MAFF 2025:

Mathematical Analysis of Fluid Flows by Variational Methods

Weierstrass Institute Berlin, September 29 – October 1, 2025

MAFF 2025 is devoted to bringing together emerging and established researchers in fluid mechanics who investigate analytic problems by means of variational techniques. The main topics are existence results, uniqueness and non-uniqueness, construction of solutions, generalized solution concepts, selection criteria, relative entropy methods, and asymptotic behavior.

The organizers,

Thomas Eiter,
Robert Lasarzik,
and László Székelyhidi

1 General Information

1.1 Venue

MAFF 2025 will take place in the Erhard-Schmidt lecture hall on the ground floor of the Weierstrass Institute, which is situated in the district of "Mitte" in the city centre of Berlin. The venue is wheel-chair accessible by appointment. Kindly inform us about any particular needs.

The nearest underground stations are **Hausvogteiplatz**, served by line U2 and **Stadtmitte**, served by lines U2 and U6. Please see www.bvg.de for more information on public transport in Berlin.

1.2 Workshop Dinner and Lunch

The workshop dinner will take place at the restaurant Tapas y Más, Neue Grünstraße 17-18, 10179 Berlin on Tuesday, September 30 starting at 6.30 pm. The dinner is covered within the conference fee and includes the meal and two drinks per person.

Here are a few places to have lunch near the venue at the Weierstrass Institute:

- Bakery Steinecke - snacks, cakes, and coffee
- Chupenga - burritos, tacos, etc.
- MALOA Poké Bowl - Hawaiian bowls
- Lunch Time - pizza, pasta, and salads
- Little Green Rabbit - fresh salads, soups, and baked potatoes
- Fontana di Trevi - Italian cuisine
- Frittenwerk - french fries and other street food
- Food trucks on Spittelmarkt (Wednesdays and Fridays only) - all kinds of street food
- Huong Sen - Vietnamese cuisine (10 minutes to walk)

2 Detailed Schedule

Monday, September 29

08:30–09:00	Registration
09:00–09:15	Opening
09:15–10:05	Eduard Feireisl: *On Wellposedness Problems Related to the Euler System of Gas Dynamics*
10:05–10:25	Jeffrey Cheng: *Uniqueness and Weak-BV Stability in the Large for Isothermal Gas Dynamics*
10:25–10:45	Marcel Śliwiński: *The Energy-variational Framework with Application to the Euler–Korteweg–Poisson System*
10:45–11:15	Coffee Break
11:15–12:05	Emil Wiedemann: *Selection of Measure-valued Solutions*
12:05–12:25	Francesco Triggiano: *Well-posedness of Rough 2D Euler Equation with Bounded Vorticity*
12:25–12:45	Parasuram Venkatesh: *A Non-conservative, Non-local Approximation of the Burgers Equation*
12:45–14:30	Lunch Break
14:30–15:20	Ewelina Zatorska: *Analysis of Multiphase Fluid Models*
15:20–15:40	Luisa Plato: *A Relative Energy Inequality for an Anisotropic Navier–Stokes–Nernst–Planck–Poisson System — Weak-strong Uniqueness and a posteriori Error Estimates*
15:40–16:00	Fan Cheng: *Analysis of Cahn–Hilliard-type Viscoelastoplastic Two-phase Flows*
16:00–16:30	Coffee Break
16:30–17:20	Mária Lukácová-Medvidová: *Variational Selection of the Dissipative Solutions of the Euler Equations: Numerical Perspective*
17:20–17:40	Alex Kaltenbach: *Analysis and Numerics for a Simplified Model for Smart Fluids*
17:40–18:00	Shyam Ghoshal: *A Convergence Rate Result for Front Tracking Approximations of Conservation Laws with Discontinuous Flux*

