

# KATHRIN HELLMUTH

## Curriculum Vitae

PostDoc at Department of Computing and Mathematical Sciences, California Institute of Technology (Caltech),  
USA — hellmuth@caltech.edu — +49 151 2097 0553 — personal website

## RESEARCH INTERESTS

---

- *Inverse problems*: parameter identification, identifiability analysis, experimental design, numerical reconstruction, Bayesian inversion
- *Scientific computing*: ensemble sampling and optimization methods, PINNs
- *Applied PDEs*: kinetic theory, modelling physical phenomena on different levels (microscopic, mesoscopic, macroscopic), particle methods, scaling limits
- *Mathematical biology*: chemotaxis

## EMPLOYMENT

---

**PostDoc** *from 05/2025*  
Department of Computing and Mathematical Sciences, California Institute of Technology (Caltech), USA  
Advisor: Prof. Dr. Franca Hoffmann

**Research and Teaching Assistant** *10/2020 - 03/2025*  
Department of Mathematics, University of Würzburg, Germany

## EDUCATION

---

**PhD in Mathematics** *10/2020 - 04/2025*  
Department of Mathematics, University of Würzburg, Germany  
Thesis: On qualitative experimental design for PDE parameter identification inverse problems  
Advisor: Prof. Dr. Christian Klingenberg

**M.Sc. and B.Sc. in Mathematics** *2014-2020*  
Department of Mathematics, University of Würzburg, Germany  
Master Thesis: Computing the Black Scholes equation with uncertain volatility using the  
stochastic Galerkin method and a Bi-Fidelity approach  
Advisor: Prof. Dr. Christian Klingenberg

**German High School Degree (Abitur)** *2014*

## AWARDS AND HONORS

---

<b>Springer Price for the best PhD contributed talk (Application)</b> XVIII International Conference on Hyperbolic Problems (HYP2022) 2022, Malaga, Spain	2022
<b>Travel grants</b> The 19th International Conference on Hyperbolic Problems (HYP2024) 2024, Shanghai, China XVIII International Conference on Hyperbolic Problems (HYP2022) 2022, Malaga, Spain SIAM Conference on Analysis of Partial Differential Equations (PD22), online conference	07/2024 06/2022 03/2022
<b>PhD scholarship</b> German Academic Scholarship Foundation (Studienstiftung des deutschen Volkes; top 1%), Bonn, Germany Marianne-Plehn-Program part-time position, Munich, Germany	2021-2025 2021-2024
<b>Study scholarship</b> Hanns-Seidel-Stiftung, Munich, Germany Max Weber-Programm of the Free State of Bavaria (top 3% of Bavarian students), Munich, Germany	2015-2020 2014-2020
<b>Vogel Award for an excellent Master thesis in digitalization and AI</b> Vogel Stiftung, Würzburg, Germany	2020
<b>Otto-Volk-Urkunde for an excellent Master and Bachelor thesis</b> Otto-Volk-Stiftung, Würzburg, Germany	2017, 2020

## PUBLICATIONS

---

### Refereed Journal Article

- [5] **A kinetic chemotaxis model and its diffusion limit in slab geometry** 2025  
*Asymptotic Analysis.*, (arxiv)  
jointly with H. Egger, N. Philippi, M. Schlottbom
- [4] **Reconstructing the kinetic chemotaxis kernel using macroscopic data: well-posedness and ill-posedness** 2025  
*SIAM Journal on Applied Mathematics*, vol. 85, no. 2, pp. 613-635, (arxiv)  
jointly with C. Klingenberg, Q. Li, M. Tang
- [3] **Kinetic chemotaxis tumbling kernel determined from macroscopic quantities** 2024  
*SIAM Journal on Mathematical Analysis*, vol. 56, no. 1, pp. 568-587, (arxiv)  
jointly with C. Klingenberg, Q. Li, M. Tang
- [2] **Computing Black Scholes with Uncertain Volatility—A Machine Learning Approach** 2022  
*Mathematics*, vol. 10, no. 3, 489, special issue "Numerical Analysis with Applications in Machine Learning", (arxiv)  
jointly with C. Klingenberg
- [1] **Multiscale convergence of the inverse problem for chemotaxis in the Bayesian setting** 2021  
*Computation*, vol. 9, no. 11, 119, special issue "Inverse Problems with Partial Data", (arxiv)  
jointly with C. Klingenberg, Q. Li, M. Tang

### Submitted

- [6] **Preserving positivity of Gauss-Newton Hessian through random sampling** (arxiv) 2024  
jointly with C. Klingenberg, Q. Li

## Conference Proceedings

- [9] **Multi-scale PDE inverse problem in bacterial movement** (link) 2023  
*SEMA SIMAI Springer Series: Proceedings of HYP 2022*  
jointly with C. Klingenberg, Q. Li
- [8] **Inverse problems for kinetic equations - an application to chemotaxis** (link) 2021  
*Oberwolfach Reports. Rep. 18, no. 3, pp. 2316–2318*
- [7] **An inverse problem for chemotaxis** (link) 2021  
*Oberwolfach Reports. Rep. 18, no. 2, pp. 1080–1083*

## Science communication

- [10] **Route planning for bacteria** 2022  
*Snapshots of modern mathematics from Oberwolfach, no.12* (link)  
jointly with C. Klingenberg

