**Submittee:** Young-Heon Kim
**Date Submitted:** 2010-12-09 11:46
**Title:** PRIMA-PARC-PIMS meeting on PDEs
**Event Type:** Conference-Workshop

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**Location:**
University of British Columbia

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**Dates:**
* Start Date: 12/07/2010 * End Date: 12/08/2010

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**Topic:**
Partial Differential Equations and related fields

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**Methodology:**
2 Expository Talks and 7 research talks.

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**Objectives Achieved:**
The purpose of this workshop is to promote communications between PDE research groups affiliated with PARC (PDE and Functional Analysis Research Center) in Korea and with PIMS/Canada. Four leading experts and two graduate students from Korea have visited, and there have been a lot of interactions of these people with local researchers. This workshop was held as a satellite meeting of CMS winter meeting (Dec. 4 -- 6), where researchers Canada (and U.S also) have participated in the special session on nonlinear PDE's. Junior researchers such as postdocs, graduate students (even an undergraduate student) have participated in either or both meetings. These activities helped making stronger connections/collaborations between researchers in Korea and Canada, for research in PDE's and education of young people. We will have a follow-up meeting in Korea in the summer of 2011.

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**Scientific Highlights:**
Topics in quantum mechanical dynamics such as (nonlinear) Schroedinger equations are discussed. Alessio Figalli explained in detail his recent result of an extension of Ambrosio-DiPerna-Lions' theory applicable to semi-classical limit of quantum mechanical dynamics. Tai-Peng Tsai explained his recent result on analysis of nonlinear Schroedinger equations near the first excited states. Stepehn Gustafson explained dynamics of geometric nonlinear Schroedinger maps . For elliptic/parabolic equations, regularity results have been discussed by Sun-Sig Byun and Seick Kim. They considered regularity of solutions when the PDE's or systems of PDE's have very rough coefficients and/or when the domains are not smooth. Ki-Ahm Lee have explained extensions of the results of Caffarelli et al, on nonlocal equations to the case when the nonlocal interaction is not symmetric. Lami Kim described her result on scalar curvature flow, which extends previous results of Ben Andrews, and others. Finally, Yong-Jung Kim explained an elegant comparison principle applicable to nonlinear evolution equations such as conservations laws and nonlinear diffusion.

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**Organizers:**
Nassif Ghoussoub, mathematics, (University of British Columbia) Tai-Peng Tsai, mathematics, (University of British Columbia) Stephen Gustafson, mathematics, (University of British Columbia) Young-Heon Kim, mathematics, (University of British Columbia)

