Sino-French Mathematical Cooperation Conference

Conference Program Book

East China Normal University, Shanghai, China

October 23 - 27, 2024

1 Conference Schedule

1.1 October 24th (PDE)

Conference Venue: 102 Lecture Hall, Mathematics Building

Time	Talks		Chair
9:00 - 9:50	**Frédéric Hélein**	Kaluza-Klein theories without a priori fibration hypotheses	**Congming Li**
9:50 - 10:40	**Wenming Zou**	Some results on the quantitative stability for the Caffarelli-Kohn-Nirenberg inequality	
10:40 - 11:00	Tea Break		
11:00 - 11:50	**Jean Dolbeault**	Stability estimates in Sobolev type inequalities	**Yuan Lou**
Lunch			
14:30 - 15:20	**Min Tang**	The pathway-based diffusion model for Modeling Intracellular Reactions Affecting Motility	**Xiaoqing He**
15:20 - 16:10	**Eric Séré**	Peierls instability in one and two dimensions	
16:10 - 16:30	Tea Break		
16:30 - 17:20	**Bobo Hua**	Discrete Steklov eigenvalue problems	**Liping Wang**
Dinner			

1.2 October 25th (PDE)

Conference Venue: 102 Lecture Hall, Mathematics Building, ECNU

Time	Talks		Chair
9:00 - 9:40	Opening ceremony and group photo		**Li Luo**
9:40 - 10:30	**Philippe Laurençot**	The thin film Muskat model: bounded weak solutions and self-similar behavior	**Yanyan Zhang**
10:40 - 11:30	**Jian Fang**	Time delay induced nonlocal problems with free boundary	
Lunch			
14:30 - 15:20	**Xinan Ma**	Best constant and extremal function for a class Hardy-Mazya-Sobolev inequality	**Feng Zhou**
15:20 - 16:10	**Louis Jeanjean**	Existence of prescribed L^2 norm solutions for nonlinear Schrödinger equations on metric graphs: the mass supercritical case	
16:10 - 16:30	Tea Break		
16:30 - 17:20	**Limin Sun**	Attainability of the best constant of Hardy-Sobolev inequalities with full boundary singularities	**Dong Ye**
Banquet			

1.3 October 25th (Algebra)

Opening Ceremony Venue: 102 Lecture Hall, Mathematics Building

Conference Venue: 401 Lecture Hall, Mathematics Building

Time	Talks		Chair
9:00 - 9:40	Opening ceremony and group photo		**Li Luo**
9:40 - 10:30	**Marc Rosso**	On Feigin's homomorphisms and quantum shuffle algebras	**Naihong Hu**
10:40 - 11:30	**Changchang Xi**	Self-injective algebras under derived equivalences	
Lunch			
14:30 - 15:20	**Christian Blanchet**	Quantum representations from Heisenberg homologies of surface configurations	**Bin Shu**
15:20 - 16:10	**Xiaowu Chen**	An invitation to module factorizations	
16:10 - 16:30	Tea Break		
16:30 - 17:20	**Haibo Jin**	Silting theory for graded gentle algebras	
Banquet			

1.4 October 26th (Algebra)

Conference Venue: 102 Lecture Hall, Mathematics Building

Time	Talks		Chair
9:00 - 9:50	**David Hernandez**	Monoidal Jantzen Filtrations and quantization of Grothendieck rings	**Li Luo**
9:50 - 10:10	Tea Break		
10:10 - 11:00	**Zhaobing Fan**	Geometric approach to quantum algebras and their representations	
Lunch			
14:30 - 15:20	**Fan Qin**	Analogs of dual canonical bases for cluster algebras from Lie theory	**Guodong Zhou**
15:20 - 15:40	Tea Break		
15:40 - 16:30	**Vladimir Dotsenko**	Operadic twisting in the SPDE context	
Dinner			

2 Organizations and Acknowledgements

Organizing Units

School of Mathematical Sciences
The Fundamental Science Center for Geometry and Algebra Center for PDE

Organizers

Naihong Hu, Li Luo, Dong Ye, Feng Zhou, Guodong Zhou.

