

2013 International Workshop on Differential Equations and Its Application

Proceedings

National Cheng Kung University  
National Center for Theoretic Science (South)

July 26 ~ 28, 2013

2013 年國際微分方程及應用研討會

論文集

國立成功大學  
國家理論科學研究中心(南區)

2013 年 7 月 26 ~ 28 日

**DEIA 2013**

**International Workshop on  
Differential Equations and its  
Applications**

**2F, NCTS (South)**

**National Cheng Kung University**

**July 26-28 | Tainan, Taiwan**



**FOREIGN SPEAKERS**

- Manoussos G. Grillakis University of Maryland
- Gen Nakamura INHA University and Hokkaido University
- Kenji Nakanishi Kyoto University
- Takayoshi Ogawa Tohoku University
- Tai-Peng Tsai University of British Columbia
- Yoshio Tsutsumi Kyoto University
- Horng-Tzer Yau Harvard University

**DOMESTIC SPEAKERS**

- Chi-Hin Chan National Chiao Tung University
- Kuo-Chang Chen National Tsing Hua University
- Jin-Cheng Jiang National Tsing Hua University
- Hung-Wen Kuo Academia Sinica
- Ying-Chieh Lin National Central University
- Hsi-Wei Shih University of Minnesota

The purpose of this workshop is to provide a platform for exchanging ideas, experiences, and current results, as well as on-going problems among researchers in the field of differential equations, dynamical systems, and their applications. Based on consideration of the geographical environment and according to a number of collaborations with the Japanese, Canadian, and American researchers in past years, such as Professor Yoshio Tsutsumi from Kyoto University, Professor Gen Nakamura from Hokkaido University, and Professor Horng-Tzer Yau from Harvard University who support the idea of hosting a workshop as an opportunity of communication. We hope this will enhance the original collaboration and create new relationships between the attendees can be expected in the near future.

National Science Council ♦ National Center for Theoretical Sciences (South) ♦ Headquarters of University Advancement, National Cheng Kung University ♦ Department of Mathematics, National Cheng Kung University

## Purpose:

The purpose of this workshop is to provide a platform for exchanging ideas, experiences, and current results, as well as on-going researches among researchers in the field of differential equations and their applications. Based on consideration of the expertise in the fields of scattering problem and inverse problem, we invite some foreign scholar and some domestic scholar to participate the activity. This idea is supported by Professor Horng-Tzer Yau, Professor Yoshio Tsutsumi, and Professor Gen Nakamura.

## Organizing Committee (籌備委員會): 依姓氏英文字母順序

Yung-Fu Fang	方永富 (成功大學數學系副教授)	Ching-Lung Lin	林景隆 (成功大學數學系教授)
Kuo-Ming Lee	李國明 (成功大學數學系教授)	Yu-Chu Lin	林育竹(成功大學數學系助理教授)
Wen-Ching Lien	連文璟 (成功大學數學系副教授)	Yu-Yu Liu	劉育佑(成功大學數學系助理教授)

## Sponsors:

National Science Council 行政院國家科學委員會,  
National Center for Theoretical Science (South) 國家理論科學研究中心(南區),  
National Cheng Kung University 國立成功大學

## Foreign Speakers:

"Manoussos Grillakis" <mggrlk@math.umd.edu>, University of Maryland  
"Gen Nakamura" <nakamuragenn@gmail.com>, INHA University  
"Kenji Nakanishi" <kenjinakanishi@gmail.com>, Kyoto University  
"Tai-Perng Tsai" <ttsai@math.ubc.ca>, University of British-Columbia  
"Yoshio Tsutsumi" <tsutsumi@math.kyoto-u.ac.jp>, Kyoto University  
"Horng-Tzer Yau" <htyau@math.harvard.edu>, Harvard University

## Domestic speakers:

"Jin-Cheng Jiang 江金城" <jcjiang@math.nthu.edu.tw>, National Tsing Hua University  
"Yin-Chieh Lin 林英杰" <liny@mx.math.ncu.edu.tw>, National Central University  
"Hsi-Wei Shih 史習偉" <shihx029@umn.edu>, University of Minnesota  
"Kuo Hung-Wen 郭鴻文" <hwkuo@math.sinica.edu.tw>, Sinica  
"Chi-Hin Chan 陳子軒" <cchan@math.nctu.edu.tw>, National Chiao Tung University  
"Kuo-Chang Chen 陳國璋" <kchen@math.nthu.edu.tw>, National Tsing Hua University

