Sebastian Pögel

RESEARCH INTERESTS

My research develops novel computational techniques for multi-loop Feynman integrals, particularly those with multiple internal masses associated with complex geometric structures such as elliptic and hyperelliptic curves and Calabi–Yau manifolds. Furthermore, I aim at making such integrals accessible to phenomenological studies, both in collider and gravitational wave physics.

Keywords: Scattering Amplitudes, Feynman Integrals, Collider Phenomenology

RESEARCH EXPERIENCE

University of Zurich, Zurich, Switzerland
- Postdoctoral researcher in the Department of Astrophysics
  - Member of the group of Harald Ita   from 01/10/2025

Paul Scherrer Institute PSI, Villigen, Switzerland
- Postdoctoral researcher in the Theory Group of the Laboratory for Particle Physics (LTP)
  - Member of the group of Harald Ita   01/11/2024 – 30/09/2025

Johannes-Gutenberg University Mainz, Mainz, Germany
- Postdoctoral researcher in the theoretical physics group   01/11/2021 – 31/10/2024
  - Member of the group of Stefan Weinzierl

EDUCATION

Université Paris-Saclay/CEA-Saclay, Gif-sur-Yvette, France
- PhD in Physics at the Institut de Physique Théorique   08/10/2018 – 31/10/2021
  - Early Stage Researcher in the European Innovative Training Network SAGEX, Marie Skłodowska-Curie grant No. 764850
  - Thesis: *Unitarity approaches to two-loop all-plus amplitudes*
  - Supervisor: David A. Kosower
  - Date of Defense: 29/09/2021

RWTH Aachen University, Aachen, Germany
- Master of Science in Physics, *with distinction*   01/10/2017 – 24/09/2018
  - Focus of study: Quantum Field Theory and Gauge Theories
  - Thesis: *Higgs Mass Precision Calculation in General Extensions of the Standard Model at the 2-Loop Level with FlexibleSUSY*
  - Supervisor: Michael Krämer

Paris Sud University, Orsay, France
- Erasmus year   01/09/2016 – 30/09/2017
  - Following the M2 ICFP Theoretical Physics Program at the *École Normal Superieur* (ENS), Paris
  - M2 Internship at CPHT, École Polytechnique
    Title: *Hidden Symmetries in Supergravity*
    Supervisor: Guillaume Bossard

RWTH Aachen University, Aachen, Germany
- Bachelor of Science in Physics   01/10/2012 – 11/07/2016
  - Thesis: *The Electron Yukawa Coupling from Higgs Decays*
  - Supervisor: Michael Krämer

PEER-REVIEWED PUBLICATIONS

- Hjalte Frellesvig, Roger Morales, Sebastian Pögel, Matthias Wilhelm; *"Calabi–Yau Feynman integrals in gravity: ε-factorized form for apparent singularities "*; arXiv: 2412.12057; Published in JHEP 02 (2025) 209
- Sebastian Pögel, Xing Wang, Stefan Weinzierl, Konglong Wu, Xiaofeng Xu; *"Self-dualities and Galois symmetries in Feynman integrals "*; arXiv: 2407.08799; Published in JHEP 09 (2024) 084
- Hans Jockers, Sören Kotlewski, Pyry Kuusela, Andrew J. McLeod, Sebastian Pögel, Maik Sarve, Xing Wang, Stefan Weinzierl; *"A Calabi–Yau-to-Curve Correspondence for Feynman Integrals"*; arXiv: 2404.05785; Published in JHEP 01 (2025) 030