3 Conference Guide

3.1 Conference Procedure

The conference runs from October 23th to the morning of October 27th, with check-out in the morning. Please have all experts check in directly at the hotel. Registration for the conference and collection of conference materials will take place at the conference venue.

Hotel Check-in Time

PDE: October 23th. Algebra: October 24th.

Hotel Check-in Venue

Courtyard by Marriott Shanghai Minhang, No. 588, Building 3, Zixing Road, Minhang District, Shanghai.

Figure 1: Courtyard by Marriott Shanghai Minhang

3.2 Dining Venue

Lunch Venue

Courtyard by Marriott Shanghai Minhang, No. 588, Building 3, Zixing Road, Minhang District, Shanghai.

Dinner Venue

Shanghai Faculty Center, No. 5858, Hongmei South Road, Minhang District, Shanghai.

Figure 2: Shanghai Faculty Center

3.3 Shuttle Bus Info

There will be a shuttle bus to pick you up between Hotel and the location of the conference.

	Oct. 24	Oct. 25	Oct. 26
Hotel–Campus	8:30	8:30	8:30
Lunch	12:00	11:40	11:10
Hotel–Campus	14:00	14:00	14:00
Dinner	17:30	17:30	16:40
Faculty Center–Hotel	20:00	20:00	19:00

3.4 Conference Venue

Mathematics Building Lecture Hall, Minhang Campus, East China Normal University.

Figure 3: Mathematics Building

4 Titles and Abstracts (PDE)

Stability estimates in Sobolev type inequalities

Jean Dolbeault

Université Paris Dauphine, France

Abstract: A qualitative stability estimate for the Sobolev inequality has been known since the work of Bianchi and Egnell in 1991. Obtaining constructive stability estimates, i.e., giving an estimate of the stability constant, has remained an open question for a very long time. Several results have been obtained in recent years for the Sobolev inequality, the logarithmic Sobolev inequality as well as a number of Gagliardo-Nirenberg interpolation inequalities, in strong norms. The aim of this lecture is to provide an overview of the various methods, results and some open problems.

Time delay induced nonlocal problems with free boundary

Jian Fang

Harbin Institute of Technology, China

Abstract: Incorporating time delay and Stefan type free boundary into reaction-diffusion equations yields some new nonlocal problems. In this talk, I will present two models alone this line and discuss their propagation dynamics when the reaction is of the KPP type.

Kaluza-Klein theories without a priori fibration hypotheses

Frédéric Hélein

Université Paris Cité, France

Abstract: I will present a Lagrangian action on fields, the critical points of which lead to solutions of the Einstein-Yang-Mills equations, in the spirit of Kaluza-Klein theories. The novelty is that the a priori fiber bundle structure hypothesis is not required: fields are defined on a space-time Y of dimension $4 + r$ without any a priori principal bundle structure, where r is the dimension of the structure group. If the latter group is compact and simply connected, to each solution of the Euler-Lagrange equations it corresponds a 4-dimensional pseudo-Riemannian manifold X (which can be interpreted as our usual space-time) in such a way that Y acquires a principal bundle structure over X equipped with a connection. Moreover the metric on X and the connection on Y are solutions of the Einstein-Yang-Mills system. If the structure group is $U(1)$ (the case which corresponds to the Einstein-Maxwell system) the situation is slightly degenerated and supplementary hypotheses are necessary.

Discrete Steklov eigenvalue problems

Bobo Hua

Fudan University, China

Abstract: Steklov eigenvalues on a domain are eigenvalues of the Dirichlet-to-Neumann operator on the boundary, which is a natural nonlocal operator. We introduce the discrete counterpart of Dirichlet-to-Neumann operator, which is defined on the boundary of a subgraph in an ambient graph. Following works of Escobar and Jammes, the Steklov eigenvalue estimate via the isoperimetric constant, so-called Cheeger type estimate, was proved by Huang-Hua-Wang and Hassannezhad-Miclo independently. However, the estimate

involves several Cheeger constants, including even the Cheeger constant for the Laplacian, and the upper and lower bounds don't match. In this talk, we introduce an isocapacitary constant in the spirit of Maz'ya, which gives the precise upper and lower bounds of Steklov eigenvalues, which match up to some constants. This is joint work with Florentin Muench and Tao Wang.

