

International Conference on
“PDEs and Semigroups in Applied Analysis”
on the occasion of Jerry Goldstein’s 80th birthday
Bari, July 12-15, 2021

Book of Abstracts
and Program



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DEGLI STUDI DI BARI
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MIUR-PRIN
2017JPCAPN

Speakers

Wolfgang ARENDT, *Universität Ulm, Germany*
Adam BOBROWSKI, *Politechnika Lubelska, Poland*
Andrei & Aurora BREAZNA, *New York, USA*
Giuseppe M. COCLITE, *Politecnico di Bari, Italy*
Hassan A. EMAMIRAD, *Université de Poitiers, France*
Fritz GESZTESY, *Baylor University, USA*
Gisèle RUIZ GOLDSTEIN, *The University of Memphis, USA*
Matthias HIEBER, *Technische Universität Darmstadt, Germany*
Ismail KÖMBE, *Istanbul Commerce University, Turkey*
Luca LORENZI, *Università di Parma, Italy*
Alessandra LUNARDI, *Università di Parma, Italy*
Giorgio METAFUNE, *Università del Salento, Italy*
Alain MIRANVILLE, *Université de Poitiers, France*
Mustapha MOKHTAR-KARROUBI, *Université de Bourgogne Franche-Comté, France*
Delio MUGNOLO, *FernUniversität in Hagen, Germany*
Gaston M. N'GUÉRÉKATA, *Morgan State University, USA*
Diego PALLARA, *Università del Salento, Italy*
Michel PIERRE, *École Normale Supérieure de Rennes, France*
Yehuda PINCHOVER, *Technion - Israel Institute of Technology, Israel*
Sergio POLIDORO, *Università degli Studi di Modena e Reggio Emilia, Italy*
Enrico PRIOLA, *Università di Pavia, Italy*
Guillermo REYES, *University of Southern California, USA*
Abdelaziz RHANDI, *Università degli Studi di Salerno, Italy*
Silvia ROMANELLI, *Università degli Studi di Bari Aldo Moro, Italy*
Ratnasingham SHIVAJI, *University of North Carolina at Greensboro, USA*
Edriss S. TITI, *University of Cambridge, UK*
Vincenzo VESPRI, *Università degli Studi di Firenze, Italy*
Glenn WEBB, *Vanderbilt University, USA*

Organizers

Anna Maria Candela, *Università degli Studi di Bari Aldo Moro*
Genni Fragnelli, *Università degli Studi di Bari Aldo Moro*
Gisèle Ruiz Goldstein, *The University of Memphis*
Sandra Lucente, *Università degli Studi di Bari Aldo Moro*
Abdelaziz Rhandi, *Università degli Studi di Salerno*
Silvia Romanelli, *Università degli Studi di Bari Aldo Moro*

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PROGRAM

Monday, July 12

**Aula Magna Aldo Cossu, Palazzo Ateneo
Università degli Studi di Bari Aldo Moro
Piazza Umberto I**

9.00-9:30 **Registration**

9.30-10:00 **Opening:**

- Prof. Stefano Bronzini, Magnifico Rettore dell'Università degli Studi di Bari Aldo Moro
- Prof.ssa Addolorata Salvatore, Direttore del Dipartimento di Matematica dell'Università degli Studi di Bari Aldo Moro

Chairwoman: *Silvia Romanelli*

10.00-10.25 **Gisèle R. Goldstein:** *Life, Love and Mathematics*

10.30-10.55 **Alain Miranville:** *The Cahn-Hilliard equation with a nonlinear source term*

11.00-11.30 *Coffee break*

11.30-11.55 **Delio Mugnolo:** *Random evolution equations on graphs and beyond*

12:00-12.25 **Alessandra Lunardi:** *On good semigroups in spaces of continuous functions*

12:30 *Lunch at “Dolce e Salato”*

Chairwoman: *Gisèle Goldstein*

14.30-14.55 **Matthias Hieber:** *The Primitive Equations on the Space $L^\infty(L^1)$: An Approach by Evolution Equations*

15.00-15.25 **Wolfgang Arendt:** *Semigroups: Continuous functions - no Hilbert space*

15.30-16.00 *Coffee break.*

16.00-16.25 **Hassan Emamirad:** *Time Fractional De Bruijn Identities in heat and Fokker-Plank Channels*

NOTE: The speakers with * will give their talk via Zoom

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PROGRAM

Thursday, July 13

**Aula XI, Dipartimento di Matematica
Università degli Studi di Bari Aldo Moro**

Chairman: *Abdelaziz Rhandi*

10.00-10.25 **Giuseppe M. Coclite**: *Nonlocal evolution equations in Peridynamics*

