Conference Schedule

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(Monday)</th><th>April 21
(Tuesday)</th><th>April 22
(Wednesday)</th><th>April 23
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<tr><td>09:00-10:00</td><td>Luc Pirio
(I)</td><td>Vasily Krylov
(II)</td><td>Luc Pirio
(III)</td><td>Jun-Muk
Hwang</td><td rowspan="2">Zhiyu Liu</td></tr>
<tr><td>10:00-10:30</td><td colspan="5">Tea Break</td></tr>
<tr><td>10:30-11:30</td><td>Vasily Krylov
(I)</td><td>Luc Pirio
(II)</td><td>Vasily Krylov
(III)</td><td>Crislaine
Kuster</td><td>Qifeng Li</td></tr>
<tr><td>11:30-14:00</td><td colspan="5">Lunch</td></tr>
<tr><td>14:00-15:00</td><td>Shigeru Mukai</td><td>Cédric
Bonnafé</td><td rowspan="4">Free
Discussion</td><td>Francesco
Russo</td><td rowspan="4">Free
Discussion</td></tr>
<tr><td>15:00-15:30</td><td colspan="2">Tea Break</td><td>Tea Break</td></tr>
<tr><td>15:30-16:30</td><td>Yoshinori
Namikawa</td><td>Boming Jia</td><td>Zhenjian
Wang</td></tr>
<tr><td>17:00-19:00</td><td></td><td>Banquet</td><td></td></tr>
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Titles and Abstracts

Mini-course

Vasily Krylov (Harvard University)

Higgs and Coulomb Branches: Geometry and Representation Theory

Higgs and Coulomb branches of quiver gauge theories form two important families of Poisson varieties that are expected to be exchanged under so-called 3D mirror symmetry. Quantized Coulomb branches are associative algebras quantizing the algebras of functions on Coulomb branches. They are closely related to many interesting representation-theoretic structures, such as Yangians, quantum groups, and Hecke algebras. Graded traces on these algebras generalize the notion of characters and are closely related to the q-characters introduced by Frenkel and Reshetikhin.

In this series of talks, I will discuss how 3D mirror symmetry, together with other physics-motivated insights, allows one to describe graded traces on some quantized Coulomb branches. In particular, this approach yields very explicit answers to purely representation-theoretic questions about representations of some of the quantum groups mentioned above. These talks are based on joint works with Dinkins, Karpov, Klyuev, and Lance.

Luc Pirio (Université de Versailles)

Lectures on Web Geometry

A web on a given manifold is a geometric structure formed locally by finitely many foliations whose leaves intersect transversally. Web geometry is concerned with the study of such structures, classically up to local analytic diffeomorphisms. In the first lecture, which should remain fairly accessible, I will introduce some basic notions in web geometry and then sketch a few results on the classical problem of the algebraization of maximal-rank webs. The second lecture will present several interesting examples of webs arising naturally on algebraic varieties. In the final lecture, I will discuss webs of conics on del Pezzo surfaces and the hyperlogarithmic functional identities associated with them.

Talks

Cédric Bonnafé (Université de Montpellier)

Singular K3 surfaces and complex reflection groups

This is a joint work with Alessandra Sarti.

Singular K3 surfaces are the K3 surfaces with maximal Picard number, namely 20. I will explain how to construct families of K3 surfaces with big Picard number using invariants of finite complex reflection groups of rank 4, each family containing some singular ones. This extends earlier work of Barth-Sarti for two reasons: firstly, we obtain much more examples by considering all reflection groups of rank 4 and, secondly, our proofs involve more theory of complex reflection groups and avoids as much as possible (but not completely) a case-by-case analysis.

Jun-Muk Hwang (IBS Center for Complex Geometry)

Fundamental forms and infinitesimal symmetries of projective varieties

We give a bound on the dimension of the linear automorphism group of a projective variety $Z \subset \mathbf{P}^n$ in terms of its fundamental forms at a general point. Moreover, we show that the bound is achieved precisely when $Z \subset \mathbf{P}^n$ is projectively equivalent to an Euler-symmetric variety. As a by-product, we determine the Lie algebra of infinitesimal automorphisms of an Euler-symmetric variety. This is a joint work with Qifeng Li.

Boming Jia (Tsinghua University)

The minimal nilpotent orbit of $\boldsymbol{E_6}$

In this talk, I will explain why the closure of the minimal nilpotent adjoint orbit $\mathbf{O}_{\min}^{E_6}$ of the complex simple Lie algebra E_6 is isomorphic to the affinization of $\mathrm{T}^*(\mathrm{SL}_4/P^u)$ where P^u is the unipotent radical of the parabolic subgroup $P_{(2,2)}$ of $\mathrm{SL}_4(\mathbf{C})$.

