# Workshop on Fano Varieties

## **Time and Venue:**

**Time:** Monday, June 23rd to Friday, June 27th, 2025 **Venue:** Lecture Hall, Jiayibing Building (2nd Floor, Jingchunyuan 82), BICMR, Peking University

# **Invited speakers:**

Osamu Fujino (Kyoto University) Kento Fujita (Osaka University) Kenta Hashizume (Niigata University) Zhengyu Hu (Chongqing Tech) Masataka Iwai (Osaka University) Zhan Li (Sustech) Roberto Svaldi (University of Milan) Sho Tanimoto (Nagoya University) Zheng Xu (PKU) Chenyang Xu (Princeton) Yue Yu (Caltech)

## **Contacts :**

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Schedule		
Organizers	Haidong Liu (Sun Yat-sen University)	
	Zhiyu Tian (Peking University)	
Date	June 23– June 27 (Monday to Friday)	
	Lecture Hall, Jiayibing Building (2nd Floor, Jingchunyuan 82), BICMR, Peking	
Location	University	
Day 1 June 23, 2025 (Monday)		
Time	Speaker	Title
10:00-10:30		Sign in
10:30-12:00	Osamu Fujino	Minimal model theory for projective morphisms between complex analytic spaces
12.00-13.30	Lunch Time	
13:30-15:00	Chenyang Xu	Discreteness of volumes
15:00-15:30	Afternoon Tea Break	
15:30-17:00	Kenta Hashizume	On boundedness and moduli space of special klt-trivial
		fibrations
Day 2 June 24, 2025 (Tuesday)		
Time	Speaker	Title
10:00-10:30		Sign in
10:30-12:00	Sho Tanimoto	Homological stability and Manin's conjecture
12:00-13:30		Lunch Time
13:30-15:00	Kento Fujita	On the coupled Ding stability and the Yau-Tian-
		Donaldson correspondence for Fano manifolds
15:00-15:30	Afternoon Tea Break	
15:30-17:00	Zhan Li	Automorphism Groups and Homogeneous Fibrations on
		Algebraic Varieties
17:30		Banquet
Day 3 June 25, 2025 (Wednesday)		
Time	Speaker	Title
10:00-10:30		Sign in
10:30-12:00	Yue Yu <sup>*</sup>	F-bundles, mirror symmetry and birational invariants
12:00-13:30		Lunch Time
13:30-15:00	Zhengyu Hu	Minimal model theory and its generalizations
15:00-15:30	Afternoon Tea Break	
15:30-17:00	Masataka Iwai	Inequalities for the second Chern class and structure theorems
Day 4 June 26, 2025 (Thursday)		
Time	Speaker	Title
10:00-10:30		Sign in
10:00-11:30	Roberto Svaldi	Boundedness theorems for fibered K-trivial varieties
11:30-13:00		Lunch Time
13:00-14:30	Zheng Xu	On the Abundance Conjecture

## Workshop on Fano Varieties

\* Online talk

### **Title and Abstract**

### Speaker: Osamu Fujino (Kyoto University)

**Title:** Minimal model theory for projective morphisms between complex analytic spaces **Abstract:** In this talk, I will explain some recent developments in the minimal model theory for projective morphisms between complex analytic spaces. Over the past few years, we have succeeded in establishing a framework for minimal model theory in this setting. I hope this framework will prove useful in the study of complex analytic singularities and the degenerations of projective varieties.

#### Speaker: Chenyang Xu (Princeton)

#### Title: Discreteness of volumes

**Abstract:** (Joint with Ziquan Zhuang) The concept of local volume of a klt singularity, which is the infimum of normalized volumes of all valuations centered at the singularity, plays a central role in the local stability theory. The Stable Degeneration Theorem says any klt singularity admits a volume preserved degeneration to a K-semistable log Fano cone singularity. In this talk, I will show that all K-semistable log Fano cone singularities with volume bounded from below are bounded. As a consequence, this implies that the set of normalized volumes of all klt singularities has 0 as its only accumulation point.

#### Speaker: Kenta Hashizume (Niigata University)

Title: On boundedness and moduli space of special klt-trivial fibrations

**Abstract:** A klt-trivial fibration is a kind of fibration which often appears in birational geometry. In this talk, I will introduce the boundedness result and the existence of the coarse moduli space of special klt-trivial fibrations over curves. I will mainly explain the boundedness of the special klt-trivial fibrations over curves with some fixed invariants. This talk is based on joint works with Masafumi Hattori.

