



丘成桐数学科学中心
YAU MATHEMATICAL SCIENCES CENTER



分析及量子物理国际研讨会

International Symposium on Analysis and Quantum Physics

June 12-16, 2025

Room A-103, TSIMF

组织者 ORGANIZERS

Long Jin(金龙), Tsinghua University

Jingxuan Zhang(张景宣), Tsinghua University

Marius Lemm, Tuebingen University

Contents

About the conference	1
Schedule	2
Long Jin(金龙)	4
Jingxuan Zhang(张景宣)	4
Marius Lemm	4
Titles and Abstracts	5
Søren Fournais	5
Simon Becker	6
Yulin Gong (龚禹霖)	7
Jian Wang (王健)	8
Konstantin Merz	9
Stéphane Nonnenmacher	10
Li Chen (陈丽)	11
Arnaud Triay	12
Emanuela Laura Giacomelli	13
Jinyeop Lee	14
Houssam Abdul-Rahman	15
Robin Reuvers	16

Oliver Siebert	17
Ou Yang, Dong Hao (欧阳东昊)	18
Jacky Chong	19
Yucheng Wang (王宇澄)	20
Wu, Xiaoxu (吴晓旭)	21
Jiangong You (尤建功)	22
Carla Rubiliani	23
Welcome to TSIMF	24
About Facilities	26
Registratlon	26
Guest Room	26
Library	27
Restaurant	27
Laundry	28
Gym	28
Playground	28
Swimming Pool	28
Free Shuttle Bus Service at TSIMF	28



About the conference

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International Symposium on Analysis and Quantum Physics

Date

June 12-16, 2025

Venue

Room A-103, TSIMF

Organizers

Long Jin(金龙), Tsinghua University

Jingxuan Zhang(张景宣), Tsinghua University

Marius Lemm, Tuebingen University

Abstract

The interplay between mathematical analysis and quantum physics has led to spectacular advances in these disciplines. The topic of this symposium is on the recent advances in analysis and the mathematical aspects of quantum physics. Key research subjects include analysis of PDEs, microlocal analysis, spectral theory, and calculus of variations, especially as related to quantum dynamical systems and interacting particle systems.

Description of the aim

The goal of this symposium is to bring together experts in the fields of mathematical analysis and quantum physics to share their recent results and enhance our understanding on the interplay of these subjects and related topics. It will provide an excellent platform for experts across disciplines to discuss potential collaboration as well as related open problems, e.g., many-body dynamical localization, rigorous theory of Bose-Einstein condensate, and many more.

Schedule

Schedule for International Symposium on Analysis and Quantum Physics, June 12-16, 2025

Time&Date	2025/6/12 (Thursday)	2025/6/13 (Friday)
7:30-9:00	Breakfast (90 minutes)	
Chair	Jingxuan Zhang 张景宣	Kangwei Li 李康伟
9:30-10:20	Søren Fournais	Stéphane Nonnenmacher
10:20-10:50	Break (within 30 minutes)	
Chair	Jingxuan Zhang 张景宣	Kangwei Li 李康伟
10:50-11:40	Becker Simon	LI CHEN 陈丽
12:00-13:30	Lunch (90 minutes)	
Chair	Long Jin 金龙	Carla Rubiliani
14:30-15:20	Yulin Gong 龚禹霖	Arnaud Triay
15:20-15:50	Break (within 30 minutes)	
Chair	Long Jin 金龙	Carla Rubiliani
15:50-16:40	JIAN WANG 王健	Emanuela Laura Giacomelli
16:40-17:30	Konstantin Merz	Lee, Jinyeop
17:30	Dinner	Banquet 18:30-20:00

The tea break time on Tuesday (June 13) morning will include a group photo session. Please attend on time.

Schedule

Shcedule for International Symposium on Analysis and Quantum Physics, June 12-16, 2025

Time&Date	2025/6/14 (Saturday)	2025/6/15 (Sunday)	2025/6/16 (Monday)
7:30-9:00	Breakfast (90 minutes)		
Chair	Danqing He 贺丹青	Bochen Liu 刘博辰	Jing Wang 王婧
9:30-10:20	Houssam Abdul-Rahman	Oliver Siebert	Jiangong You 尤建功
10:20-10:50	Break (within 30 minutes)		
Chair	Danqing He 贺丹青	Bochen Liu 刘博辰	Jing Wang 王婧
10:50-11:40	Robin Reuvers	Ou Yang, Dong Hao 欧阳东昊	Carla Rubiliani
12:00-13:30	Lunch (90 minutes)		
Chair	Free Discussion 13:30-17:00	Chenjie Fan 范晨捷	Free Discussion 13:30-17:00
14:30-15:20		Jacky Chong	
15:20-15:50		Break (within 30 minutes)	
Chair		Chenjie Fan 范晨捷	
15:50-16:40		Yucheng Wang 王宇澄	
16:40-17:30		Wu, Xiaoxu 吴晓旭	
17:30	Dinner		



Long Jin(金龙)
Tsinghua University

Long Jin participated in the IMO in 2006 and won a gold medal, graduated with a bachelor's degree from the School of Mathematical Sciences at Peking University in 2010, and obtained a Ph.D. in Mathematics from the University of California, Berkeley in 2015. He has served as a postdoctoral researcher and assistant professor at Harvard University and Purdue University, and is currently an associate professor at the Yau Mathematical Sciences Center of Tsinghua University. His research interests include microlocal analysis and semiclassical analysis, spectral theory and scattering theory. In recent years, he has made significant breakthroughs in the field of quantum chaos, publishing multiple academic papers in top journals such as Acta Math, JAMS, and CMP.



