Titles and Abstracts

1. Claude-Michel Brauner, Xiamen University
   Title: Stability issues in some free-interface problems
   Abstract: In two-dimensional free-interface problems in combustion theory, we have defined different methods to study the stability of the front flame:
   (i) The first one is the elimination of the free interface. Then, the problem is fully nonlinear with boundary conditions of Hadamard type. This method is quite general and applies to a large class of Free Boundary Problems.
   (ii) The second method consists in the derivation of a single scalar equation for the front which may capture most of the dynamics and, as a consequence, yields a reduction of the effective dimensionality of the system. A paradigm is the Kuramoto-Sivashinsky equation which models cellular instabilities and turbulence phenomena.
   In this talk, we are going to briefly discuss both methods which complement each other, since the second one allows to reach asymptotic regimes including transition to chaos.

2. Hongqiu Chen, University of Memphis, USA
   Title: Stability of solitary wave solutions to a coupled system
   Abstract: Consider here is a system
   $$U_t + U_x - U_{xxt} + (\nabla H(U))_x = 0 \quad (0.1)$$
   of nonlinear dispersive equations, where $U = U(x,t)$ is an R^2-valued function, and ∇H is the gradient of a homogeneous polynomial function $H : R^2 \to R$. We present existence and stability criteria for solitary wave solutions. Using the idea by Bona, Chen and Karakashian [1] and exploiting the accurate point spectrum information of the associated Schr¨odinger operator, we improve the stability results previously obtained by Pereira [2]. This is joint with Xiaojun Wang
   References
   [1] J. L. Bona, H. Chen and O. A. Karakashian, Stability of solitarywave solutions of systems of dispersive equations, submitted.
   [2] J.M. Pereira, Stability and instability of solitary waves for a system of coupled BBM equations, *Appl. Anal.* 84(2005), no.8, 807-819.

3. Min Chen, Purdue University, USA
   Title: Solutions of Boussinesq Syetems for Water Waves
   Abstract: In this talk, I will talk about joint work with Jerry Bona and others on comparison of various wave equations, interaction of solitary wave solutions, oblique interactions and other interesting wave simulations.

4. Lili Du, Sichuan University
   Title: Incompressible impinging jet flows and related problems
   Abstract: In this talk, we will discuss the well-posedness theory of the steady incompressible impinging jet plane flow and related problems. We establish the existence and uniqueness of the incompressible impinging jet flow in two dimensions

with two asymptotic directions. On another side, it is showed that there does not exist impinging jet flow with one asymptotic direction generally. Furthermore, we will introduce a well-posedness result on the incompressible impinging jet in rotational flows.

5. Roberto de Almeida Capistrano Filho, University of Cincinnati , USA
Title: Internal controllability results of the Korteweg-de Vries equation*
Abstract: This talk is concerned with the control properties of Korteweg-de Vries (KdV) equation posed on finite interval $(0, L)$ with a distributed control. When the control region is an arbitrary open subdomain $(l1,l2)$, we prove the null controllability of the KdV equation by means of a new Carleman inequality. As a consequence, we obtain a regional controllability result, which roughly tells us that any target function arbitrarily chosen on $(0,l1)$ and null on $(l2,L)$ is reachable. Finally, when the control region is a neighborhood of the right endpoint, an exact controllability result in a weighted L^2-space is also established. Joint work with A. F. Pazoto (UFRJ-Brazil) and L. Rosier (MINES ParisTech - France)

6. Xiaoyu Fu, Sichuan University
Title: Stabilization of wave equations with mixed boundary conditions
Abstract: In this talk, we will study the decay properties of solutions to wave equations in a bounded domain with two types of dissipative mechanisms. When the Geometric Control Condition on the dissipative region is not satisfied, we show that sufficiently smooth solutions to the equations decay logarithmically, under sharp regularity assumptions on the coefficients, the damping and the boundary of the domain involved in the equations. Our decay results rely on an analysis of the size of resolvent operators for wave equations on the imaginary axis.