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**Speakers:**
Speaker: Sun Sig Byun (Mathematics, Seoul National University, Korea) Title: Gradient estimates for nonlinear parabolic systems of p-Laplacian type Abstract: We discuss nonlinear gradient estimates for parabolic systems of p-Laplacian type with measurable coefficients in irregular domains. ///// Speaker: Alessio Figalli (Mathematics, University of Texas - Austin, US) Note: He will give two expository lectures Title: DiPerna-Lions theory for ordinary differential equations and applications to semiclassical limits ABSTRACT: At the beginning of the 90's, DiPerna and Lions developed a well-posedness theory for ordinary differential equations with Sobolev vector fields, which (roughly speaking) states the following: if $b(t)$ is a time-dependent Sobolev vector field then, for a.e. $x_0$, there exists a unique solution to the ODE $\dot x=b(t,x)$ starting from $x_0$ (this is a kind of a.e. version of the classical Cauchy-Lipschitz result). In 2004, Ambrosio extended this result to BV vector fields. The aim of these lectures is to review these result, and to show recent applications to semiclassical limits for the Schrodinger equation. ///// Speaker: Stephen Gustafson (Mathematics, UBC) Title: Singularities and asymptotics for some geometric nonlinear Schroedinger equations Abstract: I will describe some recent results on singularity (non-)formation and stability, in the energy-critical 2D setting, for some nonlinear Schroedinger-type systems of geometric origin -- the Schroedinger map and Landau-Lifshitz equation -- which model dynamics in ferromagnets and liquid crystals. ///// Speaker: Ki-Ahm Lee (Mathematics, Seoul National University, Korea) Title: Regularity theory for Nonlinear Nonlocal equations with non-symmetric kernels Abstract: Nonlocal equations comes from the in?nitesimal generator of given purely jump processes and nonlinear nonlocal equations can be derived from stochastic control theory or game theory based on the jump process. Luis A. Ca?arelli and Luis Silvestre showed various regularities when the kernel is symmetric. In this talk, we will discuss the main difficulties cased by the fact that kernel is non-symmetric. And Several different versions of A-B-P estimates will be discussed to overcome the difficulties in various range of the parameter $\sigma$ related to weight of kernels. ///// Speaker: Seick Kim (Mathematics, Yonsei University, Korea) Title: Elliptic systems with measurable coefficients of the type of Lam\'e system in three dimensions Abstract: We study the $3 \times 3$ elliptic systems $\nabla (a(x) \nabla\times u)-\nabla (b(x) \nabla \cdot u)=f$, where the coefficients $a(x)$ and $b(x)$ are positive scalar functions that are measurable and bounded away from zero and infinity. We prove that weak solutions of the above system are H\"older continuous under some minimal conditions on the inhomogeneous term $f$. We also present some applications and discuss several related topics including estimates of the Green's functions and the heat kernels of the above systems. ///// Speaker: Lami Kim (Mathematics, Seoul National University, Korea) Title: Evolution of hypersurfaces under the scalar curvature flow Abstract: We study the evolution of the hypersurfaces whose deforming rate in the normal direction at each point is proportional to the Scalar curvature. We will present the C^{1,1}-regularity and the convexity of convex hypersurface deforming under the Scalar curvature flows before the collapsing and we also discuss the preservation of ellipticity of 3 dimensional non-convex hypersurface in R^4 which is evolved under the same flow. ///// Speaker: Yong-Jung Kim (Mathematics, KAIST, Korea) Title :Generalization of Oleinik and Aronson-Benilan type one-sided inequalities Abstract: The one-sided Oleinik inequality provides the uniqueness and a sharp regularity of solutions to a scalar conservation law if its flux is convex. The Aronson-Benilan type inequalities are also one-sided and play a similar role for solutions to the porous medium or $p$-Laplacian type equations. In this talk we will discuss that these inequalities reflect the common feature of nonnegative solutions to a wide class of evolutionary equations in the form of $$ u_t=\sigma(t,u,u_x,u_{xx}),\quad u(x,0)=u^0(x)\ge0,\quad t>0,\,x\in\bfR, $$ where $u^0(x)\ge0$ is

bounded and ${\partial\over\partial q} \sigma(t,u,p,q)\ge0$. In this talk we will see that the zero level set $A(t,x_0,m):=\{x:\rhom(x-x_0,t)-u(x,t)\ge0\}$ is connected for all $t,m>0$ and $x_0\in\bfR$, where $\rhom$ is the fundamental solution of mass $m>0$. It will be discussed that this geometric structure gives a generalization of previously mentioned one-sided inequalities. ///// Speaker: Tai-Peng Tsai (Mathematics, UBC) Title: Small solutions of nonlinear Schr\"odinger equations near first excited states Abstract: Consider a nonlinear Schr\"odinger equation in $\R^3$ whose linear part has three or more eigenvalues satisfying some resonance conditions. Solutions which are initially small in $H^1 \cap L^1(\R^3)$ and inside a neighborhood of the first excited state family are shown to converge to either a first excited state or a ground state at time infinity. An essential part of our analysis is on the linear and nonlinear estimates near nonlinear excited states, around which the linearized operators have eigenvalues with nonzero real parts and their corresponding eigenfunctions are not uniformly localized in space. This is a joint work with Kenji Nakanishi and Tuoc Van Phan.

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**Links:**

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