Tuesday, September 30

09:15–10:05	Alexis Vasseur: *From Navier–Stokes to Discontinuous Solutions of the Compressible Euler*
10:05–10:25	John Cooper Faile: *Quantitative Hölder-L^2 Stability for Solutions of 2×2 Conservation Laws*
10:25–10:45	Florian Oschmann: *Γ-convergence of Some Nearly Incompressible Fluids*
10:45–11:15	Coffee Break
11:15–12:05	Elisabetta Chiodaroli: *On the Density of Wild Data for the Euler System of Gas Dynamics*
12:05–12:25	Stefanie Schindler: *Time-asymptotic Self-similarity of the Damped Euler Equations in Parabolic Scaling Variables*
12:25–12:45	Pritpal Matharu: *Unraveling Self-similar Energy Transfer Dynamics Using Variational Optimization Methods*
12:45–14:30	Lunch Break
14:30–15:20	Björn Gebhard: *On the Energy Constrained Optimal Mixing Problem*
15:20–15:40	Eliseo Luongo: *Zero-noise Selection for the Stochastic Transport Equation beyond DiPerna–Lions*
15:40–16:00	Jonas Sauer: *Well-posedness of the Stokes Equations on a Wedge with Navier-Slip Boundary Conditions*
16:00–16:30	Coffee Break
16:30–17:20	Aneta Wróblewska-Kamińska: *Coupled Vlasov and Non-Newtonian Fluid Dynamics*
17:20–17:40	Lucie Wintrová: *Existence and Time Continuity in Non-Newtonian Heat-conducting Flow Models*
18:30	Workshop Dinner

Wednesday, October 1

09:15–10:05	Roberta Bianchini: *Finite-time Singularity Formation for Scalar Stretching Equations*
10:05–10:25	Averkios Averkiou: *Compactly Supported Helical Filaments for the Incompressible Euler Equations*
10:25–10:45	Flora Philipp: *Global Existence of Weak Solutions to Navier–Stokes–Korteweg Systems*
10:45–11:15	Coffee Break
11:15–12:05	Boris Muha: *The Role of Dissipation in the Existence of Time-periodic Solutions to PDE Systems*
12:05–12:25	Domenico Angelo La Manna: *Rotating Traveling Waves on a Capillary Liquid Drop*
12:25–12:45	Giuseppe La Scala: *Bifurcation of Rotating Waves on 2D and 3D Capillary Liquid Drops*
12:45	Closing

3 Abstracts (in Alphabetical Order)

3.1 Invited Talks

Roberta Bianchini (Consiglio Nazionale delle Ricerche, Italy)

Finite-time Singularity Formation for Scalar Stretching Equations

We consider equations of the type:

$$\partial_t \omega = \omega R(\omega),$$

for general linear operators R in any spatial dimension. We prove that such equations almost always exhibit finite-time singularities for smooth and localized solutions. Singularities can even form in settings where solutions dissipate an energy. Such equations arise naturally as models in various physical settings such as inviscid and complex fluids. Joint work with Tarek Elgindi.

Elisabetta Chiodaroli (Università di Pisa, Italy)

On the Density of Wild Data for the Euler System of Gas Dynamics

In this talk we will review some recent results for the Euler system of gas dynamics describing the set of data which allow for infinitely many solutions (wild data). In particular we will show density of wild data for the (complete) Euler system of gas dynamics by combining the idea of Glimm's approximation method with the framework of convex integration.

Eduard Feireisl (Czech Academy of Sciences, Czech Republic)

On Wellposedness Problems Related to the Euler System of Gas Dynamics

We discuss the recent development concerning the (full) Euler system of gas dynamics. In particular, we address the question how to restore well posedness of the problem in the light of recent results of convex integration method. We consider several selection criteria and their relevance to identify a physically relevant as well as computable solutions.

Björn Gebhard (Universität Münster, Germany)

On the Energy Constrained Optimal Mixing Problem

The optimal mixing problem addresses the question of how fast a passive scalar can be mixed under the influence of an incompressible velocity field. The talk focuses on the case where the energy of the allowed fields, i.e. their L^2 norm, is uniformly bounded in time. In that setting perfect mixing in finite time is permitted and indeed realized in some examples by Depauw 2003 and Lunasin, Lin, Novikov, Mazzucato, Doering 2012. On the other hand a lower bound on the time in which perfect mixing can be achieved is known due to Lin, Thiffeault, Doering 2011. In the talk we will show an improvement of the lower bound for the special case of initial data depending only on one spatial coordinate. We will also discuss an example for which the new lower bound is sharp. The proofs rely on differential inclusions, variational methods and ideas of steepest descent.

