JSPS-DFG Japanese-German Graduate Externship
第 5 回 日独流体数学国際研究集会
The 5th Japanese-German International Workshop on Mathematical Fluid Dynamics

June 11 - 15, 2012 at Waseda University, Nishi-Waseda Campus

63 Bldg. 04 Conference Room

■ Program ■

		Mon, June 11	Tue, June 12	Wed, June 13	Thu, June 14	Fri, June 15
↑ Mini Course ↓	10：30 -11：30	**Maremonti ①**	**Geissert ①**	**Geissert ②**	**Geissert ③**	**Maremonti ④**
	11：30 -12：00	Coffee Break				
	12：00 -13：00	**Maekawa ①**	**Maremonti ②**	**Kozono ②**	**Maekawa ③**	**Maekawa ④**
	13：00 -14：00	Lunch Break (1H)				
	14：00 -15：00	**Kozono ①**	**Maekawa ②**	**Maremonti ③**	**Kozono ③**	**Geissert ④**
	15：00 -15：30	Coffee Break				
↑ Scientific Talks ↓	15：30 -16：00	**Hirofumi Notsu** (Waseda Univ.)	**Takahiro Okabe** (Hirosaki Univ.)	**Ryo Takada** (Kyoto Univ.)	**Bin Xie** (Shinshu Univ.)	**Kozono ④**
	16：00 -16：30	**Tomoyuki Nakatsuka** (Nagoya Univ.)	**Ken Abe** (Univ. of Tokyo)	**Erika Ushikoshi** (Tohoku Univ.)	**Kohei Soga** (Waseda Univ.)	
	16：30 -17：00	Coffee Break				
	17：00 -17：30	**Hirokazu Saito** (Waseda Univ.)	**Miho Murata** (Waseda Univ.)	**Masashi Ohnawa** (Waseda Univ.)	**Pen-Yuan Hsu** (Tokyo Univ.)	*17:00- Reseption
	17：30 -17：50	**Karen Yeressian** (TU Darmstadt)	**Bangwei She** (JGU Mainz)	**Loenz v. Below** (TU Darmstadt)	**Dario Goetz** (TU Darmstadt)	
	17：50 -18：10	**Jan-Erik Stecher** (TU Darmstadt)	**Georg Schoechtel** (TU Darmstadt)	**Rebekka Burkholz** (TU Darmstadt)	**Manuel Nesensohn** (TU Darmstadt)	
	18：10 -18：30		**Martin Sauer** (TU Darmstadt)			

Matthias GEISSERT

Technische Universität Darmstadt

Title:

Analytical Aspects of Complex Fluids

Abstract:

In this mini-course we discuss existence and uniqueness of solutions of a class of viscoelastic fluids. We start by presenting several models describing the motion of viscoelastic fluids. Roughly speaking, the motion of a viscoelastic fluid can be described by the Navier-Stokes equation coupled with a transport equation for the elastic part of the stress tensor. Hence, we have to investigate a (nonlinear) hyperbolic-parabolic coupled system. We then present different approaches to investigate the existence and uniqueness of solutions of the latter system.

Date:

① Tuesday, June 12 10:30-11:30 ② Wednesday, June 13 10:30-11:30
③ Thursday, June 14 10:30-11:30 ④ Friday, June 15 14:00-15:00

Hideo KOZONO

Waseda University

Title:

New function space in general unbounded domains and its applications to the Navier-Stokes equations

Abstract:

We consider problems on the mathematical fluid mechanics in general unbounded domains Ω with non-compact boundaries. In such domains Ω, it is known that the usual Helmholtz decompositions in $L^r(\Omega)$, $1 < r < \infty$ does not hold except $r = 2$, and hence we need to introduce another function space $\tilde{L}^r(\Omega)$ defined by $\tilde{L}^r(\Omega) = L^r(\Omega) + L^2(\Omega)$ for $1 < r \leq 2$ and $\tilde{L}^r(\Omega) = L^r(\Omega) \cap L^2(\Omega)$ for $2 \leq r < \infty$, respectively. This new function space $\tilde{L}^r(\Omega)$ plays a substitutionary role for $L^r(\Omega)$ so that the Helmholtz decomposition holds. Defining the Stokes operator A in $\tilde{L}^r(\Omega)$, we can develop well-known techniques like analyticity of the semigroup $\{e^{-tA}\}_{t>0}$ and the maximal regularity theorem on $\partial_t + A$ as well as the characterization of the domains of the fractional powers A^α, $0 < \alpha < 1$. As applications of the theory on $\tilde{L}^r(\Omega)$, we are able to treat fundamental problems on uniqueness, regularity and decay properties of weak solutions of the Navier-Stokes equations in Ω.

