



**The International Number Theory Conference in
Commemoration of Chengdong Pan**

CONFERENCE HANDBOOK

Jinan Shandong

July 29 - August 2, 2024



Amid the vibrant summer, with the fragrance of lotus flowers in the air, Shandong University sincerely appreciates it that you accepted the invitation to visit the beautiful Spring City of Jinan to attend The International Number Theory Conference in Commemoration of Chengdong Pan.

The theme of this conference is “Honoring the Past and Inspiring the Future,” in memory of Chengdong Pan’s remarkable contributions to the development of mathematics and education. Taking this opportunity, Shandong University will intensively advance the construction of basic disciplines, inspire future scholars and accelerate the construction of a world-class university committed to the great rejuvenation of the Chinese nation.

If you need any assistance during the conference, please feel free to contact our staff. We will do our best to serve you. We wish you good health and a pleasant stay!

The International Number Theory Conference in Commemoration of Chengdong Pan

Conference Date: July 30 - August 2, 2024

Conference Venue: Shandong Hotel

Conference Agenda

Date: July 30, 2024 (Tuesday) - August 2, 2024 (Friday)

Venue: Shandong Hotel, Qilu Hall

Speakers:

Jinpeng An	Peking University
Heng Huat Chan	National University of Singapore
Lei Fu	Tsinghua University
Yongquan Hu	Chinese Academy of Sciences
Bingrong Huang	Shandong University
Henryk Iwaniec	Rutgers University
Yujiao Jiang	Shandong University (Weihai)
Yuk-Kam Lau	The University of Hong Kong

Ruochuan Liu	Peking University
Yongxiao Lin	Shandong University
Yifeng Liu	Zhejiang University
Hourong Qin	Nanjing University
Zeév Rudnick	Tel Aviv University
Peter Sarnak	IAS & Princeton University
Zhiwei Sun	Nanjing University
Yichao Tian	Chinese Academy of Sciences
Jie Wu	Centre national de la recherche scientifique
Ping Xi	Xi'an Jiaotong University
Fei Xu	Capital Normal University
Libo Yang	Nankai University
Yangbo Ye	The University of Iowa
Shuai Zhai	Shandong University (Qingdao)
Yitang Zhang	UC Santa Barbara
Weizhe Zheng	Chinese Academy of Sciences
Chuanming Zong	Tianjin University

Detailed Agenda

July 30		
Afternoon		
14:00-15:00	Speaker	Yitang Zhang (UC Santa Barbara)
	Title	Combinatorial arguments in sums over primes
15:00-15:30	Refreshment Break	
15:30-16:15	Speaker	Jie Wu (CNRS)
	Title	On a sum involving the integral part function
16:20-17:05	Speaker	Yichao Tian (AMSS, CAS)
	Title	Anticyclotomic Iwasawa main conjecture for Rankin-Selberg motives
17:05	Group Photo	
July 31		
Morning		
08:30-09:30	Speaker	Henryk Iwaniec (Rutgers University)
	Title	The Riemann zeta zeros and Kloosterman sums
09:35-10:20	Speaker	Yifeng Liu (Zhejiang University)
	Title	Gan-Gross-Prasad conjecture and its number-theoretical applications
10:20-10:40	Refreshment Break	
10:40-11:25	Speaker	Lei Fu (Tsinghua University)
	Title	An effective Deligne's equidistribution theorem
	Speaker	Shuai Zhai (Shandong University, Qingdao)

11:30-12:15	Title	Elliptic curves and quadratic forms
12:15	Buffet Lunch (Shandong Hotel, Evergreen Hall)	
Afternoon		
14:00-14:45	Speaker	Yangbo Ye (The University of Iowa)
	Title	Algorithms of the Möbius function by random forests
14:50-15:35	Speaker	Jinpeng An (Peking University)
	Title	丢番图逼近中的联立奇异性
15:35-16:05	Refreshment Break	
16:05-16:50	Speaker	Ping Xi (Xi'an Jiaotong University)
	Title	The Brun-Titchmarsh Theorem
16:55-17:40	Speaker	Yongxiao Lin (Shandong University)
	Title	Nonvanishing for twists of L -functions
August 1		
Morning		
08:30-09:30	Speaker	Peter Sarnak (IAS & Princeton University)
	Title	Saturation numbers for primes and almost primes
09:35-10:20	Speaker	Ruochuan Liu (Peking University)
	Title	Recent progress in p -adic modular forms
10:20-10:40	Refreshment Break	
10:40-11:25	Speaker	Weizhe Zheng (AMSS, CAS)
	Title	Ultraproduct cohomology and the decomposition
11:30-12:15	Speaker	Yujiao Jiang (Shandong University, Weihai)

