5th Euro-Japanese Workshop on Blow-up - Luminy 2012

September 10–14, 2012

SPONSORS

Schedule

Monday, Sept. 10

9h30 – 10h00	Welcome
10h00 – 10h55	Michael WINKLER. Finite-time blow-up in the higher-dimensional Keller-Segel system
10h55 – 11h25	Coffee break
11h25 – 12h20	Yoshie SUGIYAMA. Measure valued solutions of the 2D Keller-Segel system
14h10 – 15h05	Michinori ISHIWATA. Asymptotic behavior of Palais-Smale sequences in the critical problem and its application to semilinear heat equation
15h10 – 16h05	Yuki NAITO. Global attractivity properties of stationary solutions for semilinear heat equations
16h05 – 16h35	Coffee break
16h35 – 17h30	Takasi SENBA. Oscillating solutions to a simplified chemotaxis system in high dimensional spaces
17h30 – 19h30	Free time/discussion

Tuesday, Sept. 11

9h00 – 9h55	Peter POLACIK. Exponential separation between positive and sign-changing solutions and its applications
10h00 – 10h55	François HAMEL. Inside structure of pulled and pushed fronts
10h55 – 11h25	Coffee break
11h25 – 12h20	Hitoshi ISHII. Small stochastic perturbations of Hamiltonian flows in 2D: a PDE approach
14h10 – 15h05	Miguel ESCOBEDO. Finite time blow-up for the bosonic Nordheim equation
15h10 – 16h05	Juan J.L. VELAZQUEZ. Singularity formation in general relativity
16h05 – 16h35	Coffee break
16h35 – 19h00	Poster session

Wednesday, Sept. 12

9h00 – 9h55	Kazuhiro ISHIGE. Blow-up set for type-I blowing up solutions for a semilinear heat equation
10h00 – 10h55	Hirokazu NINOMIYA. Diffusion-induced bifurcations from infinity
10h55 – 11h25	Coffee break
11h25 – 12h20	Diego CORDOBA. Finite time singularities for the free boundary incompressible Euler equations
13h30 – 19h00	Excursion

Thursday, Sept. 13

9h00 – 9h55	Adrien BLANCHET. The parabolic-parabolic Keller-Segel system with critical diffusion as a gradient flow in $\mathbb{R}^d$, $d \geq 3$
10h00 – 10h55	Takashi SUZUKI. Exclusion of boundary blowup for 2D chemotaxis system provided with Dirichlet boundary condition for the Poisson part
10h55 – 11h25	Coffee break
11h25 – 12h20	Takayoshi OGAWA. Blow-up criterion for the compressible Navier-Stokes-Poisson system
14h10 – 15h05	Frank MERLE. On the description of blow-up for critical GKdV
15h10 – 16h05	Hatem ZAAG. Construction of a multi-soliton blow-up solution to the semilinear wave equation in one space dimension
16h05 – 16h35	Coffee break
16h35 – 17h30	Fred WEISSLER. Finite-time blowup for a complex Ginzburg-Landau equation
17h30 – 19h30	Free time/discussion
19h30	Special dinner

Friday, Sept. 14

9h15 – 10h10	Hiroshi MATANO.
10h10 – 10h40	Coffee break
10h40 – 11h35	Josephus HULSHOF. Metabolic runaway in glycolysis
11h35 – 12h00	Closing session

Invited Talks

The parabolic-parabolic Keller-Segel system with critical diffusion as a gradient flow in $\mathbb{R}^d$, $d \geq 3$

Adrien BLANCHET

Abstract. It is known that, for the parabolic-elliptic Keller-Segel system with critical porous-medium diffusion in dimension $\mathbb{R}^d$, $d \geq 3$ (also referred to as the quasilinear Smoluchowski-Poisson equation), there is a critical value of the chemotactic sensitivity (measuring in some sense the strength of the drift term) above which there are solutions blowing up in finite time and below which all solutions are global in time. This global existence result is shown to remain true for the parabolic-parabolic Keller-Segel system with critical porous-medium type diffusion in dimension $\mathbb{R}^d$, $d \geq 3$, when the chemotactic sensitivity is below the same critical value. The solution is constructed by using a minimising scheme involving the Kantorovich-Wasserstein metric for the first component and the L^2-norm for the second component. The cornerstone of the proof is the derivation of additional estimates which relies on a generalisation to a non-monotone functional of a method due to Matthes, McCann, & Savaré (2009).