Date:

① Monday, June 11 14:00-15:00 ② Wednesday, June 13 12:00-13:00
③ Thursday, June 14 14:00-15:00 ④ Friday, June 15 15:30-16:30

Yasunori MAEKAWA
Kobe University

Title:

Mathematical analysis on some coherent structures of vorticity fields for viscous incompressible flows

Abstract:

There are typical structures observed in two or three dimensional viscous incompressible flows described by the Navier-Stokes equations. These structures are often expressed in terms of vorticity fields, i.e., the curl of velocity fields of the fluid. In this lecture we discuss some of these coherent structures and present recent mathematical results on the related topics. In particular, we consider the following problems.

(i) Stability of the Lamb-Oseen vortex in two-dimensional exterior domains

It is known that the Lamb-Oseen vortex describes the large time behavior of viscous incompressible flows in the whole plane when the initial vorticity is sufficiently localized. We extend this result to the case of the two-dimensional exterior domains when the circulation at infinity is sufficiently small.

(ii) Stability of the Burgers vortex in three-dimensional whole space

The Burgers vortex is known as a simple model of vortex tubes observed in the three-dimensional turbulent flows. We present some results on the spectrum of the linearized operator around the Burgers vortex. The Burgers vortex is considered as a stationary flow in the presence of a specific linear strain, and the linear strain plays an important role in the stability property. Motivated by this fact, we also consider the flows with general linear strains and discuss the existence and the nonexistence of the associated stationary flows.

(iii) Vorticity creation and formation of the vortex line along the boundary at the inviscid limit in the half plane

The inviscid limit problem of the Navier-Stokes equations is a classical issue in the fluid dynamics. However, there is a serious difficulty when the no-slip boundary condition is imposed on the velocity field, due to the appearance of the boundary layer. In the boundary layer region the vorticity is highly created and forms a vortex line, whose mechanism is formally explained by the Prandtl theory. We present a rigorous description of this behavior at the inviscid limit when the support of the initial vorticity is away from the boundary.

Date:

① Monday, June 11 12:00-13:00 ② Tuesday, June 12 14:00-15:00
③ Thursday, June 14 12:00-13:00 ④ Friday, June 15 12:00-13:00

Paolo MAREMONTI
Seconda Università degli Studi di Napoli

Title:

Stokes and Navier-Stokes IBVP with nondecaying data

Abstract:

We develop four lectures concerning a special study of the Stokes and Navier-Stokes initial boundary value problem. We assume $\Omega \subseteq \mathbb{R}^n$, $n \geq 3$, unbounded domain and nondecaying initial data. The aim is essentially to show the well posedeness (in the Hadamar sense) of the problem. We structure the topics as follows:

(i) We recall some proprieties of singular transformation in Hölder spaces; we develop some results concerning the Stokes semigroup properties with an initial data in $L^1(\Omega)$. Both these results are employed to prove some pointwise estimates for the pressure field and the velocity field respectively.

(ii) A maximum modulus theorem in exterior domains for the Stokes problem is the first problem that we discuss for nondecaying data. It is approached by means of methods of the functional analysis, and it is a natural development of some results for bounded domains obtained by Abe and Giga in their recent paper.

(iii) We discuss the well posedeness of the initial boundary value problem with nondecaying data in exterior domains. We prove that some restrictions are needed to obtain the uniqueness, even in the case of the Stokes problem.

(iv) We discuss the existence and the uniqueness of the solutions to the Navier-Stokes Cauchy problem and we give the idea for the proof of the case of an exterior domain.

The lectures are given by using a projector of pdf files and blackboard.

