



东南大学丘成桐中心 2021 年微分几何会议 10 月 15–18 日

2021 Differential Geometry Conference in Shing-Tung Yau Center
of Southeast University, October 15–18



Infinite, infinite, the secrets of the universe. — Shing-Tung Yau

东南大学丘成桐中心简介

东南大学丘成桐中心于2017年7月7日正式揭牌成立，是学校直接管理的“行政虚体、科研实体”的新型科研机构。由国际数学大师、菲尔兹奖获得者丘成桐院士任中心主任。该中心在丘成桐院士的领导下开展以纯数学研究为基础、应用数学研究为导向的高水平的学术交流和科学研究，发挥先进的数学理论与方法在解决当代工程技术重要问题中的作用，推广丘成桐院士在数学、物理等学科的杰出研究成果，真正发挥高水平理科对工科、医科等应用学科的支撑作用，体现东南大学的交叉学科优势，推进东南大学“双一流”建设，为推动江苏省国民经济和社会发展提供应用基础研究的支撑。同时在丘院士的支持指导下引进和培养高水平的科技人才，在科学研究和人才培养上产生重要的成果。

中心目前设有五个研究方向，涵盖了微分几何、代数几何、代数数论、偏微分方程、图论、数学物理等纯数学研究领域和计算科学、信息科学、数据分析、医学成像、智能电网等应用数学研究领域。根据中心目前研究工作的需要和学科建设的要求，本中心将重点引进纯数学、应用数学(特别是人工智能、数据挖掘、智能控制、图像处理)等相关领域的青年才俊和领军人才，依托学校和相关院系的支持，采取灵活特殊的支持政策，为人才的发展提供广阔的空间。

中心人员由三部分组成：东南大学相关院系与中心发展和研究课题密切相关的教师和研究人员(兼职，不脱离原二级单位)、高水平的国内外聘任研究人员、博士后研究人员和研究生。所有进入中心的人员依托所属学科通过相应学院引进。根据研究项目和发展需要，人员可以不定期的适当调整，成员也可以交叉参与不同的研究方向。

东南大学丘成桐中心诚邀海内外英才加盟，共谋发展。

中心网址：<https://yauc.seu.edu.cn/>

微分几何会议组织者



白淑亮、陈冠亨、李逸、刘海生、王俊、丘成桐

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Time (Beijing)	Speaker	Chair
9:30-9:45	Shing-Tung Yau Opening Ceremony	Jijun Liu
9:45-10:00	Break	
10:00-11:00	Fangyang Zheng	Xiaoli Chao
11:00-11:10	Break	
11:10-12:10	Huichun Zhang	Xiaoli Chao
12:10-14:00	Lunch and Break	
14:00-15:00	Shiping Liu	Shuliang Bai
15:00-15:10	Break	
15:10-16:10	Wei Xia	Guanheng Chen
16:10-16:20	Break	
16:20-17:20	Youlin Li	Guanheng Chen

(1) **Fangyang Zheng (郑方阳, Chongqing Normal University)**

- **Title:** The Hermitian geometry of Strominger connection
- **Abstract:** In this talk we will discuss the geometry of Strominger connection of Hermitian manifolds, based on recent joint works with Quanting Zhao. We will focus on two special types of Hermitian manifolds: Strominger Kähler-like (SKL) manifolds, and Strominger parallel torsion (SPT) manifolds. The first class means Hermitian manifolds whose Strominger connection (also known as Bismut connection) has curvature tensor obeying all Kähler symmetries, and the second class means Hermitian manifolds whose Strominger connection has parallel torsion. We showed that any SKL manifold is SPT, which is known as (an equivalent form of) the *AOUV Conjecture* (namely, SKL implies pluriclosedness). We obtained a characterization theorem for SPT condition in terms of Strominger curvature, which generalizes the previous theorem. We will also discuss examples and some structural results for SKL and SPT manifolds.

(2) **Huichun Zhang (张会春, Sun Yat-sen University)**

- **Title:** One-phase free boundary problems on Alexandrov spaces
- **Abstract:** In this talk, we will introduce some regularity results for variational free boundary problems on Alexandrov spaces with curvature bounded from below. It contains the Lipschitz regularity of solutions, and partial C^α -regularity of its free boundary. This is based on a joint work with Chung-Kwong Chan, and Xi-Ping Zhu.

