

# NEWSLETTER

## of the Work Group Mathematical Fluid Mechanics

### Newsletter no. 3 (2022)

#### Simon's paper accepted

The paper [E. Feireisl; C. Klingenberg; S. Markfelder, "Euler system with a polytropic equation of state as a vanishing viscosity limit", \*Journal of Mathematical Fluid Mechanics\* \(2022\)](#) has been accepted for publication.

It is the holy grail of PDEs to understand the viscosity limit of the compressible multi-d Navier Stokes equations. In this paper it is shown that if you add heat conductivity, it is possible to understand this limit in some circumstances.

#### Our seminar series on hyperbolic equations begins on Feb. 25

The hyperbolic Zoom seminar series with 12 lectures will kick off on Feb. 25, [see here](#).

- Feb. 25: [Alina Chertock](#) (Raleigh, NC, USA)
- Mar. 4: [Maria Lukacova](#) (Mainz, Germany)
- Mar. 11: [Eitan Tadmor](#) (College Park, MD, USA)
- Mar. 18: [Li Wang](#) (Minneapolis, USA)
- Mar. 25: [Jingwei Hu](#) (Seattle, USA)
- Apr. 1: [Barbara Re](#) (Torino, Italy)
- Apr. 8: [Giacomo Dimarco](#) (Ferrara, Italy)
- Apr. 15: no seminar, Easter break
- Apr. 22: [Jim Glimm](#) (Stony Brook, NY, USA)
- Apr. 29: [Alexander Kurganov](#) (Shenzhen, China)
- May 6: [Randy LeVeque](#) (Seattle, USA)
- May 13: [Martin Frank](#) (Karlsruhe, Germany)

Newsletter no. 3 (2022) (two pages)

#### To imbue BGK models with more physics works!

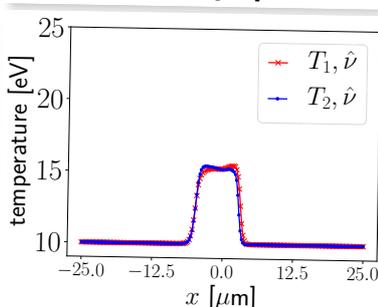
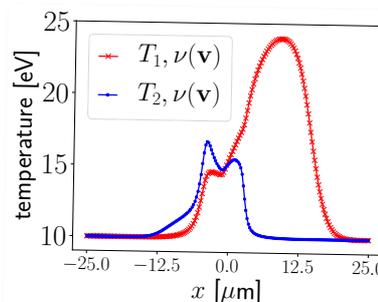
#### Paper by Sandra, Marlies et.al. submitted

The computational efficiency of kinetic BGK models compared to Boltzmann models comes at the price of the simplification of physics. We have been engaged in an endeavor of putting some physics back into BGK models.

A project in this spirit was suggested to us three years ago by Cory Hauck: in plasma the collision frequency varies with the microscopic velocity, what would that do to BGK models?

Fundamental issues had to be surmounted. In this case the equilibrium no longer is a Maxwellian. This warranted a new numerical approach, as explained in the paper: [Jeffrey Haack, Cory Hauck, Christian Klingenberg, Marlies Pirner, Sandra Warnecke: "Numerical schemes for a multi-species BGK model with velocity-dependent collision frequency"](#) which has just been submitted.

A nice outcome of this paper is that there are physical regimes that occur in inertial confinement fusion, where this modeling makes a difference, compared to standard BGK models.



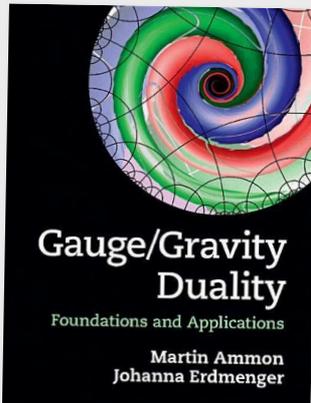
*The interpenetrating flows of two rarefied gases.*

We simulated the dynamics of two counter-streaming beams of light hydrogen-ions (red) and heavy helium-ions. A snapshot after some time is shown. In the simulation with the velocity dependent collision frequency model (top) the helium penetrates deeper into the right compared to simulation with constant collision frequency (bottom).