Mária Lukácová-Medvidová (Johannes Gutenberg-Universität Mainz, Germany)

Variational Selection of the Dissipative Solutions of the Euler Equations: Numerical Perspective

The dissipative solutions of the Euler equations can be obtained as a limit of suitable structure-preserving, consistent and stable numerical schemes. If the strong solution to the above equations exists, the dissipative solutions coincide with the strong solution on its life span. Otherwise, we apply the concept of K-convergence and prove the strong convergence of the empirical means of numerical solutions to a dissipative weak solution. The latter is the expected value of the dissipative measure-valued solutions and satisfies a weak formulation of the Euler equations, modulo the Reynolds turbulent stress. We will discuss the relation between numerical approximations of oscillatory solutions and selection criteria, such as the Dafermos criterion based on maximising the entropy production or the minimisation of the energy defect. A series of numerical simulations will illustrate theoretical results.

Boris Muha (University of Zagreb, Croatia)

The Role of Dissipation in the Existence of Time-periodic Solutions to PDE Systems

In many mechanical systems where energy is conserved, the phenomenon of resonance can occur, meaning that for certain time-periodic forces, the solution of the system becomes unbounded. Examples of partial differential equations describing such systems include the wave equation and equations of linearized elasticity (Lamé system). On the other hand, resonance does not occur in systems with strong dissipation, such as systems described by the heat equation. More precisely, in such a system, there exists a unique time-periodic solution for each time-periodic right-hand side.

In this lecture, we will address the question "how much dissipation is necessary to prevent the occurrence of resonance?". We will analyze periodic solutions to the so-called *heat-wave* system, where the wave equation is coupled with the heat conduction equation via a common boundary. In this system, dissipation only exists in the heat component, and the system can be viewed as a simplified model of fluid-structure interaction. We will demonstrate that in certain geometric configurations, there exists a unique time-periodic solution for each time-periodic right-hand side, assuming sufficient regularity of the forcing term. A counterexample illustrates that this regularity requirement is stronger than in the case of the Cauchy problem.

Finally, we will discuss the open question of whether the result is valid for arbitrary geometry or if there exists a geometry where resonance can occur.

Alexis Vasseur (The University of Texas at Austin, USA)

From Navier–Stokes to Discontinuous Solutions of the Compressible Euler

The compressible Euler equation can lead to the emergence of shock discontinuities in finite time, notably observed behind supersonic planes. A very natural way to justify these singularities involves studying solutions as inviscid limits of Navier-Stokes solutions with evanescent viscosities. The mathematical study of this problem is, however, very challenging due to the destabilizing effects of viscosity.

Bianchini and Bressan proved the inviscid limit to small BV solutions using the so-called artificial viscosities (Annals of Math. 2005). However, achieving this limit with physical viscosities remained an open question until our recent result, which was achieved in collaboration with Geng Chen and Moon-Jin Kang.

In this presentation, we will provide a basic overview of classical mathematical theories in compressible fluid mechanics and introduce the recent method of a-contraction with shifts. We will describe the basic ideas and difficulties involved in studying physical inviscid limits within the context of the barotropic Euler equations.

Emil Wiedemann (FAU Erlangen-Nürnberg, Germany)

Selection of Measure-valued Solutions

Measure-valued solutions for fluid equations have been around for decades but have received renewed interest in recent years. Measure-valued solutions and related concepts (such as dissipative or dissipative measure-valued solutions) can be useful in the study of singular limits and numerical approximation. It is usually not difficult to construct measure-valued solutions, however in many situations they display a vast degree of non-uniqueness. I will present some recent results on possible selection criteria. While there doesn't seem to be a criterion that singles out one unique solution, I shall argue that many undesirable ones are eliminated. Joint work with Dennis Gallenmüller and with Christian Klingenberg and Simon Markfelder.

Aneta Wróblewska-Kamińska (Polish Academy of Sciences, Poland)

Coupled Vlasov and Non-Newtonian Fluid Dynamics

We study a coupled kinetic-non-Newtonian fluid system on the periodic domain, where particles evolve by a Vlasov equation and interact with an incompressible power-law fluid through a drag force. We prove the global existence of weak solutions for large enough power-law exponent of the fluid's stress-strain relation. Under an additional uniform boundedness assumption on the particle density, we also establish large-time decay of a modulated energy functional measuring deviation from velocity alignment which depends on the range of power-law exponent, reflecting the role of fluid dissipation in the large-time dynamics. This is recent joint work with Young-Pil Choi and Jinwook Jung.

