

2024 International Summer School of Algebraic Geometry, Fudan University



Shanghai Center for Mathematical Sciences



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SUMMER SCHOOL INFORMATION



Speakers

- Wanchun Shen (Harvard University)
- Ruijie Yang (Humboldt-Universität zu Berlin)
- Ziquan Zhuang (Johns Hopkins University)
- Botong Wang (University of Wisconsin-Madison)
- Chen Jiang (Fudan University)

Organizers

- Zhi Jiang (SCMS)
- Zhiyuan Li (SCMS)
- Chen Jiang (SCMS)
- Jun Li (SCMS)

Conference Venue

Gu Lecture Hall, Shanghai Center for Mathematical Sciences(Second Floor)

Jiangwan Campus, Fudan University
2005 Songhu Road, Yangpu District, Shanghai
Phone: 021-31243889

谷超豪报告厅, 上海数学中心 (2楼)
上海市杨浦区淞沪路 2005 号, 复旦大学江湾校区
电话: 021-31243889



SCHEDULE

| Time | Schedule | |
|----------------|-------------------------|---|
| 07/17 Check-in | | |
| 07/18 | | |
| 9:30-10:00 | Sign In (Lobby of SCMS) | |
| 10:00-12:00 | Ruijie Yang | Title: Introduction to multiplier ideals and Milnor fibers |
| 12:00-14:30 | Lunch & Break | |
| 14:30-16:30 | Wanchun Shen | Title: Introduction to rational and Du Bois singularities |
| 07/19 | | |
| 10:00-12:00 | Ruijie Yang | Title: Introduction to p-adic zeta function and monodromy conjecture |
| 12:00-14:30 | Lunch & Break | |
| 14:30-16:30 | Wanchun Shen | Title: Introduction to the Du Bois complexes |
| 07/20 | | |
| 10:00-12:00 | Ruijie Yang | Title: Introduction to V-filtration of Kashiwara and Malgrange and higher version of multiplier ideals |
| 12:00-14:30 | Lunch & Break | |

| | | |
|-----------------|---------------|---|
| 14:30-16:30 | Wanchun Shen | Title: Survey of higher singularities |
| 07/21 | | |
| 10:00-12:00 | Attendees | Free Discussion |
| 14:30-16:30 | Attendees | Free Discussion |
| 07/22 | | |
| 09:30-11:30 | Botong Wang | Title: Hodge theory in combinatorial geometry |
| 11:30-13:30 | Lunch & Break | |
| 13:30-15:30 | Ziquan Zhuang | Title: Stability and boundedness of klt singularities |
| 07/23 | | |
| 09:30-11:30 | Botong Wang | Title: Hodge theory in combinatorial geometry |
| 11:30-13:30 | Lunch & Break | |
| 13:30-15:30 | Ziquan Zhuang | Title: Stability and boundedness of klt singularities |
| 16:00-18:00 | Chen Jiang | Title: A combinatorial problem on partitions and its application in algebraic dynamical system |
| 07/24 | | |
| 09:20-09:30 | Photo | |
| 09:30-11:30 | Botong Wang | Title: Hodge theory in combinatorial geometry |
| 11:30-13:30 | Lunch & Break | |
| 13:30-15:30 | Ziquan Zhuang | Title: Stability and boundedness of klt singularities |
| 07/25 Departure | | |

Titles and Abstracts

-----07/18-----

Ruijie Yang

Title: Introduction to multiplier ideals and Milnor fibers

Abstract: Today, we will start with a viewpoint pioneered by Arnold's school, where one can understand singularity via asymptotic integrals. Multiplier ideals in birational geometry natural arise from this perspective. A related topic is Gelfand's problem on meromorphic extension of integrals of complex powers, where Bernstein-Sato polynomials appear as a natural invariant. Along the way, Milnor fibers and nearby/vanishing cycle functors show up as crucial topological invariants.

Wanchun Shen

Title: Introduction to rational and Du Bois singularities

Abstract: The study of singularities is an important aspect of algebraic geometry. In the first lecture, we give a gentle introduction to two particular classes of singularities, the rational and Du Bois singularities.

Through examples, we will see how birational geometry comes into play with the theory of differential operators, leading to the notions of higher singularities, to be discussed later in the lecture series.

-----07/19-----

Ruijie Yang

Title: Introduction to p-adic zeta function and monodromy conjecture

Abstract: In this lecture, I will discuss Igusa's p-adic zeta function from his work on counting solution of congruence equations, which will be linked to the singularity of hypersurfaces in a mysterious way.