Finite time singularities for the free boundary incompressible Euler equations

Diego CORDOBA

Abstract. We prove the existence of smooth initial data for the 2D free boundary incompressible Euler equations (also known for some particular scenarios as the water wave problem), for which the smoothness of the interface breaks down in finite time into a splash singularity or a splat singularity. Moreover, we show a stability result together with numerical evidence that there exist solutions of the 2D water wave equation that start from a graph, turn over and collapse in a splash singularity (self intersecting curve in one point) in finite time.
Joint work with A. Castro, C. Fefferman, F. Gancedo and J. Gomez-Serrano.

Finite time blow-up for the bosonic Nordheim equation

Miguel ESCOBEDO

Abstract. The homogeneous bosonic Nordheim equation is a kinetic equation describing the dynamics of the distribution of particles in the space of moments for a dilute homogeneous quantum gas composed of bosons. I will present recent results on finite time blow up for classical solution of the homogeneous bosonic Nordheim equation with "supercritical" initial data.

Inside structure of pulled and pushed fronts

François HAMEL

Abstract. This talk is focused on the study of the inside structure of one-dimensional reaction-diffusion traveling fronts. The reaction terms are of the monostable, bistable or ignition types. Assuming that the fronts are made of several components with identical diffusion and growth rates, the spreading properties of each component is analyzed. In the monostable case, the fronts are classified as pulled or pushed ones, depending on the propagation speed. It will be shown that any localized component of a pulled front converges locally to 0 at large times in the moving frame of the front, while any component of a pushed front converges to a well determined positive proportion of the front in the moving frame. The results give a new and more complete interpretation of the pulled/pushed terminology, which can be extended to the case of general transition waves. Uniform convergence results and precise estimates of the left and right spreading speeds of the components of pulled and pushed fronts will also be reported. As far as the applications in mathematical ecology are concerned, the results show the important role of the Allee effect on the evolution of the genetic structure and diversity of traveling waves of colonization.
This talk is based on some joint works with J. Garnier, T. Giletti, E. Klein and L. Roques.

Metabolic runaway in glycolysis

Josephus HULSHOF

Abstract. I will discuss a simplified ODE-model which explains experimental observations of genetically modified glycolysis.
Joint work with Bob Planque, Meike Wortel, Bas Teusink and Frank Bruggeman.

Blow-up set for type-I blowing up solutions for a semilinear heat equation

Kazuhiro ISHIGE

Abstract. Let u be a type-I blowing up solution of the Cauchy-Dirichlet problem for a semilinear heat equation,

$$\begin{cases} \partial_t u = \Delta u + u^p, & x \in \Omega,\ t > 0, \\ u(x,t) = 0, & x \in \partial\Omega,\ t > 0, \\ u(x,0) = \varphi(x), & x \in \Omega, \end{cases} \tag{P}$$

where Ω is a (possibly unbounded) domain in $\mathbf{R}^N$, $N \geq 1$, and $p > 1$. We prove that, if $\varphi \in L^\infty(\Omega) \cap L^q(\Omega)$ for some $q \in [1, \infty)$, then the blow-up set of the solution u is bounded. Furthermore we give a sufficient condition for type-I blowing up solutions not to blow up on the boundary of the domain Ω. This enables us to prove that, if Ω is an annulus, then the radially symmetric solutions of (P) do not blow up on the boundary $\partial\Omega$.
This is a joint work with Professor Yohei Fujishima.

Small stochastic perturbations of Hamiltonian flows in 2D: a PDE approach

Hitoshi ISHII

Abstract. We present a PDE approach to averaging principles for small stochastic perturbations of Hamiltonian flows in 2D, which is based on a recent joint work with Takis Souganidis. The study of such problems was initiated by Freidlin and Wentzel and it has attracted much attention in the last several years. When the Hamiltonian flow has critical points the averaging principle exhibits complicated behavior. Asymptotically the slow (averaged) motion has 1D character and takes place on a graph, and the question is to identify the limit motion in terms of PDE problems. Previous work depended on probabilistic techniques, but our approach is based on PDE techniques and applies to general degenerate elliptic operators.

Asymptotic behavior of Palais-Smale sequences in the critical problem and its application to semilinear heat equation

Michinori ISHIWATA

Abstract. In this talk, we are concerned with the asymptotic behavior of solutions for semilinear parabolic equations involving critical Sobolev exponent. Particularly, we are interested in the behavior of threshold solutions in the nonradial setting. After introducing our recent result on the behavior of (PS)-sequence for the functional associated with the forward self-similar transformed problem, we discuss the asymptotic behavior of threshold solutions.

Title

Hiroshi MATANO

Abstract.

