Hamilton-Jacobi equation, optimal transportation
and SBV regularity

Stefano Bianchini(SISSA)

Abstract: In these 3 lectures we study the following subjects:

1) Disintegration of measures
2) Regularity properties of optimal rays
3) SBV regularity for HJ

The key result is that while the hamiltonian considered is not smooth, the solution of HJ equation still has regularity properties in some weak (measure) sense.
Liouville type equations with singular sources

Chiun-Chuan Chen (National Taiwan University)

Abstract: We consider a Liouville type equation in two dimensional domains which arises from the mean filed limit of vortices in Euler flows, prescribing Gaussian curvature problem, and limit cases of Chern-Simons models. The “total mass”, which equals the integral of the nonlinear term, plays a key role for this equation. The solutions can blow up when the total mass tends to some critical values. We will show how the delta functions in the source term affect the blowup behavior of the solutions and present a formula of the Leray-Schauder degree for the problem. Some applications will be discussed also.
Mixed type equations in gas dynamics

Shuxing Chen (Fudan University)

TBA
Large time behavior of solutions for compressible
Navier-Stokes equations

Feimin Huang (Academia Sinica, Beijing)

Abstract: In this talk, I will present recent progress on the large time behavior of solutions concerning with contact discontinuity for compressible Navier-Stokes equations.
Lagrange properties of compressible Navier-Stokes equations

Hailiang Li (Capital Normal University, Beijing)

Abstract: In this talk, we present recent results on the qualitative behavior of global solutions to compressible Navier-Stokes equations.
Global solutions of the Riemann problem for 2-D Euler equations

Jiequan Li (Capital Normal university)

Abstract: In this talk I will briefly construct global solutions to some two-dimensional Riemann problem for compressible Euler equations. The results include the expansion of a wedge of gas into the vacuum (dam collapse problem) and a global solution of the four-rarefaction-wave Riemann problem etc. Main ingredients are a couple of characteristic decompositions, the hodograph transformation and the boot-strapping technique.
Invariant Manifolds for Stationary Boltzmann Equation

Tai-Ping Liu (Academia Sinica and Stanford University)

Abstract: With Shih-Hsien Yu, we consider the decomposition of functions in microscopic variables into stable-unstable-center components. For the resonance case of one of the Euler characteristics around zero, there are two-scales combination of Knudsen-type and fluid-like waves. Our results are compared with the physical studies of bifurcation for transonic evaporation/condensation by the Kyoto School. We construct these waves through time-asymptotic analysis using the Green's function approach. Our approach also yields the monotonicity of the Boltzmann shock profiles.
Convergence to Equilibrium for the Boltzmann Equation with Soft Potentials

Xuguang Lu (Tsinghua University, Beijing)

**Abstract:** This is a joint work with Eric A. Carlen (Rutgers University, USA) and Maria C. Carvalho (University of Lisbon, Portugal) on $L^1$-convergence to equilibrium for the spatially homogeneous Boltzmann equation with soft potentials. I will first give a short review on such convergence for weak solutions of the equation with soft and very soft potentials without angular cutoff. Then I will focus on our new result on algebraic upper and lower bounds of the rate of $L^1$-convergence for soft potentials (which are not too soft) with angular cutoff. Our assumption on initial data is only that they have finite entropy and sufficiently higher order of moments. Our methods of proof are based on entropy inequalities, moment estimates, and a suitable convex combination of solutions and the Maxwellian (equilibrium) that enables us to overcome the problem of the initial data having no pointwise lower bounds.
Abstract: Landau damping [5] may be the single most famous mystery of classical plasma physics, and is of tremendous importance in galactic dynamics [1]. For the past sixty years it has been treated in the linear setting at various degrees of rigor [3,6]; but its nonlinear version has remained elusive, since the only available results [2,4] prove the existence of some damped solutions, without telling anything about their genericity.

In the first course we shall expose an introduction to the Landau damping and our main result in this work which aims to close this gap by treating the nonlinear version of Landau damping, under assumptions which cover both attractive and repulsive interactions. For this we shall be led to develop a whole theory, complete with its own functional spaces and functional inequalities, that we shall expose in the second course. In the third course,
we shall focus on the core of the proof, that is the approximation scheme and
the construction of the damped solution to the non-linear equation. All along we
shall get new insights in the physics of the problem, and identify new
mathematical phenomena.


[2] Caglioti E and Maffei C, Time asymptotics for solutions of

[3] Degond P, Spectral theory of the linearized Vlasov-Poisson equation,

decreasing solutions of the nonlinear Landau damping problem, *preprint*
(2008)

(1946)

*Mat. Sb. (N.S.)* 127(169) 445--475, 559. (1985)
Global existence and asymptotic behavior of the 
compressible Navier-Stokes equations for 
a 1D isothermal viscous gas

Yumin Qin (Donghua University, Shanghai)

Abstract: In this talk we present a recent result on the global existence and 
asymptotic behavior of the non-autonomous compressible Navier-Stokes 
equations for a 1D isothermal viscous gas.
The Two-dimensional Riemann Problem for isentropic Chaplygin gas dynamic system

Wancheng Sheng (Shanghai University, Shanghai)

Abstract: The two-dimensional Riemann problem for isentropic Chaplygin gas dynamic system consists of interactions of four planar elementary waves including shock waves ($S^\pm$), rarefaction waves ($R^\pm$) and slip lines ($J^\pm$). Different from polytropic gas, all of the elementary waves are contact discontinuities due to the system is full linear degenerate, i.e., the three eigenvalues of the system are linear degenerate. In this paper, we study the problem systematically. According to different combination of four elementary waves, we deliver a complete classification to the problem. It contains 14 cases in all. The Riemann solutions are self-similar, and the flow is transonic in self-similar plane $\left(\frac{x}{t}, \frac{y}{t}\right)$. Solutions in supersonic domains are constructed case by case except for the case $2J^+ + 2J^-$. Especially, Dirac delta waves and simple waves appear in some cases. The Dirichlet boundary value problems in subsonic domains are formed case by case. The domains are convex for two cases, and non-convex for the rest cases. The boundaries of the domains are composed of sonic curves and slip lines.
Abstract: In this talk a scheme to construct the wave propagation around a Boltzmann shock profile will be surveyed. This is a parallel processes to decompose a variable coefficient problems in constant coefficient problems around the far field of a shock wave and an essential scalar equation to analyze the global wave interactions. This reduction relies heavily on the Green's function for the constant coefficient problem so that one can show the convergence of the scheme in a exponential pointwise estimate.
Isentropic approximation to quasi one dimensional gas flow

Yongqian Zhang (Fudan University, Shanghai)

Abstract: In this talk, I will give the estimates on the difference in $L^1$ norm between the solutions for the non-isentropic and isentropic Euler equations for the quasi-1-d gas flow in the nozzle.