Existence of prescribed L^2 norm solutions for nonlinear Schrödinger equations on metric graphs: the mass supercritical case

Louis Jeanjean

Université de Bourgogne, France

Abstract: In this talk we discuss the existence of prescribed L^2 norm solutions to nonlinear Schrödinger equations set on metric graphs. A common strategy employed to find such a solution is to search for a constrained critical point of the associated energy functional. Some geometric properties of the functional vary depending on the exponent in the nonlinear term of the equation. In the so-called mass subcritical case, the functional is bounded from below and coercive on the constraint, so one may search for a critical point as a global minimum. As such, in the last years, this case has been extensively studied.

However, in the complementary case, known as the mass supercritical case, the energy functional is no longer bounded from below on the constraint and presents a lack of a priori bounds on the possible critical points. As a result, very little is yet known about this case. Through the presentation of some of the few existing results, we shall discuss the main obstacles that need to be overcome to treat this case under general assumptions. We will also present some of the tools that have already been developed for this purpose.

This talk is based on joint works with J. Borthwick, P. Carrillo, X. Chang, S. Dovetta, D. Galant, E. Serra, N. Soave, C. Troestler.

The thin film Muskat model: bounded weak solutions and self-similar behavior

Philippe Laurençot

Centre national de la recherche scientifique, France

Abstract: Existence of weak solutions to the thin film Muskat model, a second-order degenerate parabolic system with cross-diffusion, is studied. Such solutions are constructed by various approximation methods while their boundedness is a consequence of the availability of a countably infinite family of Liapunov functionals built upon homogeneous polynomials of arbitrary degree. The large time behaviour of these solutions in the whole space is also identified. These are joint works with Bogdan-Vasile Matioc (Regensburg).

Best constant and extremal function for a class Hardy-Mazya-Sobolev inequality

Xinan Ma

University of Science and Technology of China, China

Abstract: We derive an differential identity for a class p-Laplace equation, and then classify all positive finite energy cylindrically symmetric solutions of the equation (1) for $3 \leq k \leq n-1$, with the help of some a prior estimates. The Euler-Lagrange equation associated to the inequality is

$$\begin{aligned} -\Delta_p u &= \frac{u^{p^*(1)-1}}{|y|} \text{ in } \mathbb{R}^n, \\ u &> 0, \\ u &\in D^{1,p}(\mathbb{R}^n), \end{aligned} \tag{1}$$

where $p^*(1) = \frac{p(n-1)}{n-p}$, $x = (y, z) \in \mathbb{R}^k \times \mathbb{R}^{n-k}$. As a consequence, we obtain the best constant and the extremal function for the related Hardy-Mazya-Sobolev inequalities. When $p = 2$, the corresponding results was obtained by Mancini-Fabbri-Sandeep in 2006, and Alvino-Ferone-Trombetti posed a conjecture in 2006 for $1 < p < n$. This is joint work with Daowen Lin.

Peierls instability in one and two dimensions

Eric Séré

Université Paris Dauphine, France

Abstract: Peierls instability is a symmetry breaking phenomenon in crystals. I will focus on two situations: the one-dimensional polyacetylene chain and the two-dimensional graphene-like crystal. Both crystals will be treated in the tight-binding approximation, which leads to a nonlinear model that is easy to write. The question I will discuss is the characterisation of the energy minimizers. The one-dimensional model was first studied rigorously by Kennedy and Lieb, who proved that sufficiently long closed chains with an even number of atoms have a two-periodic distorsion at zero temperature, as predicted by Peierls in 1955. Graphene-like crystals were studied by Frank and Lieb: they proved a periodicity result, which raised the question of the exact shape of the periodic minimizer. I will first consider closed one-dimensional chains with an odd number of atoms: when this odd number goes to infinity, the ground state converges to a heteroclinic connection between two-periodic configurations. Then I will present a recent result on the shape of the energy minimiser for graphene-like crystals. This talk is based on joint works with Mauricio Garcia Arroyo, David Gontier, Adechola Kouande and Thaddeus Roussigne.

