

Workshop on Complex Geometry

July 9 - 11, 2007

Room 517, Meng Wah Complex, HKU

Program and Abstracts



**Institute of Mathematical Research
The University of Hong Kong**

Speakers:

✚ Kung-Ho Chan	U. Illinois, Chicago, USA
✚ Der-Chen Chang	Georgetown U., USA
✚ Jaehyun Hong	Seoul National U., Korea
✚ Jun-Muk Hwang	KIAS, Seoul, Korea
✚ Vincent Koziarz	Université de Nancy, France
✚ Conan Leung	CUHK, Hong Kong
✚ Ngaiming Mok	HKU, Hong Kong
✚ Tuen Wai Ng	HKU, Hong Kong
✚ Yum-Tong Siu	Harvard U., USA
✚ Xiaotao Sun	Chinese Academy of Sciences
✚ Wing Keung To	National U. Singapore
✚ Sai-Kee Yeung	Purdue U., USA

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PROGRAM

July 9, 2007
Monday

- 10:00 – 11:00 **Yum-Tong Siu**, Harvard U., USA
Effective termination of Kohn's algorithm for subelliptic multipliers
-
- Tea Break*
-
- 11:20 – 12:20 **Jun-Muk Hwang**, KIAS, Korea
Characteristic foliation on the discriminantal hypersurface of a holomorphic Lagrangian fibration
-
- Lunch Break*
-
- 14:30 – 15:30 **Jaehyun Hong**, Seoul National U., Korea
Complexifications of real symmetric spaces
-
- Tea Break*
-
- 15:50 – 16:50 **Tuen Wai Ng**, HKU, Hong Kong
Smale's Mean Value Conjecture and the amoebas

July 10, 2007
Tuesday

10:00 – 11:00

Sai-Kee Yeung, Purdue U., USA

General type surfaces of smallest Euler characteristic, fake projective planes and Deligne-Mostow surfaces

Tea Break

11:20 – 12:20

Vincent Koziarz, Université de Nancy, France

Representations of complex hyperbolic lattices into rank 2 classical Lie groups of Hermitian type

Lunch Break

14:30 – 15:30

Der-Chen Chang, Georgetown U., USA

Heat kernels and analysis on quadratic CR manifolds

Tea Break

15:50 – 16:50

Ngaiming Mok, HKU, Hong Kong

On the projective connection on Kähler manifolds of constant holomorphic sectional curvature

July 11, 2007
Wednesday

10:00 – 11:00 **Conan Leung**, CUHK, Hong Kong
Moduli of bundles over rational surfaces and elliptic curves

Tea Break

11:20 – 12:20 **Kung-Ho Chan**, U. Illinois, Chicago, USA
Local positivity and Seshadri constants

Lunch Break

14:30 – 15:30 **Wing Keung To**, National U. Singapore
Effective Lojasiewicz inequality and stability of bihomogeneous polynomials

Tea Break

15:50 – 16:50 **Xiaotao Sun**, Chinese Academy of Sciences
Stability of direct images of bundles under Frobenius

Cancelled

Abstracts

Kung-Ho Chan, U. Illinois, Chicago, USA

Local positivity and Seshadri constants

Let X be a smooth projective variety and L an ample line bundle on X . The Seshadri constant $\epsilon(L, x)$ at a point x on X measures the positivity of L at x . It is interesting that the Seshadri constants at generic points can be somehow related to the geometry of X . We use simple arguments to give the lower bounds of Seshadri constants for several classes of interesting examples.

Der-Chen Chang, Georgetown U., USA

Heat kernels and analysis on quadratic CR manifolds

In this talk, we first use geometric mechanics to construct kernels for heat equations with potentials. Then we may use this result to discuss regularity properties of the fundamental solution for the Kohn Laplacian on quadratic CR manifolds in $\mathbf{C}^n \times \mathbf{C}^m$. We also construct heat kernels on step two nilpotent Lie group in terms of geometric invariants.

Jaehyun Hong, Seoul National U., Korea

Complexifications of real symmetric spaces

An adapted complex structure of a complete Riemannian manifold is a complex structure on an open neighborhood of the zero section in its tangent bundle which is compatible with the Riemannian metric. For real symmetric spaces of compact type, the adapted complex structure exists on the whole tangent bundle. But usually it does not exist on the whole tangent bundle.

The maximal domain of the adapted complex structure of a real symmetric space of noncompact type has many interesting properties. We will review some of them and describe similarities with bounded symmetric domains.