- Robin Marzucca, Andrew J. McLeod, Ben Page, Sebastian Pögel, Stefan Weinzierl; *"Genus Drop in Hyperelliptic Feynman Integrals"*; arXiv: 2307.11497; Published in Phys.Rev.D 109 (2024) 3, L031901
- Sebastian Pögel, Xing Wang, Stefan Weinzierl; *"Bananas of equal mass: any loop, any order in the dimensional regularisation parameter"*; arXiv:2212.08908; Published in JHEP 04 (2023) 117
- Sebastian Pögel, Xing Wang, Stefan Weinzierl; *"Taming Calabi–Yau Feynman Integrals: The Four-Loop Equal-Mass Banana Integral"*; arXiv:2211.04292; Published in Phys.Rev.Lett. 130 (2023) 10, 101601
- Sebastian Pögel, Xing Wang, Stefan Weinzierl; *"The three-loop equal-mass banana integral in ε-factorised form with meromorphic modular forms"*; arXiv:2207.12893; Published in JHEP 09 (2022), 062

PRE-PRINTS	- Sebastian Pögel, Toni Teschke, Xing Wang, Stefan Weinzierl, *"The unequal-mass three-loop banana integral"*; arXiv:2507.23594

- Sebastian Pögel, Toni Teschke, Xing Wang, Stefan Weinzierl, *"The unequal-mass three-loop banana integral"*; arXiv:2507.23594
- Iris Bree, Federico Gasparotto, Antonela Matijašić, Pouria Mazloumi, Dmytro Melnichenko, Sebastian Pögel, Toni Teschke, Xing Wang, Stefan Weinzierl, Konglong Wu, Xiaofeng Xu, *"The geometric bookkeeping guide to Feynman integral reduction and ε-factorised differential equations"*; arXiv:2506.09124
- David A. Kosower, Sebastian Pögel *"Serendipitous Syzygies of Scattering Amplitudes"*; arXiv:2505.14857
- David A. Kosower, Sebastian Pögel *"A Unitarity Approach to Two-Loop All-Plus Rational Terms"*; arXiv:2206.14445

CONFERENCE PROCEEDINGS
- Robin Marzucca, Andrew J. McLeod, Ben Page, Sebastian Pögel, Xing Wang, Stefan Weinzierl, *"Recent developments from Feynman integrals"*; arXiv:2401.06360; Published in Acta Phys.Polon.Supp. 17 (2024) 2, 2-A11
- Sebastian Pögel, Xing Wang, Stefan Weinzierl, *"Feynman integrals, geometries and differential equations"*; arXiv:2309.07531; Published in PoS RADCOR2023 (2024) 007
- David A. Kosower, Sebastian Pögel; *"Yang–Mills All-Plus: Two Loops for the Price of One"*; arXiv:2208.06209; Published in PoS LL2022 (2022), 031

PUBLIC SOFTWARE PACKAGES
- **Mathematica package collection SpinorHelicityPackages`**
  - Author: Sebastian Pögel (building on third party code, used within licensing conditions)
  - Description: Collection of packages used for working with the spinor helicity formalism, computing one-loop integral coefficients via generalized unitarity, computing tree-level scattering amplitudes via Berends–Giele and BCFW recursion, and parametrizing on-shell kinematics using momentum-twistors. Includes a package for efficiently computing series expansion coefficients of extremely large multi-variate rational functions.

INVITED TALKS AND SEMINARS
- **Joint Belgian HEP-TH Seminar** (University of Brussels, Belgium)
  - Seminar title: *Geometry in Feynman Integrals*   02/04/2025
- **Workshop "The Arithmetic of Calabi–Yaus"** (University of Mainz, Germany)
  - Talk title: *Ansatzing ε-factorized Differential Equations for Feynman Integrals*   27/03/2025
- **Conference "Loop-the-loop"** (Online)
  - Talk title: *Tackling Apparent Singularities in Calabi–Yau Feynman Integrals*   14/11/2024
- **ETH Zurich Theory Seminar** (ETH Zurich, Switzerland)
  - Seminar: *Tackling Apparent Singularities in Calabi–Yau Feynman Integrals: An Integral for 5PM Black Hole Scattering*   13/11/2024
- **Conference "Mathematics of Scattering Amplitudes"** (Galileo Galilei Institute Florence, Italy)
  - Plenary talk: *(A) Calabi—Yau-Curve Correspondence*   30/08/2024
- **Conference "Elliptics and beyond"** (MiaPbP Munich, Germany)
  - Plenary talk: *(A) Calabi—Yau-Curve Correspondence*   06/08/2024
- **Workshop Caravel Collaboration** (University of Ghent, Belgium)
  - Workshop talk title: *Integrating Algebraically*   03/06/2024
- **Workshop Galaxies meet QCD** (ETH Zurich, Switzerland)
  - Plenary talk with title: *Special Functions in Feynman Integrals*   22/02/2024
- **Conference QCD Meets Gravity 2023** (CERN, Switzerland)
  - Plenary talk with title: *Genus Drop in Hyperelliptic Feynman Integrals*   12/12/2023