10.30-10.55 **Edriss S. Titi***: *On two geophysical problems with vanishing parameter limit*

11.00-11.30 *Coffee break*

11.30-11.55 **Mustapha Mokhtar-Karroubi***: *Convergence rate to equilibrium for collisionless transport equations with diffuse boundary operators: A new tauberian approach*

12.00-12.25 **Ismail Kömbe***: *Weighted Hardy Type inequalities with Robin Boundary Conditions*

12.30 *Lunch at “Caffè Vergnano”*

Chairman: *Wolfgang Arendt*

14.30-14.55 **Ratnasingham Shivaji***: *A uniqueness result for infinite semipositone p -Laplacian problems in a ball*

15.00-15.25 **Gaston M. N'Guérékata***: *Almost periodic elliptic equations: sub- and super-solutions*

15.30-16.00 *Coffee break.*

16.00-16.25 **Glenn Webb***: *Modelling the Aqueous Transport of an Infectious Pathogen in Regional Communities: Application to the 2010 Cholera Outbreak in Haiti*

20.00 *Social Dinner at “Piccinni 28”*

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PROGRAM

Wednesday, July 14

**Aula XI, Dipartimento di Matematica
Università degli Studi di Bari Aldo Moro**

Chairman: *Alain Miranville*

10.00-10.25 **Giorgio Metafuno**: *L^p estimates for the Caffarelli-Silvestre extension operators*

10.30-10.55 **Luca Lorenzi***: *Stability and Hopf bifurcation at high Lewis number in a combustion model*

11.00-11.30 *Coffee break*

11.30-11.55 **Enrico Priola***: *A sharp regularity result for infinite dimensional Kolmogorov equations*

12.00-12.25 **Michel Pierre***: *An L^1 -walk in reaction-diffusion systems*

12.30 *Lunch at “Caffè Vergnano”*

Chairwoman: *Alessandra Lunardi*

14.30-14.55 **Sergio Polidoro**: *The Kolmogorov equation related to a stochastic process introduced by Geman and Yor*

15.00-15.25 **Vincenzo Vespri**: *Recent results about anisotropic operators*

15.30-16.00 *Coffee break.*

16.00-16.25 **Andrei&Aurora Breazna***: *TBA*

NOTE: The speakers with * will give their talk via Zoom

**International Conference on
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PROGRAM

Thursday, July 15

**Aula XI, Dipartimento di Matematica
Università degli Studi di Bari Aldo Moro**

Chairman: *Sergio Polidoro*

10.00-10.25 **Abdelaziz Rhandi**: *The Baras-Goldstein result and its several extensions*

10.30-10.55 **Adam Bobrowski***: *Robin boundary condition is complementary to Feller's condition of sticky boundary*

11.00-11.30 *Coffee break*

11.30-11.55 **Yehuda Pinchover***: *Optimal Hardy inequalities for Schrödinger operators on graphs*

12.00-12.25 **Diego Pallara**: *Gradient estimates for perturbed Ornstein-Uhlenbeck semigroups in infinite dimensional convex sets*

12.30 *Lunch at “Caffè Vergnano”*

Chairwoman: *Anna Maria Candela*

14.30-14.55 **Fritz Gesztesy***: *Continuity properties of the spectral shift function for massless Dirac operators and an application to the Witten index*

15.00-15.25 **Silvia Romanelli**: *Ideas and highlights on the research with Jerry and Gisele Goldstein*

15.30-16.00 **Closing** and *Coffee break*.

NOTE: The speakers with * will give their talk via Zoom

**International Conference on
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ABSTRACTS

Semigroups: Continuous functions - no Hilbert space.

W. Arendt

Universität Ulm

email: wolfgang.arendt@uni-ulm.de

By methods of potential theory and the maximum principle one obtains semigroups on spaces of continuous functions. An interesting example is given by non-local boundary conditions. On Hilbert space? An open problem.