On the description of blow-up for critical GKdV

Frank MERLE

Abstract. I present a joint work with Martel and Raphaël on the complete description of the nonlinear flow near a solitary wave.

Global attractivity properties of stationary solutions for semilinear heat equations

Yuki NAITO

Abstract. We consider the Cauchy problem for a semilinear heat equation with supercritical power nonlinearity. First we recall the results of Gui, Ni and Wang (1992, 2001) on the local stability of steady states, and then we discuss global attractivity properties of steady states by Poláčik and Yanagida (2003). It is well known that the global attractivity property plays an essential role to show the existence of solutions which have interesting and surprising properties, e.g., nonstabilizing solutions and global unbounded solutions. In this talk, we will give some remarks on the global attractivity properties of steady states.

Diffusion-induced bifurcations from infinity

Hirokazu NINOMIYA

Abstract. The diffusion process is usually thought as a trivializing one. However, for some reaction-diffusion systems, the blowup of solutions may occur, though the corresponding ODE possesses a globally attractor. This is called diffusion-induced blowup. To study this phenomenon, in this talk, we consider the bifurcation from infinity. In some class of reaction-diffusion systems, this bifurcation takes place by adding the diffusion.

Blow-up criterion for the compressible Navier-Stokes-Poisson system

Takayoshi OGAWA

Abstract. The strong solution for the compressible Navier-Stokes-Poisson system is considered in the critical spaces. After establishing the local existence theory, we consider the continuing criterion for the strong solution and give some blow-up criterion for the system under the critical Serrin conditions. Some other variation of the system is also considered and we compare the result with the critical exponent appeared in the degenerate drift-diffusion system.

Exponential separation between positive and sign-changing solutions and its applications

Peter POLACIK

Abstract. In linear nonautonomous second-order parabolic equations, the exponential separation refers to the exponential decay of any sign-changing solution relative to any positive solution. In this lecture, after summarizing key results on exponential separation, we show how it can be effectively used in studies of some nonlinear parabolic problems on $\mathbb{R}^N$. In particular, we shall discuss the instability of and blowup above localized solutions, and a Liouville-type theorem for radial solutions.

Oscillating solutions to a simplified chemotaxis system in high dimensional spaces

Takasi SENBA

Abstract. We consider radial solutions to a parabolic-elliptic system in high dimensional spaces. The system is a simplified version of a chemotaxis model. It is well known that solutions to the system have many kinds of behaviors. If the initial function is sufficiently small in the sense of a suitable functional space, the solution exists globally in time. There also exist solutions blowing up in finite time and in infinite time. Besides those, the speaker and Y. Naito constructed radial oscillating solutions in two dimensional case. We will talk about the existence of oscillating solutions in high dimensional case.

Measure valued solutions of the 2D Keller-Segel system

Yoshie SUGIYAMA

Abstract. We deal with the two-dimensional Keller-Segel system describing chemotaxis in a bounded domain with smooth boundary under the nonnegative initial data. As for the Keller-Segel system, the L^1 norm is the scaling invariant one for the initial data, and so if the initial data is sufficiently small in L^1, then the solution exists globally in time. On the other hand, if its L^1 norm is large, then the solution blows up in a finite time. The first purpose of my talk is to construct a time global solution as a measure valued function beyond the blow-up time even though the initial data is large in L^1. The second purpose is to show the existence of two measure valued solutions of the different type depending on the approximation, while the classical solution is unique before the blow-up time.
Joint works with Stephan Luckhaus and J.J.L. Velázquez.

Exclusion of boundary blowup for 2D chemotaxis system provided with Dirichlet boundary condition for the Poisson part

Takashi SUZUKI

Abstract. We study a chemotaxis system on bounded domain in two dimensions where the formation of chemical potential is subject to the Dirichlet boundary condition. For such a system the solution is kept bounded near the boundary and hence the blowup set is composed of a finite number of interior points. If the initial total mass is 8π and the domain is close to a disc then the solution exhibits a collapse in infinite time of which movement is subject to a gradient flow associated with the Robin function.

Singularity formation in general relativity

Juan J.L. VELAZQUEZ

Abstract. In this talk I will describe some examples of singularity formation for the Einstein equations coupled with some suitable matter field. I will describe with some detail one example of singularity formation for the Einstein-Vlasov system jointly obtained with A. Rendall. This singularity, which is asymptotically self-similar in a suitable coordinate system, has as a relevant property the absence of formation of a horizon. In particular light-rays emanated at the center, at times arbitrarily close to the singularity, can reach points arbitrarily far away from the center.