	Title	Correlations of multiplicative functions
12:15	Buffet Lunch (Shandong Hotel, Evergreen Hall)	
Afternoon		
14:00-14:45	Speaker	Zhiwei Sun (Nanjing University)
	Title	Problems and results on combinatorial properties of
14:50-15:35	Speaker	Libo Yang (Nankai University)
	Title	Log-concavity of Kazhdan-Lusztig polynomials of uniform matroids
15:35-16:05	Refreshment Break	
16:05-16:50	Speaker	Heng Huat Chan (National University of Singapore)
	Title	Class invariants and birthday identities
16:55-17:40	Speaker	Bingrong Huang (Shandong University)
	Title	Value distribution of Hecke eigenforms
August 2		
Morning		
09:00-10:00	Speaker	Zeév Rudnick (Tel Aviv University)
	Title	Zeros of modular forms
10:00-10:20	Refreshment Break	
10:20-11:05	Speaker	Fei Xu (Capital Normal University)
	Title	Counting lattice points in central simple algebras with a given characteristic polynomial
11:10-11:55	Speaker	Yongquan Hu (AMSS, CAS)
	Title	On the dimension of Bianchi modular forms
12:00	Buffet Lunch (Shandong Hotel, Evergreen Hall)	

Afternoon		
14:00-14:45	Speaker	Yuk-Kam Lau (The University of Hong Kong)
	Title	Randomness of the Möbius function
14:45-15:15	Refreshment Break	
15:15-16:00	Speaker	Hourong Qin (Nanjing University)
	Title	A relation between the Milnor K group and the Shafarevich-Tate group
16:05-16:50	Speaker	Chuanming Zong (Tianjin University)
	Title	Post-quantum cryptography, sphere packing and sphere covering

Titles and Abstracts

丢番图逼近中的联立奇异性

Jinpeng An

(Peking University)

摘要: 在丢番图逼近中, 实数、实向量、实矩阵的奇异性由著名数学家 Khintchine 引入, 并成为度量数论中的重要研究对象。最近十余年来, 人们在计算奇异集合 Hausdorff 维数方面取得了突破性进展。报告人與人合作, 引入了联立奇异性的概念, 并给出了联立奇异集合的 Hausdorff 维数。本报告将回顾这些工作, 并介绍奇异性与联立奇异性与齐性动力系统的关系。

Class invariants and birthday identities

Heng Huat Chan

(National University of Singapore)

Abstract: The Kronecker-Weber Theorem states that every finite abelian extension of \mathbb{Q} is contained in an extension generated by certain cyclotomic units. We will discuss an analogue of this result with \mathbb{Q} and the cyclotomic units replaced by the imaginary quadratic extension and class invariants. We will then show how to generate birthday identity, which is a non-trivial identity that expresses a birthdate in terms of a sum involving the Legendre symbol.

An effective Deligne's equidistribution theorem

Lei Fu

(Tsinghua University)

Abstract: Using the Weyl integration formula, the Weyl character formula and results from harmonic analysis, we prove an Erdos-Turan type inequality for compact Lie groups, from which we deduce an effective version of Deligne's equidistribution theorem.

On the dimension of Bianchi modular forms

Yongquan Hu

(AMSS, Chinese Academy of Sciences)

Abstract: Given a level N and a weight k , we know the dimension of the space of (classical) modular forms. This turns out to be unknown if we consider Bianchi modular forms, which are modular forms over imaginary quadratic fields. Recently, Weibo Fu (Annals of Math., 2024) proved that the dimension of Bianchi modular forms of fixed level grows linearly when the weight (k, k) grows. In this talk, I will recall the background and review the history of this problem (including the work of Simon Marshall and of myself).

Value distribution of Hecke eigenforms

Bingrong Huang

(Shandong University)

Abstract: In this talk, we will discuss value distribution of Hecke eigenforms in the large weight limit. We will first introduce the quantum unique ergodicity theorem, and effective decorrelation of Hecke eigenforms. As consequences, we can prove an effective version of equidistribution of mass and zeros of linear combinations of Hecke eigenforms. Then we will talk about the L^4 norm and joint distribution of Hecke eigenforms. We can prove some conditional results under GRH and GRC, from which we get conditional results on a first moment and nonvanishing of the triple product L -functions.