7. Colette Guillopé, Universit´e Paris-Est, France
Title: Propagation of Long-Crested Water Waves: the Bore Case
Abstract: A model for the propagation of three-dimensional, surface water waves will be discussed. Of especial interest will be long-crested waves such as those sometimes observed in canals and in near-shore zones of large bodies of water. Such waves propagate primarily in one direction, taken to be the x−direction in a Cartesian framework, and variations in the horizontal direction orthogonal to the primary direction, the y−direction, say, are often ignored. However, there are situations where weak variations in the secondary horizontal direction need to be taken into account.
Our results are developed in the context of Boussinesq models, so they are applicable to waves that have small amplitude and long wavelength when compared with the undisturbed depth. Included in the theory are well-posedness results on the long, Boussinesq time scale. As mentioned, particular interest is paid to the lateral dynamics, which turn out to satisfy a reduced Boussinesq system. Waves corresponding to disturbances which are localized in the x−direction as well as bore-like disturbances that have infinite energy are taken up in the discussion. Joint work with Jerry L. Bona, Thierry Colin.

J.B.: Department of Mathematics, Statistics and Computer Science
The University of Illinois at Chicago, 851 S. Morgan St. MC 249 Chicago, IL 60607, USA
T.C.: Universit´e de Bordeaux, Institut de Math´ematiques de Bordeaux UMR CNRS 5251 and INRIA Bordeaux Sud-Ouest, 351 cours de la Lib´eration 33405 Talence, France
C.G.: Laboratoire d'Analyse et de Math´ematiques Appliqu´ees (UMR 8050) UPEC, UPEMLV, CNRS, 94010 Cr´eteil, France

8. Chun-Hsiung Hsia, National Taiwan University, Taiwan
Title: Analysis of the Long Time Stability of Implicit Euler Schemes for the Primitive Equations
Abstract: In this talk, we _rst give a survey on the primitive equations which govern the motion of the ows arising from large-scale ocean and atmosphere. We then consider implicit Euler approximation for three dimensional viscous primitive equations. We shall analyze the long time stability of implicit Euler schemes for the primitive equations.

9. Can Huang, Xiamen University
Title: Spectral Methods for Substantial Fractional Differential Equations
Abstract: In this talk, we are going to show a non-polynomial spectral Petrov-Galerkin method and associated collocation method for substantial fractional differential equations (*FDEs*). We modify a class of generalized Laguerre polynomials to form our basis. By a proper scaling of trial basis and test basis, our Petrov-Galerkin method results in a diagonal and thus well-conditioned linear systems for both fractional advection equation and fractional diffusion equation. In the meantime, we construct substantial fractional differential collocation matrices and provide explicit forms for both type of equations. The proposed method allows us to adjust a parameter in the basis selection according to different given data to maximize convergence rate. Moreover, superconvergence points for associated fractional derivative and function value of the true solution by the Petrov-Galerkin method are presented, respectively. All these findings have been proved rigorously in our convergence analysis and confirmed in our numerical experiments.

10. Chaohua Jia, Beijing University of Aeronautics and Astronautics
Title: Lower regularity solutions of an initial-boundary-value problem of the KdV equation
Abstract: In this talk, I will present some results on the well-posedness in the space Hs$(0,L)$ $(-1 < s < 0)$ of a class of initial-boundary-value problems of the KdV equation posed on the bounded interval $(0,L)$. The sharp trace regularities of the solutions to the associated linear problems are the essential ingredient in the analysis.
This is a joint work with Dr. Ivonne Rivas and Prof. Bing-Yu Zhang.

11. Jonatan Lenells, Baylor University, USA

Title: The nonlinear Schr¨odinger equation with periodic boundary values
Abstract: We consider the nonlinear Schr¨odinger (NLS) equation on the half-line with boundary values that become periodic for sufficiently large t. We prove a theorem which, modulo certain assumptions, characterizes the pairs of periodic functions which can arise as Dirichlet and Neumann values for large t. The theorem provides a constructive way of determining explicit solutions with the given periodic data. The approach leads to a class of new exact solutions of the defocusing NLS equation on the half-line.

12. Jing Li, Southwestern University of Finance and Economics
Title: A nonhomogeneous boundary value problem for the Kuramoto-Sivashinsky equation in a quarter plane
Abstract: We study the initial boundary value problems for Kuramoto-Sivashinsky equations with nonhomogeneous boundary conditions. The results on global well-posedness are obtained for the Kuramoto-Sivashinsky equation in a quarter plane.
This is a joint work with Prof. Bing-Yu Zhang and Prof. Zhixiong Zhang.