Finite-time blowup for a complex Ginzburg-Landau equation

Fred WEISSLER

Abstract. We prove that negative energy solutions of the complex Ginzburg-Landau equation $e^{-i\theta}u_t = \Delta u + |u|^\alpha u$ blow up in finite time, where $\alpha > 0$ and $-\pi/2 < \theta < \pi/2$. For a fixed initial value $u(0)$, we obtain estimates of the blow-up time T_{max}^θ as $\theta \to \pm\pi/2$. It turns out that T_{max}^θ stays bounded (respectively, goes to infinity) as $\theta \to \pm\pi/2$ in the case where the solution of the limiting nonlinear Schrödinger equation blows up in finite time (respectively, is global).
Joint work with T. Cazenave and F. Dickstein.

Finite-time blow-up in the higher-dimensional Keller-Segel system

Michael WINKLER

Abstract. We study the Neumann initial-boundary value problem for the fully parabolic Keller-Segel system

$$\begin{cases} u_t = \Delta u - \nabla \cdot (u \nabla v), & x \in \Omega,\ t > 0, \\ v_t = \Delta v - v + u, & x \in \Omega,\ t > 0, \end{cases} \qquad (\star)$$

in a ball $\Omega \subset \mathbb{R}^n$ with $n \geq 3$. This system forms the core of numerous models used in mathematical biology to describe the spatio-temporal evolution of cell populations governed by both diffusive migration and chemotactic movement towards increasing gradients of a chemical that they produce themselves.
After a brief discussion of the literature on blow-up results for the above and related systems, we focus on a novel method to detect finite-time blow-up in $(\star)$. We thereby obtain that for any prescribed $m > 0$ there exist radially symmetric positive initial data $(u_0, v_0) \in C^0(\bar{\Omega}) \times W^{1,\infty}(\Omega)$ with $\int_\Omega u_0 = m$ such that the corresponding solution blows up in finite time. Moreover, by providing an essentially explicit blow-up criterion it is shown that within the space of all radial functions, the set of such blow-up enforcing initial data indeed is large in an appropriate sense; in particular, this set is dense with respect to the topology of $L^p(\Omega) \times W^{1,2}(\Omega)$ for any $p \in (1, \frac{2n}{n+2})$.
As compared to previous approaches, our method is based on a more elaborate use of the natural energy inequality associated with $(\star)$, involving an estimate of the form

$$\int_\Omega uv \leq C \cdot \left(\left\| \Delta v - v + u \right\|_{L^2(\Omega)}^{2\theta} + \left\| \frac{\nabla u}{\sqrt{u}} - \sqrt{u} \nabla v \right\|_{L^2(\Omega)} + 1 \right),$$

valid with certain $C > 0$ and $\theta \in (0,1)$ for a wide class of smooth positive radial functions $(u, v) = (u(x), v(x))$.

Construction of a multi-soliton blow-up solution to the semilinear wave equation in one space dimension

Hatem ZAAG

Abstract. We consider the semilinear wave equation with superlinear power nonlinearity in one space dimension. The existence of an example of initial data leading to blow-up with a characteristic point has been proved earlier by Merle and Zaag. Furthermore, considering general blow-up solutions (and not just examples) with a characteristic point, those authors gave a full description of blow-up modalities, showing k solitons with alternate signs, escaping each other in the hyperbolic geometry. In the presented work, we show that all blow-up modalities predicted by those authors do occur. More precisely, given any integer $k \geq 2$ and $\zeta_0 \in \mathbb{R}$, we construct a blow-up solution with a characteristic point a, such that the asymptotic behavior of the solution near $(a, T(a))$ shows a decoupled sum of k solitons with alternate signs, whose centers (in the hyperbolic geometry) have ζ_0 as a center of mass, for all times.

Posters

Gradient blow-up analysis for a Hamilton-Jacobi equation with degenerate diffusion

Amal ATTOUCHI

Abstract. We consider a diffusive Hamilton-Jacobi equation of the form

$$\partial_t u - \Delta_p u = |\nabla u|^q, \tag{1}$$

where $p > 2$ and $q \geq p - 1$. Equations of that kind appear in physical models for surface growth ($p = 2$, $q = 2$) and can serve as a viscosity approximation to the first order PDE of Hamilton-Jacobi type. Equation (1) was extensively studied for $p = 2$ and our aim is to investigate the influence of a slower degenerate diffusion on the gradient blow-up phenomenon. We will present some recent results concerning the behavior of weak solutions including local well-posedness, regularizing effect with respect to the time variable, gradient estimate and classification of global solutions.

