Workshop on Complex Geometry

July 10 - 12, 2019

Room 210, Run Run Shaw Bldg., HKU

Program and Abstracts

Institute of Mathematical Research
Department of Mathematics

Speakers:

Yik-Man Chiang   HKUST, Hong Kong

Baohua Fu   The Chinese Academy of Sciences

Jaehyun Hong   KIAS, Seoul, Korea

Jun-Muk Hwang   KIAS, Seoul, Korea

Sui-Chung Ng   ECNU, Shanghai

Tuen Wai Ng   HKU, Hong Kong

Yum-Tong Siu   Harvard U., USA

Xiaotao Sun   Tianjin U.

Wing-Keung To   National U. Singapore

Sai-Kee Yeung   Purdue U., USA

Xiangyu Zhou   The Chinese Academy of Sciences

Organizers: Ngaiming Mok & Tuen Wai Ng

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Time / Date	July 10 (Wed)	July 11 (Thur)	July 12 (Fri)
10:00 – 11:00	Siu	Hwang	Zhou
11:00 – 11:20	Tea Break		
11:20 – 12:20	To	Fu	SC Ng
Lunch Break			
14:30 – 15:30	Yeung	Sun	TW Ng
15:30 – 15:50	Tea Break		
15:50 – 16:50		Hong	Chiang

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Program

9:55   **Ngaiming Mok**, Director, Institute of Mathematical Research
Opening Remarks

10:00 – 11:00   **Yum-Tong Siu**, Harvard U., USA
Vanishing Orders of Jacobian Determinants and Metrics from Sections of Line Bundles

Tea Break

11:20 – 12:20   **Wing-Keung To**, National U. of Singapore
Volume estimates, singular potentials and applications

Lunch Break

14:30 – 15:30   **Sai-Kee Yeung**, Purdue U., USA
Torelli locus and symmetric subvarieties of a Siegel moduli variety

Tea Break

10:00 – 11:00   **Jun-Muk Hwang**, KIAS, Seoul, Korea
On Hirschowitz's conjecture on the formal principle

Tea Break

11:20 – 12:20   **Baohua Fu**, The Chinese Academy of Sciences
Geometry of linear sections of rational homogeneous spaces

Lunch Break

14:30 – 15:30   **Xiaotao Sun**, Tianjin U.
Slope inequality and Miyaoka-Yau type inequality

Tea Break

15:50 – 16:50   **Jaehyun Hong**, KIAS, Seoul, Korea
Cohomology of Hessenberg varieties

10:00 – 11:00   **Xiangyu Zhou**, The Chinese Academy of Sciences
Multiplier ideal sheaves: properties and applications

Tea Break

11:20 – 12:20   **Sui-Chung Ng**, ECNU, Shanghai
Syzygies of ample line bundles on fake projective planes

Lunch Break

14:30 – 15:30   **Tuen-Wai Ng**, HKU, Hong Kong
The Squeezing Functions and Fridman Functions on Planar Domains

Tea Break

15:50 – 16:50   **Yik-Man Chiang**, HKUST, Hong Kong
Degenerated biconfluent Heun operator and Painievé IV

Abstracts

Yik-Man Chiang, HKUST, Hong Kong

Degenerated biconfluent Heun operator and Painievé IV

It is classical that the Painlevé equations describe integral curves on moduli spaces of Fuchsian connections with four punctures on the Riemann Sphere as well as their confluent counterparts. These Painlevé equations also exhibits certain affine Weyl group symmetries with respect to their parameters in which its solutions degenerate. We exhibit that one can identify the parameter space for Painlevé IV directly from the biconfluent Heun connection with degenerate monodromy/Stokes data. Moreover, explicit horizontal sections of certain biconfluent Heun connections are derived. These are joint works with A. Ching, C. K. Law, C. Y. Tsang and G. F. Yu.

Baohua Fu, The Chinese Academy of Sciences

Geometry of linear sections of rational homogeneous spaces

Rational homogeneous varieties are among the simplest algebraic varieties, and a better understanding of them is always a motivation for the development of algebraic geometry. The geometry of general linear sections of rational homogeneous spaces are as expected, but special ones may have much richer geometry which remains to be explored systematically. I'll survey recent progress in this direction.

