GMT & PDEs in Basel - Abstracts

Sufficient conditions for turbulence scaling laws in 2d and 3d

Michele Coti Zelati
Imperial College London

We provide sufficient conditions for mathematically rigorous proofs of the third order universal laws for both 2d and 3d stochastically forced Navier-Stokes equations. These conditions, which we name weak anomalous dissipation, replace the classical anomalous dissipation condition. For statistically stationary solutions, weak anomalous dissipation appear to be very effective and not too far from being necessary as well.

Non-uniqueness for the transport equation with Sobolev vector fields

Stefano Modena
Universität Leipzig

One of the main questions in the theory of the linear transport equation is whether uniqueness of weak solutions holds in the case the given vector field is not smooth. We show that even for incompressible, Sobolev (thus quite well-behaved) vector fields, uniqueness of solutions can drastically fail. Our result can be seen as a counterpart to DiPerna and Lions' well-posedness theorem (joint with G. Sattig and L. Székelyhidi).

Upper Semicontinuity for Divergence-Free Positive Tensors

Emil Wiedemann
Universität Ulm

Recently, D. Serre proposed the framework of divergence-free positive definite symmetric tensors (DPTs) to obtain better a priori estimates for various compressible fluid models. He proved, in particular, a Jensen-type inequality for the determinant to the power $1/(d-1)$, which suggests that a weak semicontinuity result could be obtained by virtue of standard methods of Fonseca-Müller. However, the positivity constraint excludes these methods and requires a novel approach. Joint work with Jack Skipper.

TBA

Camilla Nobili
Universität Hamburg

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Propagation of regularity for solutions of the transport equation with non-Lipschitz velocity field

Elia Bruè
Scuola Normale Superiore di Pisa

Since the work by Di Perna and Lions ('89) the continuity and transport equation under mild regularity assumptions on the vector field have been extensively studied, becoming a florid research field. The aim of this talk is to give an overview of the quantitative side of the theory, focusing mostly on the problem of propagation of regularity for ODE flows and solutions to the transport equation. We present recent results, examples, applications and open problems. This is based on joint works in collaboration with Quoc-Hung Nguyen.

TBA

Laura Caravenna
Università di Padova

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Pattern formation in colloidal systems and generalized antiferromagnetic models

Sara Daneri
Gran Sasso Science Institute, L'Aquila

Spontaneous formation of periodic patterns is a fascinating phenomenon in nature, which at microscopic scales is often originated by the competition between two forces: one attracting and short-range and one repulsive and long-range. According to the mutual strength between the two forces and the density of the material different periodic patterns can be formed: bubbles, stripes, columns, holes,... Although such structures are observed in experiments and reproduced in simulations, a mathematical proof of the fact that the ground states of the energies of the models are of this form is a challenging problem, still open in most cases (for example, for the well-studied Ohta-Kawasaki model for diblock copolymers). The reason is that the models have in general more symmetries than the expected ground states. In collaboration with E. Runa we proved that, for a generalized antiferromagnetic model

and a model for colloidal system (which corresponds to the one used by chemists in their simulations), global minimizers are, in suitable regimes, periodic stripes. Moreover, also in collaboration with A. Kerschbaum, we proved that minimizers of the diffuse-interface version of such models are one-dimensional functions. In this talk, after reviewing the main existing results towards the characterization of minimizers, I will point out the main difficulties in the above problems and the ideas that have been developed to overcome them.

Multi-material transport problems

Annalisa Massaccesi
Università di Verona

In this joint works with Andrea Marchese and coauthors, we propose an Eulerian formulation for the multicommodity flow problem, i.e., a general branched transportation problem in which m different goods are moved simultaneously. Moreover, in the atomic case, we prove that the problem can be relaxed in a mass minimization problem in a class of rectifiable currents with coefficients in a group, allowing to introduce a notion of calibration. Finally, I will show how these tools allow the modelling of the oriented mailing problem.

Renormalization and energy conservation for the axisymmetric Euler equation

Christian Seis
Universität Münster

We consider the axisymmetric Euler equations without swirl, which describe, for instance, the motion of vortex rings in ideal fluids. We will give a short overview on previous results concerning well-posedness and qualitative properties of solutions and discuss similarities and differences with the planar two-dimensional Euler equations. In the main part of the talk, we present renormalization results for vanishing viscosity solutions obtained from the Navier-Stokes equations and discuss the conservation of the kinetic energy. Joint work with Camilla Nobili.

On the structure of solenoidal vector measures on the plane

Nikolay A. Gusev
Moscow Institute of Physics and Technology

We will discuss the structure of solenoidal vector measures on the plane. It will be shown that such measures can be decomposed into a superposition of measures induced by closed simple curves. We will also provide a detailed characterization of the extremal points of the unit ball in the space of functions of bounded variation. This is a joint work with P. Bonicatto.

Nonresonant bilinear forms for partially dissipative hyperbolic systems violating the Shizuta-Kawashima condition

Roberta Bianchini

Laboratoire Jacques-Louis Lions - Sorbonne Université

. We consider a simple example of a partially dissipative hyperbolic system violating the Shizuta-Kawashima condition, i.e. such that some eigendirections do not exhibit dissipation at all. In the space-time resonances framework introduced by Germain, Masmoudi and Shatah, we prove that, when the source term has a Nonresonant Bilinear Form, as proposed by Pusateri and Shatah CPAM 2013, the formation of singularities is prevented, despite the lack of dissipation. This allows us to show that smooth solutions to this preliminary case-study model exist globally in time.

Weak solutions of the Navier-Stokes equations may be smooth for a.e. time

Maria Colombo

EPF Lausanne

In a recent result, Buckmaster and Vicol proved non-uniqueness of weak solutions to the Navier-Stokes equations which have bounded kinetic energy and integrable vorticity. We discuss the existence of such solutions, which in addition are regular outside a set of times of dimension less than 1.

Finite Energy Weak Solutions of the Navier-Stokes-Korteweg equations

Stefano Spirito

Università de L'Aquila

In this talk I will present some results concerning the analysis of the existence of finite energy weak solutions of the Navier-Stokes-Korteweg equations, which model the dynamic of a viscous compressible fluid with diffuse interface. A general theory of global existence is still missing, however for some particular cases of physical interest, it is possible to prove global existence of weak solutions. The talk is based on a series of joint works with Paolo Antonelli (GSSI - Gran Sasso Science Institute, L'Aquila).

From many-body quantum dynamics to the Vlasov equation

Chiara Saffirio
Universität Zürich

We review some results on the joint mean-field and semiclassical limit of the N-body Schrödinger dynamics leading to the Vlasov equation, which is a model in kinetic theory for charged or gravitating particles. The results we present include the case of singular interactions and provide explicit estimates on the convergence rate, using the Hartree-Fock theory for interacting fermions as a bridge between many-body and Vlasov dynamics.