A lower bound on the blow-up rate

Asma AZAIEZ

Abstract. In this work, we consider the semilinear wave equation with exponential nonlinearity with initial data in $H^1_{loc,u} \times L^2_{loc,u}\mathbb{R}$ and we show that its blow-up rate is bounded below by a quantity wich is given by the solution of its ODE associated.

Blow-up solutions to the heat equation with nonlinear boundary conditions for the supercritical case

Junichi HARADA

Abstract.. We consider the heat equation with nonlinear boundary conditions on the half space: $u_t = \Delta u$, $\partial_\nu u = u^q$ $(q > n/(n-2))$. We report the existence of finite time blow-up solutions whose asymptotic behavior is not governed by backward self-similar solutions. To construct such solutions, we apply the technique given by Herrero-Velazquez.

Small data blow-up for L^2-solution of the Schrödinger equation with a critical or subcritical non-gauge invariant power nonlinearity

Masahiro IKEDA

Abstract. This is a joint work with Yuta Wakasugi in Osaka University. We study the initial value problem for the nonlinear Schrödinger equation with a critical or subcritical nongauge invariant nonlinearity:

$$i\partial_t u + (1/2)\Delta u = \lambda |u|^p, \quad u(0,x) = f(x),$$

where $n \in \mathbb{N}$, $1 < p \leq 1 + (2/n)$, $T > 0$, $(t,x) \in [0,T)\mathbb{R}^n$, $u = u(t,x) \in \mathbb{C}$ is a complex-valued unknown function of (t,x), $\lambda \in \mathbb{C} \setminus \{0\}$, $f = f(x) \in \mathbb{C}$ is a given complex-valued function. On the poster, we will prove nonexistence of a non-trivial global weak solution for the equation with some initial data but without any size and coefficient restrictions, which implies that "small data global existence" does not hold. Furthermore, we will also prove the L^2-norm of a time local L^2-solution with a suitable initial data blows up at a finite time.

Blow-up and grow-up of energy solutions to quasilinear degenerate Keller-Segel systems

Sachiko ISHIDA

Abstract. We deal with the power-type degenerate Keller-Segel systems of parabolic-parabolic type. We establish the finite-time blow-up and time-in-global grow-up of energy solutions. The key to the proof is to construct a time-in-local energy solution and to modify the method in Winkler (2010, MMA) and I.-Ono-Yokota (to appear, MMA).
This is a joint work with Professor Michael Winkler and Professor Tomomi Yokota.

On a non-local reaction diffusion system arising in biochemical reactions

Nikos KAVALLARIS

Abstract. A reactiondiffusion system with non-local term arising as a mean field limit of a master equation using reaction radius is investigated. In particular, it is shown that a two-phase Stefan problem is derived in the limit of infinite chemical reaction rate. Moreover, the convergence of the global-in-time solutions of the preceding system towards the unique stationary solution as well as the rate of this convergence are discussed.

Higher order asymptotic expansion for the heat equation with a nonlinear boundary condition

Tatsuki KAWAKAMI

Abstract. We consider the heat equation with a nonlinear boundary condition,

$$(P) \quad \begin{cases} \partial_t u = \Delta u & \text{in} \quad \mathbb{R}^N_+ \times (0,\infty), \\ \partial_\nu u = \kappa |u|^{p-1} u & \text{on} \quad \partial\mathbb{R}^N_+ \times (0,\infty), \\ u(x,0) = \varphi(x) & \text{in} \quad \mathbb{R}^N_+, \end{cases}$$

where $\mathbb{R}^N_+$ is the half space of $\mathbb{R}^N$, $N \geq 2$, $\kappa \in \mathbb{R}$, and $p > 1 + 1/N$.

Let u be a solution of (P) satisfying

$$(\|u(t)\|_{L^q(\mathbb{R}^N_+)} + t^{1/(2q)} \|u(t)\|_{L^q(\partial\mathbb{R}^N_+)}) = O(t^{-N(1-1/q)/2})$$

as $t \to \infty$, for any $q \in [1,\infty]$. In this poster, motivated by the work of the speaker and Ishige to a semilinear heat equation in $\mathbb{R}^N$, under suitable assumptions of the initial function φ, we establish the method of obtaining higher order asymptotic expansions of the solution u as $t \to \infty$.