Jingxuan Zhang(张景宣)
Tsinghua University

Jingxuan Zhang is a postdoc at Yau Mathematical Sciences Center, Tsinghua University. His research interest lies in analysis of PDE and mathematical physics, especially in connection to condensed matter and many-body quantum physics. Before returning to Beijing in 2023, Jingxuan has studied in Toronto, Cambridge, and Copenhagen from 2016-23 and held visiting positions at St. Michael's College, Toronto and MIT from 2021-3.



Marius Lemm
University of Tuebingen

Marius Lemm is a professor of mathematical physics at the University of Tübingen in Germany. Prior to that, he was assistant professor at EPFL and held postdoctoral positions at Harvard and IAS. He obtained his Ph.D. in 2017 from Caltech, where he was supervised by Rupert L. Frank. He is interested in developing analytical tools for problem originating in quantum physics. In recent years, his research has mainly focused on quantum many-body systems (derivations of spectral gaps and Lieb-Robinson type bounds), homogenization theory, and random matrix theory.



**Søren Fournais,
Copenhagen University**

Søren Fournais, a professor at Copenhagen University's Department of Mathematical Sciences and QMath Center, was born in 1973. His research focuses on the mathematical aspects of the equations of quantum mechanics. For over the last decade, a central point of the research of Fournais and his group has been the mathematics of Bose - Einstein condensates. A major breakthrough was the proof of the two-term formula for the ground state energy of dilute Bose gases - the so-called Lee-Huang-Yang formula. To further his research, he secured an ERC Advanced Grant from the European Research Council.

Recently, Fournais and co-workers have participated in progress on the long open problem of understanding the quantum mechanical tunneling effect in the presence of strong magnetic fields. In particular, a recent manuscript gives the first formula for the tunneling in generic purely magnetic wells.

Tunnelling formulae for magnetic operators

Tunnelling with magnetic fields, semiclassical analysis, Schrödinger Operators

The mathematical analysis of the tunnelling effect between electric wells was a key milestone in semiclassical analysis reached in the 1980's with important contributions by Simon and Helffer-Sjöstrand. However, the analysis of the effect in the presence of magnetic fields was largely left open. Technically, this is because the complex phases that a magnetic field induces in the eigenfunctions causes cancellations that are delicate to control to the required precision. Although a general theory of magnetic tunnelling is still lacking at the level of generality of the non-magnetic theory, there has been important progress in recent years. I will review some recent results, both in very special geometries where separation of variables makes analysis more manageable, and a recent result which is the first “generic” calculation of a purely magnetic tunnelling effect.

Results are in particular in collaboration with Yannick Guedes Bonthonneau, Leo Morin and Nicolas Raymond.



**Simon Becker,
ETH Zurich**

Simon Becker is a mathematician currently serving as a Hermann-Weyl Instructor in the Department of Mathematics (d-math) at ETH Zurich. His primary research interests lie in the mathematical aspects of quantum mechanics, with a particular focus on the mathematical problems within condensed matter physics and quantum information theory, covering areas such as analytical methods in spectral theory and simulations.

He obtained his Ph.D. from the University of Cambridge in 2021. Following that, he worked as a Courant Instructor at New York University for one year. He has published several papers in related fields, including **Spectral characterization of magic angles in twisted bilayer graphene** and **Mathematics of magic angles in a model of twisted bilayer graphene**.

Gibbs sampling for bosonic system

ords Gibbs states, Quantum computing, Open quantum systems

We develop a rigorous framework for quantum Gibbs sampling in infinite dimensional bosonic systems using Dirichlet forms to define ergodic, completely positive quantum Markov semigroups. Our construction enables efficient thermalization dynamics for systems with unbounded Hamiltonians and supports explicit implementations via regularized creation and annihilation operators.

Applications include Gaussian models, the Bose-Hubbard model, and systems with magnetic fields, offering analytical and computational tools for simulating thermal states in continuous-variable quantum systems.

Yulin Gong (龚禹霖)

Yulin Gong is currently a Ph.D. student at Tsinghua University under the supervision of Prof. Long Jin. He holds a Bachelor's degree in Science from the University of Science and Technology of China and a Master's degree in Science from the University of Rennes 1 in France. His research interests include microlocal analysis, spectral geometry, and hyperbolic geometry. His current research focuses on the spectral distribution of damped wave-type operators on compact hyperbolic surfaces.

Maximal speed of propagation for lattice bosons under long-range interactions.

We study the quantum time evolution of a system of bosons on a lattice generated by a long-range Hamiltonian with power-law decaying terms. We establish the first thermodynamically stable particle propagation bound in this setting, thus showing the finiteness of the speed of boson transport across the lattice. The main novelty in our proof is a multi-scale adaptation of the adiabatic space-time localisation observable method, which allows removing the dependence of the error term from far-away particles.