The Riemann zeta zeros and Kloosterman sums

Henryk Iwaniec

(Rutgers University)

Abstract: This will be a report on my joint work in progress with Brian Conrey. The basic goal is to estimate the sixth power moment of partial sums of the Riemann zeta function on the critical line. Our desired bound is not perfect, yet it is good enough to derive the same zero-density estimation which one gets (indirectly by Jutila's method) by applying the true bound for the full sixth power

moment. The results are conditional subject to some natural assumptions about cancellation in sums of Kloosterman sums.

Correlations of multiplicative functions

Yujiao Jiang

(Shandong University, Weihai)

Abstract: Understanding the correlations of multiplicative functions is a central issue in analytic number theory, closely linked to several unsolved problems such as Chowla's conjecture on the autocorrelation of the Möbius function and the additive divisor problem. In this talk, we will discuss our work concerning the correlations on two types of multiplicative functions. As applications, we make some progress on shifted convolution problems for $GL(m) \times GL(2)$ ($m \geq 4$) and Hypothesis C of Iwaniec-Luo-Sarnak.

Randomness of the Möbius function

Yuk-Kam Lau

(The University of Hong Kong)

Abstract: The Möbius function is a classical important function whose oscillatory behaviour is dictated by the non-trivial zeros of the Riemann zeta function. There have been several attempts to understand its potential randomness. In particular, Sarnak's conjecture on Möbius disjointness in dynamical systems has received much attention. In this talk we give a brief account of some recent work by different researchers.

Nonvanishing for twists of L -functions

Yongxiao Lin

(Shandong University)

Abstract: Let F be a Hecke-Maass cusp form on GL_3 and χ be primitive Dirichlet characters modulo q . We discuss the simultaneously nonvanishing problem for the Dirichlet L -function $L(s, \chi)$ and the twisted GL_3 L -function $L(s, F \times \chi)$ in the case when

the modulus q of χ 's is an almost-prime. This is a work in progress with Junxian Li (UC Davis) and Xiannan Li (Kansas State).

Recent progress in p -adic modular forms

Ruochuan Liu
(Peking University)

Abstract: We will briefly introduce some of the recent developments in the field of p -adic modular forms.

Gan-Gross-Prasad conjecture and its number-theoretical applications

Yifeng Liu
(Zhejiang University)

Abstract: Gan-Gross-Prasad conjecture and its refinement Ichino-Ikeda conjecture have recently been completely solved for unitary groups under the effort of a group of people. In this talk, we will survey this progress and focus on its various applications in number theory, including the Beilinson-Bloch-Kato conjecture, Iwasawa's main conjecture, and subconvexity bounds for central L -values.

A relation between the Milnor K group and the Shafarevich-Tate group

Hourong Qin
(Nanjing University)

Abstract: The congruent number problem has a long history. We will introduce the congruent number problem and related research, and present our recent research on this problem. We will explain the connection between the congruent numbers and the Milnor K groups and the connection between the Milnor K group and the Shafarevich-Tate group.

Zeros of modular forms.

Zeév Rudnick
(Tel Aviv University)

Abstract: I will discuss old and new results about the distribution

of zeros of various families of modular forms, such as Eisenstein series, Hecke eigenforms, Poincare series, and the Miller basis, and the connection with Quantum Unique Ergodicity.

Saturation numbers for primes and almost primes

Peter Sarnak

(IAS & Princeton University)

Abstract: The classical problems such as twin primes and Goldbach-Waring, of producing an abundance of primes and almost primes can be formulated in terms of saturation numbers. This allows for their investigation more generally in terms of orbits of affine linear and nonlinear morphisms. We review some highlights and recent developments.

Problems and results on combinatorial properties of primes

Zhiwei Sun

(Nanjing University)

Abstract: Combinatorial properties of primes depend on the exact values (not asymptotic behaviors) of primes. In this talk we give a survey of problems and results on combinatorial properties of primes. In particular, we introduce various results and conjectures of the speaker on the prime-counting function.

Anticyclotomic Iwasawa main conjecture for Rankin-Selberg motives

Yichao Tian

(AMSS, Chinese Academy of Sciences)

Abstract: Let M be the Rankin-Selberg motive arising from a regular algebraic conjugate self-dual cuspidal automorphic representations of minimal weight on $GL_n \star GL_{n+1}$ over a CM number field F . Consider an anti-cyclotomic \mathbb{Z}_p^d -extension F_∞ / F such that M is good ordinary at the p -adic primes ramified in F_∞ . In a recent joint work with Yifeng Liu and Liang Xiao, we prove that under some technical assumptions, the characteristic ideal of the

Bloch-Kato Selmer group for M along F_∞/F contains the corresponding p -adic L -function, constructed previously by Yifeng Liu.

