeton	
03–15/04/2023	Perimeter Institute, Waterloo	
23–24/03/2023	(S) MATHEXP-PolSys Seminar, Inria Saclay	
22/08–02/09/2022	(S) New connections in number theory and physics, INI Cambridge	
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)	
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 Montpellier	
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	

Scientific activities (continued)


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	
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	

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

Scientific activities (continued)

25–29/03/2013 Institut des Hautes Études Scientifiques, Bures-sur-Yvette 






Workshops and conferences

- 02–05/10/2023 (S) Tropical Geometry and Infrared Divergences: Heated Discussions on Cool Topics, Institute for Advanced Study, Princeton 
- 07–11/08/2023 Amplitudes conference, CERN, Geneva 
- 10–14/07/2023 (S) SIAM Conference on Applied Algebraic Geometry, Eindhoven 
- 14–16/06/2023 From perturbative to non-perturbative QFT, Münster 
- 19–22/07/2022 (S) Group34 (ICGTMP), Straßbourg 
- 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 
- 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 












Scientific activities (continued)

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	
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

02–04/08/2023 (S)	Amplitudes Summer School, CERN, Geneva	
08–09/06/2023 (S)	Workshop and School on Complex Lagrangians, Integrable Systems, and Quantization, Oxford	
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	

Scientific activities (continued)

- 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* 