Ewelina Zatorska (University of Warwick, UK)

Analysis of Multiphase Fluid Models

In this talk I will focus on analysis of models of multi-phase compressible flows. I will present the existence theory and discuss our recent progress and open problems regarding various singular limits.

3.2 Contributed Talks

Averkios Averkiou (University of Bath, UK)

Compactly Supported Helical Filaments for the Incompressible Euler Equations

We consider the 3D Euler equations in vorticity formulation for an ideal, incompressible fluid. Our focus is on constructing solutions that exhibit high concentration of vorticity along a time-evolving curve, known as vortex filaments.? In this talk, we revisit the so-called Vortex Filament Conjecture for the particular case of vortex helices and provide a rigorous construction of a compactly supported helical filament, associated with a rotating-translating helix evolving by its binormal curvature flow. This is joint work with Professor Monica Musso.

Fan Cheng (Freie Universität Berlin, Germany)

Analysis of Cahn–Hilliard-type Viscoelastoplastic Two-phase Flows

A model describing viscous, elastic, and plastic material behavior of two-phase flows has been developed. This model is used in geodynamics, e.g., to describe the evolution of fault systems in the lithosphere over geological time scales. The system consists of a momentum balance, an evolution law for an extra stress tensor, and a Cahn–Hilliard-type evolution law that governs phase transition. The Cauchy stress in the momentum balance is constituted by a Stokes-like term as well as by a contribution from the extra stress. The evolution law for the extra stress incorporates the Zaremba–Jaumann time derivative and a non-smooth plastic dissipation mechanism. To analyze this system, appropriate concepts of generalized solutions are addressed. This is joint work with Marita Thomas (FU Berlin) and Robert Lasarzik (WIAS Berlin) within project B09 "Materials with discontinuities on many scales" of CRC 1114 "Scaling Cascades in Complex Systems" funded by the German Research Foundation.

Jeffrey Cheng (The University of Texas at Austin, USA)

Uniqueness and Weak-BV Stability in the Large for Isothermal Gas Dynamics

For the 1-d isothermal Euler system, we consider the family of entropic BV solutions with possibly large, but finite, total variation. We show that these solutions are stable with respect to large perturbations in a class of weak solutions to the system which may not even be BV. The method is based on the construction of a modified front tracking algorithm, in which the theory of a-contraction with shifts for shocks is used as a building block. The main contribution is to construct the weight in the modified front tracking algorithm in a large-BV setting.

John Cooper Faile (University of Texas at Austin, USA)

Quantitative Hölder-L^2 Stability for Solutions of 2×2 Conservation Laws

In this talk we discuss resent developments in the stability and uniqueness of solutions to 2×2 conservations laws in 1-d. In particular, the new Hölder-L^2 estimate of the form

$$\|u(\cdot, \tau) - v(\cdot, \tau)\| \leq K\sqrt{\|u(\cdot, 0) - v(\cdot, 0)\|},$$

where v is the limit of front tracking solutions and u is a bounded entropic solution with strong traces. As an application these results we deduce the first uniqueness results in the L^2 theory for initial data with infinite total variation. This is a joint work with Geng Chen and Sam Krupa.

Shyam Ghoshal (Tata Institute for Fundamental Research, India)

A Convergence Rate Result for Front Tracking Approximations of Conservation Laws with Discontinuous Flux

We consider the initial value problem for a scalar conservation law in one space dimension with a single spatial flux discontinuity, the so-called two-flux problem. We prove that a well-known front tracking algorithm has a convergence rate of at least one-half. The fluxes are required to be smooth, but are not required to be convex or concave, monotone, or even unimodal. We require that there are no more than finitely many flux crossings, but we do not require that they satisfy the so-called crossing condition. If both fluxes are strictly increasing or strictly decreasing, then our analysis yields a convergence rate of one, in agreement with a recent result. Similarly, if the fluxes are equal, i.e., there is no flux discontinuity, we obtain a convergence rate of one in this case also, in agreement with a classical result. The novelty of this paper is that the class of discontinuous flux conservation laws for which there is a front tracking error estimate is expanded, and that the method of analysis is new; we do not use the Kuznetsov lemma, which is commonly used for this type of analysis. This is a joint work with John D. Towers.