Robin boundary condition is complementary to Feller's condition of sticky boundary

A. Bobrowski

Politechnika Lubelska

email: bobrowscy@gmail.com

Let $C[0, \infty]$ be the space of continuous functions on the right half-axis \mathbb{R}^+ with limits at $+\infty$, and let $C[-\infty, \infty]$ be the space of continuous functions on the entire \mathbb{R} that have limits at both $-\infty$ and $+\infty$. It has been known for some time that classical Feller–Wentzel boundary conditions for the Laplace operator in $C[0, \infty]$ are in one-to-one correspondence with certain subspaces of continuous functions on \mathbb{R} that are invariant for the basic cosine family and the heat semigroup. In particular, the Robin boundary condition

$$f'(0) = \gamma f(0)$$

where $\gamma \geq 0$ is a parameter, is linked with the subspace $C_R^\gamma \subset C[-\infty, \infty]$ of g that satisfy $g(-x) = g(x) - 2\gamma \int_0^x e^{-\gamma(x-y)} g(y) dy$ for $x \geq 0$. We find a natural operator P_γ that projects $C[-\infty, \infty]$ onto C_R^γ and with its help prove a surprising result saying that, for $\gamma > 0$, C_R^γ is complemented by the subspace $C_F^\gamma \in C[-\infty, \infty]$ linked with the particular case of Feller–Wentzel boundary conditions, describing slowly reflecting boundary (or: sticky boundary), that is, with the condition

$$f''(0) = \gamma f'(0).$$

Therefore, in a sense, the slowly reflecting boundary condition complements the Robin boundary condition, and so the basic cosine family (and thus also the heat semigroup) can be naturally split into its parts in the invariant subspaces related to these boundary conditions. This result is a counterpart of the elementary fact that the basic cosine family leaves the subspaces of even and odd functions invariant; these subspaces are linked with the Neumann and Dirichlet boundary conditions, respectively.

TBA

A. Breazna

New York

email: Andrei.breazna@regeneron.com; Aurora.breazna@regeneron.com

Nonlocal evolution equations in Peridynamics

G.M. Coclite

Politecnico di Bari

email: giuseppemaria.coclite@poliba.it

Some materials may naturally form discontinuities such as cracks as a result of scale effects and long range interactions. Peridynamic models such behavior introducing a new nonlocal framework for the basic equations of continuum mechanics. In this lecture we review some recent results obtained in the field. More precisely, well-posedness in suitable fractional Sobolev spaces for the fully nonlinear model and a study of the dispersive properties in the linear one dimensional case are exploited. We compare some new discovered nonlocal features with the classical local scenario.

Those results were obtained in collaboration with S. Dipierro (Perth), G. Fanizza (Lisbon), F. Maddalena (Bari), M. Romano, and E. Valdinoci (Perth).

Time Fractional De Bruijn Identities in heat and Fokker-Plank Channels

H.A. Emamirad

Université de Poitiers

email: Hassan.Emamirad@math.univ-poitiers.fr

The de Bruijn identity in information theory consider that if p is the solution of the heat equation, then the derivative of the Shannon entropy for this solution is equal to the amount of Fisher information at p . By using Goldstein's abstract evolution equation theorem we show that the same procedure is valide if we change the heat equation by a conformable time fractional heat equation and the same conclusion remains true. we give also a generalization of this identity when we replace the heat equation by Fokker-Planck equation.

Continuity properties of the spectral shift function for massless Dirac operators and an application to the Witten index

F. Gesztesy

Baylor University

email: Fritz.Gesztesy@baylor.edu

e report on recent results regarding the limiting absorption principle for multi-dimensional, massless Dirac-type operators (implying absence of singularly continuous spectrum) and continuity properties of the associated spectral shift function.

We will motivate our interest in this circle of ideas by briefly describing the connection to index theory for non-Fredholm operators, particularly, to the notion of the Witten index.

This is based on various joint work with A. Carey, J. Kaad, G. Levitina, R. Nichols, D. Potapov, F. Sukochev, and D. Zanin.

Life, Love and Mathematics

G. Ruiz Goldstein

The University of Memphis

email: ggoldste@memphis.edu

This talk will focus on the history of my joint research with Jerry Goldstein in four areas: (1) quantum mechanics and Thomas-Fermi Theory, (2) instantaneous blowup and nonexistence of positive solutions, (3) boundary conditions (4) mathematical finance. A brief explanation of our main results in these areas will

be given. As is often the case, life takes crazy paths. In our case, what started as a common interest in mathematical questions has led to a lifelong relationship of love, family and mathematics.

**The Primitive Equations on the Space $L^\infty(L^1)$:
An Approach by Evolution Equations**

M. Hieber

Technische Universität Darmstadt
email: hieber@mathematik.tu-darmstadt.de

In this talk we discuss the primitive equations on the scaling invariant space $L^\infty(L^1)$ and prove local and global well-posedness of these equations in the strong sense under

various assumptions on the initial data. Our proof is based on an iteration scheme, which relies in an essential way on mapping properties of the underlying semigroup in the $L^\infty(L^1)$ -setting.