## TEACHING EXPERIENCE

---

### University of Würzburg

#### Mathematics for Machine Learning

Lecture, graduate level course

*fall 2024*

Exercise class, graduate level course

*fall 2023, fall 2022*

#### Partial Differential Equations in Mathematical Physics

Exercise class, graduate level course

*spring 2024, fall 2021*

#### Linear Algebra I

Exercise class, first semester B.Sc. course

*spring 2021, fall 2020*

#### Analysis I

Student teaching assistant, first semester B.Sc. course

*fall 2019*

## INVITED TALKS

---

#### Applied Mathematics Seminar

Darmstadt, Germany

*01/2025*

#### Meeting of the Collaborative Research Center 1456

Göttingen, Germany

*11/2024*

#### Workshop on "Kinetic Equations and Machine Learning"

Shanghai Jiao Tong University, Shanghai, China

*06/2024*

#### Applied Mathematics Seminar

RWTH Aachen University, Aachen, Germany

*01/2024*

#### Inverse Problems Seminar

University of Augsburg, Augsburg, Germany

*01/2024*

#### Mini-Symposium "Inverse Problems of Transport Equations and Related Topics"

11th Applied Inverse Problems Conference, Göttingen, Germany

*09/2023*

#### Applied Mathematics Seminar

Johann Radon Institute for Computational and Applied Mathematics of the Austrian Academy of Sciences (RICAM), Linz, Austria

*11/2022*

## ORGANIZATION OF SCIENTIFIC EVENTS

---

#### Minisymposium "Kinetic Models and Inverse Problems"

SIAM Conference on Analysis of Partial Differential Equations (PD22), online conference

*03/2022*

## SERVICE

---

### Outreach

Organizational support of a statewide mathematics contest for schoolchildren (Mathematik-Olympiade Bayern) *03/2023*

### Women in STEM

Mentoring of a 9th grade STEM interested school girl with the CyberMentor program *2021-2022*

### Teaching Organization

Revision of online learning course material for university teaching in Mathematics *06-10/2023*

### Talent Promotion

Commission member in the selection seminar for new study scholarship recipients of the German Academic Scholarship Foundation (Studienstiftung des deutschen Volkes) *10/2024*

## LANGUAGES

---

**German** mother tongue  
**English** fluent

**Italian** fluent  
**Spanish** beginner

## PROGRAMMING SKILLS

---

All computer programs used in our papers were written by myself in **Matlab** and **Python**.

## WORKSHOPS AND CONFERENCES THAT I GAVE A TALK AT

---

<b>German-Speaking Inverse Problems Society 2024 Annual Meeting</b> Siegen, Germany	<i>09/2024</i>
<b>The 19th International Conference on Hyperbolic Problems (HYP2024)</b> Shanghai, China	<i>07/2024</i>
<b>Workshop on "Kinetic Equations and Machine Learning"</b> Shanghai, China	<i>06/2024</i>
<b>Chemnitz Symposium on Inverse Problems</b> Würzburg, Germany	<i>11/2023</i>
<b>16th Hirschegg Workshop on Conservation Laws</b> Hirschegg, Austria	<i>09/2023</i>
<b>11th Applied Inverse Problems Conference</b> Göttingen, Germany	<i>09/2023</i>
<b>SIAM Conference on Computational Science and Engineering (CSE23)</b> Amsterdam, Netherlands	<i>03/2023</i>
<b>Junior Researchers Meeting</b> University of Wisconsin-Madison, WI, USA	<i>09/2022</i>
<b>XVIII International Conference on Hyperbolic Problems (HYP2022)</b> University of Málaga, Spain	<i>06/2022</i>
<b>Inverse problems in biology</b> Institut Henri Poincaré, Paris, France	<i>03/2022</i>
<b>SIAM Conference on Analysis of Partial Differential Equations (PD22)</b> online conference	<i>03/2022</i>
<b>Tissue growth and movement (Poster presentation)</b> Institut Henri Poincaré, Paris, France	<i>01/2022</i>
<b>Small Collaboration: Advanced Numerical Methods for Nonlinear Hyperbolic Balance Laws and Their Applications (hybrid meeting)</b> MFO Oberwolfach, Germany	<i>08/2021</i>
<b>Small Collaboration: Modeling Phenomena from Nature by Hyperbolic Partial Differential Equations (hybrid meeting)</b> MFO Oberwolfach, Germany	<i>04/2021</i>

## REFERENCES

---

### **Dr. Qin Li**

Department of Mathematics  
University of Wisconsin-Madison  
Van Vleck Hall, 480 Lincoln Dr.  
Madison, WI, 53705, USA  
Email: qinli@math.wisc.edu  
Phone: +1 (608)262-2881

### **Dr. Min Tang**

Institute of Natural Sciences and School of Mathematics  
Shanghai Jiaotong University  
800 Dongchuan road,  
Shanghai, 200240, CHINA  
Email: tangmin@sjtu.edu.cn  
Phone: +86 21-54742607

**Dr. Christian Klingenberg**

Department of Mathematics  
University of Würzburg  
Emil-Fischer-Straße 40  
97074 Würzburg, GERMANY  
Email: christian.klingenberg@uni-wuerzburg.de  
Phone: +49 931 31-85045

**Dr. Matthias Schlottbom**

Department of Applied Mathematics  
University of Twente  
Zilverling (building no. 11), Hallenweg 19  
7522 NH Enschede, THE NETHERLANDS  
Email: m.schlottbom@utwente.nl  
Phone: +31 53 489 5458

**Dr. Herbert Egger**

RICAM Johann Radon Institute for Computational  
and Applied Mathematics and  
Institute for Numerical Mathematics  
Johannes-Kepler University Linz  
Science Park 2, Altenberger Str. 69  
4040 Linz, AUSTRIA  
Email: herbert.egger@jku.at  
Phone: +43 732 2468 4051

*date: May 11, 2025*