

第6届北京师范大学偏微分方程

研讨会及高级课程

The 6th BNU-PDE Workshop and Minicourses



组织者/Organizers: 保继光, 李岩岩, 李海刚, 熊金钢

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2017年6月28日 至 2017年7月7日

日程/Schedule

地点/Room:

June 28 Morning: Main Building 1124, June 28 Afternoon: Main Building 1220
 June 29 – July 7: Main Building 1124. Main Building=后主楼

Workshop:

June 28, 2017	June 29, 2017
Morning section	
10:00 – 11:00 Caffarelli, Luis (Public Lecture)	9:00 – 10:00 Caffarelli, Luis
	10:10 – 10:40 Dong, Hongjie
	10:45 – 11:15 Li, Haigang
	11:25 – 11:55 Yu, Hui
	12:00 – 12:30 Li, Li
Afternoon section	
14:00 – 14:30 Sire, Yannick	
14:35 – 15:05 Nguyen, Luc	
15:15 – 15:45 Kriventsov, Dennis	
15:50 – 16:20 Jin, Tianling	

Minicourses:

Date\Time	8:00 – 9:50	10:00 – 11:50	14:00 – 15:50
July 1	Sire, Yannick	Nguyen, Luc	
July 3	Sire, Yannick	Nguyen, Luc	
July 4	Nguyen, Luc	Kriventsov, Dennis	Yu, Hui
July 5	Gui, Changfeng	Zhu, Meijun	Dong, Hongjie
July 6	Sire, Yannick (9:00 – 11:00)		
July 7	Sire, Yannick (9:00 – 11:00)		

报告信息/Talks & Lectures Information

CAFFARELLI, LUIS

TITLE (PUBLIC): Free boundary problems: an overview

ABSTRACT: Free boundary phenomena take place when a variable under consideration: heat propagation, an optimization process, the behavior of a membrane changes discontinuously. We will give some examples and the type of mathematics involved in its study.

TITLE: A two membrane type problem

ABSTRACT: The two membrane problem was introduced by Vergara-Caffarelli and Chipot and can be described as a linearization of "pushing two balloons against each other". In recent work with De Silva and Savin we develop a theory for general interactions, for instance for quantities involving fractional operators of different orders.

DONG, HONGJIE

TITLE (TALK): Boundary estimates for elliptic equations with Dini mean oscillation coefficients

ABSTRACT: We show that weak solutions to elliptic equations in divergence form with zero Dirichlet boundary conditions are continuously differentiable up to the boundary when the leading coefficients have Dini mean oscillation and the lower order coefficients verify certain conditions. Similar results are obtained for non-divergence form equations. We also obtain a weak type-(1,1) estimates up to the boundary and derive a Harnack inequality for non-negative adjoint solutions to non-divergence form elliptic equations, when the leading coefficients have Dini mean oscillation. This is a joint work with Seick Kim and Luis Escauriaza

TITLE: Weighted estimates for elliptic and parabolic equations

ABSTRACT: In this lecture, I will present some recent results about weighted mixed-norm L_p estimates for elliptic and parabolic equations. In the first part of the lecture, I will review the Hardy-Littlewood maximum function theorem and the Fefferman-Stein sharp function theorem with A_p weights in the space of homogeneous type, and their applications to elliptic and parabolic equations with rough coefficients in nonsmooth domains. This is a joint work with Doyoon Kim. In the second part of the lecture, I will discuss a result jointly with Chiara Gallarati about higher-order elliptic and parabolic equations with VMO coefficients and general boundary conditions, which satisfy the Lopatinskii-Shapiro condition. Such condition is also known as the complementing condition in the famous work by Agmon-Douglis-Nirenberg.

GUI, CHANGFENG

TITLE: The Sphere Covering Inequality and its application to a Moser-Trudinger type

inequality and mean field equations

ABSTRACT: In this lecture, I will introduce a new geometric inequality: the Sphere Covering Inequality. The inequality states that the total area of two distinct surfaces with Gaussian curvature less than 1, which are also conformal to the Euclidean unit disk with the same conformal factor on the boundary, must be at least 4π . In other words, the areas of these surfaces must cover the whole unit sphere after a proper rearrangement. We apply the Sphere Covering Inequality to show the best constant of a Moser-Trudinger type inequality conjectured by A. Chang and P. Yang. Other applications of this inequality include the classification of certain Onsager vortices on the sphere, the radial symmetry of solutions to Gaussian curvature equation on the plane, classification of solutions for mean field equations on flat tori and the standard sphere, etc. The resolution of several open problems in these areas will be presented.

JIN, TIANLING

TITLE: On the best constants and minimizers for the fractional Sobolev inequality in domains

ABSTRACT: We consider a version of the fractional Sobolev inequality in domains and study whether the best constant in this inequality is attained. For the half-space and a large class of bounded domains we show that a minimizer exists, which is in contrast to the classical Sobolev inequalities in domains. This is joint work with Rupert L. Frank and Jingang Xiong.

KRIVENTSOV, DENNIS

TITLE (TALK): Free Boundary Problems From Spectral Optimization

ABSTRACT: I will describe how minimizing functions of the Dirichlet eigenvalues of a domain, subject to volume constraint or penalization, gives rise to free boundary problems of Bernoulli type. These free boundary problems pose some new challenges: they are vector-valued, feature functions which may change sign, and in some cases may be expected to have new types of singular points. I will also describe some recent results, with Fanghua Lin, about this regularity of such free boundaries.

