

GUANGXI NORMAL UNIVERSIT

# The 6th China-Japan Geometry Conference

# Conference Guide

Guilin, China December 23-29, 2021



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#### Introduction

The 6th China-Japan geometry conference is going to be held in Guilin, China (Guangxi Normal University) from Dec. 23-29, 2021, which is delayed by Covid-19. The 1st Japan-China geometry conference was held in Kyoto and Nara, Japan from September 6-12, 2015 (Kyoto University and Nara Women's University). The 2nd China-Japan geometry conference was held in Fuzhou, China from September 6-12, 2016 (Fujian Normal University). The 3rd Japan-China geometry conference was held in Sendai, Japan from September 1-7, 2017 (Tohoku University). The 4th China-Japan geometry conference was held in Hefei, China from September 6-12, 2018 (University of Science and Technology of China). The 5th Japan-China geometry conference was held in Kusatsu, Japan from September 1-7, 2019 (Ritsumeikan University).

#### **Sponsors:**

Guangxi Normal University

**Beijing Normal University** 

Osaka City University, Advanced Mathematical Institute, MEXT joint Usage/Research Center on Mathematics and Theoretical physics

Conference Time: December 23-29, 2021

Conference Venue: Jin-Gui hall on the 2th floor, Guilin Bravo Hotel, Guilin



#### **Scientific Committee:**

Akito Futaki (Tsinghua University) Toshiki Mabuchi (Osaka University) Yoshihiro Ohnita (Osaka City University) Anmin Li (Sichuan University) Gang Tian (Peking University) Weiping Zhang (Nankai University)

#### **Organizing Committee:**

Qing-Ming Cheng (Fukuoka University) Ryushi Goto (Osaka University) Ryoichi Kobayashi (Nagoya University) Reiko Miyaoka (Tohoku University) Hitoshi Moriyoshi (Nagoya University) Takashi Shioya (Tohoku University) Qing Ding (Fudan University) Haizhong Li (Tsinghua University) Jiayu Li (University of Science and Technology of China) Zizhou Tang (Nankai University) Changping Wang (Fujian Normal University)

#### **Local Organizers:**

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Beijing Natural Science Foundation (No. Z190003),

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## Schedule

	December 23, Thursday			
		Arrival day		
	Z	<b>December 24, Frida</b> oom Meeting: 826 090 0 Code: 123456		
Chair	Time	Speaker	Title	
	Beijing time: 09:00-09:15 Tokyo time: 10:00-10:15	Opening speeches by Prof. G. Tian and Prof. R. Miyaoka	Opening ceremony	
	Beijing time: 09:20-10:10 Tokyo time: 10:20-11:10	Akito Futaki (Tsinghua University)	Deformation quantization and obstructions to the existence of closed star products	
Weiping Zhang	Beijing time: 10:15-11:05 Tokyo time: 11:15-12:05	Kefeng Liu (Chongqing University of Technology and UCLA)	Extensions of holomorphic forms	
	Beijing time: 11:10-11:30 Tokyo time: 12:10-12:30	Photo time		
	Beijing time: 11:30-14:00 Tokyo time: 12:30-15:00		Lunch time	



Qing-Ming	Beijing time: 14:00-14:50 Tokyo time: 15:00-15:50	Yoshinori Hashimoto (Tokyo Inst. Tech.)	Anticanonically balanced metrics and the Hilbert-Mumford criterion for the delta_m-invariant of Fujita-Odaka
Cheng	Beijing time: 14:55-15:10 Tokyo time: 15:55-16:10		Tea Break
	Beijing time: 15:10-16:00 Tokyo time: 16:10-17:00	Shouhei Honda ( Tohoku University)	Weakly non-collapsed RCD spaces are strongly non-collapsed
H. Moriyoshi	Beijing time: 16:05-16:55 Tokyo time: 17:05-17:55	Eiji Inoue (Riken )	Perelman's entropy in Kähler geometry
	Beijing time: 17:30-19:30 Tokyo time: 18:30-20:30	Reception	
<b>December 25, Saturday</b> Zoom Meeting: 815 680 93649 Code: 123456			
Chair	Time	Speaker	Title
	Beijing time: 09:00-09:50 Tokyo time: 10:00-10:50	Gang Tian (Peking University)	Recent progress on Kahler-Ricci flow
R. Miyaoka	Beijing time: 09:55-10:30 Tokyo time: 10:55-11:30		Tea Break