## Julian Meusel submitted his Master thesis

The physicist Johanna Erdmenger works on the correspondence between the Einstein equations and quantum field theory, called gauge/gravity duality. Using this, certain solutions of the Einstein equations can be translated into solutions of the 3-d quantum field equations. This idea is generating great excitement in the physics community.

It is possible to write the Einstein equations as a first order hyperbolic system of PDEs. These have to be set up with the proper initial and boundary data so they fit the above duality. This has been done in Julian's Master thesis. Given the large number of equations, this was quite a job.



The cover of Prof. Erdmenger's book

## New Bachelor thesis students

Christopher Schäfer will write his Bachelor thesis on gauge-gravity duality.

Robin Nowak in his Bachelor thesis plans to work on finite volume methods.

## Upcoming scientific conferences

Go ahead and click the links to check where you might want to participate.

- Jan. 10 - June 24, 2022: [Frontiers in kinetic theory: connecting microscopic to macroscopic scales - KineCon 2022](#) , a one semester program organized at the Newton Institute at Cambridge University with 5 one week workshops in this time
- Feb. 14 - 18: [Rigorous analysis of incompressible fluid models and turbulence](#) organized at the Newton Institute by Edriss Titi et. al.
- Mar. 7 - 9, 2022: [Workshop on inverse problems in biology](#), at the Poincaré Institute in Paris, co-organized by Marie Doumic
- March 7 - 11, 2022: [Perspectives on Multiphase Fluid Dynamics, Continuum Mechanics and Hyperbolic Balance Laws](#) in Luminy near Marseille, France, organized among others by Dumbser and Warnecke
- March 14 - 18, 2022: [SIAM Conference on Analysis of Partial Differential Equations online](#), organized by Sid Mishra and Emil Wiedemann
- May 16 - 20, 2022: [The Boltzmann Equations: in the trail of Torsten Carlemann](#), near Stockholm, Sweden
- April 4 - 8, 2022: [HIGH ORDER NONLINEAR NUMERICAL METHODS FOR EVOLUTIONARY PDEs: THEORY AND APPLICATIONS \(HONOM\)](#) in Braga, Portugal, organized by Raphael Loubère und Stephane Clain
- April 10 - 15, 2022: [Structure preserving discretizations](#), in Oberwolfach, organized by Bruno Després, Michael Dumbser, myself
- May 23 - 29, 2022: [Sharing Higher-order Advanced Research Knowledge on Finite Volume \(SHARK-FV\)](#) in Portugal, organized by Raphael Loubère und Stephane Clain
- June 12 - 18, 2022: [Summer School on "Methods and models of kinetic theory"](#) organized by Marzia Bisi (Parma) among others
- June 20 - 25: HYP2022: [18th International Conference on Hyperbolic Problems, Theory, Numerics, Applications](#) - Part 2 (formerly HYP 2020), in Malaga, Spain, organized by Carlos Pares
- June 19 - 24, 2022 ["Numerical methods for kinetic equations"](#) a summer school by Eric Sonnendrücker and Lukas Einkemmer in the alps in Italy
- June 27 - July 1, 2022: [Hyperbolic balance laws & beyond](#), in Magdeburg, organized by Helzel and Lukacova
- July 18 - 22, 2022: [When Kinetic Theory meets Fluid Mechanics](#), in Zürich, organized among others by Alexis Vasseur
- Aug. 22 - 26, 2022: [10th International Conference on Numerical Methods for Multi-Material Fluid Flow \(MULTIMAT 2021\)](#) in Zürich, organized by Remi Abgrall and others
- Sept. 12 - 14, 2022: [Nils Henrik Risebro birthday conference](#) in Oslo, organized among others by Fjordholm, Holden, Mishra
- Oct. 9 - 14, 2022: [Computation of hyperbolic and related PDEs: A conference in honor of Remi Abgrall](#), organized by Sid Mishra at ETH Zurich on Monte Verità (Ascona, Switzerland)