(3) **Shiping Liu (刘世平, University of Science and Technology of China)**

- **Title:** Bakry-Émery curvature on graphs as an eigenvalue problem
- **Abstract:** Bakry-Émery theory has been a source of spectacular mathematical results. In particular, many geometric and analytic results have been derived on graphs under Bakry-Émery curvature conditions in recent years. The Bakry-Émery curvature at a vertex of a graph is defined via a discrete Bochner-type inequality about the graph Laplacian. I will explain how to reformulate it in terms of the smallest eigenvalue of a rank one perturbation of the so-called curvature matrix. This provides an analogue of the basic fact in Riemannian geometry that the optimal Ricci curvature lower bound at a point is the smallest eigenvalue of the Ricci curvature tensor. Some direct applications will also be presented. This is based on joint works with David Cushing, Supanat Kamtue and Norbert Peyerimhoff.

(4) **Wei Xia (夏炜, Chongqing University of Technology)**

- **Title:** Remarks on obstructions of deforming complex structures and cohomology contractions
- **Abstract:** It is a well-known theorem of Clemens which says that the obstruction classes of deforming the complex structure on a compact Kähler manifold is annihilated by Dolbeault cohomology classes. We will talk about some generalizations of this result to non-Kähler manifolds. In particular, we will show the obstructions of deforming complex structures is related to the Bott-Chern deformations of (p, q) -forms.

(5) **Youlin Li (李友林, Shanghai Jiaotong University)**

- **Title:** Nonexistence and existence of fillable contact structures on 3-manifolds
- **Abstract:** In this talk, we construct infinitely many closed 3-manifolds which admit no symplectic fillable contact structure. All these 3-manifolds are obtained by Dehn surgeries along L -space knots and L -space two-component links. On the other hand, we show that Dehn surgeries along certain knots and links admit Stein fillable contact structures as long as the surgery coefficients are sufficiently large. This is joint work with Fan Ding and Zhongtao Wu.



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Time (Beijing)	Speaker	Chair
10:00-11:00	Wanke Yin	Liang Zhao
11:00-11:10	Break	
11:10-12:10	Bobo Hua	Liang Zhao
12:10-14:00	Lunch and Break	
14:00-15:00	Sheng Rao	Sen Yang
15:00-15:10	Break	
15:10-16:10	Xueyuan Wan	Yang Shen
16:10-16:20	Break	
16:20-17:20	Johnny Lim Khai Yang	Yang Shen

(1) **Wanke Yin (尹万科, Wuhan University)**

- **Title:** Finite type conditions for real hypersurfaces in \mathbb{C}^n
- **Abstract:** In this talk, we will focus on various finite type conditions for smooth pseudo-convex hypersurfaces in \mathbb{C}^n . We will talk about their relations, as well as their roles played in the sub-elliptic estimates. In particular, we will introduce the recent progress on the Bloom conjecture, which are based on the joint works with Xiaojun Huang, Wei Chen, Yinxiang Chen and Pingshan Yuan.

(2) **Bobo Hua (华波波, Fudan University)**

- **Title:** Exponential decay of generalized subharmonic functions on graphs with positive spectrum
- **Abstract:** We prove sharp l^2 decay estimates of nonnegative generalized subharmonic functions on graphs with positive Laplacian spectrum, which generalizes the result by Li and Wang on Riemannian manifolds. This is a joint work with Zhiqin Lu.

(3) **Sheng Rao (饶胜, Wuhan University)**

- **Title:** Deformation limit and bimeromorphic embedding of Moishezon manifolds
- **Abstract:** Let $\pi : \mathcal{X} \rightarrow \Delta$ be a holomorphic family of compact complex manifolds over an open disk in \mathbb{C} . If the fiber $\pi^{-1}(t)$ for each nonzero t in an uncountable subset B of Δ is Moishezon and the reference fiber X_0 satisfies the local deformation invariance for Hodge number of type $(0, 1)$ or admits a strongly Gauduchon metric introduced by D. Popovici, then X_0 is still Moishezon. We also obtain a bimeromorphic embedding $\mathcal{X} \dashrightarrow \mathbb{P}^N \times \Delta$. This talk is based on a joint work with I-Hsun Tsai.

(4) **Xueyuan Wan (万学远, Chongqing University of Technology)**

- **Title:** Curvature of the base manifold of a Monge-Ampère fibration and its existence
- **Abstract:** In this talk, we will consider a special relative Kähler fibration which satisfies a homogenous Monge-Ampère equation, which is called a Monge-Ampère fibration. There exist two canonical types of generalized Weil-Petersson metrics on the base complex manifold of the fibration. For one of the generalized Weil-Petersson metrics, we obtain an explicit curvature formula and prove that the holomorphic bisectional curvature is non-positive, the holomorphic sectional curvature, the Ricci curvature and the scalar curvature are all bounded from above by a negative constant. For a holomorphic vector bundle over a compact Kähler manifold, we shall prove that it admits a projectively flat Hermitian structure if and only if the associated projective bundle fibration is a Monge-Ampère fibration. In general, we can prove that a relative Kähler fibration is Monge-Ampère if and only if an associated infinite rank Higgs bundle is Higgs-flat. We also discuss some classical examples of Monge-Ampère fibrations. This work is joint with Xu Wang.