These mapping properties are related to anisotropic estimates for the heat semigroup subject to Dirichlet or Neuman boundary conditions.

This is joint work with Y. Giga, M. Gries, A. Hussein and T. Kashiwabara.

Weighted Hardy Type inequalities with Robin Boundary Conditions

I. Kömbe

Istanbul Commerce University
email: ikombe40@gmail.com

In this talk, I will describe recent work in collaboration with Abdullah Yener, where we prove a general weighted Hardy type inequality for the p -Laplace operator with Robin boundary condition. Furthermore, I will present some Heisenberg-Pauli-Weyl type inequalities with boundary terms on balls with radius R at the origin in \mathbb{R}^n .

Stability and Hopf bifurcation at high Lewis number in a combustion model

L. Lorenzi

Università di Parma
email: luca.lorenzi@unipr.it

In this talk we analyze the stability of the traveling wave solution for an ignition-temperature, first-order reaction model of thermal-diffusional combustion, in the case of high Lewis numbers ($Le > 1$). In contrast to conventional Arrhenius kinetics where the reaction zone is infinitely thin, the reaction zone for stepwise temperature kinetics is of order unity. The system of two parabolic PDEs is characterized by a free interface at which ignition temperature Θ_i is reached. We turn the model to a fully nonlinear problem in a fixed domain. When the Lewis number is large, we define a bifurcation parameter $m = \Theta_i/(1 - \Theta_i)$ and a perturbation parameter $\varepsilon = 1/Le$. The main result is the existence of a critical value $m^c(\varepsilon)$ close to $m^c = 6$ at which Hopf bifurcation holds for ε small enough.

On good semigroups in spaces of continuous functions

A. Lunardi

Università di Parma
email: alessandra.lunardi@unipr.it

I will consider semigroups of bounded operators P_t acting in the space $C_b(X)$ of the bounded continuous functions from a separable Banach space X to \mathbb{R} . In this framework, “good” means that for every $f \in C_b(X)$ the function $(t, x) \mapsto P_t f(x)$ is continuous in $[0, +\infty) \times X$, and there exist $M > 0$, $\omega \in \mathbb{R}$ such that $\|P_t f\|_\infty \leq M e^{\omega t} \|f\|_\infty$ for every $t \geq 0$, $f \in C_b(X)$.

The generator of P_t in the space $C_b(X)$ is the operator L whose resolvent $R(\lambda, L)$ is given by

$$(R(\lambda, L)f)(x) = \int_0^\infty e^{-\lambda t} P_t f(x) dt, \quad \lambda > \omega.$$

I will talk about some familiar properties of strongly continuous semigroups that have suitable generalizations to this setting.

A large class of such semigroups are the so called “generalized Mehler semigroups”, that may be expressed as

$$P_t f(x) = \int_X f(T_t x + y) \mu_t(dy), \quad f \in C_b(X),$$

where T_t is a strongly continuous semigroup in X , and $\{\mu_t : t \geq 0\}$ is a family of probability Borel measures, weakly continuous with respect to $t \in [0, +\infty)$. In this case, the generators are pseudo-differential operators. In finite dimension ($X = \mathbb{R}^n$) they include the Laplacian and the powers of $-\Delta$, all Ornstein-Uhlenbeck operators, and Ornstein-Uhlenbeck operators with fractional diffusion part. In infinite dimension they include again different types of Ornstein-Uhlenbeck operators, the Gross Laplacian Δ_G and $(-\Delta_G)^\alpha$ for $\alpha \in (0, 1)$.

For such semigroups and generators several regularity results will be reviewed.

L^p estimates for the Caffarelli-Silvestre extension operators

G. Metafune

Università del Salento

email: giorgio.metafune@unisalento.it

We study elliptic and parabolic problems governed by the singular elliptic operators

$$\mathcal{L} = \Delta_x + D_{yy} + \frac{c}{y} D_y - \frac{b}{y^2}$$

in the half-space $\mathbb{R}_+^{N+1} = \{(x, y) : x \in \mathbb{R}^N, y > 0\}$.

Joint work with C. Spina and L. Negro.

The Cahn-Hilliard equation with a nonlinear source term

A. Miranville

Université de Poitiers

email: Alain.Miranville@math.univ-poitiers.fr

Our aim in this talk is to discuss the existence of solutions to the Cahn-Hilliard equation with a nonlinear source term and a logarithmic potential. Such an equation has applications, e.g., in image processing and tumor growth.