Hypergeometric solutions of a singular Cauchy problem

Mohamed Amine KERKER

Abstract. We give an explicit representation of solutions, in terms of hypergeometric functions, of the following singular Cauchy problem

$$\begin{cases} \left[\frac{1}{t}\partial_t^2 - \partial_x^2 + a(t,x)\partial_t + b(t,x)\partial_x + c(t,x)\right] u(t,x) & = & 0, \ (t,x) \in \Omega \\ u(0,x) & = & x^\alpha w(x), \quad \alpha \in \mathbb{C} \\ \partial_t u(0,x) & = & 0, \end{cases}$$

where Ω is a neighborhood of the origin of $\mathbb{C}^2$, and a, b, c are holomorphic functions in Ω and w is holomorphic in $\Omega \cap \{t=0\}$. We show that the solutions are holomorphic, ramified around the characteristic surface.

1. A. Bentrad, *Représentation hypergéométrique de la solution pour une classe d'opérateurs d'ordre deux*, Publicationes Mathematicae Debrecen, Tomus, 48, Fasc, 1–2, 1–11 (1996).

2. A. Bentrad, S. Kichenassamy, *Hypergeometric functions and singular solutions of wave equations*, Commun. Contemp. Math. 11 (3) (2009) 447–458.

3. S. Kichenassamy, W. Littman, *Blow-up surfaces for nonlinear wave equations, I*, Comm. PDE 18(1993) 431–452 II: Comm. PDE, 18 (1993) 1869–1899.

4. M.J. Rodriguez-Alvarez, G. Rubio, L. Jódar, *Exact solution of variable coefficient mixed hyperbolic partial differential problems*, Appl. Math. Lett. 16 (2003), no. 3, 309–312.

Heat equation with absorption and non-decaying initial data

Kanako KOBAYASHI

Abstract. In this poster we give the precise description of the large time behavior of the solution u of the Cauchy problem,

$$\begin{cases} \partial_t u = \Delta u - u^\beta & \text{in} \quad \mathbf{R}^N \times (0,\infty), \\ u(x,0) = \lambda + \varphi(x) \geq 0 & \text{in} \quad \mathbf{R}^N, \end{cases}$$

by using the ordinary differential equation $\zeta' = -\zeta^\beta$ and the heat equation. Here $N \geq 1$, $\beta > 1$, $\lambda > 0$, and φ is a bounded continuous function such that $\varphi \in L^p(\mathbf{R}^N)$ for some $1 \leq p < \infty$.

A Keller-Segel system with critical mass in any dimension

Alexandre MONTARU

Abstract. We study radial solutions in a ball of $\mathbb{R}^N$ of a modified Keller-Segel parabolic-elliptic system : the flux induced by the chemoattractant is given by $J = u^q \nabla c$ where u is the density of cells, c the concentration of the chemoattractant and $q = \frac{2}{N}$.

The case $N = 2$ corresponds to the classical Keller-Segel model for which the existence of a critical mass is well known. For $N \geq 3$, serious difficulties arise, due to the nonlinear and non-Lipschitz nature of the flux function. We prove existence of a critical mass M. More precisely, if m denotes the total mass of the cells, we show the following results :
- If $m < M$, there is a unique stationary solution toward which the solution u(t) of the system converges when t goes to infinity;
- If $m > M$, a finite time blow-up occurs.
- The most interesting phenomena occur for the critical value $m = M$, where a continuum of compactly supported steady-states exists. We show that the solutions nevertheless stabilize to a single steady-state.

This is in sharp contrast with the case $N = 2$, where infinite time blow-up occurs when the mass is critical.

Solvability of a nonlinear boundary value problem

Sámuel PERES

Abstract. We examine the number of positive solutions of the equation $u'' = au^p$ on $(-l, l)$ with the boundary conditions $u'(l) = u^q(l)$, $u'(-l) = -u^q(-l)$ in dependence on the parameters $p, q \in \mathbb{R}$ and $a, l > 0$. This problem has been studied only for $p, q > 1$ up to now. We present results for a larger set of parameters.

Nonlinear convective reaction-diffusion equations under dynamical boundary conditions: Blow-up, blow-up rate and blow-up set

Jean-François RAULT

Abstract. Using the technique of the lower and upper-solutions, we investigate blow-up phenomena for positive solutions of nonlinear reaction-diffusion equations including a nonlinear convection term $\partial_t u = \Delta u - g(u) \cdot \nabla u + f(u)$ in a bounded domain of $\mathbb{R}^N$ under the dissipative dynamical boundary conditions $\sigma \partial_t u + \partial_\nu u = 0$. After establishing the occurrence of the blow-up in finite time, we derive some bounds for the blow-up rate of the solutions when approaching the blow-up time. Finally, in the one-dimensional case, we determine the blow-up set for a class of initial data.
Joint work with Joachim von Below and Gaëlle Pincet Mailly.