Wanchun Shen

Title: Introduction to the Du Bois complexes

Abstract: To get a better understanding of Du Bois singularities, we take a closer look into the "Du Bois complexes" that feature in their definition. These objects arise naturally from Deligne's mixed Hodge theory for singular varieties, and attracted attention recently due to their importance in the study of higher singularities.

-----07/20-----

Ruijie Yang

Title: Introduction to V-filtration of Kashiwara and Malgrange and higher version of multiplier ideals

Abstract: Today, we will see how Hodge theory naturally enters into the picture and why mixed Hodge modules capture much more refined information. The V-filtration of Kashiwara-Malgrange will be introduced as an important tool. Towards the end of this lecture, we will introduce Hodge-theoretic refinement of multiplier ideals, including Hodge ideals by Mustata-Popa and higher multiplier ideals by Schnell-Yang.

Wanchun Shen

Title: Survey of higher singularities

Abstract: In the last lecture, we discuss some refinements of rational and Du Bois singularities, known as the k -rational and k -Du Bois singularities. We give an overview of the main properties of these singularities in the local complete intersection (lci) case, and open problems beyond the lci case.

-----07/22-----

Botong Wang

Title: Hodge theory in combinatorial geometry

Abstract: In these lectures, we will give a survey on the recent resolution of two conjectures in matroid theory. The first one is the Heron-Rota-Welsh conjecture by Adiprasito-Huh-Katz, and the second one is the Dowling-Wilson conjecture by Braden-Huh-Matherne-Proudfoot-Wang. The main idea is to attach algebraic geometric invariants to a given matroid, and use ideas from Hodge theory to derive combinatorial properties.

Ziquan Zhuang

Title: Stability and boundedness of klt singularities

Abstract: Donaldson and Sun showed that smoothable Kähler-Einstein Fano varieties have algebraic metric tangent cones, and they conjectured that these metric tangent cones only depend on the algebraic structure of the singularities. I'll talk about a local K-stability theory of singularities developed in the past few years that proves Donaldson-Sun's conjecture and goes beyond. The first two lectures will focus on a generalization of Donaldson-Sun's conjecture called the Stable Degeneration Conjecture, while the last lecture will be about the boundedness of singularities.

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Chen Jiang

Title: A combinatorial problem on partitions and its application in algebraic dynamical system

Abstract: A partition of an positive integer is a way of writing this positive integers into the sum of several integers. Partitions are classical objects in combinatoric. I will introduce a linear algebra problem from partitions and its solution. Then I will explain its application in algebraic dynamical systems.

-----07/24-----

Botong Wang

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ACCOMMODATION



SCMS Guest House

Jiangwan Campus, Fudan University
2005 Songhu Road, Yangpu District, Shanghai
Tel: 021-31243777
(Breakfast not included)

上海数学中心专家楼
地址：上海市淞沪路 2005 号，复旦大学江湾校区
前台电话：021-31243777
(不含早餐)



DIRECTION

To SCMS Guest House (on campus)

From Pudong Airport (PVG)

- Taxi: takes about 50mins and costs around 170RMB
- Subway: Line-2 and Line-10 to Xinjiangwancheng Station, and walk about 5mins to No.3 Gate of Jiangwan Campus, Fudan University
- Take Maglev Speed Train to Longyang Road Station(50RMB), then take taxi or subway

From Hongqiao Airport (SHA)

- Taxi: takes about 50mins and costs around 95RMB
- Submay: Line-10 to Xinjiangwancheng Station, and walk 5mins to No.3 Gate of Jiangwan Campus, Fudan University

SCMS Guest House is next to the No.3 Gate of Jiangwan Campus, Fudan University(off-campus). Since it is not open to the public, the gate to the guest house is kept locked. You need to ring a bell when you arrive



DINING INFORMATION



Dining hall on Campus:

Please use your lunch coupon for lunch at dining hall(first floor)

Restaurants in U-Fun(悠方) Shopping Mall:

Located near No.3 Gate of Jiangwan Campus(15mins walking from SCMS)

Wujiaochang(五角场) Area:

There are many fancy restaurants in shopping malls in this area; it takes 15mins from Campus to get there via the subway Line-10



CENTER INFORMATION/ IT SERVICE

SCMS Hours

Monday-Friday from 9:30am-5:30pm
Keycard needed for off-hour access

Mail

The mailing address of SCMS is:
Shanghai Center for Mathematical Sciences Jiangwan Campus, Fudan
University
2005 Songhu Road, Yangpu District, Shanghai
Postcode: 200438

WIFI(07.18-07.24) eduroam

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Password: Scms2024

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Password: Scms2024