(5) **Johnny Lim Khai Yang (Universiti Sains Malaysia)**

- **Title:** An equivariant Toeplitz index theory on manifolds with boundary
- **Abstract:** In this talk, we will explore a Toeplitz index defined on an odd-dimensional compact manifold with boundary which acts by a compact group of isometries of the manifold. This is an equivariant version of the Toeplitz index theory based on the non-equivariant version by Dai and Zhang. In particular, the equivariant Toeplitz index is given by the equivariant spectral flow from the Dirac operator equipped with a modified Atiyah-Patodi-Singer boundary condition to its conjugation by a continuous family of unitaries over the manifold. Upon some decomposition of spectral flow, an equivariant Dai-Zhang's eta-type invariant arises, which make up a part of the boundary correction terms. This can also be viewed as the direct odd analog of Donnelly's equivariant version of the celebrated Atiyah-Patodi-Singer index theory. This is joint work with Hang Wang.



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Time (Beijing)	Speaker	Chair
10:00-11:00	Yong Lin	Feida Jiang
11:00-11:10	Break	
11:10-12:10	Pak-Yeung Chan	Feida Jiang
12:10-14:00	Lunch and Break	
14:00-15:00	Fusheng Deng	Jun Wang
15:00-15:10	Break	
15:10-16:10	Xueping Huang	Xin Nie
16:10-16:20	Break	
16:20-17:20	Quanting Zhao	Xin Nie

(1) Yong Lin (林勇, Tsinghua University)

- **Title:** Heat kernel of n -forms on subgraphs of a complete graph
- **Abstract:** We derive expression for the subgraph heat kernel on 0-forms and compute the coefficients of the expansion. We also obtain the subgraph heat kernel of the Laplacian on 1-forms. By using the heat kernel expansions for the Laplacian on a subgraph of a complete graph, we obtain formal expansions for the Green function of the Laplacian. This is a joint work with Ngai and Yau.

(2) Pak-Yeung Chan (陈柏杨, University of California, San Diego)

- **Title:** Steady Kähler Ricci Solitons with nonnegative Ricci curvature and integrable scalar curvature
- **Abstract:** Ricci soliton arises naturally in the singularity analysis of the Ricci flow. Steady Ricci soliton is a kind of soliton whose associated Ricci flow evolves by reparametrizing a fixed metric. It is closely related to the Type II limit solution to the Ricci flow. Steady Ricci soliton with integrable scalar curvature was studied by Deruelle in 2012, later by Catino-Mastrolia-Monticelli in 2016, Munteanu-Sung-Wang in 2019, Deng-Zhu in 2020. In this talk, we shall discuss a classification result on the steady Kähler Ricci solitons with nonnegative Ricci curvature and integrable scalar curvature. We then apply the result to study the steady Kähler Ricci soliton with subquadratic volume growth or fast curvature decay.

(3) Fusheng Deng (邓富声, University of Chinese Academy of Sciences)

- **Title:** 有界域的凸性和拟凸性的 L^2 性质刻画
- **Abstract:** 熟知, 凸域上的 ∂ -方程和拟凸域上的 $\bar{\partial}$ 方程满足某种形式的 L^2 估计. 本报告将阐明相关结果的逆也成立, 也就是说, 如果一个有界域上的 ∂ 方

程 (或 $\bar{\partial}$ 方程) 可解且满足一定的 L^2 估计, 那么该区域一定是凸的 (或拟凸的)。该报告基于与张旭俊合作的工作。

(4) **Xueping Huang (黄学平, Nanjing University of Information Science and Technology)**

- **Title:** A note on some nonlocal semilinear differential inequalities
- **Abstract:** In a long series of works of Verbitsky, jointly with Grigor'yan and many others, a toolbox of potential theoretic methods is developed and applied to semilinear elliptic differential inequalities on manifolds. We make the observation that the quasi-metric property of the Green kernel alone gives the minimal solution, without appealing to local Harnack inequalities. In this way, the potential theoretic approach can be applied to non-local analogues of differential inequalities. For example, we can treat the α -th power of the Laplacian on manifolds and the Laplacian on weighted graphs in a uniform way. This talk is based on joint work with Qingsong Gu and Yuhua Sun.

