NEWSLETTER

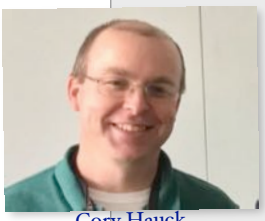
of the Work Group Mathematical Fluid Mechanics

Newsletter no. 15 (2022)

Paper based on Sandra's thesis accepted to JCP

The paper *J. Haack, C. Hauck, C. Klingenberg, M. Pirner, S. Warnecke: "Numerical schemes for a multi-species BGK model with velocity-dependent collision frequency"* has been accepted by the Journal of Computational Physics.

This is based on the work in *Sandra Warnecke's thesis*. Being published in this high level journal is an acknowledgement of the quality of the work. The role of Cory Hauck was seminal in this project.



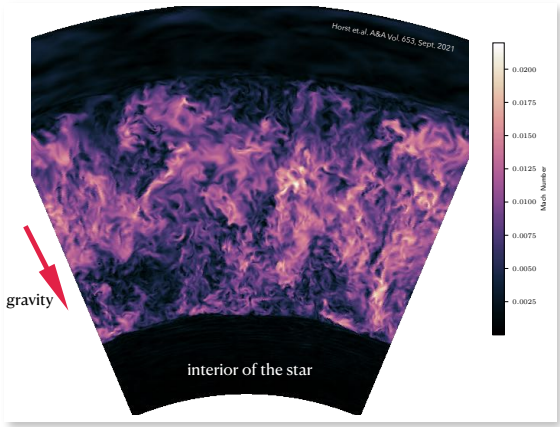
Cory Hauck

Amelie Gehring begins her Master thesis with us

Amelie Gehring will do her Master thesis with us. She will join our research effort on completing PDE models using measurements, our way to solve inverse problems.

Years of collaboration with Fritz Röpke bear fruit

The astrophysicist Fritz Röpke *and his group* simulate the evolution of stars. For this he needs to numerically solve the compressible Euler equations with a gravitational source term. This flow regime has two challenges: i.) the flow is near a stationary solution (near a hydrostatic equilibrium) and ii.) tends to be close to incompressible flow. We needed to find finite volume schemes that could handle both situations, that is find i.) well-balanced schemes and also find ii.) low Mach schemes. Even though we were eventually successful on both counts, it is was only when we realized that these two properties are closely intertwined and needed to be numerically treated accordingly (*Wasilij Barsukow's thesis* paved the way), that the astrophysical code of Fritz Röpke's team finally resulted in good simulations. To get to this point took many years, and we are there now!



Simulation of the flow inside a star, the flow is turbulent. The flow carries "fuel" from the interior of the star to its outside. This is a cut through a three dimensional flow simulation.

An overview article acknowledges our contribution

The Springer *Journal Living Reviews in Computational Astrophysics* has published an overview article on well-

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This semester I teach Mathematics of Machine Learning

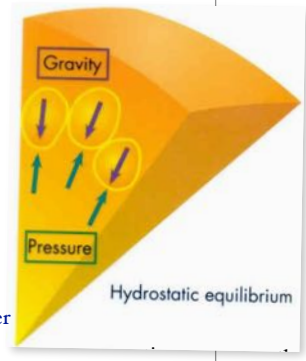
This semester I am teaching a Master's course on the mathematical foundations of machine learning. This is jointly with Kathrin Hellmuth, who helps me with this course and is also doing the exercise section.

This is the first time such a course is being offered in our mathematics department. This resulted in about two-thirds of all our mathematics master students signing up for this course, showing the pent-up demand of our math students for such a course.

Our work group has a new poster

Our math dept. puts up posters of the various research groups. *Here* (and below) you can see the new poster of our work group.

balanced methods for the Euler equations with gravity, *see here*. We have made many contributions to this subject because of our collaboration with Röpke (see the above article). This is reflected in this article by its viewpoint on the subject, close to ours.



a slice of a star, where pressure and gravity balance each other

Upcoming scientific conferences

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

- Nov. 7 - 10, 2022: "*Numerical Methods for the Kinetic Equations of Plasma Physics*" (NumKin 2022) in Garching (near Munich), organized by Eric Sonnendrücker

- Nov. 14 - 18, 2022: *Research School on Kinetic Theory*, in Luminy (near Marseille, France), organized by José Carillo, Markus Schmittchen and others

- Dec. 12 - 16, 2022: *Kinetic and hyperbolic equations: modeling, analysis and numerics*, in Toulouse (France), organized among others by Francis Filbet

- Feb. 26 - March 3, 2023: *SIAM Conference on Computational Sciences and Engineering or SIAM CSE23*, held in Amsterdam, organized among others by Hans deSterck

- March 29 - 31, 2023: *4th European conference on Non-equilibrium gas flows*, in Eindhoven, Netherlands

- May, 2023 (either 8-12 or 22-26): *Sharing Higher-order Advanced Research Know-how on Finite Volume (SHARK-FV)* in Portugal, organized by Raphael Loubère and others

- June 26 - 30, 2023: *NumHyp 2023 (Numerical methods for hyperbolic problems)* in Bordeaux, France. organized by Christophe Berthon and others *(the "important dates" on the website are in 2023)*

New!

- Sept. 4 - 8, 2023: *European Conference on Numerical Mathematics and Advanced Applications (ENUMATH)*, in Lisbon, Portugal

- summer of 2024: *International Conference on Hyperbolic Problems: Theory, Numerics and Applications (HYP 2024)* in Shanghai, China, organized by Shi Jin