**Program:**

<b>2013 International Workshop on Differential Equations and Its Applications</b>					
2013/07/26~ 2013/07/28 at NCTS (South), Tainan, Taiwan					
Program					
	Friday(07/26)	Saturday(07/27)		Sunday(07/28)	
		Chair: Yoshio Tsutsumi	Chair: Jenn-Nan Wang		
		0900~1000 Horng-Tzer Yau	0900~1000 Gen Nakamura		
		1000~1020 Break	1000~1020 Break		
		Chair: Ching-Lung Lin	Chair: Chun-Kong Law		
		1020~1120 Kuo-Chang Chen	1020~1105 Yin-Chieh Lin		
		Chair: Jen-Hsu Chang	Chair: Kenji Nakanishi		
		1130~1215 Jin-Cheng Jiang	1115~1215 Manoussos Grillakis		
		1215~1230 Group Photo Taking	1215~1230 Group Photo Taking		
1330~1440	Registration	1230~1400 Lunch	1230~1400 Lunch		
	Opening Ceremony:	Chair: Tai-Perng Tsai			
1440~1500		1400~1500 Kenji Nakanishi			
	Chair: Horng-Tzer Yau				
1500~1600	Yoshio Tsutsumi	1500~1600 Break			
1600~1620	Break				
	Chair: Chiun-Chuan Chen	Chair: Wen-Ching Lien			
1620~1720	Tai-Perng Tsai	1600~1645 Hung-Wen Kuo			
	Chair: Sze-Bi Hsu	Chair: Jyh-Hao Lee			
1730~1815	Chi-Hin Chan	1700~1745 Hsi-Wei Shih			
1820~	Buffet	1810~ Banquet			

**Title and Abstract:** -----

Yoshio Tsutsumi 堤譽志雄 <tsutsumi@math.kyoto-u.ac.jp> 日本京都大學數學系教授

Title: Global  $L^2$  solutions for the 1D Zakharov equations with additive noises

Abstract: We consider the global existence of  $L^2$  solutions for the 1D Zakharov equations with additive noises. The 1D Zakharov equations with additive noises are proposed to model the Langmuir turbulence in the ionospheric plasma. We employ the argument by Colliander, Holmer and Tzirakis (2008) to prove the global existence of solutions for the Cauchy problem with Schrodinger part in  $L^2$  and wave part in  $\dot{H}^{-1/2}$ .

-----  
Tai-Perng Tsai <ttsai@math.ubc.ca> (University of British Columbia)

Title: Forward Discretely Self-Similar Solutions of the Navier-Stokes Equations

Abstract: Extending the work of Jia and Sverak on self-similar solutions of the Navier-Stokes equations, we show the existence of large, forward, discretely self-similar (DSS) solutions for DSS initial data  $u_0$  with factor  $\lambda$ , assuming either the DSS factor  $\lambda$  is sufficiently close to 1 according to the Holder norm of  $u_0$ , or if  $u_0$  is axisymmetric with no swirl. I will also discuss their relevance to the uniqueness problem.

-----  
陳子軒 Chi-Hin Chan <cchan@math.nctu.edu.tw>

Title: Real Analytic Stationary Parallel Laminar Navier-Stokes Flows in the Round Sphere or the 2D Hyperbolic Space.

Abstract: In this talk, we will discuss the existence of real-analytic stationary Navier-Stokes flows with isotropic streamlines in all latitudes in some simply-connected flow region on a rotating round sphere. When the sphere is replaced by a 2-dimensional hyperbolic space, we can also discuss the analog existence result for stationary parallel laminar Navier-Stokes flows along a circular-arc boundary portion of some compact obstacle in the 2-D hyperbolic space. In any one of these cases, we show that a parallel laminar flow with a Poiseuille's flow profile ceases to be a stationary Navier-Stokes flow, due to the curvature of the background manifold.

-----  
Horng-Tzer Yau <htyau@math.harvard.edu>

Title: Random Matrix and Partial Differential Equation

Abstract:

-----  
陳國璋 Kuo-Chang Chen <kchen@math.nthu.edu.tw>

Title: The Kepler problem revisited

Abstract: The Newtonian 2-body problem is also called the Kepler problem in honor of Johannes Kepler (1571-1630) for his discovery of three laws of planetary motion, based on which Newton deduced in 1687 the celebrated law of universal gravitation. It is widely considered a well-understood problem, as solving it with

given initial data and proving Kepler's three laws require nothing more than tools from elementary calculus. In this talk I will present a nonclassical approach which gives us more insights into Keplerian orbits.