Date:

① Monday, June 11 10:30-11:30 ② Tuesday, June 12 12:00-13:00
③ Wednesday, June 13 14:00-15:00 ④ Friday, June 15 10:30-11:30

Ken ABE
The University of Tokyo

Title:

The Stokes flow in exterior domains with non-decaying initial velocity

Abstract:

Analyticity of semigroups is one of fundamental properties for semigroups associated to parabolic equations. In this talk we study analyticity of the Stokes semigroup in spaces of bounded functions both in bounded and unbounded domains. In particular, we discuss the problem in an exterior domain as a typical example of an unbounded domain. Even existence of solution is non-trivial in that case. We derive analyticity of the Stokes semigroup by solving the unique existence for the Stokes equations with non-decayng initial data. This talk is based on a joint work with Professor Yoshikazu Giga.

Date:

Tuesday, June 12 16:00-16:30

Lorenz von BELOW
Technische Universität Darmstadt

Title:

The spin-coating process with heat transfer

Abstract:

In [1] Denk, Geissert, Hieber, Saal and Sawada proved wellposedness of a model for the spin coating process. The model they studied is a one-phase free boundary value problem for a Newtonian fluid which takes rotational effects into account. We present an extension of their model which includes the effect of heat transfer and prove existence of a uniquely determined solution on an arbitrary time interval $(0; T)$ provided the initial data are sufficiently small.

References:

[1] Robert Denk, Matthias Geissert, Matthias Hieber, Jürgen Saal, and Okihiro Sawada. *The spin-coating process: Analysis of the free boundary value problem.* Communications in Partial Differential Equations, 36(7):1145-1192, 2011.

Date:

Wednesday, June 13 17:30-17:50

Rebekka BURKHOLZ
Technische Universität Darmstadt

Title:

A Stochastic FitzHugh-Nagumo Model

Abstract:

We study a stochastic version of the FitzHugh-Nagumo model, a stochastic semilinear evolution equation with dissipative nonlinearity and additive (Gaussian) noise which describes the signal propagation in the axon of a neural cell.
Thus it is of the form

$$dX(t) = (AX(t) + F(X(t)))dt + \sqrt{Q}dW(t),$$
$$X(0) = x \in D(A) \cap D(F) \subset H = L^2(0,1) \times L^2(0,1).$$

We take advantage of the fact that A generates an analytic semigroup (of contractions) to prove the existence and uniqueness of a mild solution with deterministic initial value of the system above. Although the nonlinearity F does not fulfil the standard linear growth condition, this mild solution exists for all $x \in H$.
With additional assumptions on the coefficients our analysis results in a proof of existence and uniqueness of an invariant measure μ for the random dynamical system. Then in the last step we identify the associated Kolmogorov operator on the set of cylindrical functions.

Date:

Wednesday, June 13 17:50-18:10

Dario GOETZ

Technische Universität Darmstadt

Title:

On the compressible Navier-Stokes flow with Neumann boundary conditions

Abstract:

The mathematical analysis of a compressible viscous fluid flow with a free boundary relies on a thorough investigation of the corresponding linear compressible Navier-Stokes flow with Neumann boundary conditions. In this talk, we are concerned with showing $\mathcal{R}$-sectoriality of the appearing Stokes operator in the half-space. Due to the presence of a non-constant density-term, one has to deal with λ-dependent coefficients in this problem.

Date:

Thursday, June 14 17:30-17:50

Pen-Yuan HSU

The University of Tokyo

Title:

On nonexistence for stationary solutions to the Navier-Stokes equations with a linear strain

Abstract:

In this work we consider stationary solutions to the three-dimensional Navier-Stokes equations for viscous incompressible flows in the presence of a linear strain. For certain class of strains we prove a Liouville type theorem under suitable decay conditions on vorticity fields.

Date:

Thursday, June 14 17:00-17:30

Miho MURATA

Waseda University

Title:

On the sectorial $\mathcal{R}$ -boundedness of the Stokes operator for the compressible viscous fluid flow in the half-space with slip boundary condition

Abstract:

We consider the maximal L_p-L_q regularity for the compressible viscous fluid flow in the half-space with slip boundary condition. The key of the proof of maximal L_p-L_q regularity is to consider the sectorial $\mathcal{R}$-boundedness of the Stokes operator for the corresponding resolvent problem. Therefore in this talk, we mainly would like to report the sectorial $\mathcal{R}$-boundedness of the Stokes operator.

Date:

Tuesday, June 12 17:00-17:30

Tomoyuki NAKATSUKA

Nagoya University

Title:

Uniqueness of steady Navier-Stokes flows in exterior domains

Abstract:

In this talk, we present a uniqueness theorem for stationary solutions to the Navier-Stokes equations in three-dimensional exterior domains. We establish the regularity theory for the perturbed Stokes equations in the Lorentz space, and then we give the proof of the theorem employing the bootstrap argument.