Complex-valued heat equation with quadratic nonlinearity

Masahiko SHIMOJO

Abstract. We consider the Cauchy problem for a system of parabolic equations which is derived from a complex-valued equation with a quadratic nonlinearity.

Our equation has a relation with the viscous Constantin-Lax-Majda equation, which is known as a one dimensional model for the vorticity equation.

First, a criterion that the solution exists globally in time and converges to the trivial steady state is shown. Next, in one dimensional space, we provide solutions with nontrivial imaginary part that blow up simultaneously.

This is the joint work with H. Ninomiya, E. Yanagida and J.S. Guo.

Finite-time blowup and global-in-time unbounded solutions to a parabolic-parabolic quasilinear Keller-Segel system

Christian STINNER

Abstract. We study radially symmetric solutions to a quasilinear parabolic-parabolic Keller-Segel system in a ball in $\mathbb{R}^n$ for $n \geq 2$. Critical nonlinearities had been identified such that in the subcritical case the solution is global in time and bounded while in the supercritical case the solution blows up, but it was not known whether the blowup takes place in finite or infinite time. Assuming a condition on the growth of the chemotactic sensitivity function, we prove that any solution blows up in finite time in the whole supercritical case. Moreover, we provide an example showing that in presence of a suitable decay of the sensitivity function some solutions blow up in infinite time in the supercritical case without any restriction concerning the initial mass. An important ingredient of our proof is a detailed analysis of the Liapunov functional.

This is a joint work with T. Cieślak.

Hydrodynamical limit of kinetic model for chemotaxis

Nicolas VAUCHELET

Abstract. In this work we focus on the description of aggregation phenomena of cells by chemotaxis. A hydrodynamical limit of a one dimensional kinetic model for chemotaxis is obtained. The limit equation is a non local conservation law, for which finite time blow-up occurs, giving rise to measure-valued solutions and discontinuous velocities. An adaptation of the notion of duality solutions, introduced for linear equations with discontinuous coefficients, leads to an existence result. Uniqueness is obtained through a precise definition of the nonlinear flux as well as the complete dynamics of aggregates. Accurate numerical simulation allows to recover the dynamics of aggregates.

Asymptotic expansion of solutions to the dissipative equation with anomalous diffusion

Masakazu YAMAMOTO

Abstract. The Cauchy problem for the linear dissipative equation with a potential is studied. The dissipative effect of this equation is given by the fractional Laplacian which describes an anomalous diffusion. The goal is to derive the asymptotic expansion of decaying solutions. When the asymptotic expansion of solutions via Escobedo and Zuazua is derived, the anomalous diffusion causes a difficulty. The argument for obtaining the asymptotic expansion of solutions with arbitrary high-order is developed.

Participants

ATTOUCHI Amal	U. Paris 13, France	attouchi@math.univ-paris13.fr
AZAIEZ Asma	U. Paris 13, France	azaiez@math.univ-paris13.fr
AZOUANI Azzedine	FU Berlin, Germany	azouani@zedat.fu-berlin.de
BEDROSSIAN Jacob	NYU, USA	jacob@cims.nyu.edu
BLANCHET Adrien	U. Toulouse, France	adrien.blanchet@univ-tlse1.fr
BOKES Pavol	U. Bratislava, Slovakia	pavol.bokes@fmph.uniba.sk
CORDOBA Diego	ICMAT Madrid, Spain	dcg@icmat.es
CORRIAS Lucilla	U. Evry, France	lucilla.corrias@univ-evry.fr
ESCOBEDO Miguel	UPV, Bilbao, Spain	miguel.escobedo@ehu.es
FILA Marek	U. Bratislava, Slovakia	fila@fmph.uniba.sk
FUJISHIMA Yohei	Osaka U., Japan	fujishima@sigmath.es.osaka-u.ac.jp
HAMEL Francois	U. Marseille, France	francois.hamel@univ-amu.fr
HARADA Junichi	Waseda U., Japan	harada-j@aoni.waseda.jp
HULSHOF Josephus	VU Amsterdam, Netherlands	jhulshof@few.vu.nl
IAGAR Razvan	U. Valencia, Spain	razvan.iagar@uv.es
IKEDA Masahiro	Osaka U., Japan	m-ikeda@cr.math.sci.osaka-u.ac.jp
ISHIDA Sachiko	Tokyo U. Sci., Japan	kosachibi914@gmail.com
ISHIGE Kazuhiro	Tohoku U., Japan	ishige@math.tohoku.ac.jp
ISHII Hitoshi	Waseda U., Japan	ishii@edu.waseda.ac.jp
ISHIWATA Michinori	Fukushima U., Japan	ishiwata@sss.fukushima-u.ac.jp
KAN Toru	Tohoku U., Japan	sa7m08@math.tohoku.ac.jp
KAVALLARIS Nikos	U. Samos, Greece	nkaval@aegean.gr
KAWAKAMI Tatsuki	Osaka Prefecture U., Japan	kawakami@ms.osakafu-u.ac.jp
KERKER Mohamed-Amine	U. Reims, France	a_kerker@yahoo.com
KOBAYASHI Kanako	Tohoku U., Japan	sb1m18@math.tohoku.ac.jp
LAURENÇOT Philippe	U. Toulouse, France	laurenco@math.univ-toulouse.fr
LI Yuxiang	U. Nanjing, China	lieyx@seu.edu.cn
MAHMOUDI Nejib	U. Paris 13 and U. Tunis, Tunisia	mahmoudinejib@yahoo.fr
MALOGROSZ Marcin	U. Warsaw, Poland	malogrosz@mimuw.edu.pl
MATANO Hiroshi	U. Tokyo, Japan	matano@ms.u-tokyo.ac.jp
MATOS Julia	U. Evry, France	julia.matos@univ-evry.fr
MERLE Frank	U. Cergy, France	frankemerle@yahoo.fr
MEUNIER Nicolas	U. Paris 5, France	nicolas.meunier@parisdescartes.fr
MONTARU Alexandre	U. Paris 13, France	montaru@math.univ-paris13.fr