(5) **Quanting Zhao (赵全庭, Central China Normal University)**

- **Title:** Maximal nilpotent complex structures
- **Abstract:** Let the pair (\mathfrak{g}, J) be a nilpotent Lie algebra \mathfrak{g} (NLA for short) endowed with a nilpotent complex structure J . Motivated by a question in the work of Cordero, Fernández, Gray and Ugarte [Compact nilmanifolds with nilpotent complex structures: Dolbeault cohomology, *Trans. Amer. Math. Soc.*, **352** (2000), no. 12, 5405–5433], we will show that $2 \leq \nu(J) \leq 3$ for (\mathfrak{g}, J) when $\nu(\mathfrak{g}) = 2$, where $\nu(\mathfrak{g})$ is the step of \mathfrak{g} and $\nu(J)$ is the step of the complex structure J . When $\nu(\mathfrak{g}) = 3$, for arbitrary $n \geq 3$, there exists a pair (\mathfrak{g}, J) such that $\nu(J) = \dim_{\mathbb{C}} \mathfrak{g} = n$, for which we call the J in the pair (\mathfrak{g}, J) , satisfying $\nu(J) = \dim_{\mathbb{C}} \mathfrak{g} = n$, a maximal nilpotent (MaxN for short) complex structure. If time permits, we will discuss several properties of such MaxN complex structures.

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Time (Beijing)	Speaker	Chair
10:00-11:00	Haizhong Li	Xiaoliu Wang
11:00-11:10	Break	
11:10-12:10	Jian Wang	Xiaoliu Wang
12:10-14:00	Lunch and Break	
14:00-15:00	Xiaokui Yang	Yi Li
15:00-15:10	Break	
15:10-16:10	Dekai Zhang	Haisheng Liu
16:10-16:20	Break	
16:20-17:20	Siyuan Ma	Haisheng Liu

(1) **Haizhong Li** (李海中, Tsinghua University)

- **Title:** Curvature flows for hypersurfaces and their geometric applications
- **Abstract:** Isoperimetric inequality is one of the oldest problems in mathematics, which relates with convex geometry, differential geometry and geometric PDEs. Recently, the isoperimetric type inequalities in hyperbolic space have been investigated by using the hypersurface curvature flows, including the inverse curvature flows, quermassintegral preserving curvature flows, contracting curvature flows, and locally constrained curvature flows. In this talk, I will survey some recent progress in this field.

(2) **Jian Wang** (王健, Stonybrook University)

- **Title:** Topological rigidity and positive scalar curvature
- **Abstract:** In this talk, we will describe some topological rigidity and its relationship with positive scalar curvature. Precisely, we will present a proof that a complete contractible 3-manifold with positive scalar curvature is homeomorphic to the Euclidean 3-space. We will furthermore explain the interplay between minimal surfaces, scalar curvature and the topology at infinity.

(3) **Xiaokui Yang** (杨晓奎, Tsinghua University)

- **Title:** The geometry and topology of manifolds with RC-positive curvature
- **Abstract:** In this presentation, we discuss the geometry and topology of compact Kähler manifolds with RC-positive tangent bundle, and describe the relationship between RC-positivity and rational connectedness in algebraic geometry.

(4) **Dekai Zhang** (张德凯, Shanghai University)

- **Title:** Hermitian Yang-Mills flow

- **Abstract:** Recently, the deformed Hermitian Yang-Mills equation has been extensively studied. In this talk, we introduce a deformed Hermitian Yang-Mills flow in the supercritical case on a compact Kähler manifold. Under a suitable condition on the subsolution, we show the longtime existence of the flow and we prove that the solution converges exponentially to the solution of the elliptic deformed Hermitian Yang-Mills equation which has been solved by Collins-Jacob-Yau by the method of continuity. This is a joint work with Professor Jixiang Fu.

(4) **Siyuan Ma (马思远, Sorbonne Université)**

- **Title:** On the stability problem of Kerr spacetimes
- **Abstract:** The theory of General Relativity by Albert Einstein describes how a four-dimensional reality called space-time fluctuates in response to energy and matter fields, and is stated in terms of a system of equations called the Einstein field equations. The axisymmetric, rotating Kerr black hole solutions, among the many explicit solutions to the equations, are the most extraordinary ones since black holes are usually modeled by them. The problem of investigating the nonlinear stability of the Kerr space-times as solutions to the Einstein field equations is well-known as the Kerr stability conjecture. I will present joint work with Andersson (AEI), Backdahl (Chalmers), and Blue (Edinburgh) on the linear stability of Kerr space-times as well as some recent progress towards the nonlinear stability.