Alex Kaltenbach (Technische Universität Berlin, Germany)

Analysis and Numerics for a Simplified Model for Smart Fluids

In this talk, the functional-analytical framework for the treatment of a simplified model for so-called 'smart fluids' is introduced and the most demanding mathematical challenges are highlighted. Moreover, a weak convergence analysis for a fully-discrete finite element approximation is presented. In general, a fluid is called 'smart', when it can change its rheological properties through various external stimuli (e.g., electric or magnetic fields, temperature, light, pH value, concentrations of chemical molecules). This opens the way for a variety of technical applications in aerospace, automotive, heavy machinery, electronic, and biomedical industry. Due to the variable dependency of the power-law index, extracting compactness properties needed for the passage to the limit of a fully-discrete finite element approximation is not possible via standard results. We will see that all the necessary compactness is already included in the fully-discrete finite element approximation.

Domenico Angelo La Manna (Università degli Studi di Napoli Federico II, Italy)

Rotating Traveling Waves on a Capillary Liquid Drop

We consider the free boundary problem for a liquid drop of nearly spherical shape with capillarity. By exploiting the variational (i.e., Hamiltonian) structure of the system, we show the existence of rotating traveling profiles bifurcating from the stationary solution (i.e., the spherical shape).

Giuseppe La Scala (Scuola Superiore Meridionale, Italy)

Bifurcation of Rotating Waves on 2D and 3D Capillary Liquid Drops

We consider the free boundary problem for a $d-$dimensional, $d = 2, 3$, irrotational liquid drop of nearly-spherical shape with capillarity. We show that from spherical drops, we find rotating drops with nearly-spherical shape. To this term, we first write the Craig–Sulem formulation for the free-boundary problem, then we lead a bifurcation-theoretical analysis for the rotating drop equations. In 2D case, the bifurcation is from double eigenvalues, and it can be attained by Crandall–Rabinowitz Bifurcation Theorem. In 3D case, the eigenvalues are in general more degenerate. Therefore, we exploit the Hamiltonian structure of drop equations and their symmetries to show bifurcation through variational Moser–Weinstein method (Moser '76, *Periodic orbits near an equilibrium and a theorem by Alan Weinstein*), together with Benci $\S^1$-index for $\S^1-$invariant functionals defined over spheres (Benci '81, *A geometrical index for the group S1 and some applications to the study of periodic solutions of ordinary differential equations*). The 2D case is a single-authored work, the 3D one is a joint work with P. Baldi and D.A. La Manna.

Eliseo Luongo (Universität Bielefeld, Germany)

Zero-noise Selection for the Stochastic Transport Equation beyond DiPerna–Lions

We investigate $L^\infty_t L^p_x$ solutions of the stochastic transport equation with drift in $L^\infty_t W^{1,q}_x$. Our first result shows that, thanks to a regularization-by-noise effect, we can prove strong existence and pathwise uniqueness in a range of parameters (p, q) where the deterministic transport equation admits non-unique weak solutions. Our second focus is on the zero-noise limit: as the noise intensity vanishes, solutions converge to the unique renormalized solution of the deterministic transport equation in the sense of DiPerna–Lions. Furthermore, this convergence is quantified by a Large Deviations Principle in the space $L_t^\infty L_x^p$, describing the probability of deviations from the deterministic limit. The talk is based on a joint work with G. Crippa and U. Pappalettera.