Date:

Monday, June 11 16:00-16:30

Manuel NESENSOHN
Technische Universität Darmstadt

Title:

L_p-theory for a class of viscoelastic fluids with a free surface

Abstract:

The investigated model is a generalization of the Oldroyd-B model. An approach to the corresponding free boundary problem without surface tension in Lagrangian coordinates is presented. Local in time existence of a unique strong L_p-solution for arbitrary large initial data is shown.

Date:

Thursday, June 14 17:50-18:10

Hirofumi NOTSU
Waseda University

Title:

Analysis of characteristics finite difference schemes for convection-diffusion problems

Abstract:

Numerical schemes based on the method of characteristics have a special advantage, i.e., symmetry of the coefficient matrix of each system of linear equations, which reduces computational costs. We will talk on an L_2-analysis of newly developed characteristics finite difference schemes of second order in time for convection-diffusion problems.

Date:

Monday, June 11 15:30-16:00

Masashi OHNAWA
Waseda University

Title:

Decay rates towards traveling waves for a model system of radiating gas

Abstract:

The present research is concerned with the asymptotic behavior of a discontinuous solution over $\mathbb{R}$ to a model system of radiating gas:

$$u_t + uu_x + q_x = 0,$$
$$-q_{xx} + q + u_x = 0.$$

We assume the initial data satisfy $u_0(x) \to u_\pm$ as $x \to \pm\infty$ with $u_- > u_+$ and $|u_- - u_+| \leq 1/2$. Under these asymptotic conditions, this system supports a smooth traveling wave solution uniquely up to shifts. We focus on the case when the initial data have discontinuity at one point and show that the solution in the sense of Kruzkov converges to a traveling wave at exactly the same rate as the decay rate of the initial perturbation from the traveling wave.

Date:

Wednesday, June 13 17:00-17:30

Takahiro OKABE

Hirosaki University

Title:

Initial profile for the slow decay of the Navier-Stokes flow in the half-space

Abstract:

We consider the asymptotic behavior of the incompressible viscous fluid in the half-space governed by the usual Navier-Stokes equations. Especially, we consider the energy-decay problem of the weak solution to the Navier-Stokes equations. For this direction, there are many results on the upper bound for the energy-decay. For the whole space case, by the Fourier splitting method for the linear Stokes flow, we also have the lower bound of the energy decay. However, for the half-space case, it seems that there are few result on the lower bound of the decay problem. Our previous result [1] derived the lower bound of the slow decay of the linear Stokes flow and [1] characterized the initial profile which causes the lower bound. However, since we consider specific initial data, tangential flow, we do not include two dimensional case. Our aim is to consider more general initial data and to derive the lower bound for the two-dimensional flow.

References:

[1] T. Okabe, *Lower bound of L^2 decay of the Navier-Stokes flow in the half-space $\mathbb{R}^n_+$ and its asymptotic behavior in the frequency space*, submitted.

Date:

Tuesday, June 12 15:30-16:00

Hirokazu SAITO

Waseda University

Title:

On the L_p-L_q maximal regularity of the Neumann-Dirichlet problem for the Stokes equations in an infinite layer

Abstract:

In this talk, I would like to consider the L_p-L_q maximal regularity of the Stokes problem with Neumann-Dirichlet-type boundary condition in an infinite layer. This Stokes problem is linearized of a free surface problem which is called the ocean problem. The free boundary problem in L_2-L_2 framework is considered by Beale and Nishida. They proved a unique existence of its global solution and its decay properties in [1]. We need the L_p-L_q maximal regularity of the Stokes problem in order to deal with the free boundary problem in L_p-L_q-framework. In view of this, I will report the L_p-L_q maximal regularity of the Stokes problem.

References:

[1] J.T.Beale and T.Nishida, *Large-time behavior of viscous surface waves*, Recent topics in nonlinear PDE, II (Sendai, 1984), 1-14, North-Holland Math. Stud., 128, North-Holland, Amsterdam, 1985.