TITLE: Regularity for Spectral Optimizers

ABSTRACT: We will discuss the problem of minimizing a function of the Dirichlet eigenvalues of a domain, subject to a volume constraint or penalization. I will touch on some of the history and motivation for such problems, and then focus on the question of regularity of the boundary of minimal sets. To obtain regularity of the boundary, it will be necessary to approximate the problem by a "more regular" one. Counterintuitively, this is not just to avoid technical issues, but is needed even to figure out what the Euler-Lagrange equation for the problem is. This is based on joint work with Fanghua Lin.

LI, HAIGANG

TITLE: Optimal estimates for elliptic equations and systems from composite material

ABSTRACT: We study a class of second-order elliptic equations and systems of divergence form, with discontinuous coefficients and data, which models the conductivity problem and linear elasticity problem in composite materials. For the vector-valued case, we establish pointwise upper bounds on the blow-up rate of the gradients of solutions of the Lam\{'e} system with partially infinite coefficients in all dimensions as the distance between the surfaces of discontinuity of the coefficients of the system tends to zero. For the scalar-valued case, we establish optimal gradient estimates by showing the explicit dependence of the elliptic coefficients and the distance between interfacial boundaries of inclusions. The novelty of these estimates is that they unify the known results in the literature and answer open problem (b) proposed by Li-Vogelius (2000) for the isotropic conductivity problem. We also obtain more interesting higher-order derivative estimates, which answers open problem (c) of Li-Vogelius (2000). This talk is based on joint work with J.G. Bao, Y.Y. Li and H.J. Dong.

LI, LI

TITLE: Homogeneous solutions of stationary Navier-Stokes equations with isolated singularities

ABSTRACT: In this talk, I will present a classification result on all (-1)-homogeneous axisymmetric no swirl solutions of incompressible stationary Navier-Stokes equations which are smooth on the unit sphere minus south and/or north poles. Sverak showed that all (-1)-homogeneous solutions which are smooth on the unit sphere are Landau solutions. If we allow solutions to have singularities at south and/or north poles, all such solutions can be parameterized as a four/two dimensional surface with boundary in appropriate function spaces. We proved using implicit function theorem that there are axisymmetric solutions with nonzero swirl, emanating from every point of the interior and one part of the boundary of the solution surface. If time allows, I will also present some local expansion results near the singular points. This is a joint work with YanYan Li and Xukai Yan.

NGUYEN, LUC

TITLE (TALK): Recent progresses on nonlinear Yamabe problems in conformal geometry

ABSTRACT: The Yamabe problem asks to find on a given conformal class of metrics a metric of constant scalar curvature. I will discuss nonlinear analogues where the scalar curvature, which is the trace of the Ricci curvature tensor, is replaced by other functions of the eigenvalues of the Ricci curvature tensor. Joint work with Yanyan Li.

TITLE: Bocher-type theorems for fully nonlinear, degenerate elliptic and conformally invariant equations

ABSTRACT: A well-known theorem of Bocher asserts that a positive harmonic function in a punctured ball can be expressed as a sum of a multiple of the fundamental solution

and a regular harmonic function on the ball. We will present a generalization for fully nonlinear, degenerate elliptic and conformally invariant equations.

SIRE, YANNICK

TITLE (TALK): Singular perturbation limits of fractional Allen-Cahn

ABSTRACT: I will report on recent work with V. Millot and K. Wang on the singular limit for a fractional Allen-Chan equation leading to stationary nonlocal minimal surfaces. I will introduce these latter concepts and will prove the convergence result, based on a deep Geometric Measure Theory argument from Marstrand.

TITLE: Some problems involving nonlocal diffusion

ABSTRACT: I will describe several problems involving nonlocal operators ranging from symmetry of solutions to semi linear elliptic equations, conformal geometry and regularity theory. I will emphasize on qualitative aspects. The course will be accessible to students and researchers.

YU, HUI

TITLE (TALK): On a special class of nonlocal elliptic operators

ABSTRACT: In this talk we introduce a nonlocal version of the Hessian matrix and a special class of fully nonlinear nonlocal elliptic operators associated with such a matrix. We give three results concerning the regularity of this class of elliptic operators that remain open for more general nonlocal elliptic operators.

TITLE: Motion of a set driven by the mean curvature and capacity potential

ABSTRACT: We study the motion of the boundary of a set, where the velocity depends on the mean curvature and the normal derivative of the capacity potential of the set. We show that starting from smooth initial data one has a smooth flow for short time. To study the flow after singularities, we also propose two possible notions of weak solutions motivated by the comparison property and gradient flow structure of the smooth flow.

ZHU, MEIJUN

TITLE: On the extension of sharp Hardy-Littlewood-Sobolev inequality

ABSTRACT: In my first part, I shall introduce our recent work on the extension of sharp HLS on the whole space or on the upper half space. Focus will be on our recent publication (with Dou and Guo) in Adv. Math.

In my second part, I shall describe the sharp HLS type inequalities on bounded domains and corresponding extremal value problems. Extension operators based on Riesz and Poisson kernels will be discussed (joint work with M. Gluck); Sharp HLS inequalities on bounded domains and corresponding integral equations on bounded domains will be addressed (joint with Dou and Guo).

参会人员表/ Participants

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