

# NEWSLETTER

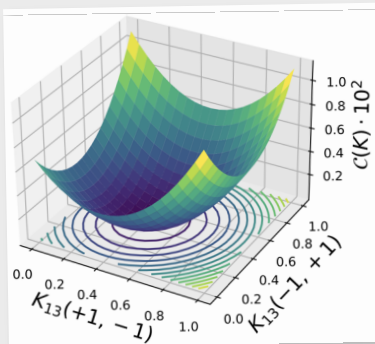
## of the Work Group Mathematical Fluid Mechanics

*Newsletter no. 13 (2024)*

### Paper with Kathrin Hellmuth accepted

The paper Kathrin Hellmuth, Christian Klingenberg, Qin Li, Min Tang: "Reconstructing the kinetic chemotaxis kernel using macroscopic data: well-posedness and ill-posedness" has been accepted for publication in the SIAM Journal on Applied Mathematics.

The inverse problem for the kinetic chemotaxis equations is studied numerically. Also its sensitivity to the measured data is considered.



The loss function  $\mathcal{E}$  for numerically solving the inverse problem for one coefficient is shown. The measured data is chosen such that  $\mathcal{E}$  is convex near its minimum.

### Lena Baumann submitted paper

The paper Lena Baumann, Lukas Einkemmer, Christian Klingenberg, Jonas Kusch: "A stable multiplicative dynamical low-rank discretization for the linear Boltzmann-BGK equation" has been submitted to a journal.

The numerical dynamic low rank approach (DLRA) is applied to a linear kinetic equation and stability shown under a CFL condition. The DLRA is shown to be computationally more efficient.

### Guests in 2025

This year 2024 we had seven academic guests visiting our workgroup: Constantine Dafermos, Daniel Butros, Philippe Helluy, Praveen Chandrashekar, Marlies Pirner, Hyunju Kwon and Wasilij Barsukow.

For next year I have invited a number of guests, all of whom agreed to come, albeit some without a fixed date. They are:

- **Michael Dumbser** (Trento, Italy) plans to visit for a week in spring. He works on numerics of conservation laws. Elena Gaburro is one of his students.

- **Lukas Einkemmer** (Innsbruck, Austria) plans to visit for a few days in spring. He works on scientific computing, numerical analysis, and plasma physics. Lena Baumann and myself collaborate with him on the efficient dynamical low rank numerical method for kinetic equations.

- **Mengni Li** (Nanjing, China) plans to visit for a month late April into May. She obtained her PhD in 2022 at Tsinghua University, Beijing, China. She works on the theory of nonlinear wave equations.

- **Praveen Chandrashekar** (Bangalore, India) plans to visit for a some weeks sometime in May/June. He works on numerics of conservation laws. Yu-Chen Cheng / Lisa Lechner and myself work with him on central schemes for MHD / the Active Flux method.

- **Jan Nordström** (Linköping, Sweden) plans to visit May 25 - June 7. He is an expert on the analysis of numerical scheme, for example for obtaining energy estimates for discretizations of conservation laws.

- **Wasilij Barsukow** (Bordeaux, France) plans to visit for a week in fall. Lisa Lechner and Junming Duan have an ongoing project with him on the Active Flux method.



Michael Dumbser



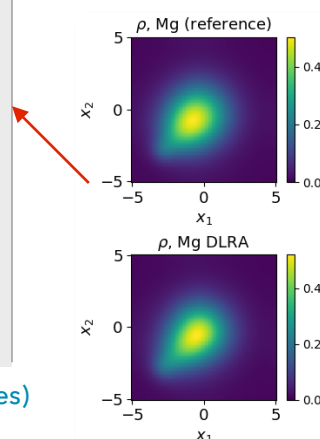
Lukas Einkemmer



Praveen



Jan Nordström

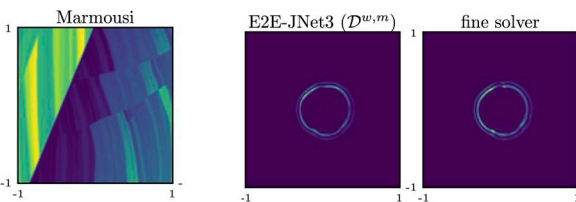


Numerical results for the density  $\rho(t,x)$  of a 2-dimensional beam test problem for the linear BGK kinetic equation. Above is a reference solution, below the solution computed with the DLRS algorithm.