Attainability of the best constant of Hardy-Sobolev inequalities with full boundary singularities

Liming Sun

Academy of Mathematics and Systems Sciences, CAS, China

Abstract: We consider a type of Hardy-Sobolev inequality, whose weight is singular on the whole domain boundary. We are concerned with the attainability of the best constant of such inequality. In dimension two, we link it to a conformally invariant one using the conformal radius of the domain. The best constant of such inequality on a smooth domain is achieved if and only if the domain is non-convex. In higher dimensions, the best constant is achieved if the domain has negative mean curvature somewhere.

The pathway-based diffusion model for Modeling Intracellular Reactions Affecting Motility

Min Tang

Shanghai Jiao Tong University, China

Abstract: The pathway-based diffusion model (PBDM) can model the bacteria density when their motility is affected by the external environment through intracellular reactions. We give some analytical results for the PBDM and explain its difficulty. Then we study a discrete version of it. The discrete model consists of N reaction-diffusion equations for N different species. Each species has different diffusion coefficient and they can gradually transit from one species to another, depending on the environment. We establish the strict positivity of the steady-state N-equation system with Neumann boundary conditions. The system satisfies the relative entropy inequality and thus has long-time convergence.

Some results on the quantitative stability for the Caffarelli-Kohn-Nirenberg inequality

Wenming Zou

Tsinghua University, China

Abstract: In this talk, I will report some results on the quantitative stability for the Caffarelli-Kohn-Nirenberg inequality, including the non-degenerate case and degenerate case (i.e., the parameters fall on the Felli-Schneider curve). We consider both the functional and the critical settings.

5 Titles and Abstracts (Algebra)

Quantum representations from Heisenberg homologies of surface configurations

Christian Blanchet

Université Paris Cité, France

Abstract: The homological nature of certain quantum representations is known from the 90th. It was a key ingredient in Bigelow's proof of the linearity of braid groups. We will show that using representations of the Heisenberg groups we obtain homologies of surface configurations with mapping class group action and quantum sl(2) action. We will discuss the case of the Schroedinger representations. This is based on joint work with Awais Shaukat and Martin Palmer and independant work by Marco de Renzi and Jules Martel.

An invitation to module factorizations

Xiao-Wu Chen

University of Science and Technology of China, China

Abstract: Module factorizations are natural extensions of the well-known matrix factorizations in the sense of David Eisenbud. We will give an introduction to module factorizations. The main application is on MCM modules over complete intersections.

Operadic twisting in the SPDE context

Vladimir Dotsenko

Université de Strasbourg, France

Abstract: I shall explain how operadic twisting, invented by Willwacher to work with graph complexes of Kontsevich, can be used to resolve an important problem of characterizing the chain rule symmetry in the context of stochastic PDEs. This is joint work with Yvain Bruned.

Geometric approach to quantum algebras and their representations

Zhaobing Fan

Harbin Engineering University, China

Abstract: By using mixed perverse sheaves and Deligne's weight theory, we give a geometric construction of the negative part of a two-parameter quantum algebra based on Lusztig's work. Moreover, we show that the two-parameter quantum algebra is a two-cocycle deformation, depending only on the second parameter, of its one-parameter analogue. We further give a connection between the categories of weight modules of these two algebras. This is a joint work with Yiqiang Li.

Monoidal Jantzen Filtrations and quantization of Grothendieck rings

David Hernandez

Université Paris Cité, France

Abstract: We introduce a monoidal analogue of Jantzen filtrations in the framework of monoidal categories with generic braidings. It leads to a deformation of the multiplication of the Grothendieck ring. We conjecture, and we prove in many remarkable situations, that this deformation is associative so that our construction yields a quantization of the Grothendieck ring. This is a joint work with Ryo Fujita.

Silting theory for graded gentle algebras

Haibo Jin

East China Normal University, China

Abstract: We give a full description of graded gentle algebras (which are not necessarily homologically smooth or proper) whose perfect derived categories admit silting objects. We apply this to determine which graded gentle algebras admit pre-silting objects that are not partial silting. As the second application, we give a complete invariant for graded gentle algebras, which confirm a conjecture by Lekili and Polishchuk. This talk is based on a work joint with Sibylle Schroll and Zhengfang Wang.