	Beijing time: 10:30-11:20 Tokyo time: 11:30-12:20	Toshiki Mabuchi (Osaka University)	On the problem of deformation invariance of plurigenera for compact Kähler manifolds
	Beijing time: 11:30-14:00 Tokyo time: 12:30-15:00		Lunch time
Haizhong Li	Beijing time: 14:00-14:50 Tokyo time: 15:00-15:50	Bo Liu (East China Normal University)	Differential K-theory, eta-invariant, and localization
	Beijing time: 14:55-15:20 Tokyo time: 15:55-16:20		Tea Break
	Beijing time: 15:20-16:10 Tokyo time: 16:20-17:10	Atsushi Fujioka (Kansai University)	Equivariant projections between spaces of closed equicentroaffine curves
R. Goto	Beijing time: 16:15-17:05 Tokyo time: 17:15-18:05	Ayato Mitsuishi (Fukuoka University)	Eigenvalues of p or ∞-Laplacian on metric (measure) spaces
	Beijing time: 17:30-19:30 Tokyo time: 18:30-20:30		Dinner time



	December 26, Sunday Zoom Meeting: 881 881 79993 Code: 123456			
Chair	Time	Speaker	Title	
Anmin Li	Beijing time: 08:30-09:20 Tokyo time: 09:30-10:20	Daisuke Kazukawa (Osaka University)	Convergence of metric transformed spaces	
	Beijing time: 09:25-09:40 Tokyo time: 10:25-10:40		Tea Break	
	Beijing time: 09:40-10:30 Tokyo time: 10:40-11:30	Youhei Sakurai (Saitama University)	Liouville theorems for harmonic map heat flow along ancient super Ricci flow via reduced geometry	
R. Kobayashi	Beijing time: 10:35-11:25 Tokyo time: 11:35-12:25	Guozhen Wang (Shanghai Center for Mathematical Sciences)	Classical and motivic stable homotopy groups	
	Beijing time: 11:30-14:00 Tokyo time: 12:30-15:00		Lunch time	
Changping Wang	Beijing time: 14:00-14:50 Tokyo time: 15:00-15:50	Shin Nayatani (Nagoya University)	First-eigenvalue maximization and embedding optimization	
wang	Beijing time: 14:55-15:20 Tokyo time: 15:55-16:20		Tea Break	



Zizhou Tang	Beijing time: 15:25-16:10 Tokyo time: 16:25-17:10 Beijing time: 16:15-17:05 Tokyo time: 17:15-18:05 Beijing time: 17:30-19:30	Qianzhong Ou (Guangxi Normal University) Tadayuki Watanabe (Kyoto University)	Liouville theorem for a class semilinear elliptic problem on Heisenberg group Families of diffeomorphisms of some 4-manifolds constructed by graphs Dinner time
	Tokyo time: 18:30-20:30		Dimer time
	10.30-20.30	December 27, Monda	ay
		Free discussion	
		December 28, Tuesd	av
	Z	oom Meeting: 884 137 0 Code: 123456	-
Chair	Time	Speaker	Title
	Beijing time: 09:00-09:50 Tokyo time: 10:00-10:50	Hiroshi Tamaru (Osaka City University)	Codimension one Ricci soliton subgroups of solvable Iwasawa groups
T. Shioya	Beijing time: 09:55-10:25 Tokyo time: 10:55-11:25	Tea Break	
	Beijing time: 10:25-11:15 Tokyo time: 11:25-12:15	Hikaru Yamamoto (Tsukuba University)	An Example of the Noncompact Yamabe Flow having the Infinite-time Incompleteness