Pritpal Matharu (MPI für Mathematik in den Naturwissenschaften, Germany)

Unraveling Self-similar Energy Transfer Dynamics Using Variational Optimization Methods

In this talk we will discuss the problem of constructing flow evolutions leading to a self-similar energy cascade consistent with Kolmogorov's statistical theory of turbulence. As a first step in this direction, we focus on the one-dimensional viscous Burgers equation as a toy model. Its solutions exhibiting self-similar behavior, in a precisely-defined sense, are found by framing this problems in terms of PDE-constrained optimization. The main physical parameters are the time window over which self-similar behavior is sought (equal to approximately one eddy turnover time), viscosity (inversely proportional to the "Reynolds number"), and an integer parameter characterizing the distance in the Fourier space over which self-similar interactions occur. Local solutions to this nonconvex PDE optimization problems are obtained with a state-of-the-art adjoint-based gradient method, formulated via variational techniques. Two distinct families of solutions, termed *viscous* and *inertial*, are identified and are distinguished primarily by the behavior of enstrophy which, respectively, uniformly decays and grows in the two cases. The physically meaningful and appropriately self-similar inertial solutions are found only when a sufficiently small viscosity is considered. These flows achieve the self-similar behaviour by a uniform steepening of the wave fronts present in the solutions. The methodology proposed and the results obtained represent an encouraging proof of concept for this approach to be employed to systematically search for self-similar flow evolutions in the context of three-dimensional turbulence.

Florian Oschmann (Czech Academy of Sciences, Czech Republic)

Γ-convergence of Some Nearly Incompressible Fluids

We consider the compressible Navier-Stokes equations in a sequence of bounded domains $(\Omega_\varepsilon)_\varepsilon > 0$, combined with a low Mach number $\mathrm{Ma}(\varepsilon) > 0$. Under appropriate conditions on the convergence of domains $\Omega_\varepsilon \to \Omega$ and $\mathrm{Ma}(\varepsilon) \to 0$, we will show that the limiting equations are the incompressible Navier-Stokes equations in the domain Ω. This is joint work with P. Bella (TU Dortmund) and E. Feireisl (CAS).

Flora Philipp (Technische Universität Wien, Austria)

Global Existence of Weak Solutions to Navier–Stokes–Korteweg Systems

We investigate the global existence of weak solutions to Navier–Stokes–Korteweg systems with drag forces. In particular we assume a density-dependent viscosity of the form $\nu\nabla \cdot (\rho\nabla v)$ and Korteweg terms $\kappa\rho\nabla(\psi'(\rho)\Delta\psi(\rho))$ where $\psi'(\rho) = \rho^{\alpha/2}$ with $\alpha \in [-1, 0]$. This parameter range interpolates between the quantum Navier–Stokes case ($\alpha = -1$) and the classical capillarity case ($\alpha = 0$), thus establishing existence results for a broader class of capillarity-viscosity couplings. The analysis is based on the use of a free energy and the BD-entropy, and exploits additional regularity properties derived via the systematic integration-by-parts technique introduced by Jüngel and Matthes.

Luisa Plato (Weierstraß-Institut für Angewandte Analysis und Stochastik, Germany)

A Relative Energy Inequality for an Anisotropic Navier–Stokes–Nernst–Planck–Poisson System — Weak-strong Uniqueness and *a posteriori* Error Estimates

In this talk, I build upon the framework of suitable weak solutions to the anisotropic Navier–Stokes–Nernst–Planck–Poisson (NSNPP) system and establish a relative energy inequality for these solutions. This inequality serves as the basis for proving the weak-strong uniqueness property. Additionally, it can be exploited as a tool to obtain *a posteriori* error estimates. We are interested in the high-viscosity-low-Reynolds number limit of the NSNPP, which leads to the anisotropic Stokes–Nernst–Planck–Poisson (SNPP) system. Utilizing the relative energy framework, we derive an error estimate for the distance between solutions to the NSNPP and SNPP model in natural energy and dissipation norms.

Jonas Sauer (Friedrich-Schiller-Universität Jena, Germany)

Well-posedness of the Stokes Equations on a Wedge with Navier-Slip Boundary Conditions

I will present well-posedness and regularity results in a certain class of weighted Sobolev spaces for the stationary and incompressible Stokes equations subject to Navier-slip boundary conditions

$$\begin{cases} -\nu\Delta\mathbf{u} + \nabla p = \mathbf{f} & \text{in } \Omega, \\ \operatorname{div}\mathbf{u} = 0 & \text{in } \Omega, \\ \mathbf{u}\cdot\mathbf{n} = 0 & \text{on } \partial\Omega, \\ \mathbf{u}\cdot\boldsymbol{\tau} + \beta\partial_{\mathbf{n}}(\mathbf{u}\cdot\boldsymbol{\tau}) = 0 & \text{on } \partial\Omega, \end{cases}$$