---

江金城 Jin-Cheng Jiang <jiangjc@math.sinica.edu.tw>

Title: On One Dimensional Quantum Zakharov System

Abstract: In this paper, we discuss the properties of one dimensional quantum Zakharov system which describes the nonlinear interaction between the quantum Langmuir and quantum ion-acoustic waves. Especially, we prove the local well posedness of the Cauchy problem in low regularity spaces. This is a joint work with Chi-Kun Lin and Shuanglin Shao.

---

Kenji Nakanishi 中西賢次 <n-kenji@math.kyoto-u.ac.jp> 日本京都大學數學系教授

Title: Global dynamics for the Zakharov systems

Abstract: This talk is based on joint work with Zihua Guo, Shuxia Wang, Sanghyuk Lee and Chengbo Wang. We investigate global behavior of solutions for the Zakharov system and the Klein-Gordon-Zakharov system in three dimensions. These are coupled systems of wave and Schrodinger or Klein-Gordon equations, describing nonlinear interactions of ion acoustic waves and Langmuir oscillations in plasma. Thanks to frequency localization of resonant interaction, the local well-posedness for these systems has been well investigated in Sobolev spaces. On the other hand, the time-global behavior is much less understood, either in the blow-up case or in the scattering case, for which analysis the mixed linear parts tend to be a serious obstruction. Under the radial symmetry, however, we are able to investigate it in the natural energy space, exploiting the frequency localization of resonance in the normal form, together with the improved Strichartz estimate for radial solutions. Plugging this into the Kenig-Merle approach, we obtain classification of global dynamics below the ground state energy into the scattering region and the blowup region. If time permits, I will also talk about its extensions, beyond the ground state energy, or without the radial symmetry.

---

郭鴻文 Hung-Wen Kuo <hwkuo@math.sinica.edu.tw> (中研院)(台大)

Title: Equilibrating effect of Maxwell-type boundary condition in highly rarefied gas.

Abstract: We study the equilibrating effects of the boundary and intermolecular collision in the kinetic theory for rarefied gases. We consider the Maxwell-type boundary conditions, which have weaker equilibrating effect than the commonly studied diffuse reflection boundary condition. The gas region is the spherical domain in  $\mathbb{R}^d$ ,  $d=1,2$ . First, without the equilibrating effect of the collision, we obtain the algebraic convergence rates to the steady state for free molecular flow with variable boundary temperature. The convergence behavior has intricate dependence on the accommodation coefficient of the Maxwell-type boundary condition. We then construct the steady state solutions of the full Boltzmann equation for large Knudsen numbers and small boundary temperature variation. We establish the nonlinear stability with exponential rate of the stationary Boltzmann solutions. The results hold for the models of Maxwell, hard potential, and hard sphere molecules. Our analysis is based on the explicit formulations of the boundary condition for symmetric domains. -----

史習偉 Hsi-Wei Shih <shihx029@umn.edu>

Title: Global spacetime bounds for the energy-critical nonlinear wave equation in high spatial dimensions

Abstract: I will present my recent result on global spacetime bounds for the energy-critical nonlinear wave equation in all space dimensions  $d$  greater than and equal to 3. This extends work in the case  $d = 3$  of Tao, who proved a certain global Strichartz norm has an explicit double-exponential bound in the energy, Our work uses Tao's argument extensively, but differs in important points too. Besides applying also in high dimensions, we get a sharper bound (though still double-exponential) in the case  $d = 3$ . These explicit bounds are interesting not only for the intrinsic value, but also through their connection with regularity problem for slightly energy-supercritical nonlinear wave equations.

---

Gen Nakamura 中村玄 <gnaka@math.sci.hokudai.ac.jp> 日本北海道大學數學系教授

Title: Linear sampling method for the heat equation

Abstract: The linear sampling method (LSM) is the most well known non-iterative inversion scheme to identify the medium discontinuities such as cracks, cavities and inclusions in a medium. So far the LSM has been developed mostly for static or stationary measurements which use electric current, heat flux and wave. As for the dynamical measurement there are very few studies on the LSM. Some preliminary studies were done for the heat equation by me and my collaborators, and also for the wave equation by others. In this talk we will consider the LSM for the heat equation and present my previous result and some of its further developments.

---

林英杰 Yin-Chieh Lin <liny@mx.math.ncu.edu.tw> National Central University, Postdoc

Title: Classical Solution to 2-Dimensional Generalized Benjamin-Bona-Mahony Equation on Upper Half Plane

Abstract: We consider the initial-boundary value problem for the two-dimensional generalized Benjamin-Bona-Mahony equation on upper half plane. This problem is closely related to the Buckley-Leverett equation for two-phase flow in a porous medium modified by including dependence of the capillary pressure on the rate of change of saturation. In this talk, we will present our strategy for finding the classical solution of the equation.