	Beijing time: 11:30-14:00 Tokyo time: 12:30-15:00	Lunch time		
	Beijing time: 14:00-14:50 Tokyo time: 15:00-15:50	Wangjian Jian (Chinese Academy of Sciences)	Volume estimate along Ricci flow and application to Kahler-Ricci flow	
Y. Ohnita	Beijing time: 14:55-15:20 Tokyo time: 15:55-16:20		Tea Break	
	Beijing time: 15:20-16:10 Tokyo time: 16:20-17:10	Masashi Yasumoto (Kyushu University)	Construction of discrete surfaces via integrable transformations	
	Beijing time: 16:15-17:05 Tokyo time: 17:15-18:05	Jiyuan Han (Westlake University)	Variational approach to generalized Kähler Ricci Soliton equations and limits of Kähler Ricci flow	
Jiayu Li	Beijing time: 17:10-17:20 Tokyo time: 18:10-18:20	Clo	osing ceremony	
	Beijing time: 17:30-19:30 Tokyo time: 18:30-20:30	Dinner time		
	December 29, Wednesday			
Leaving day				



## Summary

1. Akito Futaki (Tsinghua University)

Title: Deformation quantization and obstructions to the existence of closed star products

Abstract: A star product is a non-commutative product on the set of formal functions, i.e. formal power series with coefficients in smooth functions. Giving a star product is called deformation quantization. The trace of a star product is an algebra character from the non-commutative algebra of formal functions into the abelian algebra of formal constants. The trace is expressed as an  $L^2$  product with a function called the trace density. A star product is said to be closed if the trace density is constant, i.e. the trace is given by the integration. In this talk, we discuss on obstructions to the existence of closed star product as in the similar spirit of K ä ehler geometry.

2. Kefeng Liu (Chongqing University of Technology and UCLA)

Title: Extensions of holomorphic forms

Abstract: I will discuss a new localization method using L^2-Hodge theory to solve obstruction equations to extend holomorphic forms under deformation of complex structures.

3. Yoshinori Hashimoto (Tokyo Inst. Tech.)

Title: Anticanonically balanced metrics and the Hilbert-Mumford criterion for the delta\_m-invariant of Fujita-Odaka

Abstract: The existence of Kähler-Einstein metrics has been actively studied in relation to the Geometric Invariant Theory, and it has been established that it is equivalent to the uniform Ding stability, which is in turn equivalent to Fujita-Odaka's delta invariant being larger than 1. On the other hand, we can consider a finite dimensional approximation of each of these objects: the Kähler-Einstein metrics can be approximated by the anticanonically balanced metrics, the uniform Ding stability by the

Chow-type stability condition defined by Saito-Takahashi, and the delta



invariant by the delta\_m invariant. Rubinstein-Tian-Zhang proved that the anticanonically balanced metrics exist if and only if delta\_m > 1. We prove that they are further equivalent to the Chow-type stability condition, establishing the equivalence of all these finite dimensional approximations: in particular it gives a Hilbert-Mumford type criterion for delta\_m > 1, which is a purely algebro-geometric result proved by means of an analytic method.

#### 4. Shouhei Honda ( Tohoku University)

Title: Weakly non-collapsed RCD spaces are strongly non-collapsed Abstract: A metric measure space is said to be an RCD(K, N) space if the Ricci curvature is bounded below by K, the dimension is bounded above by N and the  $H^{1,2}$ -Sobolev space is Hilbert. Moreover an RCD(K, N) space is said to be non-collapsed if the reference measure coincides with the N-dimensional Hausdorff measure. In this talk we prove that if an RCD(K, N) space has the Hausdorff dimension N, then the space is non-collapsed, up to multiplication of a positive constant to the reference measure. This confirms a conjecture raised by De Philippis-Gigli. This is a joint work with Camillo Brena (Scuola Normale Superiore), Nicola Gigli (SISSA) and Xingyu Zhu (Georgia Tech).

