THE UNIVERSITY  OF HONG KONG

Institute of Mathematical Research
Department of Mathematics

Workshop on Complex Geometry 2025

Room 210, Run Run Shaw Building, The University of Hong Kong

	June 11, 2025 (Wednesday)	**June 12, 2025 (Thursday)**	**June 13, 2025 (Friday)**
09:55-10:00	*Opening Remarks*		
10:00-11:00	Yum-Tong Siu	Ilya Kossovskiy	Sai-Kee Yeung
11:00-11:30	***Tea Break***		
11:30-12:30	Yik-Man Chiang	Kwok-Kin Wong	Qifeng Li
12:30-14:30	***Lunch break***		
14:30-15:30	Kwok-Wai Chan	Cong Ding	
15:30-16:00	***Tea Break***		
16:00-17:00	Xin Zhang	Kenneth Chiu	

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All are welcome

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Titles and Abstracts

Kwok-Wai Chan CUHK

Smoothing singular Calabi-Yau varieties

I will explain an algebraic framework for smoothing singular Calabi-Yau varieties. The key idea is to glue local dg Lie algebras (or dg Batalin-Vilkovisky algebras), coming from suitable local models, to get a global object. The observation is that while this object is only a pre-differential graded Lie algebra (pre-DGLA), it is sufficient to prove unobstructedness of the corresponding Maurer-Cartan equation (a singular version of the Bogomolov-Tian-Todorov theorem), so it can be regarded as a singular version of the Kodaira-Spencer DGLA. Our framework applies to degenerate CY varieties previously studied by Friedman, Kawamata-Namikawa and Gross-Siebert, as well as a more general class of varieties called toroidal crossing spaces (by the work of Felten-Filip-Ruddat). This talk is based on joint works with Conan Leung and Ziming Nikolas Ma. The research to be reported in this talk was substantially supported by grants from the RGC of the Hong Kong Special Administrative Region, China (CHUCK14305322, CHUCK14305023 and CHUCK14302524).

Edmund Yik-Man Chiang HKUST

A Weyl-algebraic approach to special functions

We re-formulate some classical special functions in terms of Weyl-algebraic language. Such reformulation allows us to discover difference versions of classical special functions. We shall explain how this reformulation is inspired by difference Nevanlinna theories.

Kenneth Chiu HKU

Some topics surrounding mixed Hodge theory

We will first review notions in mixed Hodge theory, including variations of mixed Hodge structures, their period mappings, and weakly special subvarieties. Next,

we will discuss applications of mixed Hodge theory in functional transcendence and Diophantine geometry.

Functional transcendence: The Ax-Schanuel theorem is a function field analogue of the Schanuel's conjecture for exponentials in transcendental number theory. This theorem is extended Hodge theoretically in the past decade. When phrased geometrically, it roughly says that if the intersection of a given algebraic variety and the graph of a period mapping is "unlikely", then this intersection should be related to group orbits of Hodge structures. We will review the history of the subject. A version of Ax-Schanuel for principal bundles with flat connections is proved by Blázquez-Sanz, Casale, Freitag and Nagloo. We will explain how their theorem and jet spaces can be used to deduce the Ax-Schanuel theorem for derivatives of mixed period mappings. If time permits, we will discuss speculations on p-adic transcendence.

Diophantine geometry: We will present results on sparsity of integral points in the mixed Hodge setting. It is based on theory developed by Brunebarbe-Maculan and Ellenberg-Lawrence-Venkatesh about constructing a certain cover and counting points in it. We will also present several conjectures.

Cong Ding Shenzhen University

Rigidity of smooth Schubert cycles in rational homogeneous spaces in higher Picard number

Given a multiple of Schubert cycle $r[X_w]$ in a rational homogeneous space $X = G/P$, if any subvariety $Z \subset X$ with $[Z] = r[X_w]$ must have $Z = g_1X_w + \cdots + g_rX_w$ for some $g_i (1 \leq i \leq r) \in G$, then $X_w \subset X$ is said to be Schur rigid. In particular, if we only assume that this holds for $r = 1$, then $X_w \subset X$ is said to be homologically rigid. The rigidity of Schubert cycles is a classical problem and there are many known results when X is of Picard number one. In this talk, I will discuss some recent progress of this problem when X is of higher Picard number and X_w is smooth. This is a joint work with Qifeng Li.