Crislaine Kuster (Tsinghua University)

Minimal-degree foliations on cominuscule Grassmannians

Let X be a cominuscule Grassmannian. In this talk, we describe foliations on X with minimal degree. We prove that every codimension-one foliation of degree zero on a cominuscule Grassmannian arises from a pencil of hyperplanes, and we further determine the structure of codimension-one foliations of degree one. We also present families of examples of higher-codimensional foliations of minimal degree on classical Grassmannians, Lagrangian Grassmannians, and spinor varieties. This is joint work with Vladimiro Benedetti and Alan Muniz.

Qifeng Li (Shandong University)

Minimal rational curves on equivariant compactifications of symmetric spaces

Let X be a smooth equivariant compactification of a symmetric space. In this talk, we will discuss when a minimal rational curve on X is the orbit closure of a 1-parameter group. In case the symmetric space is of group type, the answer is positive and moreover the VMRT is the closure of an adjoint orbit. This generalizes a result of Brion and Fu's on wonderful compactifications to arbitrary equivariant compactifications. This is a joint work with Jun-Muk Hwang.

Zhiyu Liu (Zhejiang University)

Irreducible symplectic varieties with a large second Betti number

Irreducible symplectic varieties are one of three building blocks of varieties with Kodaira dimension zero, which are higher-dimensional analogs of K3 surfaces. Despite their rich geometry, there have been only a limited number of approaches to construct irreducible symplectic varieties. In this talk, I will introduce a general criterion for the existence of irreducible symplectic compactifications of non-compact Lagrangian fibrations, based on the minimal model program and the geometry of Lagrangian tori. As an application, I will explain how to get a (singular) 42-dimensional irreducible symplectic variety with the second Betti number at least 24. This is a joint work with Yuchen Liu and Chenyang Xu.

Shigeru Mukai (Kyoto University & MCM, CAS)

Reid sextic mod $\boldsymbol{p}$ *and related symplectic varieties*

Reid sextic is the K3 surface defined as the common zero locus of the elementary symmetric functions of degree 1, 2 and 3 in the projective 5-space. We study symplectic varieties which are naturally associated with it over the prime field in characteristic p = 2, 3 and 5, emphasizing the relation with Mathieu groups and some other sporadic simple groups.

Yoshinori Namikawa (Kyoto University and RIMS)

Symplectic singularities and Kaledin's conjecture

Symplectic singularities play an important role in algebraic geometry and geometric representation theory. All known examples of such singularities show up with natural $\mathbf{C}^*$-action. About 20 years ago, Kaledin conjectured that a symplectic singularity is always conical; more precisely, it admits a conical $\mathbf{C}^*$-action where the symplectic form is homogeneous. Recently we proved Kaledin's conjecture conditionally, but in a substantially stronger form. The idea is to use Donaldson-Sun theory in complex differential geometry to connect with the theory of Poisson deformations of symplectic varieties. This is a joint work with Y. Odaka.

Francesco Russo (University of Catania)

On the tangent degree of a projective variety

The tangent degree $\tau(X)$ of a projective variety $X^n \subset \mathbf{P}^N$ is the number of tangent spaces to X at smooth points passing through a general point of the tangent variety $\mathrm{Tan}(X) \subseteq \mathbf{P}^N$, if positive and finite; it is equal to zero if $\dim(\mathrm{Tan}(X)) < 2n$. We shall prove some lower bounds for $\tau(X)$ and for $\deg(\mathrm{Tan}(X))$ and provide some classification results when the bounds are attained either in small dimension/codimension and/or under the smoothness assumption.

Finally for $N \geq 2n+1$ we shall consider varieties $X^n \subset \mathbf{P}^N$ having $\tau(X) > 1$ (unexpected behaviour), provide their classification for $n = 2$ and discuss the problem for $n \geq 3$.

This is joint work with Jordi Hernandez Gomez.

Zhenjian Wang (Hefei National Laboratory)

Properties of Homogeneous Polynomials in Relation to Mixed Hodge Structures

The study of variations of mixed Hodge structures and Torelli-type theorems is an active area of research in mixed Hodge theory. Classically, the Hodge structures on the cohomology of a smooth projective hypersurface can be described explicitly in terms of its defining polynomial, thereby reducing questions about variations of Hodge structures to properties of the polynomial itself. For a pair of smooth projective hypersurface---and hence a pair of homogeneous polynomials---one can similarly define variations of mixed Hodge structures and establish Torelli-type theorems. In this talk, we explore key properties of homogeneous polynomials that play a fundamental role in the study of variations of mixed Hodge structures and global Torelli theorems.