#### 5. Eiji Inoue (Riken)

Title: Perelman's entropy in Kähler geometry

Abstract: K ä hler-Ricci soliton is a K ä hler metric on Fano manifold satisfying an Einstein type equation on Ricci curvature, which generalizes K ä hler-Einstein metric. CscK metric is another generalization of K ä hler-Einstein metric concerned with scalar curvature, which has the advantage that the notion makes sense on general Kähler manifold beyond Fano manifold. I have been studying a framework on a generalization of these two notions which I call mu-cscK metric. On one hand, the notion is motivated by a moment map picture on K ä hler-Ricci soliton. Such moment map picture is a fundamental observation in recent developments on the existence of Kähler-Einstein metric: it is a portal to K-stability and YTD conjecture. Based on this picture, we introduce muK-stability of



polarized variety concerned with the existsence of mu-cscK metrics. I intend to exlpain this perspective only briefly. On the other hand, volume minimization argument in Tian-Zhu's study on K ä hler-Ricci soliton is another fundamental observation apart from the moment map picture. In a generalization of Tian-Zhu's result to mu-cscK metric, we encounter Perelman's entropy, which is originally introduced in his analysis of Ricci flow and Ricci soliton. I would like to explain how Perelman's entropy plays a profound role in the theory of mu-cscK metric and muK-stability.

#### 6. Gang Tian (Peking University)

Title: Recent progress on Kahler-Ricci flow

Abstract: The analytic MMP is to study birational geometry of Kahler manifolds by using Ricci flow. In this talk, I will discuss some recent progress.

7. Toshiki Mabuchi (Osaka University)

Titie: On the problem of deformation invariance of plurigenera for compact Kähler manifolds

Abstract: In this talk, we give a report of our recent work on the problem of deformation invariance of plurigenera for compact Kähler manifolds.

8. Bo Liu (East China Normal University)

Title: Differential K-theory, eta-invariant, and localization

Abstract: In 1968, using the topological K-theory, Atiyah and Segal established a localization formula for the equivariant index which computes the equivariant index via the contribution near the fixed point sets of the group action. It is natural to ask whether such localization property holds for more complex spectral invariants, e.g. eta invariant. In this talk, we will provide a localization formula in differential K-theory and use it to obtain a version of localization formula for the equivariant eta invariant with respect to an S^1-action. Furthermore, we will discuss some recent progress on the equivariant eta invariant. This is a joint work with Xiaonan Ma.



#### 9. Atsushi Fujioka (Kansai University)

Title: Equivariant projections between spaces of closed equicentroaffine curves

Abstract: In this talk, we consider the spaces of closed equicentroaffine curves, on which the diffeomorphism group of the circle acts. In particular, we will show the transformation rule of the curvatures for equicentroaffine curves by this action, and obtain equivariant projections from the space of curves in higher dimensional space into the space of plane or space curves.

#### 10. Ayato Mitsuishi (Fukuoka University)

Title: Eigenvalues of p- or  $\infty$ -Laplacian on metric (measure) spaces Abstract: My talk depends on two recent works, by myself and by myself and Qing Liu (Fukuoka University). Both works are inspired by the papers due to Juutinen, Lindqvist and Manfredi (1999) and to Fukagai, Ito and Narukawa (1999). A part of the talk is about a relation between "fake" eigenvalues of p-Laplacian and a certain sequence of metric invariants, called packing radii introduced by Grove and Markvorsen. In this case, a base space is an abstract metric measure space (PI-space). The rest of the talk is about a principal eigenvalue problem of infinity Laplacian on abstract metric spaces.