Following this strategy, we were also able to control higher moments of the number operator. This opens the door to proving the first thermodynamically stable Lieb-Robinson bounds for bosonic systems with long-range hopping.



Jian Wang
(王健)

Employment

Institut des Hautes Études Scientifiques	Bures-sur-Yvette, France
Postdoctoral Researcher, mentor: Laure Saint-Raymond	September 2024 – Date
University of North Carolina at Chapel Hill	Chapel Hill, USA
Postdoctoral Research Associate, mentor: Hans Christianson	August 2021 – July 2024
University of California, Berkeley	Berkeley, USA
Graduate Student Instructor/Researcher	August 2016 – July 2022

Education

University of California, Berkeley	Berkeley, USA
Ph.D in Mathematics, advisor: Maciej Zworski	August 2016 – May 2021
Tsinghua University	Beijing, China
B.S. in Mathematics	September 2012 – July 2016

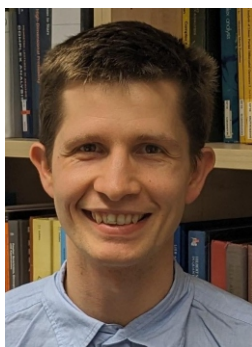
Visiting Positions

Institut des Hautes Études Scientifiques	Bures-sur-Yvette, France
Invited Researcher	November 2023 – December 2023
Tsinghua University	Beijing, China
Visiting Scholar	June 2023 – July 2023

Resonances for shear flows and complex deformation

shear flows, resonances, Orr--Sommerfeld equation

For shear flows in a 2D channel, we define resonances near regular values of the shear profile for the Rayleigh equation under an analyticity assumption. This is done via complex deformation of the interval on which the Rayleigh equation is considered. We show such resonances are inviscid limits of the eigenvalues of the corresponding Orr--Sommerfeld equation. We present examples for which the viscous perturbations of embedded eigenvalues are unstable. Joint work with Malo Jézéquel.



**Konstantin Merz,
Technische Universität Braunschweig**

Konstantin Merz is an interim professor at the Institute for Partial Differential Equations at Technische Universität Braunschweig.

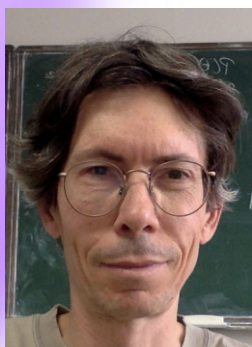
His research fields are analysis and mathematical physics, especially Schrödinger operators with general kinetic energies. Specifically, it includes eigenvalue estimation, heat kernel estimation, functional inequalities, and multi-particle quantum systems. He has published many papers in related fields, such as "Equivalence of Sobolev norms involving generalized Hardy operators" and "Proof of the strong Scott conjecture for Chandrasekhar atoms", and "Random Schrödinger operators with complex decaying potentials".

In addition, he has also organized seminars, such as the "Gauss Mini Workshop on Analysis, PDE, and Mathematical Physics" and the "Minisymposium on Mathematical Analysis of Complex Quantum Systems" at the annual meeting of the German Mathematical Society. In terms of teaching, he has taught courses such as Harmonic Analysis, Discrete

On the electron distribution of relativistic atoms and heat kernel estimates

Relativistic atoms, fractional Laplacian, heat kernel estimates

The study of the electron distribution in atoms and molecules is paramount in quantum physics and chemistry. By the uncertainty principle, the innermost electrons move with velocities which are a substantial fraction of the speed of light. Hence, a relativistic description is mandatory. In this talk, we present new pointwise upper bounds for the sum of the squares of the eigenfunctions of the relativistic Chandrasekhar operator, in particular for each angular momentum channel separately. Our proof is concise and primarily relies on recently established heat kernel bounds for Hardy perturbations of subordinated Bessel heat kernels. This talk is based on joint works with Krzysztof Bogdan and Tomasz Jakubowski, and with Rupert Frank.



Stéphane Nonnenmacher,
University Paris-Saclay

Stéphane Nonnenmacher is professor of mathematics at University Paris-Saclay in Orsay (France), after a previous appointment in the Theoretical Physics Institute of the French Atomic Energy Commission. Professor Nonnenmacher has long been engaged in the field of Quantum Chaos, which stands at the crossroads between dynamical systems, partial differential equations, and mathematical physics. In particular, he has addressed the phenomenon of Quantum Ergodicity, which describes the energy concentration of "vibration eigenmodes" in chaotic cavities (or hyperbolic manifolds), in the limit of high frequencies. Another aspect of his research concerns the spectral properties for open chaotic systems, in particular the distribution of quantum resonances in such systems. Both research topics involve the use of advanced semiclassical analysis tools, combined with the ergodic theory of chaotic dynamical systems.