where Ω is the two-dimensional wedge-shaped domain

$$\Omega := \{(x,y) \in \mathbb{R}^2 : x, y > 0 \text{ and } y < \tan(\theta)x\}$$

for some opening angle $\theta \in (0,\pi)$. The novelty of these results is the combination of an unbounded wedge-type domain and the Navier-slip boundary condition which is *not scaling invariant*. The resulting difficulties are overcome by first constructing a variational solution in a second order weighted Sobolev space and subsequently proving higher regularity up to the tip of the wedge by employing an iterative scheme. The talk is based on joint work with Marco Bravin, Manuel Gnann, Hans Knüpfer, Nader Masmoudi and Floris Roodenburg.

Stefanie Schindler (Weierstraß-Institut für Angewandte Analysis und Stochastik, Germany)

Time-asymptotic Self-similarity of the Damped Euler Equations in Parabolic Scaling Variables

In this talk, we investigate the long-time behavior of solutions to the compressible Euler equations with frictional damping on the real line, where we prescribe nonzero values for the density at spatial infinity. To this end, we transform the system into parabolic scaling variables and derive a relative entropy inequality, which allows to conclude the convergence of the density towards a self-similar solution to the porous medium equation while the associated limit momentum is governed by Darcy's law.

Marcel Śliwiński (Weierstraß-Institut für Angwandte Analysis und Stochastik, Germany)

The Energy-variational Framework with Application to the Euler–Korteweg–Poisson System

We present the energy-variational framework in the context of a broad class of evolutionary partial differential equations. Building on earlier work on abstract evolution equations [1] and conservation laws [2], we extend the approach to encompass a wider range of systems. In particular, we consider new examples, such as the Euler–Korteweg–Poisson equations, which illustrate the adaptability of the framework. We identify the key structural assumptions that require modification or generalization in order to accommodate these new problems. This is a joint work with Thomas Eiter and Robert Lasarzik [3].

1. A. Agosti, R. Lasarzik, and E. Rocca. Energy-variational solutions for viscoelastic fluids. *Adv. Nonlinear Anal.*, 13, 2024. doi:10.1515/anona-2024-0056.

2. T. Eiter and R. Lasarzik. Existence of energy-variational solutions to hyperbolic conservation laws. *Calc. Var.*, 63:103, 2024. doi:10.1007/s00526-024-02713-9.

3. T. Eiter, R. Lasarzik, and M. Śliwiński. Energy-variational framework in fluid dynamics — existence and selection. *In preparation*, 2025.

Francesco Triggiano (Scuola Normale Superiore Pisa, Italy)

Well-posedness of Rough 2D Euler Equation with Bounded Vorticity

We consider the 2D Euler equation with bounded initial vorticity and perturbed by rough transport noise. We show that a unique solution exists, which coincides with the starting condition advected by the Lagrangian flow. Moreover, we prove that the solution map is continuous with respect to the initial vorticity, the advecting vector fields and the rough perturbation. As an immediate corollary, we obtain a Wong–Zakai result for fractional Brownian driving paths.

Parasuram Venkatesh (Tata Institute of Fundamental Research, India)

A Non-conservative, Non-local Approximation of the Burgers Equation

The analysis of non-local regularisations of scalar conservation laws is an active research program. Applications of such equations are found in modelling physical phenomena, such as traffic flow. In this work, we propose an inviscid, non-local regularisation in a non-divergence form. The salient feature of our approach is that we can obtain sharp a priori estimates on the total variation (TV) and supremum norm, and justify the singular limit for Lipschitz initial data up to the time of catastrophe. For generic conservation laws, this result is sharp, since we can demonstrate non-convergence when the initial data features simple discontinuities. However, when the flux derivative is linear, such as for the Burgers equation, we obtain stronger limits on the singular limit. Therefore, we devote special attention to regularisations of the Burgers equation, specifically the limiting behaviour of solutions to the Cauchy problems with fixed initial data.