#### Speaker: Sho Tanimoto (Nagoya University)

Title: Homological stability and Manin's conjecture

**Abstract:** I present our proofs for a version of Manin's conjecture over \$F\_q\$ for q large and Cohen—Jones—Segal conjecture over C for rational curves on split quartic del Pezzo surfaces. The proofs share a common method which builds upon prior work of Das—Tosteson. The main ingredients of this method are (i) the construction of bar complexes formalizing the inclusion-exclusion principle and its point counting estimates, (ii) dimension estimates for spaces of rational curves using conic bundle structures, (iii) estimates of error terms using arguments of Sawin— Shusterman based on Katz's results, and (iv) a certain virtual height zeta function revealing the compatibility of bar complexes and Peyre's constant. Our argument verifies the heuristic approach to Manin's conjecture over global function fields given by Batyrev and Ellenberg–Venkatesh, and it is a nice combination of various tools from algebraic geometry (birational geometry of moduli spaces of rational curves), arithmetic geometry (simplicial schemes, their homotopy theory, and Grothendieck—Lefschetz trace formula), algebraic topology (the inclusion-exclusion principle and Vassiliev type method of the bar complexes) and some elementary analytic number theory. This is

joint work with Ronno Das, Brian Lehmann, and Phil Tosteson with a help by Will Sawin and Mark Shusterman.

#### Speaker: Kento Fujita (Osaka University)

Title: On the coupled Ding stability and the Yau-Tian-Donaldson correspondence for Fano manifolds

**Abstract:** We interpret the reduced coupled Ding stability of Fano manifolds in the notion of reduced coupled stability thresholds. As a corollary, we solve a modified version of the conjecture by Hultgren and Witt Nystroem for coupled Kaehler-Einstein metrics on Fano manifolds. This is a joint work with Yoshinori Hashimoto.

#### Speaker: Zhan Li (Southern University of Science and Technology)

Title: Automorphism Groups and Homogeneous Fibrations on Algebraic Varieties

**Abstract:** Algebraic varieties with nef anticanonical bundles exhibit homogeneous structures for their Albanese morphisms and maximal rationally chain-connected (MRC) fibrations. In this talk, we examine the relationship between automorphism groups and these homogeneous structures. Besides, a classical theorem by Nishi and Matsumura establishes a natural group homomorphism associated with the Albanese morphism, which induces the Chevalley decomposition of the automorphism group up to an isogeny. We extend this perspective by proving an analogous result for the MRC fibrations. This is joint work with Jinsong Xu.

#### Speaker: Yue Yu\*(Caltech)

Title: F-bundles, mirror symmetry and birational invariants

**Abstract:** I will introduce F-bundles, the spectral decomposition theorem and the equivariant unfolding theorem. I will discuss applications to quantum cohomology, mirror symmetry and birational invariants. Based on arXiv preprints 2411.02266, 2505.09950 and work in progress with Katzarkov, Kontsevich, Pantev.

### Speaker: Zhengyu Hu (Chongqing Tech)

Title: Minimal model theory and its generalizations.

**Abstract:** I will give an introduction to minimal model theory for higher dimensional varieties/pairs. And thereafter I will talk some of the generalizations for dlt generalized pairs and their deformations. The last part is based on a joint work with C. Birkar.

### Speaker: Masataka Iwai(Osaka University)

Title: Inequalities for the second Chern class and structure theorems

Abstract: It was shown by Miyaoka and Yau that for any  $n\$ -dimensional smooth projective complex variety X with an ample canonical divisor, the Miyaoka–Yau inequality  $2(n+1)c_2(X)c_1(X)^{n-2} \ge n c_1(X)^{n}$  holds. Moreover, if the equality holds in this inequality, then the universal cover of X is isomorphic to the unit ball in  $\mbox{mathbb}(C)^n$ . In this talk, I will present several inequalities involving the second Chern class for projective klt varieties and the structure theorems when the equality holds. This talk is based on joint work with Shin-ichi Matsumura (Tohoku University) and Niklas Muller (University of Duisburg-Essen).

### Speaker: Roberto Svaldi (University of Milan)

Title: Boundedness theorems for fibered K-trivial varieties

**Abstract:** I will report on work in collaboration with Engel, Filipazzi, Greer and, Mauri on boundedness results for fibered K-trivial varieties. We will outline a proof that irreducible Calabi-Yau varieties admitting an abelian or K3 fibration are birationally bounded in a fixed dimension; and similarly, that Lagrangian fibrations of symplectic varieties, in a fixed dimension, are analytically bounded.