Random eigenstates of the Quantum Cat Map

Quantum Chaos ; Quantum Ergodicity ; Random Wave Model

Long standing conjectures in Quantum Chaos address the statistical properties of eigenmodes of quantized chaotic systems, in the semiclassical/small wavelength limit. A prototypical model is the Laplacian on a compact Riemannian manifold of negative curvature, which is viewed as the quantization of a classical particle following the (chaotic) geodesic flow. At the macroscopic scale, the Quantum Unique Ergodicity conjecture asserts that all the eigenmodes of the Laplacian should asymptotically equidistribute across the manifold. At the microscopic (or wavelength) scale, Berry's random wave conjecture predicts that the eigenmodes should enjoy the same local statistical properties as monochromatic random waves. So far, results on Berry's conjecture have been obtained for random quasimodes, that is, random combinations of eigenmodes, in spectral windows of appropriate dimensions. The quantized hyperbolic automorphisms of the 2-torus, also known as "Quantum Cat Maps", form a family of toy models of quantized chaotic systems, which enjoy atypical spectral properties. In particular, in the semiclassical limit, the model can feature "maximally large" spectral multiplicities.

These multiplicities allow us to consider random eigenmodes of the Quantum Cat Map, instead of quasimodes. We show that, with high probability, those random eigenmodes are all equidistributed across the torus phase space, and their local statistical properties converge to those of standard Gaussian random states, which is the analogue of Berry's monochromatic random waves in this context.

This is a joint work with Nir Schwartz



**Li Chen (陈丽),
University of Mannheim**

Li Chen is a professor at the University of Mannheim in Germany and has made outstanding achievements and has profound academic attainments in the field of mathematics. Li Chen obtained her Ph.D. from Jilin University in 2001. From 2001 to 2003, she did post-doctoral research at the Institute of Mathematics, Chinese Academy of Sciences. From 2003 to 2013, she worked at Tsinghua University, and since 2014, she has been a Chair Professor at the University of Mannheim in Germany. Her research direction is partial differential equations and their applications. Her main achievements have been published in many internationally renowned mathematics journals. Professor Chen Li is very active in the academic field. She has presided over several projects funded by the National Natural Science Foundation of China and is currently in charge of three projects funded by the German National Natural Science Foundation. She has also been invited to the United States, Canada, France, Italy, Austria and other countries to participate in academic conferences and give academic reports.

On the mean-field limit of Vlasov-Poisson-Fokker-Planck equations

Mean-field limit, Vlasov equation, relative entropy

In this talk I will focus on the derivation of effective descriptions for interacting many-body systems, which is an important branch of applied mathematics. We prove a propagation of chaos result for a system of N particles subject to Newtonian time evolution with or without additional white noise influencing the velocities of the particles. We assume that the particles interact according to a regularized Coulomb-interaction with a regularization parameter that vanishes in the $N \rightarrow \infty$ limit. The respective effective description is the so called Vlasov-Poisson-Fokker-Planck (VPFP), respectively the Vlasov-Poisson (VP) equation in the case of no or sub-dominant white noise. To obtain our result we combine the relative entropy method from Jabin and Wang (2016) with the control on the difference between the trajectories of the true and the effective description provided in Huang, Liu, and Pickl (2020 for the VPFP case respectively in Lazarovic and Pickl for the VP case. This allows us to prove strong L^1 convergence of the marginals. This talk is based on the joint work with Jinwook Jung, Peter Pickl, and Zhenfu Wang.



Arnaud Triay

Arnaud Triay is a professor at Ludwig - Maximilians - Universität München (LMU). His research and teaching are at the interface between mathematical analysis and quantum mechanics. For example, he taught courses as « Mathematical quantum mechanics » or « Partial differential equations ». His research interests lie in the mathematical analysis of many-body quantum mechanics and in particular mean-field limits and dilute Bose gases. Arnaud Triay obtained a master's degree in mathematics from École Normale Supérieure de Lyon in France from 2012 to 2016 and a doctorate degree in mathematics from the University of Paris Dauphine (Paris 9) from 2016 to 2019.

The free energy of the dilute Bose gas at low temperature

In 1957 Lee Huang and Yang proposed a formula for the first eigenvalues of a Bose system in the dilute regime. I will present recent works where we derive an asymptotic expansion on the free energy per unit volume in agreement with the LHY formula. Our result holds for temperatures for which the thermal contribution to the free energy is of the same order as the famous zero-temperature LHY correction.

This is joint work with Florian Haberberger, Christian Hainzl, Phan Thành Nam, Benjamin Schlein and Robert Seiringer.



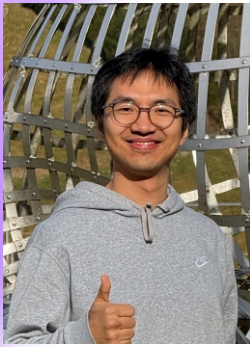
**Emanuela Laura
Giacomelli**

Emanuela Laura Giacomelli is an Assistant Professor in Mathematical Physics at the Department of Mathematics at the University of Milan. Her research focuses on mathematical problems in Quantum Mechanics, with a particular emphasis on problems arising from Many-Body Quantum Systems and from Ginzburg-Landau Theory of Superconductivity. In particular, her recent works focuses on the study of correlations in dilute fermionic systems.

The Huang-Yang formula for the low-density Fermi gas in 3D

Quantum Mechanics, Many-Body Systems, Fermi Gas

In 1957, Huang and Yang predicted an asymptotic formula for the ground state energy of a dilute Fermi gas in the thermodynamic limit. This formula highlights a remarkable universality, showing that the correlation energy depends solely on the interaction's scattering length. In this talk, I will present a rigorous proof of the Huang-Yang prediction, employing a bosonization approach that interprets suitable pairs of fermions as bosons.



