Wolfgang Pauli Institut c/o
Fakultät f. Mathematik, Univ. Wien
Oskar Morgensternplatz 1 A-1090 Vienna

PAULI - SYMPOSIUM

"Asymptotic Analysis & Geophysical flows"

The **Wolfgang Pauli Institute,** the FWF DoktoratsKolleg „Dissipation and Dispersion in Nonlinear PDEs" and the FWF SpezialforschungsBereich "Taming Complexity in PDE Systems" kindly invite to the "double conference" of **Rupert KLEIN** (FU Berlin) and **Edriss TITI** (Cambridge).

Time: **Monday, 22. Aug. 2022, 10:15 – 12:15**

Place: **„Skylounge",** Fak.Mathematik, Oskar-Morgensternplatz 1

10h15: coffee & cake

0) 10h25: "Introduction" by **Norbert J. MAUSER** (WPI c/o U. Wien)

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1) 10h30 – 11h20 : Rupert KLEIN (FU Berlin) :

"Asymptotic analysis: What is it and what is it good for?"

Abstract: famous mathematicians, some of them practitioners themselves, have associated "asymptotics" with the "dark arts", "inventions of the devil", "a toolbox of tricks for special cases", and the like. In 40 years of experience with it I have come to a broader perspective, and that is the topic of this lecture. Most and foremost, I view Mathematics as the "science of structure", and I will argue why this leads me to consider asymptotics to be quite a systematic mathematical endeavour. I will highlight that asymptotics is found all over the place, from the applied mathematics of practical engineering to the award-winning work of a recent Fields medalist, and that the common denominator is the search for structure and understanding. Seen this way, the multi-faceted nature of asymptotics comes out as a necessity rather than as a reason for mockery. An asymptotic theory of tropical storms that is under development in my group will provide examples to go with my elaborations.

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2) 11h20 – 12h10 : Edriss TITI (U. Cambridge, Texas A & M, Weizmann) :

"Mathematical Analysis of Geophysical Models"

Abstract: We present recent results concerning the global regularity of certain geophysical models. In particular, the three-dimensional Planetary Geostrophic and the Primitive Equations (PE) of oceanic and atmospheric dynamics with various anisotropic viscosity and turbulence mixing diffusion. However, in the non-viscous (inviscid) case it can be shown that, with or without rotation, the PE are linearly and nonlinearly ill-posed in the context of Sobolev spaces, and that there is a one-parameter family of initial data for which the corresponding smooth solutions of the primitive equations develop finite-time singularities (blowup). However, the PE will be shown to be well-posed in the space of real analytic functions, and we will discuss the effect of rotation on prolonging the life-span of analytic solutions. Capitalizing on the above results, we provide rigorous justification of the derivation of the viscous PE of planetary scale oceanic dynamics from the three-dimensional Navier-Stokes equations, for vanishing small values of the aspect ratio of the depth to horizontal width. Specifically, we can show that the Navier-Stokes equations, scaled appropriately by the small aspect ratio parameter of the physical domain, converge strongly to the primitive equations, globally and uniformly in time, and that the convergence rate is of the same order as the aspect ratio parameter.

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Short Biographies:

Rupert Klein received his doctorate in 1988 in mechanical engineering at the RWTH Aachen and then spent 2 years as a postdoc with Andrew Majda in Princeton. After his habilitation back in Aachen he was professor at the Bergische Universität Wuppertal before accepting a chair in scientific computing at the FU Berlin, with focus on modeling and simulation of global environment systems.
He also worked for many years for the Potsdam-Institute for Climate Impact Research, as deputy director and as head of the Data & Computation department.
His large field of research interests around the asymptotic analysis and numerics of multi-scale dynamics is focussed on climate models including social (human) systems. Also, he works on electronic structures and in reactive gas dynamics in combustion (of car engines).
In 2003 he received the Leibniz award, the German equivalent to the Austrian Wittgenstein award.
Other awards Klein received include a 3-year fellowship of the European Centre for Medium Range Weather Forecasts (ECMWF), Reading, UK.
He is member of the Berlin-Brandenburgischen Akademie der Wissenschaften and very active also in international cooperation projects (like the HYKE network).

Edriss Titi received his doctorate in 1986 under the supervision of Ciprian Foias. Currently he holds the Nonlinear Mathematical Sciences Professorial Chair at the Univ. of Cambridge, UK; he is a University Distinguished Professor and the Arthur Owen Professor of Mathematics at Texas A&M Univ.; moreover he is Professor of Computer Science and Applied Mathematics at the Weizmann Institute of Science in Israel.
Titi's research in applied and computational mathematics lies at the interface between rigorous applied analysis and physical applications. Specifically, in studying the Euler and the Navier-Stokes and other related nonlinear partial differential equations. The applications include fluid mechanics, oceanic and atmospheric dynamics and their coupling with moisture micro-physics in clouds formation, turbulence, chemical reactions, nonlinear fiber optics, control theory and data assimilation for weather and climate prediction.
Titi is a Fellow of the AMS and of the SIAM, the John Simon Guggenheim Memorial Foundation, USA; and the Institute of Physics, UK. He is the recipient of many international scientific awards including the Stanislaw M. Ulam Distinguished Scholar, the Humboldt Research Award for Senior U.S. Scientists, Germany, the Einstein Visiting Fellow, Germany and the Gaspard Monge Distinguished Professorship, France. He is also a co-recipient of the SIAM Prize on Best Paper in Partial Differential Equations (2009), and the 2020 International Consortium of Chinese Mathematicians Best Paper Award (Gold Medal).