- **Niels–Bohr Institute Joint Theory Seminar** (University of Copenhagen, Denmark)
  - Seminar with title: *Geometry in Feynman Integrals* 16/11/2023
- **Niels–Bohr Institute Journal Club** (University of Copenhagen, Denmark)
  - Presentation of paper: *Genus Drop in Hyperelliptic Feynman Integrals* 15/11/2023
- **Higgs Centre for Theoretical Physics Amplitudes Seminar** (Edinburgh University, United Kingdom)
  - Seminar with title: *Geometry in Feynman Integrals* 19/10/2023
- **Geometries and Special Functions for Physics and Mathematics** (Bethe Center for Theoretical Physics, Bonn, Germany)
  - "My favourite problem" talks, with title: *Automorphic forms for Calabi–Yau Integrals?* 21/03/2022
- **Workshop Elliptic Integrals in Fundamental Physics** (Johannes-Gutenberg University, Mainz, Germany)
  - Plenary talk with title: ε-*Factorization with Meromorphic Modular Forms* 13/09/2022
- **Max-Planck-Institute for Physics Theory Seminar** (Munich, Germany)
  - Seminar with title: *Yang-Mills All-Plus Amplitudes: Two Loops for the Price of One* 22/04/2022
- **SLAC Elementary Particle Physics Seminar** (online)
  - Seminar with title: *Two Loops for the Price of One in Yang–Mills* 17/09/2021
- **Conference "QCD Meets Gravity VI"** (online)
  - Plenary talk with title: *New techniques for rational terms of two-loop amplitudes* 02/12/2020
- **9th Workshop "Katharsis of Ultimate Theory Standards"** (Julius-Maximilians-Universität, Würzburg, Germany)
  - Plenary talk with title: *Higgs Mass at 2-Loop Level for FlexibleSUSY* 16/07/2018

CONTRIBUTED TALKS, POSTERS AND SEMINARS

- **Conference "Physics and Number Theory"** (Online)
  - Talk title: *Calabi–Yaus and Curves: A correspondence from Feynman Integrals* 20/01/2025
- **Quantum Fields & Strings Group Meeting** (Perimeter Institute, Waterloo, Canada)
  - Overview Talk with title: *Feynman Integrals, Calabi–Yaus & all that* 11/10/2024
- **Conference "Amplitudes 2023"** (CERN, Switzerland)
  - Poster with title: *Genus Drop in Hyperelliptic Feynman Integrals* 07/08/2023
- **Conference "QCD Meets Gravity"** (University of Zurich, Switzerland)
  - Talk with title: *Epsilon factorization for Calabi–Yau integrals* 15/12/2022
- **Conference "Amplitudes 2022"** (Prague, Czech Republic)
  - Poster with title: *The three-loop equal-mass banana integral in ε-factorized form with meromorphic modular forms* 08/08/2022
- **Conference "Loops and Legs in Quantum Field Theory 2022"** (Ettal, Germany)
  - Talk with title: *Yang–Mills All-Plus: Two Loops for the Price of One* 26/04/2022
- **3rd SAGEX Workshop** (online)
  - Talk with title: *Rational Terms of Two-loop All-Plus Amplitudes* 27/07/2020
- **2nd SAGEX Workshop** (Humboldt-Universität zu Berlin, Berlin, Germany)
  - Talk with title: *The two-loop all-plus gluon amplitude* 24/02/2020
- **1st SAGEX Workshop** (DESY, Hamburg, Germany)
  - Talk with title: *Two-Loop All-Plus Gluon Amplitudes at Arbitrary Multiplicity* 01/08/2019