Jaehyun Hong, KIAS, Seoul, Korea

Cohomology of Hessenberg varieties

Hessenberg varieties are subvarieties of complete flag varieties G/B associated to Hessenberg subspaces, which are b-submodules of g containing b, where b and g are the Lie algebras of B and G. When the subspace is the sum of b and the negative root spaces, it is the toric variety associated with the fan defined by the hyperplanes orthogonal to the roots of g. In this talk we will investigate the Weyl group action on the cohomology spaces of Hessenberg varieties.

Jun-Muk Hwang, KIAS, Seoul, Korea

On Hirschowitz's conjecture on the formal principle

A compact complex submanifold of a complex manifold is said to satisfy the formal principle if its formal neighborhood determines its germ of analytic neighborhoods. In 1981, Hirschowitz conjectured that an unobstructed submanifold satisfies the formal principle if its normal bundle is globally generated. I explain an approach to this conjecture by Cartan's equivalence method for geometric structures.

Sui-Chung Ng, ECNU, Shanghai

Syzygies of ample line bundles on fake projective planes

We will talk about the syzygies of the embeddings defined by the ample line bundles on a fake projective plane. The syzygies are studied in terms of the so-called N_p properties, in which for instance the N_0 property is equivalent to projective normality and the N_1 property is the same as projective normality together with the generation of vanishing ideal by quadratic polynomials. We will give an explicit lower bound M_p such that L^m will satisfy the N_p property for any ample line bundle L on a fake proejctive plane and when m is at least M_p. This is a joint work with Sai-Kee Yeung.

Tuen Wai Ng, HKU, Hong Kong

The Squeezing Functions and Fridman Functions on Planar Domains

In 2012, Deng, Guan and Zhang introduced the concept of squeezing function for a bounded domain. This function of several complex variables is a very interesting new biholomorphic invariant and it also has a dual function, namely the Fridman function. In this talk, we shall focus on the squeezing functions and Fridman functions of some simple planar domains and explain how some classical tools in geometric function theory can be used to study these functions. The results are joint work with Chiu Chak Tang and Jonathan Tsai.

Yum-Tong Siu, Harvard U., USA

Vanishing Orders of Jacobian Determinants and Metrics from Sections of Line Bundles

The vanishing orders of multiplier ideal sheaves take over the role of PDE estimates in problems of complex geometry. There are two important techniques involving such vanishing orders. One is the method of differential relations to use Jacobian determinants to reduce vanishing orders, which originated from complex Neumann problems of weakly pseudoconvex domains. Another is the method of precise achievement of vanishing orders of metrics from sections of line bundles, which is the foundation for analytic approaches to effective problems and complex geometry problems involving plurigenera, the finite generation of the canonical ring and the abundance conjecture.

Xiaotao Sun, Tianjin U.

Slope inequality and Miyaoka-Yau type inequality

Let S be a minimal smooth projective surface of general type over an algebraically closed field of characteristic $p > 0$. In this talk (joint with Yi Gu and Mingshuo Zhou), I will show a slope inequality and its colloary: a Miyaoka-Yau type inequality. In particular, it implies that $\chi(O_S) > 0$ for any smooth surfaces S of general type (a question posed by Shepherd-Barron on 1991).

Wing-Keung To, National U. Singapore

Volume estimates, singular potentials and applications

In this talk, I will discuss some joint works with J.-M. Hwang on finding sharp lower bounds on volumes of certain complex analytic varieties via singular potentials. The background manifolds are bounded

symmetric domains and their quotients. Some applications/motivations will also be discussed.

Sai-Kee Yeung, Purdue U., USA

Torelli locus and symmetric subvarieties of a Siegel moduli variety

The purpose of this talk is to present some geometric approaches to study the possibility of realization of a locally symmetric space as a totally geodesic subvariety in the Torelli locus of a Siegel modular space. Restricting to Hermitian symmetric subvarieties of a Siegel modular variety, it is related to conjectures of Coleman and Oort for cases other than complex curves.

Xiangyu Zhou, The Chinese Academy of Sciences

Multiplier ideal sheaves: properties and applications

After recalling basic properties of the multiplier ideal sheaves, we talk about some new properties and applications.