On a sum involving the integral part function

Jie Wu

(CNRS & Université Paris-Est Créteil)

Abstract: Let f be an arithmetic function satisfying some simple conditions. The aim of this paper is to establish some asymptotic estimates for quantities

$$\psi_f(x) := \sum_{n \leq x} \Lambda(n) f\left(\frac{x}{n}\right), \quad \pi_f(x) := \sum_{p \leq x} f\left(\left[\frac{x}{p}\right]\right)$$

for $x \rightarrow \infty$, where $\Lambda(n)$ is the von Mangoldt function and $[t]$ is the integral part of $t \in \mathbb{R}$. These generalise or sharpen some recent results of Saito-Suzuki-Takeda-Yoshida. As an application, we show that

$$\sum_{p \leq x, \left[\frac{x}{p}\right] \text{ is prime}} 1 \sim \left(\sum_p \frac{1}{p(p+1)} \right) \frac{x}{\log x}$$

This is a joint work with Hengcai Tang.

The Brun-Titchmarsh Theorem

Ping Xi

(Xi'an Jiaotong University)

Abstract: The classical Brun-Titchmarsh theorem gives an upper bound, which is of correct order of magnitude, for the number of primes in an individual arithmetic progression. We will discuss our recent work on sharpening this theorem with better constants by combining Dirichlet polynomials, character/exponential sums, ℓ -adic cohomology and spectral theory of automorphic forms. If time permits, we also mention its connection with the Landau-Siegel zero and subconvex bounds for Dirichlet L -functions. This is a joint work with Junren Zheng.

Counting lattice points in central simple algebras with a given

characteristic polynomial

Fei Xu

(Capital Normal University)

Abstract: Eskin, Mozes and Shah determined an asymptotic formula for integral matrices with a given irreducible characteristic polynomial over \mathbb{Z} . We'll extend this result to a central simple algebra based on our previous work about counting integral points in homogeneous spaces. This is a joint work in progress with Jiaqi Xie.

Log-concavity of Kazhdan-Lusztig polynomials of uniform matroids

Libo Yang

(Nankai University)

Abstract: Elias, Proudfoot and Wakefield conjectured that the Kazhdan-Lusztig polynomial of every matroid is log-concave. This interesting conjecture remains widely open. In this talk I will show how to prove this conjecture for uniform matroids and q -uniform matroids. This is based on my joint works with Alice Gao, Ethan Li, Matthew Xie, Philip Zhang, and Zhong-Xue Zhang.

Algorithms of the Möbius function by random forests and neural networks

Yangbo Ye

(The University of Iowa)

Abstract: The Möbius function contains important arithmetic information, but its known algorithms are all based on integer factorization and hence are exponentially slow. In this talk, novel algorithms of the Möbius function by machine learning techniques without factorization will be presented.

Elliptic curves and quadratic forms

Shuai Zhai
(Shandong University, Qingdao)

Abstract: In this talk, I will discuss fundamental results concerning elliptic curves and explore the connections between the number of representations of integers by quadratic forms, K -groups, the class number of imaginary quadratic fields, and the central L -values of elliptic curves.

Combinatorial arguments in sums over primes

Yitang Zhang
(University of California Santa Barbara)

Abstract: Many problems in analytic number theory are reduced to estimating certain sums over primes. In this field the combinatorial arguments introduced by I.M. Vinogradov, Pan Cheng Dong, R.C. Vaughan, D.R. Heath-Brown and others play important roles. In this talk we will summarize their work, and describe a new argument that can be used to break the barriers of the Bombieri-Vinogradov theorem.

Ultraproduct cohomology and the decomposition theorem

Weizhe Zheng
(AMSS, Chinese Academy of Sciences)

Abstract: Ultraproducts of étale cohomology provide a large family of Weil cohomology theories for algebraic varieties. Their properties are closely related to questions of ℓ -independence and torsion-freeness of ℓ -adic cohomology. I will present recent progress in ultraproduct cohomology with coefficients and applications, such as an integral ℓ -adic decomposition theorem for l large enough. This talk is based on joint work with Anna Cadoret.

Post-quantum cryptography, sphere packing and sphere covering

Chuanming Zong
(Tianjin University)

Abstract: On July 5, 2022, the National Institute of Standards and Technology announced four possible post-quantum cryptography standards, three of them are based on lattice theory. It is well-known that the security of the lattice cryptography relies on the hardness of the shortest vector problem (SVP) and the closest vector problem (CVP). In fact, the SVP is a sphere packing problem and the CVP is a sphere covering problem. In this talk we will show these connections and present some recent progresses in quantum computing, sphere packing and sphere covering.