Date:

Monday, June 11 17:00-17:30

Martin SAUER

Technische Universität Darmstadt

Title:

Ergodicity for Generalized Newtonian Fluids

Abstract:

We study so called generalized Newtonian fluids arising as a more general model of the Navier-Stokes equations in mathematical fluid dynamics. A prominent example are the Power Law or Ladyzhenskaya fluids having a power law type structure with exponent p for the stress tensor. The main features of such equations besides the better description of non-Newtonian behaviour are global uniqueness results depending on the exponent p. Under stochastic forcing these equations have been discovered only recently and in this talk we will consider them perturbed by additive noise. We study existence and uniqueness of stationary distributions and their ergodic properties.

Date:

Tuesday, June 12 18:10-18:30

Georg Schoechtel

Technische Universität Darmstadt

Title:

Simulation of stationary fractional Ornstein-Uhlenbeck process and application to turbulence

Abstract:

We investigate several methods to simulate the stationary fractional Ornstein-Uhlenbeck (sfOU) process, i.e. the stationary solution of the Langevin equation driven by a fractional Brownian motion (fBM) with arbitrary Hurst parameter in (0,1). In particular, we discuss the spectral approximate simulation method and the applicability of the circulant embedding method, the fastest known exact simulation. As an application we introduce a two-dimensional random fluid velocity field defined as a series of sfOU processes, which satisfies a linear stochastic partial differential equation driven by a fBM. The usefulness of such random velocity fields in simulations is that we can create random velocity fields with desired statistical properties, thus generating artificial images of realistic turbulent flows.

Date:

Tuesday, June 12 17:50-18:10

Bangwei SHE

Johannes Gutenberg- Universität Mainz

Title:

Kinetic flux vector splitting(KFVS) method for compressible two-phase flow containing non-conservative products

Abstract:

As the Baer-Nunziato model well prescribed the interaction between two phases, it had become research hot spot. The non-conservative terms in the model can't be treated as flux or common source terms, and none of existed discrete methods for the non-conservative terms are mature. We propose a KFVS scheme in microscopic view. Then numerical fluxes can be got by integrating particle velocity distribution function. Besides, the non-conservative terms are explicitly introduced into the evolution and construction of numerical fluxes, thus well handled the non-conservative terms. We also prospect the same accuracy with schemes constructed by Riemann solver, but much less calculation loads.

Date:

Tuesday, June 12 17:30-17:50

Kohei SOGA

Waseda University

Title:

Time global stability of the Lax-Friedrichs scheme

Abstract:

I show time global stability of the Lax-Friedrichs scheme applied to initial value

problems of scalar conservation laws and Hamilton-Jacobi equations under the periodic setting. We observe a stochastic and variational approach to the Lax-Friedrichs scheme, formulating the value function for the discretized equations with random walks. This approach yields locally uniform convergence of approximate entropy solutions to the exact ones, except any "small" neighborhoods of shocks. It is shown by techniques of viscosity solutions that exact entropy solutions at $t = 1$ are bounded by a constant independent of initial data. Combining these two results, we obtain several compactness of approximate solutions, which leads to time global stability. It is very hard to obtain the results here by the usual functional analytic approach to the Lax-Freidrichs scheme.

Date:

Thursday, June 14 16:00-16:30

Jan-Erik STECHER

Technische Universität Darmstadt

Title:

Cirac Concentrations in Lotka-Volterra parabolic PDE

Abstract:

In this presentation a diploma thesis based on a paper written by Benoit Perthame and Guy Barles will be discussed. It deals with a parabolic nonlinear PDE which describes the evolution of species, including small mutations. We will illustrate existence and uniqueness results and present convergence results by letting mutations vanish. This leads to a specific structure of the solution. It can be written as a sum of Dirac measures, which can be interpreted as a mathematical way to support Darwin's Law of Evolution.

Date:

Monday, June 11 17:50-18:10

Ryo Takada

Kyoto University

Title:

Time periodic solutions to the Navier-Stokes equations in the rotational framework

Abstract:

In this talk, we consider the Navier-Stokes equations in the rotational framework with the time periodic external force. Using a dispersive estimate for the Coriolis term, we give a sufficient condition on the size of the external force for the existence of time periodic solutions in terms of the Coriolis parameter. It follows from our

condition that the unique existence of time periodic solutions is guaranteed for large external forces provided the speed of rotation is sufficiently fast.