#### 11. Daisuke Kazukawa (Osaka University)

Title: Convergence of metric transformed spaces

Abstract: Gromov introduced a distance function, called the observable distance, on the set of isomorphism classes of metric measure spaces. The topology induced by the observable distance is based on the concentration of measure phenomenon due to Lévy and V. Milman and is called the concentration topology. He also introduced a natural compactification with respect to the concentration topology. The element of its compactification is called the pyramid and the topology on it is called the weak topology. In this talk, I will explain the metric transformation of metric measure spaces and pyramids, and compare the convergence of the sequence of metric transformed spaces with the original sequence. As an application, we will



show that spheres with standard Riemannian metric converge to an infinite-dimensional Gaussian space in the sense of pyramids as the dimension diverges to infinity.

#### 12. Youhei Sakurai (Saitama University)

Title: Liouville theorems for harmonic map heat flow along ancient super Ricci flow via reduced geometry

Abstract: This talk is based on the joint work with Keita Kunikawa (Utsunomiya university). We have obtained a Liouville theorem for heat equation along ancient super Ricci flow via Perelman's reduced geometry. Recently, we generalize the target spaces, and formulate several Liouville theorems for harmonic map heat flow. In this talk, I will introduce such Liouville theorems. In our Liouville theorems, we impose a growth condition concerning Perelman's reduced distance. For non-positively curved target spaces, our growth condition is sharp. On the other hand, for positively curved target spaces, it is not clear that our growth condition is sharp. However, in the static case, the growth condition can be improved, which is almost sharp in view of the example constructed by Schoen-Uhlenbeck. I will discuss the sharpness in more detail in the talk.

13. Guozhen Wang (Shanghai Center for Mathematical Sciences)

Title: Classical and motivic stable homotopy groups

Abstract: The computations of homotopy groups of spheres is a basic problem in topology. Many questions depends on the structure of the stable stems, such as the classification of smooth structures. Recently we developed motivic methods for computing the stable homotopy groups. By introducing the Chow t-structure, we proved the algebraicity of the special fiber of the motivic deformation. This enabled us to compute the first 90 stems of the stable homotopy groups of spheres. As an application, we get the number of smooth structures of spheres between dimension 5 and 90.

14. Shin Nayatani (Nagoya University)

Title: First-eigenvalue maximization and embedding optimization Abstract: In 1970, Hersch proved that on the two-sphere the first



eigenvalue (multiplied by area for scale invariance) was maximized by the round metrics (and by them only). Then in 1973, Berger asked whether a similar scale-invariant quantity was bounded from above on an arbitrary compact manifold. In this talk, after reviewing the progress on the Berger problem, I will introduce an eigenvalue maximization problem concerning the Bakry-\'Emery Laplacian on a weighed Riemannian manifold. I will also introduce an embedding optimization problem, and discuss the relation between these two problems.

15. Qianzhong Ou (Guangxi Normal University)

Title:Liouville theorem for a class semilinear elliptic problem on Heisenberg group

Abstract: We talk about a classical semilinear elliptic equation on Heisenberg group and show an entire Liouville theorem that classified completely all solutions to this equation in subcritical case. A pointwise estimate near the isolated singularity was also provided. The soul of the proofs is an a priori integral estimate, which deduced from a generalized Jerison and Lee's formula. This is a joint work with professor Xi-Nan Ma.

16. Tadayuki Watanabe (Kyoto University)

Title: Families of diffeomorphisms of some 4-manifolds constructed by graphs

Abstract: I will explain a cut-and-paste method to construct families of diffeomorphisms of manifolds of dimensions at least 4 by using a higher dimensional analogue of Goussarov-Habiro's trivalent graph surgery in 3-dimension. I will also explain that the families constructed by trivalent graphs admit families of positive scalar curvature (psc) metrics if the manifold X admits one. These families represent elements of  $pi_k(Diff(X))$  that are often nontrivial but lie in the kernel of the map induced by the natural map from Diff(X) to the space of psc metrics on X. This work is partially joint with Boris Botvinnik.