Lee, Jinyeop
(이진엽, 李濤燁)

Lee, Jinyeop (이진엽, 李濤燁) is currently a postdoctoral researcher in the Department of Mathematics at the University of British Columbia, working under the supervision of Chiara Saffirio. Located in Vancouver, Canada, the University of British Columbia (UBC) is one of the country's leading research universities, known for its strong emphasis on innovation, interdisciplinary collaboration, and global impact. UBC consistently ranks among the top institutions worldwide, particularly in the fields of science, engineering, and sustainability.

Jinyeop Lee's research lies at the intersection of mathematical physics, probability theory, and applied mathematics. In mathematical physics, he focuses on the analysis of many-body quantum systems, with particular attention to Bose-Einstein condensation, fermionic dynamics, and anyonic models. His work often involves deriving effective equations, such as the Hartree, Gross-Pitaevskii, and Vlasov equations, from first-principles quantum dynamics. In probability theory, he is interested in topics including random matrix theory and spin glass models. His applied mathematics research is informed by problems arising in physics and engineering, such as homogenization and micromechanics of composite materials.

Derivation of the Vlasov equation from the fermionic many-body Schrödinger system using the Husimi measure

Many-body quantum system, Husimi measure, Vlasov equation

This work offers a derivation of the Vlasov equation from fermionic many-body Schrödinger systems, utilizing the Husimi measure as a connecting tool between classical mechanics and quantum mechanics. We start with an intuitive overview of the Vlasov equation, followed by a concise investigation of the many-body Schrödinger equation. The core of our discussion is about the usage of the Husimi measures to bridge these two equations. Participants will be introduced to the underlying formalism and techniques for the derivation process.



Houssam Abdul-Rahman

Houssam Abdul-Rahman is employed by the United Arab Emirates University (UAEU). His main research fields lie in mathematical physics, encompassing disordered quantum many-body systems, many-body localization, quantum information theory, and the transport properties of periodic quantum systems. He holds bachelor's and master's degrees in science from Jordan University of Science and Technology, and a doctorate from the University of Alabama at Birmingham in the United States. He previously held a postdoctoral position at the University of Arizona and a visiting position at New York University Abu Dhabi.

From Ballistic to Arbitrarily Slow Transport in Periodic Systems Lieb-Robinson velocity, Periodic Schrodinger Operators, Quantum Walks in electric fields.

Periodic systems are often associated with ballistic transport. But how slow can this transport get? In this talk, we present two different periodic quantum models that are well known to exhibit ballistic transport. We explore how the propagation velocity, while remaining positive, can be made arbitrarily small.

First, we discuss a class of discrete-time one-dimensional quantum walks associated with CMV unitary matrices in the presence of a periodic local field. These walks are parametrized by a transmission parameter $t \in [0, 1]$. We show that the asymptotic velocity can be made arbitrarily small by choosing a periodic local field with a sufficiently large period. Specifically, we prove an upper bound on the velocity that decays exponentially with the period of the field, leading to localization-like behavior.

Second, we consider the discrete Schrödinger operator $-\Delta + \mu V$, where $-\Delta$ is the discrete Laplacian and V is a p -periodic non-degenerate potential. We establish a Lieb-Robinson-type bound showing that the maximum propagation velocity scales as $O(1/\mu)$ as $\mu \rightarrow \infty$. Additionally, the asymptotic velocity decays as $O(1/\mu^{p-1})$, demonstrating that increasing μ significantly suppresses transport.



Robin Reuvers

Robin Reuvers has been working at Roma Tre University since 2022, engaging in research in the fields of mathematical physics, quantum mechanics, fermionic and bosonic many-body systems, entanglement, and statistical mechanics.

Ground state energy of a low-density fermi gas in 1D

dilute quantum gases, 1D physics, ground state energy

I will discuss some topics that are relevant to 1-dimensional fermions with strong, repulsive 2-body interactions. Contrary to the 2 and 3d cases, this can be thought of as a low-density limit. In the spin-1/2 case, the Heisenberg antiferromagnet appears in the effective Hamiltonian, even if the particles live in an interval. This is joint work with Johannes Agerskov and Jan Philip Solovej.



Oliver Siebert

I am currently a departmental postdoc (Krener Assistant Professor) at the University of California Davis with Bruno Nachtergaele as my mentor, working in various areas of mathematical many-body quantum theory, especially with continuous systems. Before that, I worked as a postdoc with Marius Lemm in Tübingen and for a short time at EPFL. I received my Ph.D. from the University of Jena under the supervision of Davis Hasler in the field of non-relativistic QED at positive temperature.

On the thermodynamic limit of interacting fermions in the continuum

Interacting continuous fermions · Thermodynamic limit · C^* -dynamical system

In this talk I will consider the dynamics of non-relativistic fermions in infinite volume in the continuum, interacting through a non-regularized pair potential. Employing methods developed by Buchholz in the framework of resolvent algebras for bosons, I will show how the CAR algebra can be extended such that the dynamics acts as a group of C^* -automorphisms, which are continuous in time in all sectors of fixed particle numbers. Using the subalgebra generated by time-averages, one obtains a C^* -dynamical system which is dense in the extended CAR algebra with respect to the seminorms of fixed particle numbers. The discussion is significantly shorter than in the bosonic case and provides a potential framework for discussing KMS states.