Convergence rate to equilibrium for collisionless transport equations with diffuse boundary operators: A new tauberian approach

M. Mokhtar-Kharroubi

Université de Bourgogne Franche-Comté

email: mustapha.mokhtar-kharroubi@univ-fcomte.fr

This work provides a new tauberian approach to the study of quantitative time asymptotics of stochastic collisionless transport semigroups $(U_H(t))_{t \geq 0}$ on $L^1(\Omega \times \mathbb{R}^d)$ with smooth open set $\Omega \subset \mathbb{R}^d$ and general stochastic diffuse boundary operators $H \in \mathcal{L}(L^1(\Gamma_+), L^1(\Gamma_-))$ where Γ_+ and Γ_- are respectively the outgoing and incoming part of the phase space. Under very general assumptions on the initial density f , we obtain an optimal rate of convergence to equilibrium of the form

$$\|U_H(t)f - \Phi_H\| \leq C_f \varepsilon_f(t) (1+t)^{-N_H}$$

where $C_f > 0$ is a constant, Φ_H is the invariant density of $(U_H(t))_{t \geq 0}$, $\varepsilon_f(t) \rightarrow 0$ ($t \rightarrow +\infty$) and N_H is an integer related to *the maximal gain of moments* that the boundary operator H is able to induce. The proof relies on a representation of the collisionless transport semigroups by a (kind of) Dyson-Phillips series and on the analysis of the trace on the imaginary axis of Laplace transform of *remainders of large order* of this series.

References:

1. B. Lods and M. M-K. Convergence rate to equilibrium for collisionless transport equations with diffuse boundary operators: A new tauberian approach (2021). arXiv:2104.06674v1.
2. B. Lods, M. M-K and R. Rudnicki. Invariant density and time asymptotics for collisionless kinetic equations with partly diffuse boundary operators. *Ann. Inst. H. Poincaré Anal. Non Linéaire* 37 (2020).

Random evolution equations on graphs and beyond

D. Mugnolo

FernUniversität in Hagen

email: delio.mugnolo@fernuni-hagen.de

I will study diffusion-type equations supported on structures that are randomly varying in time, following the evolution of a system along the path of a random walk whose states are diffusion equations driven by different graph Laplacians. After settling the issue of well-posedness, I will focus on the asymptotic behavior of solutions and show convergence of the propagator towards a deterministic steady state. If time allows, I will also briefly turn to a different viewpoint and follow the evolution of a system not any more along a tree-like time structure corresponding to all possible paths of the Markov chain, but rather along a time structure given by a general network. In this rather general setting I can prove well-posedness and certain qualitative properties of the solution. This talk is based on joint articles with Stefano Bonaccorsi (Trento), Francesca Cottini (Milano-Bicocca) and Amru Hussein (Kaiserslautern).

Almost periodic elliptic equations: sub- and super-solutions

G. M. N'Guérékata

Morgan State University

email: Gaston.N'Guerekata@morgan.edu

We use the method of sub- and super-solutions to show that if an almost periodic second-order semilinear elliptic equation possesses an ordered pair of sub- and super-solutions, then very many equations in the envelop have either almost automorphic solutions, or Besicovitch almost periodic solutions. We provide an application to almost periodically forced pendulum equations.

Gradient estimates for perturbed Ornstein-Uhlenbeck semigroups in infinite dimensional convex sets

D. Pallara

Università del Salento

email: diego.pallara@unisalento.it

Let X be a separable Hilbert space endowed with a non-degenerate centred Gaussian measure γ and let λ_1 be the maximum eigenvalue of the covariance operator associated with γ . The associated Cameron–Martin space is denoted by H . For a sufficiently regular convex function $U : X \rightarrow \mathbb{R}$ and a convex set $\Omega \subseteq X$, we set $\nu := e^{-U}\gamma$ and we consider the semigroup $(T_\Omega(t))_{t \geq 0}$ generated by the self-adjoint operator defined via the quadratic form

$$(\varphi, \psi) \mapsto \int_{\Omega} \langle D_H \varphi, D_H \psi \rangle_H d\nu,$$

where φ, ψ belong to $D^{1,2}(\Omega, \nu)$, the Sobolev space defined as the domain of the closure in $L^2(\Omega, \nu)$ of D_H , the gradient operator along the directions of H .

