

Workshop on Harmonic Analysis and Applications

This workshop aims to bring together leading experts and researchers in the field of Harmonic Analysis to explore recent advancements and open problems. The workshop will feature a mini-course by Hong Wang, focusing on the recent breakthrough in Kakeya problem. In addition, there will be research lectures by prominent scholars in the field, covering a diverse range of topics in analysis.

Time and Venue:

June 17-19, 2025, Siyuan Hall, Zhihua Building (智华楼四元厅), Peking University

Institution:

Peking University

Invited speakers:

Zhenbin Cao (Institute of Mathematics HNAS)

Shengwen Gan (University of Wisconsin – Madison)

Xiaoqi Huang (Louisiana State University)

Shihe Liu (Peking University)

Yixuan Pang (University of Pennsylvania)

Hong Wang (New York University, Courant Institute of Mathematical Science)

Shukun Wu (Indiana University)

Ruixiang Zhang (UC Berkeley)

Schedule:

17-June

Time	Titles	Speakers
9:00-9:30	Opening Session	
9:30-10:30	Union of tubes and Kakeya sets I	Hong Wang
10:30-11:00	Tea break	
11:00-12:00	Introduction to weighted restriction estimates	Ruixiang Zhang
12:00-14:00	Lunch	
14:00-15:00	On local smoothing estimates for wave equations	Shengwen Gan
15:00-15:30	Tea break	

15:30-16:30	On delocalization of Anderson-Bernoulli model with decaying potential	Shihe Liu
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18-June

Time	Titles	Speakers
9:30-10:30	Union of tubes and Kakeya sets II	Hong Wang
10:30-11:00	Tea break	
11:00-12:00	Strichartz estimates for the Schrödinger equation on the sphere	Xiaoqi Huang
12:00-14:00	Lunch	
14:00-15:00	Weighted L^2 restriction for quadratic manifolds of arbitrary codimensions	Zhenbin Cao
15:00-15:30	Tea break	
15:30-16:30	Comparison of nondegeneracy conditions for quadratic manifolds of arbitrary codimensions	Yixuan Pang

19-June

Time	Titles	Speakers
9:30-10:30	Union of tubes and Kakeya sets III	Hong Wang
10:30-11:00	Tea break	
11:00-12:00	Restriction and decoupling estimates for quadratic surfaces in \mathbb{R}^3 .	Shukun Wu
12:00-14:00	Lunch	

Contact:

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Sponsors:

School of Mathematical Sciences, Peking University
 Key Laboratory of Mathematics and Applications, Peking University
 National Center for High-Level Talent Training in Mathematics

Titles and abstracts:

Speaker: Hong Wang (New York University, Courant Institute of Mathematical Science)

Title: Union of tubes and Kakeya sets

Abstract: We discuss techniques (Córdoba argument, projection theory) to prove volume bounds on union of tubes in \mathbb{R}^2 and \mathbb{R}^3 , with applications to the Kakeya problem. This is joint work with Josh Zahl.

Speaker: Ruixiang Zhang (UC Berkeley)

Title: Introduction to weighted restriction estimates

Abstract: Weighted (Fourier) restriction estimates is ubiquitous in subjects such as analysis, number theory and geometric measure theory. We will use a few examples to introduce these estimates and applications and talk about progress on a few problems. We will also compare the problems to the classical Fourier restriction estimate and discuss their key connections and differences.

Speaker: Shengwen Gan (University of Wisconsin – Madison)

Title: On local smoothing estimates for wave equations.

Abstract: The previously known exponent in the local smoothing estimate is the decoupling exponent $p=2(n+1)/(n-1)$. In this talk, I will introduce local smoothing estimates and discuss some previous methods on this problem. Then, I will discuss a new method that incorporates wave packet density and refined decoupling, and briefly outline how this approach leads to a local smoothing estimate with an exponent that improves upon the decoupling exponent.

Speaker: Shihe Liu (Peking University)

Title: On delocalization of Anderson-Bernoulli model with decaying potential

Abstract: We will briefly introduce the localization and delocalization of Anderson model, especially the Anderson-Bernoulli model with decaying potential. The report will mainly take a glance at the application of decoupling of probability and restriction theory in the study of absolute continuous spectrum of Anderson-Bernoulli model, which originates from works of Bourgain. Some result about the construction of extended state will also be shown, together with the needed renormalization.

Speaker: Xiaoqi Huang(Louisiana State University)

Title: Strichartz estimates for the Schrödinger equation on the sphere

Abstract: We will discuss optimal space-time estimates in $L^q_{t,x}$ spaces for solutions to the Schrödinger equation on the standard round sphere, which is related to the results of Burq, Gérard and Tzvetkov (2004). The proof is based on the arithmetic properties of the spectrum of the Laplacian on the sphere, as well as local bilinear oscillatory integral estimates in harmonic analysis, which allow us to relate the problem to Strichartz estimate on one-dimensional tori. This is based on joint work with Christopher Sogge.

Speaker: Zhenbin Cao(Institute of Mathematics HNAS)

Title: Weighted L^2 restriction for quadratic manifolds of arbitrary codimensions

Abstract : We systematically introduce weighted L^2 restriction for quadratic manifolds of arbitrary codimensions. Main ingredients of proof are sharp uniform Fourier decay estimates for quadratic manifolds and a refinement of the Du-Zhang method. To obtain sharp uniform Fourier decay, we need some arguments from matrix analysis. We will also compare our results with prior results.

Speaker: Yixuan Pang(University of Pennsylvania)

Title: Comparison of nondegeneracy conditions for quadratic manifolds of arbitrary codimensions

Abstract : We obtain an almost complete relation diagram on all existing nondegeneracy conditions for quadratic manifolds of arbitrary codimensions. These conditions comes from various topics in harmonic analysis: Fourier restriction, decoupling, Fourier decay, Fourier dimension, weighted restriction, and Radon-like transforms. The diagram has many implications, such as "best possible Stein-Tomas implies best possible $\ell^p L^p$ decoupling". The proof of the diagram requires a combination of ideas from Fourier analysis, complex analysis, convex geometry, geometric invariant theory, combinatorics, and matrix analysis. This is joint work with Zhenbin Cao, Jingyue Li, and Changxing Miao.

Speaker: Shukun Wu(Indiana University)

Title: Restriction and decoupling estimates for quadratic surfaces in \mathbb{R}^3 .

Abstract: We first discuss a recent framework for the Fourier restriction conjecture. It proposes to attack the restriction conjecture using the decoupling theorems and two-ends incidence inequalities. Then, we will focus on three dimensions and discuss a bilinear refined decoupling inequality, which is useful to establish a desirable restriction estimate for hyperbolic paraboloid. This talk is based on joint work with Hong Wang and Ciprian Demeter.