RESEARCH VISITS

University of Ghent, Ghent, Belgium
- Collaboration visit 30/03/2025 – 04/04/2025

Perimeter Institute, Waterloo, Canada
- Three week visit 02/03/2025 – 22/03/2025

Perimeter Institute, Waterloo, Canada
- Four week visit 14/09/2024 – 13/10/2024

Niels Bohr Institute, Copenhagen, Denmark
- Collaboration visit 13/11/2023 – 17/11/2023

Higgs Center University of Edinburgh, Edinburgh, United Kingdom
- Collaboration visit 16/10/2023 – 20/10/2023

CERN Theory department, CERN, Switzerland
- Collaboration visit 17/04/2023 – 21/04/2023

	CERN Theory department, CERN, Switzerland	
	▪ Collaboration visit	22/05/2023 – 26/05/2023
	Pauli-Center, ETH Zürich, Switzerland	
	▪ Two-week visit	03/06/2019 – 14/06/2019
TEACHING	**University of Zurich**, Zurich, Switzerland	
	▪ Tutor for the Bachelor course *Electrodynamics*	01/02/2025 – 31/07/2025
	Johannes-Gutenberg University Mainz, Mainz, Germany	
	▪ Lecturer for Master course *Quantum Field Theory II*	08/01/2024 – 10/02/2024
	RWTH Aachen University, Aachen, Germany	
	▪ Tutor for the Bachelor course *Theory I: Classical Mechanics*	09/04/2018 – 30/09/2018
INDUSTRY	**RISC Software GmbH**, Hagenberg im Mühlkreis, Austria	
	▪ Three-month SAGEX industry secondment in the Medical Informatics department	
	• Developing machine learning translation of CT/MRI medical imaging data, building on CycleGAN	
		18/01/2021 – 09/04/2021
OUTREACH	**Physics Institute of Johannes-Gutenberg University Mainz, Germany**	
	▪ Outreach talk for prospective Bachelor and Master students	07/07/2023
	Press release published on website of the Johannes-Gutenberg University Mainz	
	▪ Drafting of press release and creation of associated graphic	21/03/2023
	Virtual exhibition: SAGEX At the Frontier of Physics	
	▪ Creation of text and animations for section	
	Amplitudes from Physical Principles	10/08/2018 – 31/10/2021
	SAGEX movie: Doing a PhD in Physics	
	▪ Filming of material used for movie, appearance in film	10/08/2018 – 31/10/2021
	SAGEX Twitter account	
	▪ Management of official account for two months	01/03/2019 – 30/04/2019
	▪ Management of official account for two months	01/09/2020 – 31/10/2020
ORGANIZATION OF SCIENTIFIC EVENTS	**Workshop Organization Caravel Collaboration** (University of Zurich)	
	▪ Co-organization of three day international workshop, focused on developments in the Caravel collaboration	25/06/2025 – 27/06/2025
MANAGEMENT ROLES	**Member of SAGEX Network Training Task Group**	
	▪ Representative of Early Stage Researchers in the network, providing student input for planning of SAGEX schools and workshops	08/10/2018 – 31/10/2021
LANGUAGES	▪ German (native)	
	▪ English (fluent reading, speaking, writing, CEFR C2)	
	▪ French (conversational, UNIcert I, CEFR B1)	
	▪ Italian (conversational)	
SKILLS	**Mathematica**	
	▪ Extensive knowledge in programming and package development	
	▪ Developed code available in public repositories	
	▪ Work on extension of FlexibleSUSY` package	
	Experience with other Programming Languages, Tools & Libraries	
	▪ LaTeX, Kira, C++, Git, Python, Maple, PyTorch, OpenPBS, Slurm	