A suitable approximation procedure allows us to prove some pointwise gradient estimates for $(T_\Omega(t))_{t \geq 0}$. In particular, we show that

$$|D_H T_\Omega(t) f|_H^p \leq e^{-p\lambda_1^{-1}t} (T_\Omega(t) |D_H f|_H^p), \quad t > 0, \nu\text{-a.e. in } \Omega,$$

for any $p \in [1, \infty)$ and $f \in D^{1,p}(\Omega, \nu)$. We deduce some relevant consequences of the previous estimate, such as the logarithmic Sobolev inequality and the Poincaré inequality in Ω for the measure ν and some improving summability properties for $(T_\Omega(t))_{t \geq 0}$. In addition we prove that if f belongs to $L^p(\Omega, \nu)$ for some $p \in (1, \infty)$, then

$$|D_H T_\Omega(t) f|_H^p \leq K_p t^{-\frac{p}{2}} T_\Omega(t) |f|^p, \quad t > 0, \nu\text{-a.e. in } \Omega,$$

where K_p is a positive constant depending only on p . Finally we investigate on the asymptotic behaviour of the semigroup $(T_\Omega(t))_{t \geq 0}$ as t goes to infinity.

L. Angiuli, S. Ferrari, D. Pallara: Gradient estimates for perturbed Ornstein-Uhlenbeck semigroups on infinite dimensional convex domains, *J. Evol. Equ.* 19 (2019), 677-715.

An L^1 -walk in reaction-diffusion systems

M. Pierre

École Normale Supérieure de Rennes

email: michel.pierre@ens-rennes.fr

In reaction-diffusion systems preserving positivity and dissipating the total mass, the L^1 -norm of the solution is a priori uniformly bounded for all time. This is however not sufficient to provide global existence of solutions and finite time blow up may occur. It is known that, if the nonlinear reactive-terms are bounded in space-time L^1 , then global existence of weak solutions holds. This is the case for a large subclass of these systems. But it does not for instance include the important systems arising in the evolution of concentrations in a reversible chemical reaction. This is an open problem. However, it can be proved that weak " L^1 -solutions" do exist for the corresponding stationary systems. We will explain why and describe all these L^1 -types of results.

Optimal Hardy inequalities for Schrödinger operators on graphs

Y. Pinchover

Technion - Israel Institute of Technology

email: pincho@technion.ac.il

For a given subcritical discrete Schrödinger operator H on a weighted infinite graph X , we construct a Hardy-weight w which is optimal in the following sense. The operator $H - \lambda w$ is subcritical in X for all $\lambda < 1$, null-critical in X for $\lambda = 1$, and supercritical near any neighborhood of infinity in X for any $\lambda > 1$. Our results rely on a criticality theory for Schrödinger operators on general weighted graphs.

This is a joint work with Matthias Keller and Felix Pogorzelski.

The Kolmogorov equation related to a stochastic process introduced by Geman and Yor

S. Polidoro

Università degli Studi di Modena e Reggio Emilia

email: sergio.polidoro@unimore.it

In several articles Yor, and later Matsumoto and Yor, and then Geman and Yor, focused on the problem of finding an explicit expression of the density of a quite simple stochastic process, which appears in Finance. They obtained some very interesting results in the framework of the Stochastic Theory. I present some related results obtained, in the framework of the Partial Differential Equations, in a research in collaboration with Anceschi, Cibelli, Muzzioli, Pagliarani and Rossi, under different assumptions on the regularity of the coefficients of the PDE.

A sharp regularity result for infinite dimensional Kolmogorov equations

E. Priola

Università di Pavia

email: enrico.priola@unipv.it

We consider an infinite dimensional Ornstein-Uhlenbeck generator L associated to the stochastic evolution equation

$$dX_t = AX_t dt + dW_t, \quad X_0 = x \in H,$$

where $A : \text{dom}(A) \subset H \rightarrow H$ is a negative definite self-adjoint operator on a separable Hilbert space H having A^{-1} of trace class and W is a cylindrical Wiener process on H .

We establish new optimal regularity results for the Kolmogorov equation $\lambda u - Lu = f$ on H , where $\lambda > 0$, $f : H \rightarrow \mathbb{R}$ is Borel and bounded. In particular we show that the first derivative $Du : H \rightarrow H$ verifies $Du(x) \in \text{dom}((-A)^{1/2})$, for any $x \in H$, and moreover

$$\sup_{x \in H} |(-A)^{1/2} Du(x)|_H = \|(-A)^{1/2} Du\|_0 \leq C \|f\|_0.$$

These results allow also to prove weak uniqueness for some critical SPDEs like

$$dX_t = AX_t dt + (-A)^{1/2} F(X_t) dt + dW_t, \quad X_0 = x \in H.$$

The Baras-Goldstein result and its several extensions

A. Rhandi

Università degli Studi di Salerno

email: arhandi@unisa.it

In this talk we recall the famous Baras-Goldstein result concerning the existence and nonexistence of positive solutions to Schrödinger equations with singular potentials. We present the Cabré-Martel approach and give several extensions based on weighted Hardy's inequalities with optimal constants.