Ou Yang, Dong Hao
(欧阳东昊)

I obtained a Bachelor degree in mathematics and physics, master and PhD degree in mathematics from University of Toronto, under supervision by Prof Israel Michael Sigal. I am currently a postdoc at department of mathematics in LMU Munich, under supervision by Prof Phan Thanh Nam. During my PhD period, I was working in the field of open quantum system, more specifically, quantum master equation. Currently, I am working on minimization problem in Hartree-Fock-Bogoliubov model (which is also the main topic of my talk for this conference).

Mass-Critical Neutron Stars in the Hartree-Fock and Hartree-Fock-Bogoliubov Theories

Hartree-Fock-Bogoliubov theory, Concentration-compactness theorem, calculus of variations

We investigate the ground states of neutron stars and white dwarfs in the Hartree-Fock (HF) and Hartree-Fock-Bogoliubov (HFB) theories. It is known that the system is stable below a critical mass, which depends on the gravitational constant, while it becomes unstable if the total mass exceeds the critical mass. We prove that, if the total mass is at the critical mass, the HFB minimizers do not exist for any gravitational constant, while the HF minimizers exist for every gravitational constant except for a countable set, which is fully characterized by the Gagliardo-Nirenberg inequality for orthonormal systems. Our results complement the existence results in the sub-critical mass case established in [E. Lenzmann and M. Lewin, Duke Math. J., 2010].



Jacky Chong

Research Interest

Dispersive PDEs, harmonic analysis, many-body quantum physics.

Education

University of California, San Diego B.S. Mathematics June 2012

University of Maryland, College Park Ph.D. Mathematics July 2019

Ph.D. Advisors: Manoussos Grillakis, Matei Machedon

Thesis: Application of Dispersive PDE Techniques to the Studies of the Hartree–Fock–Bogoliubov System for Bosons.

Quantitative Derivation of the Two-Component Gross–Pitaevskii Equation with Uniform-in-Time Convergence Rate

We derive the time-dependent two-component Gross–Pitaevskii equation as an effective description of the dynamics of a dilute two-component Bose gas near its ground state, which exhibits a two-component Bose–Einstein condensate, in the Gross–Pitaevskii limit. Our main result establishes a uniform-in-time bound on the convergence rate between the many-body dynamics and the effective description, explicitly quantified in terms of the particle number N , and also implies a uniform-in-time bound for the one-component case. This improves upon the works of Michelangeli and Olgiati [2, 3] by providing a sharper, N -dependent, timeindependent convergence rate. Our approach further extends the framework of Benedikter, de Oliveira, and Schlein [1] to the multi-component Bose gas setting. More specifically, we develop the necessary Bogoliubov theory to analyze the dynamics of multi-component Bose gases in the Gross–Pitaevskii regime.

The talk is based on our recent work arXiv:2501.18787. This is joint work with Jinyeop Lee and Zhiwei Sun.



Yucheng Wang
(王宇澄)

Yucheng Wang is a postdoctoral fellow at The Hong Kong Polytechnic University. She mainly research on the partial differential equations. One topic is about the "Global existence and decay estimates of solutions to the chemotaxis - shallow water system". Regarding this coupled system in two-dimensional bounded domain or the whole space, including both vacuum and non-vacuum states. She explored the global existence and decay estimates of solutions from three aspects: the non-vacuum state in the whole space, the non-vacuum state in a bounded domain, and the vacuum state in a bounded domain. In addition, in collaboration with Prof. Li Chen and others, she has achieved certain results in the research on the mean-field control problem of the two-dimensional and high-dimensional Keller-Segel system.

Mean-Field Control for Diffusion Aggregation Equation with Coulomb Interaction

Optimal control of PDE, Mean-field limit, Convergence in probability

The mean-field control problem for a multi-dimensional diffusion--aggregation system with Coulomb interactions (the so-called parabolic elliptic Keller--Segel system) is considered. The existence of optimal control is proven through the Γ convergence of the corresponding control problem of the interacting particle system. There are three building blocks in the overall argument. First, for the optimal control problem at the particle level, instead of using the classical method for stochastic systems, we directly study the control problem of high-dimensional parabolic equations, specifically, the Liouville equation. Second, we obtain strong propagation of chaos results for the interacting particle system by combining the convergence in probability and relative entropy methods. Owing to this strong mean field limit result, we avoid imposing compact support requirements for control functions, which have often been used in the literature. Third, because of the strong aggregation effect, additional difficulties arise from the control function in obtaining the well-posedness theory of the diffusion--aggregation equation, making known methods inapplicable. Instead, we use a combination of local existence results and bootstrap arguments to obtain the global solution in the subcritical regime. This work is collaborated with Prof. Li Chen and Zhao Wang.