### Speaker: Zheng Xu (PKU)

Title: On the Abundance Conjecture

**Abstract:** In this talk, I will discuss the abundance conjecture, a central problem in birational geometry. I will begin by reviewing the main known results related to this conjecture and outlining the key ideas behind them.

I will then present my recent joint work with Jihao Liu. In particular, I will explain how the nonvanishing conjecture implies the abundance conjecture in the case where the numerical dimension is 1. I will also prove the abundance conjecture for fivefolds with numerical dimension 1 and Kodaira dimension at least 0.

# **Entering the campus**

For non-PKU personnel, you may enter the campus by swiping your ID card or presenting your passport in the Authorized Entry Period.

During the conference, it is recommended that you enter through the East Gate and Southeast Gate.

During this period, you may enter and exit the campus unlimited times. If you experience any issue on swiping your ID card upon first entry, please ask the security guard to check the "Frequent Visitor List(常客名单)".

## Accommodation

As you requested, we have booked the room for registered participants who are outside Beijing during 22-27 June, at No.1 and No. 9 building of Zhongguanxinyuan Hotel (中关新园 1 号楼和 9 号楼), No.126 Zhongguancun North Street, Haidian District, Beijing (北京市海淀区中关村北大街 126 号).

BICMR will not be able to cover the accommodation for all conference participants.

If your accommodation dates change, please contact us as soon as possible to make the necessary adjustments. There is no guarantee that housing will be available outside of your confirmed dates.



# Directions

### From Beijing Capital Airport (PEK):

Taxi: About 1-2 hours (depending on the time of your arrival), 100-150 RMB.

**Metro:** Take Capital Airport Express to Sanyuanqiao (三元桥) station, then transfer to subway line 10 (counter-clockwise loop) to Haidian Huangzhuang (海淀黄庄) station, then transfer to subway line 4 (northbound) to Peking University East Gate (北京大学东门) station. About 1.5 hours and 30 RMB.

### From Beijing Daxing Airport (PKX):

Taxi: About 1.5-2 hours (depending on the time of your arrival), 300-400 RMB.

Metro 1: Take Daxing Airport Express to Caoqiao (草桥) station, then transfer to subway line 19 (northbound) to Mudanyuan (牡丹园) station, then transfer to subway line 10 (counter-clockwise loop) to Haidian Huangzhuang (海淀黄庄) station, then transfer to subway line 4 (northbound) to Peking University East Gate (北京大学东门) station. About 1.5 hours and 40 RMB. Metro 2: Take Daxing Airport Express to Caoqiao (草桥) station, then transfer to subway line 10 (clockwise loop) to Haidian Huangzhuang (海淀黄庄) station, then transfer to subway line 10 (clockwise loop) to Haidian Huangzhuang (海淀黄庄) station, then transfer to subway line 4 (northbound) to Peking University East Gate (北京大学东门) station. About 2 hours and 40 RMB. Metro+Taxi: Take Daxing Airport Express to Caoqiao (草桥) station, then go out and take a taxi there. About 1.5 hours and 120-180 RMB.

# **Dining information**

**Meals:** Lunch box will be provided during the conference. Breakfast (included in hotel) and dinner are at your own expense. If you have any special dietary requirements, please let us know in advance.

### **Dining inside campus**

Most restaurants on campus are only open to students. There are also restaurants/cafés on campus that are open to the public. These include:

Chinese restaurant of Shaoyuan (勺园中餐厅) Western restaurant of Shaoyuan (勺园西餐厅) 3W Coffee Paradise Coffee Faculty's house (教师之家) (Note: you may need to be accompanied by a faculty/postdoc to go there). There are also food trucks on campus.

### Dining outside campus

Restaurants are available in your hotel.

Changchunyuan (畅春园) area: there are many restaurants outside the small west gate (小西门).

Haidianhuangzhuang (海淀黄庄) area, Wudaokou (五道口) area, and Suzhoujie (苏州街) area have many fancier places and some shopping malls. About 30 minutes walking distance from the campus.

For foreign visitors who want to try some of the best dishes/pubs in Beijing, we recommend visiting Sanlitun (三里屯) area or the Nanluoguxiang (南锣鼓巷). You need to take public transport/taxi to these places.