17. Hiroshi Tamaru (Osaka City University)

Title: Codimension one Ricci soliton subgroups of solvable Iwasawa groups

Abstarct: It is known that a simply connected solvable Lie group endowed with a left-invariant Ricci soliton metric can be isometrically embedded into the solvable Iwasawa group of a noncompact symmetric space. Motivated by this result, we classify codimension one subgroups of the solvable Iwasawa groups of irreducible symmetric spaces of noncompact type, whose induced metrics are Ricci solitons. In this talk, we explain this result with emphasis on the background. This talk is based on a joint work with Miguel Dominguez-Vazquez and Victor Sanmartin-Lopez.

18. Hikaru Yamamoto (Tsukuba University)

Title: An Example of the Noncompact Yamabe Flow having the Infinite-time Incompleteness

Abstract: I explain a recent result on the noncompact Yamabe flow which is joint work with Jin Takahashi at Tokyo Institute of Technology. The noncompact Yamabe flow is complicated compared to the compact case. There are many unexpected phenomena from the viewpoint of the compact Yamabe flow. One of the remaining questions is the following. If each Riemannian metric is complete under the Yamabe flow on a noncompact manifold for all time and the long time limit exists, then is the limit also complete? I give the negative answer to this question by giving a counterexample.

19. Wangjian Jian (Academy of Mathematics and Systems Science, Chinese Academy of Sciences)

Title: Volume estimate along Ricci flow and application to Kahler-Ricci flow

Abstract: We will focus on the volume estimate along Ricci flow, and talk about their refinements, mainly the non-collapsing estimate and relative volume comparison under different conditions. Then as application, we will show how to apply such volume estimate to study the geometry of



long-time solution of the Kahler-Ricci flow.

#### 20. Masashi Yasumoto (Kyushu University)

Title: Construction of discrete surfaces via integrable transformations Abstract: Bobenko and Pinkall showed that any discrete minimal surface in Euclidean 3-space can be described by a discrete version of Weierstrass representation from discrete holomorphic functions. Continuing from this result, several discrete Weierstrass-type representations such as Bryant representation for discrete constant mean curvature 1 surfaces in hyperbolic 3-space were obtained by an application of integrable transformations. In this talk we introduce that all such Weierstrass-type representations are given by an application of the Omega dual transformation that is a generalization of the Christoffel transformation. This gives a unified description of all known Weierstrass-type representations, and new representation formulae arise. This is based on joint work with Mason Pember and Denis Polly. If time permits, we also introduce our attempt to obtain new discrete holomorphic functions. We deform a given discrete minimal surface into a new discrete minimal surface. As an application, we propose a new method to create a new discrete holomorphic function corresponding to new discrete minimal surface. This is based on ongoing project with Yoshiki Jikumaru.

#### 21. Jiyuan Han (Westlake University)

Title: Variational approach to generalized Kähler Ricci Soliton equations and limits of Kähler Ricci flow.

Abstract: By using the variational approach, we show that on a log Fano variety, the existence of a generalized Kähler Ricci soliton(e.g, Kähler Einstein, Kähler Ricci soliton) is equivalent to a uniform stability condition (G-uniform g-Ding stable). Under a similar framework, we also show the algebraic uniqueness of Kähler Ricci flow limits on a Fano manifold. This project is a joint work with Chi Li.



# The list of participants

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### **Transportation**

All the participants are arranged to accommodate in Guilin Bravo Hotel. Guilin Bravo Hotel is located near the Rong-Lake, which is a part of the famous two-rivers-four-lakes scenic area in Guilin.

Hotel address: No.14 Rong-lake South Road, Xiangshan District, Guilin, China (Guilin Bravo Hotel)

1. The hotel is 28 km away from Guilin International Airport and 50 minutes away by taxi.

2. It's 2 km away from Guilin South Railway Station.

○ 檜湖船闸	
Rong-Lake	信义路
	天剧院 ng Theater
The Children's Palace 桂林市检察的	桂林宾馆 The Guilin Bravo Hotel
Taohua River	