13. Shenghao Li, University of Cincinnati, USA
Title: A Non-homogeneous Boundary Value Problem for Sixth Order Boussinesq Equation Posed on the Half Line
Abstract: In this talk, we will discuss an initial and boundary value problem for sixth order Boussinesq equation $u_{tt} - u_{xx} - (u^2)_{xx} + \beta u_{xxxx} - u_{xxxxxx} = 0$ where $\beta = \pm 1$ posed on the right half line with nonhomogeneous boundary value conditions. It is shown that the problem is locally well-posed with initial data in non-homogeneous Sobolev spaces $H^s(\mathbb{R}^+)$ for $s \geq 0$. Additionally, a related global result will be presented.

14. Yue Liu, University of Texas at Arlington, USA
Title: On the rotation-two-component-Camassa-Holm system modelling the equatorial water waves
Abstract: In this talk, a modified two-component Camassa-Holm system with the effect of the Coriolis force in the rotating fluid is derived, which is a model in the equatorial water waves. The effects of the Coriolis force caused by the Earth's rotation and nonlocal nonlinearities on blow-up criteria and wave-breaking phenomena are then investigated. Our refined analysis relies on the method of characteristics and conserved quantities and is proceeded with the Riccati-type differential inequality. Finally, conditions which guarantee the permanent waves are obtained by using a method of the Lyapunov function.

15. Yuanwei Qi, University of Central Florida, USA
Title: Existence of Multiple Traveling Waves in An Isothermal Diffusion Systems with Linear Decay
Abstract: In this talk, I shall present some recent results on a reaction-diffusion system which models isothermal auto-catalysis of order m + 1 (m > 1) with linear decay as well as a micro-organism growth and competition in a flow reactor. We prove

existence of multiple traveling waves which has distinctive number of local maxima. It shows a very different feature of the model from the same isotherml autocatalysis without decay, or from the model with the same order of decay. Also, the phenomena is totally new with now precedent in single equation settings.

16. Lionel Rosier, Mines ParisTech, PSL
    Title: Control and stabilization of the Benjamin-Ono equation
    Abstract: The Benjamin-Ono (BO) equation, posed on the line, arises as a model in wave propagation in stratified fluids, and its well-posedness has been widely studied. In this talk, we are concerned with the exact controllability and the stabilization of the BO equation on the periodic domain T = R/2πZ. The control is assumed to be supported in a (small) subdomain. We shall present two recent works. The first one gives local controllability/stabilization results in H^s(T), $s > 1/2$, when some (localized) damping is incorporated in the equation (joint work with Felipe Linares). The second one provides global controllability/stabilization results in L^2(T) with a simple control/feedback and it relies strongly on some extension of Molinet-Pilod bilinear estimates (joint work with Camille Laurent and Felipe Linares).

17. Jie Shen, Xiamen University and Purdue University, USA
    Title: Efficient spectral methods for solving a class of fractional PDEs two-sided fractional derivatives
    Abstract: We consider spectral approximations of PDEs with two-sided fractional derivatives. For the PDEs with Riesz derivatives, we construct spectral methods using special basis functions based on generalized Jacobi functions which lead to diagonal systems, and we derive rigorous error estimates which show that the convergence rate is of spectral type in properly weighted Sobolev spaces despite the fact that the solutions have singularities at the endpoints. For PDEs with more general two-sided fractional derivatives, we construct efficient spectral-element methods with geometric mesh to achieve spectral accuracy. We shall also discuss how to solve multi-dimensional fractional PDEs with spectral methods.

18. Shuming Sun, Virginia Tech, USA
    Title: Initial-Boundary Value Problems on KdV and NLS Equations
    Abstract: The talk will discuss the initial- and boundary-value problems (IBVP) of the Korteweg-de Vries (KdV) and nonlinear Schrodinger (NLS) equation posed in a quarter plane and on a bounded interval with nonhomogeneous boundary conditions. It will be shown that the IBVPs are locally well-posed in certain Banach spaces. The ideas used for the well-posedness is based upon the estimates of the corresponding boundary integrals for the nonhomogeneous boundary data as well as the results from the initial value problems. The comparison between the solutions of KdV equation posed in finite intervals and half lines will be provided. Moreover, the extension for NLS equations to higher dimensional cases in spatial variables will be discussed. (This is a joint work with J. Bona, H. Chen, B. Zhang, and Yu Ran)

19. Jiahong Wu, Oklahoma State University, USA
Title: The 2D MHD equations with partial dissipation
Abstract: This talk presents recent work on the global regularity problem concerning the twodimensional (2D) magnetohydrodynamic (MHD) equations with only partial or fractional dissipation. Due to the nonlinear coupling between the evolution equations of the velocity and the magnetic field in the MHD system, the global regularity problem can be extremely difficult when only partial dissipation is present. We will report recent efforts on several partial or fractional dissipation cases and will cover both incompressible and compressible flows.