Wu, Xiaoxu (吴晓旭)

I am currently a postdoctoral fellow at the Australian National University. Prior to this, I held a Visiting Assistant Professor position at Texas A&M University and a postdoctoral research fellowship at the Fields Institute, where I worked with Israel Michael Sigal. In 2023, I completed my Ph.D. in mathematics at Rutgers University under the supervision of Avy Soffer. My research interests lie in mathematical approaches to quantum information, scattering theory, wave turbulence, and quantum algorithms.

Local decay estimate

The primary objective of quantum scattering theory is to classify the possible large-time behaviors of solutions to Schrödinger equations and to prove that all solutions converge to a superposition of these asymptotic states as time goes to plus or minus infinity. This is known as asymptotic completeness (AC). Historically, local decay estimates (LD) have played a fundamental role in establishing AC. In this talk, I will introduce how to capture all free flows without using LD and how AC can be used to establish LD for the scattering part of the solution. As a direct application, we obtain global-in-time Strichartz estimates for quasi-periodic time-dependent potentials.



Jiangong You
(尤建功)

Jiangong You, Chair Professor at the Chern Institute of Mathematics, Nankai University, specializes in mathematical physics and dynamical systems. He has published over 80 papers in prestigious journals such as *Invent. Math.*, *Duke Math. J.*, *GAFA*, *Ann. ENS*, *PRL*, *Cambridge J. Math.*, *AJM*, *CMP*, *Anal. PDE*, *IMRN*, *JMPA*, *Math. Ann.*, *Adv. Math.*, and *Trans. AMS*. He has been invited to deliver a one-hour plenary lecture at the International Congress on Mathematical Physics (ICMP) and a 45-minute lecture at the International Congress of Mathematicians (ICM). His research has been recognized with numerous awards, including the TWAS Award in Mathematics from The World Academy of Sciences (TWAS), the First Prize in Natural Science from the Ministry of Education of China, the Second Prize in the National Natural Science Award of China, among others.

Almost Mathieu Operators and Beyond **Cantor spectrum, localization, phase transition**

Almost Mathieu operators (AMO), fundamental models in quantum physics, constitute a special class of quasiperiodic Schrödinger operators. They exhibit a rich array of spectral phenomena, including Cantor spectra, localization, delocalization, and phase transitions. In this talk, we will provide a concise overview of the key results and open problems in the study of AMO, as well as their generalizations.



Carla Rubiliani

I am Carla Rubiliani, a second-year Ph.D. student at the University of Tübingen, under the supervision of Prof. Marius Lemm. My work primarily focuses on quantum many-body dynamics and particle transport. Together with Marius Lemm, Jingxuan Zhang, and Israel M. Sigal, I co-authored three papers focusing on proving upper bounds for the propagation speed of bosons on lattice systems, and I am currently working on extending those results to derive Lieb-Robinson bounds for long-range bosonic systems.

Since the beginning of my Ph.D. in 2023, I have participated in several conferences and seminars on mathematical physics, talking about my research. For example, I have spoken at seminars at Warwick and Kyoto University, as well as at the Young Researchers Symposium in Strasbourg and workshops held at Harvard and Oberwolfach. During this time, I was a member of a committee, representing junior members within the Collaborative Research Center TRR 352 "Mathematics of Many-Body Quantum Systems and Their Collective Phenomena", a joint government grant between the University of Tübingen, Ludwig Maximilian University and the Technical University in Munich. As a member of the committee, I organized meetings and seminars to bring together young researchers in mathematical physics. Since April 2024, I have been an International Research Associate at RIKEN, Japan. Here I am working with Tomotaka Kuwahara on problems related to Lieb-Robinson bounds and topics in quantum information theory.

Maximal speed of propagation for lattice bosons under long-range interactions.

We study the quantum time evolution of a system of bosons on a lattice generated by a long-range Hamiltonian with power-law decaying terms. We establish the first thermodynamically stable particle propagation bound in this setting, thus showing the finiteness of the speed of boson transport across the lattice. The main novelty in our proof is a multi-scale adaptation of the adiabatic space-time localisation observable method, which allows removing the dependence of the error term from far-away particles.

Following this strategy, we were also able to control higher moments of the number operator. This opens the door to proving the first thermodynamically stable Lieb-Robinson bounds for bosonic systems with long-range hopping.