## Paper with Luis Kaiser accepted

The paper [Luis Kaiser, Richard Tsai, Christian Klingenberg: "Efficient Numerical Wave Propagation Enhanced by an End-to-End Deep Learning Model"](#) has been accepted in Proceedings of 'Numerical Mathematics and Advanced Applications (ENUMATH 2023)', Lecture Notes in Computational Science and Engineering (Springer Verlag).

When solving seismic inverse problems the need for very efficient solvers for the wave equation with varying wave speed is important. For this we present an efficient machine learning algorithm.



On the left, one sees the irregular distribution of wave speed in a 2-dim domain. In the right two panels are the solution of the wave equation in such a domain, first using an efficient neural network, then the solution on a very fine grid, which takes much longer to compute.

## Upcoming conferences

Here is a list of upcoming workshops and conferences that are new my list:

- **annual meeting of the DFG hyperbolic priority program** in March 2025 for two days, in Darmstadt. Lisa Lechner, Wasilij Barsukow and myself are part of this DFG priority program.

- **30th Biennial Numerical Analysis**, June 24 - 27, 2025 in Glasgow. I have not attended a previous meeting of this biennial conference.

- **European Conference on Numerical Mathematics and Advanced Applications (ENUMATH 2025)**, Sept. 1 - 5, 2025, in Heidelberg. The paper with Luis Kaiser above was accepted for the proceedings of the last one of this series of biennial conferences.

- **Workshop on Hyperbolic Problems**, Sept. 24 - 26, 2025, in Nürnberg, organized by Emil Wiedemann. This will be a meeting on theoretical questions for multi-dimensional conservation laws.

## Upcoming scientific conferences

Click on the links and check where you might want to participate.

- Dec. 2 - 4, 2024: [19th MHD days 2024](#) in Potsdam, Germany, organized by Rainer Arlt
- Dec. 9 - 11, 2024: [XVIII "Würzburg" Winter Workshop on Stellar Astrophysics 2024](#), in Heidelberg, organized by Fritz Röpke
- Dec. 16 - 20, 2024: [14th AIMS conference on differential equations](#), in Abi Dhabi, UAE, organized by the [American Institute of Mathematical Sciences](#) (AIMS)
- March 3 - 7, **2025**: [SIAM Conference on Computational Science and Engineering \(CSE25\)](#), in Fort Worth, Texas, USA
- March (~ 2 days): Annual Meeting of the DFG Priority program on Hyperbolic equations, in Darmstadt, organized by Martin Oberlack
- June 9 - 13, 2025: [Numerical methods for hyperbolic problems 2025](#) (NumHyp25), in Darmstadt, organized by Jan Giesselmann and others
- June 24 - 27, 2025: [30th Biennial Conference in Numerical Analysis](#) in Glasgow, organized by persons from the University of Strathclyde, Glasgow
- July 13 - 18, 2025: [International Conference on Spectral and High-Order Methods](#) (ICOSAHOM), in Montreal, Canada
- Sept. 1 - 5, 2025, [European Conference on Numerical Mathematics and Advanced Applications](#) (ENUMATH 2025) in Heidelberg, organized by Barbara Wohlmuth among others
- Sept. 14 - 20, 2025: Hirscheegg Workshop, in the Kleinwalsertal, Austria, organized by Ferdinand Thein and Gerald Warnecke
- Sept. 24 - 26, 2025: Workshop on Hyperbolic Problems, in Nürnberg, organized by Emil Wiedemann and others
- one week in Nov. 2025: SIAM Conference on Analysis of Partial Differential Equations (PD25), somewhere in the USA
- sometime in **2026**: Finite Volume and Complex Applications 11, in Münster, Germany
- 2nd half of July, 2026: 20th International Conference on Hyperbolic Problems: Theory, Numerics and Applications, in Stuttgart, Germany

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## The lectures in my student seminar this winter semester 2024/25

Every semester I run a literature seminar for Bachelor and Master students. This semester there will be 11 talks. You can find them listed [here](#) (scroll down).