Lucie Wintrová (Charles University, Czech Republic)

Existence and Time Continuity in Non-Newtonian Heat-conducting Flow Models

In this talk, we explore the behavior of a non-Newtonian, heat-conducting fluid within a bounded domain. The fluid's viscous stress response, described by the Cauchy stress tensor $\mathcal{S}$, depends on the temperature and non-linearly on the velocity gradient, governed by a power-law index p. We impose a homogeneous Dirichlet boundary condition on the velocity – ensuring no mass flows across the boundary – and a Dirichlet condition on the temperature, allowing thermal interaction with the surroundings. Focusing on the two-dimensional case with a power-law

index $p \geq 2$, we establish the existence of a suitable weak solution, i.e., one that satisfies the entropy equality. Building on this framework, we then derive estimates that yield a rigorous proof of the continuity of temperature in time.

4 List of Participants

Asjad, Muhammad Imran
UMT Lahore
Pakistan

Averkiou, Averkios
U Bath
UK

Bianchini, Roberta
CNR Rome
Italy

Böhm, Maik
U Duisburg-Essen
Germany

Chemnitz, Robin
FU Berlin
Germany

Cheng, Fan
FU Berlin
Germany

Cheng, Jeffrey
UT Austin
USA

Chernobai, Mikhail
MPI-MIS Leipzig
Germany

Chiodaroli, Elisabetta
U Pisa
Italy

Eiter, Thomas
FU Berlin & WIAS Berlin
Germany

Faile, John Cooper
UT Austin
USA

Feireisl, Eduard
CAS Prague
Czech Republic

Gau, Moritz
WIAS Berlin
Germany

Gebhard, Björn
U Münster
Germany

Ghoshal, Shyam
TIFR Bengaluru
India

Hensel, Sebastian
U Bonn
Germany

Heslin, Patrick
MPI-MIS Leipzig
Germany

Hopf, Katharina
WIAS Berlin
Germany

Huysmans, Lucas
MPI-MIS Leipzig
Germany

Inversi, Marco
MPI-MIS Leipzig
Germany

Ipocoana, Erica
FU Berlin
Germany

Kaltenbach, Alex
TU Berlin
Germany

Kamra, Devansh
U Regensburg
Germany

La Manna, Domenico A.
U Napoli
Italy

La Scala, Giuseppe
SSM Napoli
Italy

Lasarzik, Robert
WIAS Berlin
Germany

Leotta, Fabio
TU Darmstadt
Germany

Lukácová-Medvidová, Mária
JGU Mainz
Germany

Luongo, Eliseo
U Bielefeld
Germany

Matharu, Pritpal
MPI-MIS Leipzig
Germany

Mielke, Alexander
WIAS Berlin
Germany

Muha, Boris
U Zagreb
Croatia

Murmann, Simon
U Jena
Germany

Nesi, Matteo
U Basel
Switzerland

Nguyen, Tuan Tung
TU Wien
Austria

Oschmann, Florian
CAS Prague
Czech Republic

Peschka, Dirk
WIAS Berlin
Germany

Philipp, Flora
TU Wien
Austria

Plato, Luisa
WIAS Berlin
Germany

Rebucci, Annalaura
MPI-MIS Leipzig
Germany

Rosemeier, Juliane
FU Berlin
Germany

Sauer, Jonas
U Jena
Germany

Schindler, Stefanie
WIAS Berlin
Germany

Schrumpf, Lino
TU Berlin
Germany

Sharif, Akram
MPI-MIS Leipzig
Germany

Skondrić, Stefan
FAU Erlangen-Nürnberg
Germany

Śliwiński, Marcel
WIAS Berlin
Germany

Székelyhidi, László
MPI Leipzig & U Leipzig
Germany

Triggiano, Francesco
SNS Pisa
Italy

Vasseur, Alexis
UT Austin
USA

Venkatesh, Parasuram
TIFR Bengaluru
India

Violini, Alessandro
U Basel
Switzerland

Wachtendonk, Jan
FU Berlin
Germany

Wahab, Abdul
HTW Berlin
Germany

Wiedemann, Emil
FAU Erlangen-Nürnberg
Germany

Wintrová, Lucie
U Prague
Czech Republic

Wróblewska-Kamińska, Aneta
PAS Warsaw
Poland

Yin, Xi-Yuan
MPI-MIS Leipzig
Germany

Zainelabdeen, Marwa
WIAS Berlin
Germany

Zatorska, Ewelina
U Warwick
UK