---

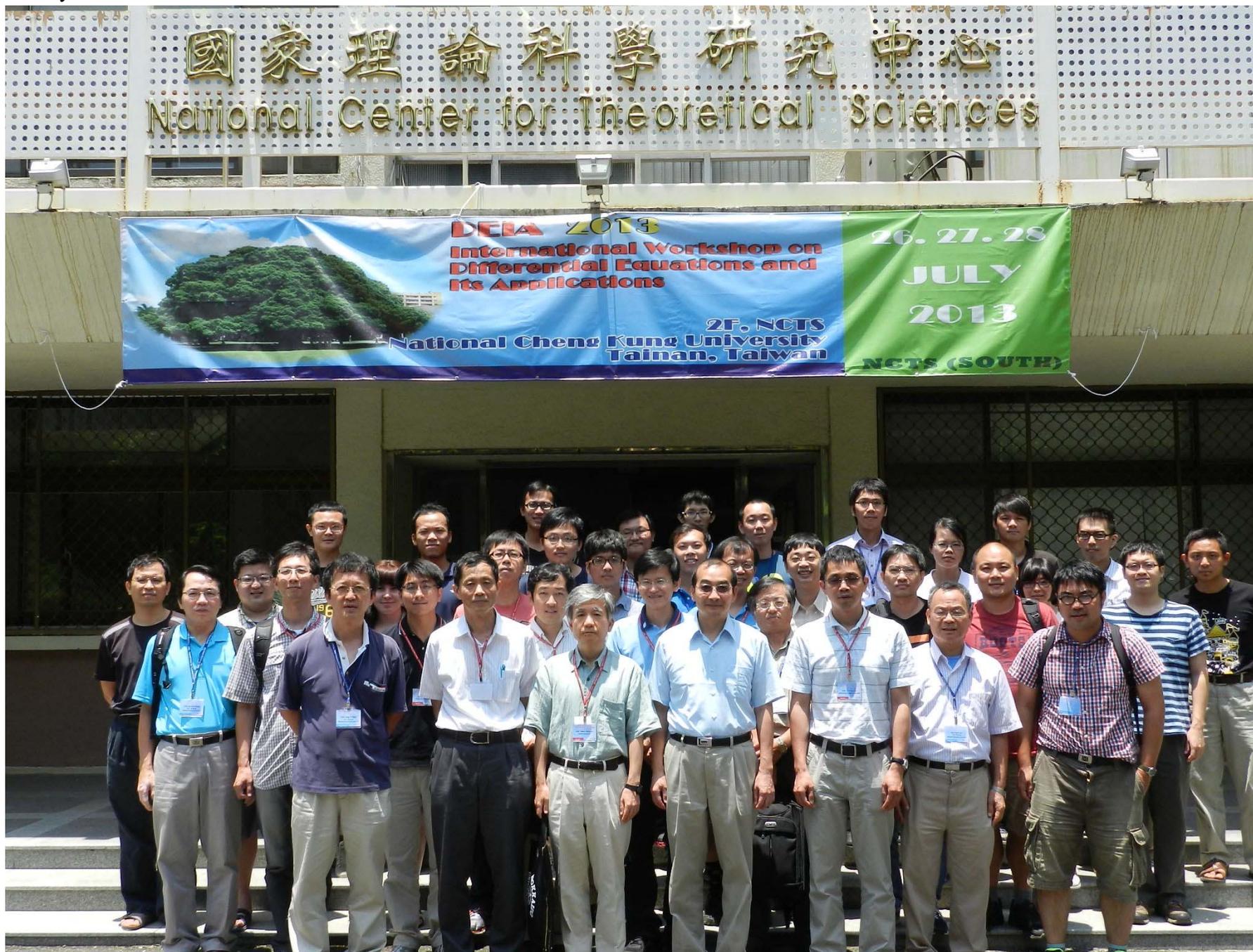
"Manoussos Grillakis" <mggrlk@math.umd.edu>

Title: The role of pair excitations in the evolution of condensates

Abstract: (joint work with M. Machedon and D. Margetis) In the present talk, I would like to consider the evolution of  $N$  identical quantum particles (Bosons), for  $N$  large but finite. I am interested in certain aspects of the evolution namely that of an (approximately) factorized state. The evolution does not preserve this type of state and we consider pair excitations as an effective (second order) correction. We derive a coupled system based on a Lagrangian formulation consistent with the  $N$ -body dynamics and prove that it does indeed approximate the exact dynamics in Fock space for sufficiently long times.

---

Group Photos: July 27 2013



Group Photo: July 28 2013



Banyan Tree on Campus of NCKU



Talk Slides