NAITO Yuki	Ehime U., Japan	ynaito@ehime-u.ac.jp
NGUYEN Than	U. Paris Sud, France	thanh_nam2412@yahoo.com
NGUYEN Van Tien	U. Paris 13, France	nguyenvt@math.univ-paris13.fr
NINOMIYA Hirokazu	Meiji U., Japan	ninomiya@math.meiji.ac.jp
NOUAILI Nejla	U. Paris-Dauphine, France	nouaili@ceremade.dauphine.fr
OGAWA Takayoshi	Tohoku U., Japan	ogawa@math.tohoku.ac.jp
PERES Samuel	U. Bratislava, Slovakia	peres@fmph.uniba.sk
PHAN Quoc Hung	U. Paris 13, France	hunghailang@yahoo.com
POLACIK Peter	U. Minnesota, USA	polacik@math.umn.edu
QUITTNER Pavol	U. Bratislava, Slovakia	quittner@fmph.uniba.sk
RASHEED Maan	U. Sussex, UK	M.Abdul-Kadhim-Rasheed@sussex.ac.uk
RAULT Jean-François	U. Calais, France	jfrault@lmpa.univ-littoral.fr
SCHWEYER R'emi	U. Toulouse, France	remi.schweyer@math.univ-toulouse.fr
SEKI Yukihiro	U. Bonn, Germany	seki@ms.u-tokyo.ac.jp
SENBA Takasi	Kyushu Inst. Tech., Japan	senba@mns.kyutech.ac.jp
SHIMOJO Masahiko	Hokkaido U., Japan	Shimojo@math.sci.hokudai.ac.jp
SIERZEGA Mikolaj	U. Warwick, UK	m.l.sierzega@warwick.ac.uk
SOUPLET Philippe	U. Paris 13, France	souplet@math.univ-paris13.fr
STINNER Christian	U. Paderborn, Germany	christian.stinner@math.uni-paderborn.de
STUKE Hannes	FU Berlin, Germany	h.stuke@fu-berlin.de
SUGIYAMA Yoshie	Osaka City U., Japan	sugiyama@tsuda.ac.jp
SUZUKI Takashi	Osaka U., Japan	suzuki@sigmath.es.osaka-u.ac.jp
TAYACHI Slim	U. Tunis, Tunisia	slimtayachi@yahoo.fr
VAUCHELET Nicolas	U. Paris 6, France	vauchelet@ann.jussieu.fr
VELAZQUEZ Juan J.L.	U. Bonn, Germany	velazquez@iam.uni-bonn.de
WANG Chao	U. Cergy, France	wangchao_no1@hotmail.com
WEISSLER Fred	U. Paris 13, France	weissler@math.univ-paris13.fr
WINKLER Michael	U. Paderborn, Germany	michael.winkler@math.uni-paderborn.de
YAMAMOTO Masakazu	Hirosaki U., Japan	yamamoto@cc.hirosaki-u.ac.jp
YANAGIDA Eiji	Tokyo Inst. Tech., Japan	yanagida@math.titech.ac.jp
ZAAG Hatem	U. Paris 13, France	Hatem.Zaag@univ-paris13.fr

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