Ideas and highlights on the research with Jerry and Gisèle Goldstein

S. Romanelli

Università degli Studi di Bari Aldo Moro

email: silvia.romanelli@uniba.it

The talk is based on some ideas developed with Jerry and Gisele Goldstein during many years of collaboration in the framework of both Wentzell boundary conditions and (C_0) semigroups arising in Mathematical Finance.

A uniqueness result for infinite semipositone p -Laplacian problems in a ball

R. Shivaji

University of North Carolina at Greensboro

email: r_shivaj@uncg.edu

We prove the uniqueness of positive radial solutions to a class of singular p -Laplacian equations in a ball with Dirichlet boundary condition when a parameter is large. The reaction term exhibits infinite semipositone structure at zero and is not necessarily increasing or concave on $(0, \infty)$.

Joint work with K.D. Chu and D.D.Hai.

On two geophysical problems with vanishing parameter limit

E.S. Titi

University of Cambridge, Texas A&M University, Weizmann Institute of Science

email: est42@damp.cam.ac.uk

In this talk we will provide rigorous justification for the derivation of the Primitive Equations of planetary scale oceanic dynamics from the 3D incompressible Navier-Stokes equations, for small values of the aspect ratio of the depth to horizontal width. Furthermore, we will also consider the singular limit behavior of a tropical atmospheric model with moisture, as the moisture phase transition convective adjustment relaxation time parameter tends to zero. Rate of convergence will also be provided.

Recent results about anisotropic operators

V. Vespri

Università degli Studi di Firenze

email: vincenzo.vespri@unifi.it

In this talk I will speak about recent results about rough regularity for solutions to anisotropic operators obtained with Ciani, Duzgun, Liao, Marcellini, Mosconi and Skrypnik. The knowledge about this argument is very fragmented and it is not clear not only what is the correct approach but also what are the results to prove. We will give a survey of the known results and we will speak of the open problems.

**Modelling the Aqueous Transport of an Infectious Pathogen in Regional Communities:
Application to the 2010 Cholera Outbreak in Haiti**

G. Webb

Vanderbilt University

email: glenn.f.webb@vanderbilt.edu

A mathematical model is developed to describe the dynamics of the spread of a waterborne disease among communities located along a flowing waterway. The model is formulated as a system of reaction-diffusion-advection partial differential equations in this spatial setting. The compartments of the model consist of susceptible, infected, and recovered individuals in the communities along the waterway, together with a term representing the pathogen load in each community and a term representing the spatial concentration of pathogens flowing along the waterway. The model is applied to the cholera outbreak in Haiti in 2010.