Jun-Muk Hwang, KIAS, Seoul, Korea

Characteristic foliation on the discriminantal hypersurface of a holomorphic Lagrangian fibration

We give a Kodaira-type classification of general singular fibers of a holomorphic Lagrangian fibration in Fujiki's class. Our approach is based on the study of the characteristic vector field of the discriminantal hypersurface, which naturally arises from the defining equation of the hypersurface via the symplectic form. As an application, we show that the characteristic foliation of the discriminantal hypersurface has algebraic leaves which are either rational curves or smooth elliptic curves. This is a joint work with Keiji Ogusio.

Vincent Koziarz, Université de Nancy, France

Representations of complex hyperbolic lattices into rank 2 classical Lie groups of Hermitian type

Let Γ be a lattice in $SU(m, 1)$ and let ρ be a representation of Γ into the group of isometries of a rank 2 Hermitian symmetric space of non-compact type. Using the correspondence between representations of fundamental groups of Kähler manifolds and Higgs bundles, we will show that the Toledo invariant associated to ρ satisfies a Milnor-Wood type inequality and we will characterize representations with maximal invariant. This is a joint work with Julien Maubon.

Conan Leung, CUHK, Hong Kong

Moduli of bundles over rational surfaces and elliptic curves

It is known from the work of Friedman-Morgan-Witten and Donagi that del Pezzo surfaces of degree $9 - n$ one-to-one correspond to flat E_n bundles over an elliptic curve. In this talk I will explain my joint work with Jiajin Zhang, in which we construct G -bundles over a broader class of rational surfaces for any simple, compact and simply-connected Lie group, simply laced or not. Then we extend the above correspondence to all flat G bundles over an elliptic curve.

Ngaiming Mok, HKU, Hong Kong

On the projective connection on Kähler manifolds of constant holomorphic sectional curvature

The complex projective space P^n , the Euclidean space C^n and the complex hyperbolic space form, equivalently the complex unit ball B^n , share the common feature of possessing a complete Kähler metric of constant holomorphic sectional curvature. The Levi-Civita connections of these canonical metrics agree with the natural holomorphic projective connections. In particular, the second fundamental form on a complex submanifold is holomorphic. We examine applications of this elementary but basic fact which underlies the geometries of P^n , C^n and B^n and their quotient manifolds. An example is the proof, by means of harmonic forms, that the tangent bundle of the ambient space form splits holomorphically on a compact complex submanifold S if and only if S is totally geodesic, a well-known result in the case of P^n due to Van de Ven. (The Euclidean case was a recent result established by Jahnke.) Another application is to the study of holomorphic mappings between compact complex hyperbolic space forms.

Tuen Wai Ng, HKU, Hong Kong

Smale's Mean Value Conjecture and the amoebas

In this talk, we shall introduce the theory of amoebas to the study of Smale's mean value conjecture for polynomials. In particular, we shall prove that for each fixed degree, the set of all extremal polynomials is compact.

Yum-Tong Siu, Harvard U., USA

Effective termination of Kohn's algorithm for subelliptic multipliers

Will discuss the problem of the effective termination of Kohn's algorithm for subelliptic multipliers for bounded smooth weakly pseudoconvex domains of finite type. Will show how to apply techniques of local algebraic geometry to prove the effective termination of Kohn's algorithm for the case of special domains and indicate how the method of proof is to be extended to the smooth case.

Xiaotao Sun, Chinese Academy of Sciences

Stability of direct images of bundles under Frobenius

Let X be a smooth projective variety over k of positive characteristic. We prove that the instability of direct image of a bundle V under the Frobenius morphism is bounded by the instability of V and its tangent bundle. For curves, it implies that the direct image of any stable bundle is still stable.

Wing Keung To, National U. Singapore

Effective Lojasiewicz inequality and stability of bihomogeneous polynomials

In this talk I will describe some joint work with Sai-Kee Yeung on getting two effective versions of effective Lojasiewicz inequality for affine algebraic varieties defined by homogeneous polynomials over a number field. This work is motivated from our earlier study of certain stability property of bihomogeneous polynomials which are positive on C^n , or more generally, those which are positive on affine algebraic varieties. In addition, I will also discuss the semi-stability problem for non-negative bihomogeneous polynomials and some preliminary related result in a pet project with my MSc student Ms Hoi-Nam Mok.

Sai-Kee Yeung, Purdue U., USA

General type surfaces of smallest Euler characteristic, fake projective planes and Deligne-Mostow surfaces

The talk is about classification of smooth surfaces of general type with smallest possible Euler-Poincare characteristic, which is 3. We reduce the problem to classification of fake projective planes, rely on the joint work with Gopal Prasad on their classifications and apply a recent joint work with Martin-Deraux on a problem of Toledo related to Deligne-Mostow surfaces.