20. Juan-Ming (Jim) Yuan, Providence University, Taiwan
Title: Some Results on Higher-order Nonlinear Wave Equations
Abstract: This talk concerns the nonlinear dispersive waves in a water channel. Results from the study of a special version of the classical Boussinesq model system for the two-way propagation of water waves will be presented.
The talk will feature presentations about theoretical work, numerical analysis, and implementation of numerical schemes.

21. Bingyu Zhang, University of Cincinnati, USA
Title: Boundary Integral Operator and Its Applications
Abstract: In the past three decades, harmonic analysis has played important roles in the rapid advances of the study of nonlinear dispersive wave equations. In particular, many new tools have been developed to establish various well-posedness results for the pure initial value problems of nonlinear dispersive wave equations. However, how those harmonic analysis based tools can be used effectively to study non-homogeneous boundary value problems of nonlinear dispersive wave equations is still yet to be investigated. In this talk, I will introduce the concept of the boundary integral operator and show how it can play important roles in studying non-homogeneous boundary value problems of nonlinear dispersive wave equations. Especially I will demonstrate through examples of the KdV equation and the Schr□odinger equation how the boundary integral operator can enable us to use those harmonic analysis baesd tools to study non-homogeneous boundary value problems effectively.

22. Dajun Zhang, Shanghai University
Title: Direct and integrable discretization of some water wave equations
Abstract: Integrable nonlinear models can be solved exactly. Many integrable water wave models, such as the Korteweg-de Vries (KdV) equation, modi_ed Korteweg-de Vries (mKdV) equation, nonlinear Schr□odinger (NLS) equation and Kadomtsev-Petviashvili (KP) equation, have different discrete/numerical schemes. Integrable discrtization means to discretize a nonlinear PDE and meanwhile try to keep its integrability as much as possible. Direct discretization, numerically, requests a simple map between continuous and discrete spaces: $(t; x) \to (m; n)$ via $(t = t_0 + mq; x = x_0 + np)$ where p and q are steps. However, most known integrable discretizations are

not direct.
In this talk we will present discrete schemes which are both direct and integrable for several water wave models including the KdV, mKdV, NLS and KP equations. The discretizations keep indefinitely many conservation laws and symmetries. We hope this talk can inspire some connection between numerical discretization and integrable discretization, although it looks naive for this moment.

23. Zhixiong Zhang, Sichuan University
Title: A non-homogeneous boundary value problem for the Burgers' equation and the complex Ginzburg - Landau equation
Abstract: In this talk, we concern with the well-posedness of the Burgers' equation and the complex Ginzburg - Landau equation with non-homogeneous boundary conditions. By harmonic analysis method, we obtain both the local and the global well-posedness of the equations in a half line or in a finite interval. Our results show that both equations are well-posed in the state space H^s when $s>-1/2$.
Joint work with Jing Li, Bing-Yu Zhang

24. Zhimin Zhang, Beijing Center for Computational Science
Title: A new approach for solving the time-dependent Ginzburg—Landau superconductivity model
Abstract: We prove well-posedness of time-dependent Ginzburg—Landau system in a nonconvex polygonal domain, and decompose the solution as a regular part plus a singular part. We see that the magnetic potential is not in H^1 in general, and the finite element method (FEM) may give incorrect solutions. To remedy this situation, we reformulate the equations into an equivalent system of elliptic and parabolic equations based on the Hodge decomposition, which avoids direct calculation of the magnetic potential. The essential unknowns of the reformulated system admit H^1 solutions and can be solved correctly by the FEMs. We then propose a decoupled and linearized FEM to solve the reformulated equations and present error estimates based on proved regularity of the solution. Numerical examples are provided to support our theoretical analysis and show the efficiency of the method.