Participants

Angela Albanese, *angela.albanese@unisalento.it*
Luciana Angiuli, *luciana.angiuli@unisalento.it*
Wolfgang Arendt, *wolfgang.arendt@uni-ulm.de*
Rossella Bartolo, *rossella.bartolo@poliba.it*
Irene Benedetti, *irene.benedetti@unipg.it*
Davide Bignamini, *davideaugusto.bignamini@unimore.it*
Adam Bobrowski, *bobrowscy@gmail.com*
Sallah Eddine Boutiah, *boutiah@univ-setif.dz*
Andrei Breazna, *Andrei.breazna@regeneron.com*
Aurora Breazna, *Aurora.breazna@regeneron.com*
Alessandro Camasta, *a.camasta2@studenti.uniba.it*
Anna Canale, *acanale@unisa.it*
Anna Maria Candela, *annamaria.candela@uniba.it*
Biagio Cassano, *biagio.cassano@unicampania.it*
Mirella Cappelletti Montano, *mirella.cappellettimontano@uniba.it*
Tiziana Cardinali, *tiziana.cardinali@unipg.it*
Silvia Cingolani, *silvia.cingolani@uniba.it*
Giuseppe M. Coclite, *giuseppemaria.coclite@poliba.it*
Elena Cordero, *elena.cordero@unito.it*
Simone Creo, *simone.creo@uniroma1.it*
Marcello D'Abbicco, *marcello.dabbicco@uniba.it*
Lorenzo D'Ambrosio, *lorenzo.dambrosio@uniba.it*
Ciro D'Apice, *cdapice@unisa.it*
Roberto Denk, *robert.denk@uni-konstanz.de*
Giuseppe Devillanova, *giuseppe.devillanova@poliba.it*
Nicola De Nitti, *nicola.de.nitti@fau.de*
Giovanni Dore, *giovanni.dore@unibo.it*
Tiziana Durante, *tdurante@unisa.it*
Hassan A. Emamirad, *Hassan.Emamirad@math.univ-poitiers.fr*
Simone Ferrari, *simone.ferrari@unisalento.it*
Genni Fragnelli, *genni.fragnelli@uniba.it*
Simona Fornaro, *simona.fornaro@unipv.it*
Marco Gallo, *marco.gallo@uniba.it*
Fritz Gesztesy, *Fritz.Gesztesy@baylor.edu*
Gisèle Ruiz Goldstein, *ggoldste@memphis.edu*
Jerome A. Goldstein, *jgoldste@memphis.edu*
Maurice Goldstein, *mrgldstt@memphis.edu*
Federica Gregorio, *fgregorio@unisa.it*
Roberto Guglielmi, *rguglielmi@uwaterloo.ca*
Matthias Hieber, *hieber@mathematik.tu-darmstadt.de*
Alessia Kogoj, *alessia.kogoj@uniurb.it*
Ismail Kömbe, *ikombe40@gmail.com*
Lorenzo Lamberti, *llamberti@unisa.it*
Angelo L'Abbate, *angelo.labbate@rse-web.it*
Nicola L'Abbate, *nicola.labbate@unifg.it*
Maria Rosaria Lancia, *mariarosaria.lancia@uniroma1.it*
Annunziata Loiudice, *annunziata.loiudice@uniba.it*
Luca Lorenzi, *luca.lorenzi@unipr.it*
Raffaele Losindaco, *r.losindaco@studenti.uniba.it*
Sandra Lucente, *sandra.lucente@uniba.it*
Alessandra Lunardi, *alessandra.lunardi@unipr.it*
Maria Manfredini, *maria.manfredini@unimore.it*
Rosanna Manzo, *rmanzo@unisa.it*

Antonio Masiello, *antonio.masiello@poliba.it*
Claudio Mele, *claudio.mele1@unisalento.it*
Federica Mennuni, *federica.mennuni@uniba.it*
Giorgio Metafune, *giorgio.metafune@unisalento.it*
Alain Miranville, *Alain.Miranville@math.univ-poitiers.fr*
Mustapha Mokhtar-Karroubi, *mustapha.mokhtar-kharroubi@univ-fcomte.fr*
Gianluca Mola, *gianluca.mola@gmail.com*
Jeff Morgan, *jfmorgan@central.uh.edu*
Dimitri Mugnai, *dimitri.mugnai@unitus.it*
Delio Mugnolo, *delio.mugnolo@fernuni-hagen.de*
Luigi Negro, *luigi.negro@unisalento.it*
Gaston M. N'Guérékata, *Gaston.N'Guerekata@morgan.edu*
Dian Palagachev, *dian.palagachev@poliba.it*
Diego Pallara, *diego.pallara@unisalento.it*
Michel Pierre, *michel.pierre@ens-rennes.fr*
Yehuda Pinchover, *pincho@technion.ac.il*
Sergio Polidoro, *sergio.polidoro@unimore.it*
Marianna Porfido, *mporfido@unisa.it*
Andrea Posilicano, *posilicano@uninsubria.it*
Enrico Priola, *enrico.priola@unipv.it*
Abdelaziz Rhandi, *arhandi@unisa.it*
Silvia Romanelli, *silvia.romanelli@uniba.it*
Addolorata Salvatore, *addolorata.salvatore@uniba.it*
Jacopo Schino, *jschino@impan.pl*
Ratnasingham Shivaji, *r_shivaj@uncg.edu*
Chiara Spina, *chiara.spina@unisalento.it*
Caterina Sportelli, *caterina.sportelli@uniba.it*
Christian Tacelli, *ctacelli@unisa.it*
Edriss S. Titi, *est42@damtp.cam.ac.uk*
Cristina Urbani, *urbani@mat.uniroma2.it*
Giusi Vaira, *giusi.vaira@uniba.it*
Vincenzo Vespri, *vincenzo.vespri@unifi.it*
Paola Vernole, *paolavernole@tiscali.it*
Maria Agostina Vivaldi, *maria.vivaldi@sba.uniroma1.it*
Glenn Webb, *glenn.f.webb@vanderbilt.edu*