Analogs of dual canonical bases for cluster algebras from Lie theory

Fan Qin

Beijing Normal University, China

Abstract: The (quantized) coordinate rings of many interesting varieties from Lie theory are (quantum) cluster algebras. We construct the common triangular bases for these algebras. Such bases provide analogs of the dual canonical bases, whose existence has been long expected in cluster theory. For symmetric Cartan matrices, they are positive and admit monoidal categorification after base change. Moreover, we will see that the coordinate rings of double Bott-Samelson cells are categorified by representations of quantum affine algebras.

On Feigin's homomorphisms and quantum shuffle algebras

Marc Rosso

Université Paris Cité, France

Abstract: Quantum upper triangular subalgebras are known to be the subalgebras generated in degree1 of certain quantum shuffle algebras, and Feigin's maps are morphisms to some quantum polynomial algebras. D. Rupel extended Feigin's homomorphisms to the whole quantum shuffle algebras, using the explicit expression for the product in terms of braid group action. We give another simple construction, avoiding explicit computations, using quantum quasi-shuffle algebras. First we establish a universal property of quantum quasi-shuffle algebras relative to the construction of Hopf algebra morphisms, and second show that quantum polynomial algebras can be realized naturally as quotients of quantum quasi-shuffle algebras. Then the general morphism is obtained by composition of this quotient map with an algebra morphism (constructed via the universal property) from the quantum shuffle algebra to a quantum quasi-shuffle algebra.

Self-injective algebras under derived equivalences

Changchang Xi

Capital Normal University, China

Abstract: Self-injective algebras form a class of interesting algebras in representation theory. They appear in many branches of mathematics such as topological quantum field and knot theory. In this talk, we investigate behaviours of this class of algebras under derived equivalences. We show that the Nakayama permutations of two derived equivalent, self-injective Artin algebras are conjugate, and that the weak symmetry and self-injectivity of finite-dimensional algebras over an arbitrary field are invariant of derived equivalences.

The contents of this talk are taken from a joint paper with Jin Zhang, for more details, see J. Pure Appl. Algebra 229 (2025), no.1, paper no. 107795.

6 List of Participants

Name	University	Country
Philippe Laurençot	Centre national de la recherche scientifique	France
Louis Jeanjean	Université de Bourgogne	France
Vladimir Dotsenko	Université de Strasbourg	France
Christian Blanchet	Université Paris Cité	France
Frédéric Hélein	Université Paris Cité	France
David Hernandez	Université Paris Cité	France
Marc Rosso	Université Paris Cité	France
Jean Dolbeault	Université Paris Dauphine	France
Eric Séré	Université Paris Dauphine	France
Fan Qin	Beijing Normal University	China
Bobo Hua	Fudan University	China
Zhaobing Fan	Harbin Engineering University	China
Jian Fang	Harbin Institute of Technology	China
Wenming Zou	Tsinghua University	China
Honglian Zhang	Shanghai University	China
Jiao Zhang	Shanghai University	China
Congming Li	Shanghai Jiao Tong University	China
Yuan Lou	Shanghai Jiao Tong University	China
Min Tang	Shanghai Jiao Tong University	China
Changchang Xi	Capital Normal University	China
Xiao-Wu Chen	University of Science and Technology of China	China
Xinan Ma	University of Science and Technology of China	China
Liming Sun	Academy of Mathematics and Systems Sciences, CAS	China
Yuanyuan Feng	East China Normal University	China
Xiaoqing He	East China Normal University	China
Naihong Hu	East China Normal University	China
Xia Huang	East China Normal University	China
Xiangyu Jiao	East China Normal University	China
Haibo Jin	East China Normal University	China
Ziling Li	East China Normal University	China
Li Luo	East China Normal University	China
Bin Shu	East China Normal University	China
Liping Wang	East China Normal University	China
Dong Ye	East China Normal University	China

Name	University	Country
Hairong Yuan	East China Normal University	China
Yanyan Zhang	East China Normal University	China
Chunyi Zhao	East China Normal University	China
Feng Zhou	East China Normal University	China
Guodong Zhou	East China Normal University	China