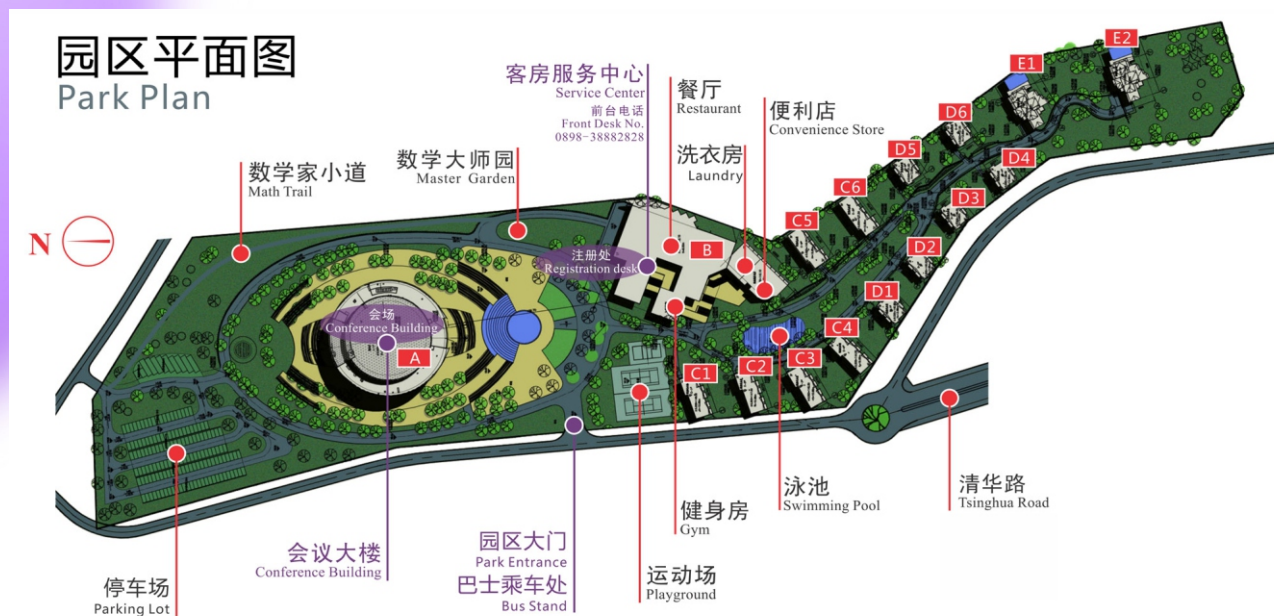
Welcome to TSIMF



The facilities of TSIMF are built on a 23-acre land surrounded by pristine environment at Phoenix Hill of Phoenix Township. The total square footage of all the facilities is over 29,000 square meter that includes state-of-the-art conference facilities (over 10,000 square meter) to hold many international workshops simultaneously, two reading rooms of library, a guest house (over 10,000 square meter) and the associated catering facilities, a large swimming pool, gym and sports court and other recreational facilities.

Management Center of Tsinghua Sanya International Forum is responsible for the construction, operation, management and service of TSIMF. The mission of TSIMF is to become a base for scientific innovations, and for nurturing of innovative human resource; through the interaction between leading mathematicians and core research groups in pure mathematics, applied mathematics, statistics, theoretical physics, applied physics, theoretical biology and other relating disciplines, TSIMF will provide a platform for exploring new directions, developing new methods, nurturing mathematical talents, and working to raise the level of mathematical research in China.

About Facilities



Registration

Conference booklets, room keys and name badges for all participants will be distributed at the front desk. Please take good care of your name badge. It is also your meal card and entrance ticket for all events.



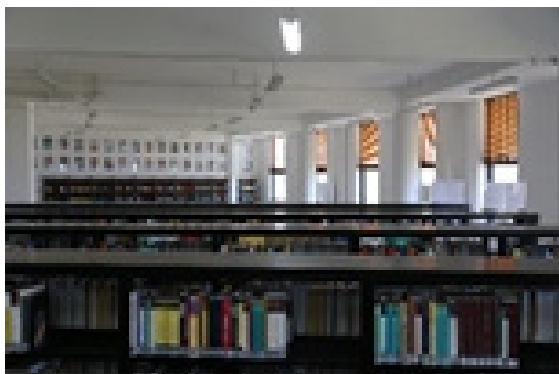
Guest Room

All the rooms are equipped with: free Wi-Fi (Password:tsimf123), TV, air conditioning and other utilities.

Family rooms are also equipped with kitchen and refrigerator.



Library



Opening Hours: 09:00am-22:00pm

TSIMF library is available during the conference and can be accessed by using your room card. There is no need to sign out books but we ask that you kindly return any borrowed books to the book cart in library before your departure.



In order to give readers a better understanding of the contributions made by the Fields Medalists, the library of Tsinghua Sanya International Mathematics Forum (TSIMF) instituted the Special Collection of Fields Medalists as permanent collection of the library to serve the mathematical researchers and readers.

So far, there are 271 books from 49 authors in the Special Collection of Fields Medalists of TSIMF library. They are on display in room A220. The participants are welcome to visit.



Restaurant

All the meals are provided in the restaurant (Building B1) according to the time schedule.



Breakfast 07:30-08:30

Lunch 12:00-13:30

Dinner 17:30-19:00

Laundry

Opening Hours: 24 hours

The self-service laundry room is located in the Building(B1).



Gym

Opening Hours: 24 hours

The gym is located in the Building 1 (B1), opposite to the reception hall. The gym provides various fitness equipment, as well as pool tables, tennis tables etc.



Playground

Playground is located on the east of the central gate. There you can play basketball, tennis and badminton. Meanwhile, you can borrow table tennis, basketball, tennis balls and badminton at the reception desk.

Swimming Pool

Please enter the pool during the open hours, swimming attire and swim caps are required, if you feel unwell while swimming, please stop swimming immediately and get out of the pool. The depth of the pool is 1.2M-1.8M.

Opening Hours: 13:00-14:00 18:00-21:00



Free Shuttle Bus Service at TSIMF

We provide free shuttle bus for participants and you are always welcome to take our shuttle bus, all you need to do is wave your hands to stop the bus.

Destinations: Conference Building, Reception Room, Restaurant, Swimming Pool, Hotel etc.



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