Date:

Wednesday, June 13 15:30-16:00

Erika USHIKOSHI
Tohoku University

Title:

Hadamard variational formula for the Green function for the velocity and pressure of the Stokes equations of the perturbations of domains

Abstract:

We consider the Stokes equations describing the motion of the incompressible fluid moving slowly on the bounded domain with the smooth boundary. In this talk, we investigate the Hadamard variational formula of the Stokes equations for the velocity and pressure by a new approach. Here the Hadamard variational formula is first introduced by J. Hadamard and gives the variation of the Green function under a certain perturbation of its domain.

Date:

Wednesday, June 13 16:00-16:30

Karen YERESSIAN
Technische Universität Darmstadt

Title:

Spatial decay estimates for elliptic integro-differential equations

Abstract:

For elliptic integro-differential equations, which arise from Levy stochastic processes, we prove spatial decay estimates in the form of weighted norms. Our approach is general, allowing different decay rates. Applications of such estimates include bounding the domain for numerical calculations and proving the existence of solutions in unbounded domains with growing force term at infinity.

Date:

Monday, June 11 17:30-17:50

Bin XIE
Shinshu University

Title:

Stochastic Fractal Burgers type equations with conservation laws

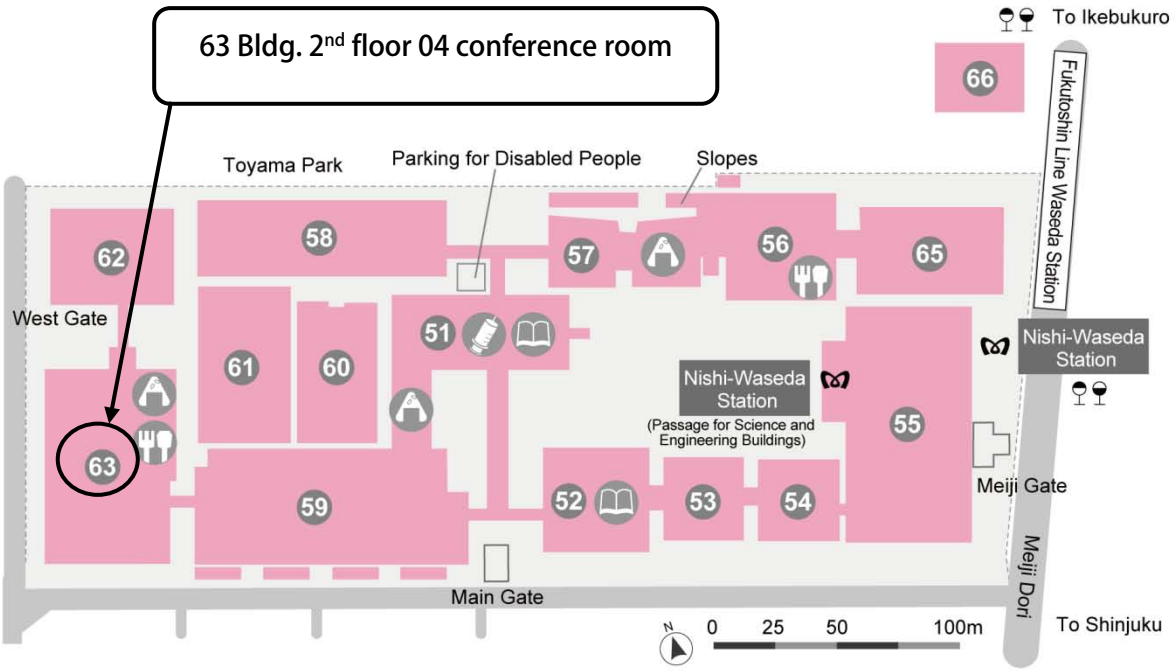
Abstract:

I will consider a fractal Burgers type equation driven by some noise. The operator appeared in such equation is the generator of a symmetric α-stable process with $\alpha \in (0, 2)$. Such equation is a classical stochastic Burgers equation when $\alpha = 2$ and it represents a scalar conservation law with random forcing as α converges to 0. Without the noise term, to the best of my knowledge such equation is initially studied by P. Biler, T. Funaki and W. A. Woyczynski in 1998 and the well-posed problem is considered according to the index α. In this talk, I will add some noise to their equation and consider the existence and uniqueness of its solutions in different frameworks, which depends on α.

Date:

Thursday, June 14 15:30-16:00

Campus Map



Organizers : Yoshihiro Shibata (Waseda University)
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