Ilya Kossovskiy SUSTech

Sphericity and analyticity of a strictly pseudo-convex hypersurface in low regularity

It is well known that the sphericity of a strictly pseudoconvex CR-hypersurface amounts to the vanishing of its Chern-Moser tensor. The latter is computed pointwise

in terms of the 6-jet of the hypersurface at a point, and thus requires regularity of the hypersurface of class at least C^6. In our joint work with Zaitsev, we apply our recent theorem on the analytic regularizability of a strictly pseudoconvex hypersurface to find a necessary and sufficient condition for the sphericity of a strictly pseudoconvex hypersurfaces of arbitrary regularity starting with C^2. Further, we obtain a simple condition for the analytic regularizability of hypersurfaces of the respective classes. Surprisingly, despite of the seemingly analytic nature of the problem, our technique is geometric and is based on the Reflection Principle in SCV.

Qifeng Li Shandong University
Deformation rigidity of wonderful group compactifications

For a complex connected semisimple linear algebraic group G of adjoint type and of rank n, De Concini and Procesi constructed its wonderful compactification $\bar{G}$, which is a smooth Fano $G\times G$-variety of Picard number n enjoying many interesting properties. In this talk, we will discuss on the rigidity of the wonderful compactification $\bar{G}$ under Fano deformation. Namely, for any regular family of Fano manifolds over a connected base, if one fiber is isomorphic to $\bar{G}$, then so are all other fibers. It answers a question raised by Bien and Brion in their work on the local rigidity of wonderful varieties. This is a joint work with Baohua Fu.

Yum-Tong Siu Harvard University
Effective Subellipticity in Terms of D'Angelo Finite Type

Will discuss recent results concerning effective subelliptic estimates in the $\bar{\partial}$-Neumann problem for weakly pseudoconvex domains with smooth boundary in terms of D'Angelo's finite type condition.

Kwok-Kin Wong Shenzhen University
Hyperbolicity of Compactifications and Carathéodory Geometry

We study hyperbolicity of compactifications of quasi-projective manifolds from the perspective of Carathéodory geometry on the universal coverings. This is then applied to study the hyperbolicity of the Baily-Borel and Siu-Yau compactification of non-compact locally Hermitian symmetric spaces of finite volume and Deligne-Mumford

compactification of a moduli space of hyperbolic Riemann surfaces. As a consequence, we obtain a generalization of Nadel [Ann. Math., 1989] for the above settings.

Sai-Kee Yeung Purdue University

On the limit of Weierstrass measure on stable curves

Let M be a Riemann surface. A usual Weierstrass point is a point on M at which there is a holomorphic one form vanishing to order at least the dimension of the space of holomorphic one forms. This notion can be generalized to L^n for any ample line bundle L on M. It is observed by Olsen in 70's that the distribution of Weierstrass points is dense on M in the usual complex topology as $n \to \infty$. A surprising result of Mumford and Neeman in 80's states that the weighted Dirac measure of Weierstrass points of L^n approaches the pull back of the flat metric from its Jacobian variety as $n \to \infty$. On the other hand, it is observed in the work of Ballico, Furio, Gatto, Lax, Little and others in the 80-90's that the picture on a stable rational curve is different in the sense that a corresponding Weierstrass measure is not dense in complex topology. The goal of the talk is to explain a joint work with Ngaifung Ng in this direction to clarify the situation.

Xin Zhang HKU

Pair correlation in Apollonian circle packings

Starting with three mutually tangent circles on the plane, an Apollonian circle packing is formed by iteratively inscribing circles in the interstices. In this talk, we explain how to use homogeneous dynamics to study the fine-scale structures of Apollonian circle packings.