NEWSLETTER

of the Work Group Mathematical Fluid Mechanics

3rd newsletter 2021

Today I tread new territory: for the first time in these newsletters, I write about politics. Another new feature are short reports of recent papers of the work group.   *Christian Klingenberg*

Paper featured

In Klingenberg, C., Lai, R., Li, Q.: "*Reconstruction of the emission coefficient in the nonlinear radiative transfer equation*", SIAM Journal on Applied Mathematics Vol. 81, Issue 1 (2021), *view PDE*, the inverse problem for the radiative transfer equation in a so-called black body is considered. This is a kinetic model. It is proven that by measuring the radiation density on the surface, the absorption and emission coefficient can be uniquely determined.

$$\begin{cases} \partial_t u + \theta \cdot \nabla_x u = -\mu u + \int_{\mathbb{S}^{n-1}} \Phi(\theta', \theta) u(t, x, \theta') \, d\theta' + u_b \\ \partial_t T = \Delta_x T - u_b + \mu \frac{1}{|\mathbb{S}^{n-1}|} \int_{\mathbb{S}^{n-1}} u(t, x, \theta) \, d\theta \, , \end{cases}$$

In this kinetic model u describes the radiation intensity, T is the temperature. μ is the absorption coefficient, $u_b = \sigma T^4$ is the so called black body emission, with σ being the emission coefficient.

A co-author in the above paper is *Qin Li* from Madison, Wisc. (USA). She obtained her PhD with Shi Jin. She is an expert on kinetic theory. In the PhD project of Kathrin Hellmuth we have begun to collaborate with her.

Marlies Pirner receives a 2 year post-doc grant

The Deutsche Forschungsgemeinschaft (DFG) awards grants for scientific research proposals on a competitive basis. Marlies wrote a DFG grant proposal "*Modeling and mathematical description of concrete physical applications in the context of kinetic theory*" in 2019. She was asked to revise it in 2020. Now she was awarded the grant, paying for a two year post-doc position for herself, Oct. 2021 - Sept. 2023. What a relief!

On the shortage of vaccine in Germany

Assuming the present rate of Corona vaccinations will continue as they are now, the time needed to vaccinate the majority of the population is around 3 months in Great Britain (GB) versus around 2 years in Germany. One factor in this huge difference is the availability of vaccine. How come there is much less vaccine available in Germany compared to GB?

For this we look at the contracts for vaccine made with the pharmaceutical companies. Even though the investment for developing the vaccine was heavily subsidized, the contracts for buying the vaccine stipulate: i.) the companies keep the patents, ii.) the price for the vaccine may not be revealed, iii.) donations and resale of the vaccine by the buyer is not allowed, iv.) the delivery times of the vaccine are when it suits the company, v.) the companies get liability protection. In other words, the pharmaceutical companies managed to obtain contracts such that they can act with impunity.

It is my guess now, that GB pays more money for the vaccine than Germany, and that the pharmaceutical companies are free to deliver to GB first.

Preprint featured

In Barsukow, W., Klingenberg, C.: "*Exact solution and a truly multi-d Godunov scheme for the acoustic equations*", submitted (2020), view PDF among other things an exact solution of the two-dimensional Riemann problem for the 2-d linearized Euler equations is constructed. One can prove that for some initial conditions the solution has a singularity!
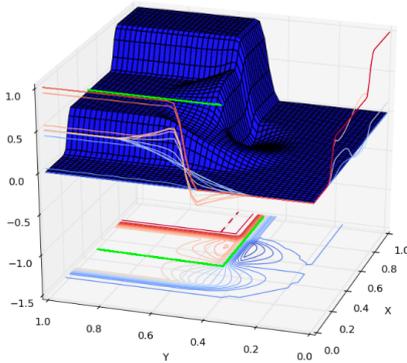
The numerical solution of the x-component of velocity of the linearized Euler equations, which has a provably logarithmic singularity at the origin. The numerics in the picture above smear out this singularity.

Upcoming scientific conferences

I am trying to keep this list up-to-date. I encourage you to click the links and check, where you may want to participate.

2021:

- Feb. 8 - 10: *Methods and models of kinetic theory 2022* in Torino, Italy, organized among others by Maria Groppi

- March 1 - 5: Oberwolfach: *Hyperbolic Balance Laws: modeling, analysis, and numerics*, organized among others by Remi Abgrall and Maria Lukacova

- March 1 - 5, *SIAM Conference on Computational Science and Engineering*, online

- March 22- 26: *Kinetic Equations: From Modeling, Computation to Analysis*, in Marseille, France, organized by Shi Jin (still in its planning stage)

- April: *Nils-Henrik Risebro's birthday conference* in Oslo, Norway (still in its planning stage)

- May 24 - 28: *The Legacy of Carlo Cercignani: from Kinetic Theory to Turbulence Modeling* Milan, Italy, organized among others by Tommaso Ruggeri

- June 21 - 24: *SIAM Conference on Mathematical & Computational Issues in the Geosciences (GS21)*, in Milan, (still in its planning stage)

- June 28 - July 2: *18th International Conference on Hyperbolic Problems, Theory, Numerics, Applications* (HYP 2020), (still in its planning stage)

- July 5 - 9: *THE BOLTZMANN EQUATION: IN THE TRAIL OF TORSTEN CARLEMAN*, near Stockholm, Sweden

- July 12 - 16: *International Conference on Spectral and Higher Order Methods* ICOSAHOM 2020, Vienna (online only), Wasilij and myself plan to run a mini-symposium there

- fall: Special program on Numerical Methods for Nonlinear Hyperbolic PDEs; at SUSTech, Shenzhen, China: organized by Alex Kurganov (still in its planning stage)

2022:

- some time in spring: *HIGH ORDER NONLINEAR NUMERICAL METHODS FOR EVOLUTIONARY PDEs: THEORY AND APPLICATIONS (HONOM)* in Braga, Portugal, organized by Raphael Loubère und Stephane Clain

- end of May: *Sharing Higher-order Advanced Research Know-how on Finite Volume (SHARK-FV)* in Portugal, organized by Raphael Loubère und Stephane Clain (still in its planning stage)

- July 18 - 22, 2022: *When Kinetic Theory meets Fluid Mechanics*, Zürich

- Sept. 5 - 9, 2022: *10th International Conference on Numerical Methods for Multi-Material Fluid Flow (MULTIMAT 2021)* in Zürich, organized by Remi Abgrall