Deformations and birational geometry of algebraic varieties

Date: January 19 - 23, 2026
Place: RIMS, Kyoto university, Room 420.

	10:00–10:50	11:10-12:00	13:40–14:30	14:50–15:40	16:00–16:50
Jan.19(Mon)	Odaka	Yoshioka	Oguiso	Kawamata	Saccà (online)
20(Tue)	Yamagishi	Bellamy	Schedler	Hwang	Fu (online)
21(Wed)	Mukai	Nakajima	C. Lehn	M. Lehn	Namikawa
22(Thu)	Laza	Hubbard	Wye	Hikita	Gross (online)
23(Fri)	Mizuno	Moriwaki	——	——	——

Reception: 21(Wed) 18:00–20:00 (Camphora @ Kyoto university)

Jan.19 (Mon)

10:00 – 10:50 **Odaka, Yuji** (Kyoto University)

Canonical torus action on symplectic singularities (Kaledin's conjecture)

11:10 – 12:00 **Yoshioka, Kota** (Kobe University)

Stability and Fourier-Mukai transforms on an elliptic surface

13:40 – 14:30 **Oguiso, Keiji** (The University of Tokyo)

On K3 surfaces with non-elementary hyperbolic automorphism group

14:50 – 15:40 **Kawamata, Yujiro** (The University of Tokyo)

A deformation of a coherent sheaf over a non-commutative base

16:00 – 16:50 **Saccà, Giulia** (Columbia University)

Lagrangian fibrations and Gushel-Mukai manifolds

Jan.20 (Tue)

10:00 – 10:50 **Yamagishi, Ryo** (Kyushu University)

Duality involution on symplectic moduli spaces

11:10 – 12:00 **Bellamy, Gwyn** (The University of Glasgow)

Hamiltonian Cox spaces

13:40 – 14:30 **Schedler, Travis** (Imperial College London)

Building blocks of symplectic singularities and resolutions

14:50 – 15:40 **Hwang, Jun-Muk** (IBS center for Complex Geometry)

Holomorphic symplectic geometry of elliptic surfaces

16:00 – 16:50 **Fu, Baohua** (Chinese Academy of Sciences)

Symplectic singularities arising from cotangent bundles

Jan.21 (Wed)

10:00 – 10:50 **Mukai, Shigeru** (RIMS, Kyoto University)

Cubic fourfolds with many cusps and associated symplectic manifolds

11:10 – 12:00 **Nakajima, Hiraku** (IPMU, The University of Tokyo)

Involutions on quiver varieties and bow varieties

13:40 – 14:30 **Lehn, Christian** (Ruhr University Bochum)

Nonvanishing and semiampleness results for irreducible holomorphic symplectic manifolds

14:50 – 15:40 **Lehn, Manfred** (Johannes Gutenberg University Mainz)

On the discriminant locus of Lagrangian fibrations

16:00 – 16:50 **Namikawa, Yoshinori** (RIMS, Kyoto University)

Towards a characterization of toric hyperkaehler varieties among symplectic singularities

Jan.22 (Thu)

10:00 – 10:50 **Laza, Radu** (Stony Brook University)

Hodge Theory and Moduli

11:10 – 12:00 **Hubbard, Austin** (Imperial College London)

Classifying toric hyperkähler varieties

13:40 – 14:30 **Wye, Ruth** (University of Bath)

Hilbert schemes of crepant partial resolutions

14:50 – 15:40 **Hikita, Tatsuyuki** (RIMS, Kyoto University)

Canonical bases for conical symplectic resolutions

16:00 – 16:50 **Gross, Mark** (University of Cambridge)

Relative quantum cohomology and vector fields on intrinsic mirrors

Jan.23 (Fri)

10:00 – 10:50 **Mizuno, Yuki** (Waseda University)

Bondal–Orlov's reconstruction theorem in noncommutative projective geometry

11:10 – 12:00 **Moriwaki, Atsushi** (Chubu University)

Adelic structures of countable fields

Organizers

Kotaro Kawatani (Wakayama Medical University),
Daisuke Matsushita (Hokkaido University),
Yasunari Nagai (Waseda University),
Taro Sano (Kobe University).

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Titles and Abstracts

Odaka, Yuji (Kyoto): Canonical torus action on symplectic singularities (Kaledin's conjecture)

Around 2000, Kaledin conjectured that any symplectic singularity is quasi-homogeneous, namely that it admits some local $\mathbb{C}^*$-action with positive weights, at least along slice directions. In this talk, we prove this conjecture conditionally but with a substantial strengthening: the existence of a canonical torus action with positive weights (on all directions).

Our approach is based on geometry of (singular) hyperKähler metrics, which gives a geometric meaning to the canonicity of the torus action from the viewpoint of K-stability or the metrics. We combine the Donaldson-Sun theory of singular metrics with Namikawa's theory of Poisson deformations, thereby relating a metric version of tangent cone to the expected symmetry of symplectic singularities. Our results are also connected to the LeBrun-Salamon conjecture for contact varieties.

This is joint work with Prof. Y. Namikawa (see arXiv:2503.15791).

Yoshioka, Kota (Kobe): Stability and Fourier-Mukai transforms on an elliptic surface

We shall introduce a stability condition for a coherent sheaf associated to an elliptic surface. Then we study the behavior under relative Fourier-Mukai transforms.

Oguiso, Keiji (Tokyo): On K3 surfaces with non-elementary hyperbolic automorphism group

This talk is based on my joint work with Professors Koji Fujiwara (Kyoto University) and Xun Yu (Tianjin University). We show the finiteness of the Néron-Severi lattices of complex (projective) K3 surfaces whose automorphism groups are non-elementary hyperbolic, under the assumption that the Picard number greater than or equal to 6, which is optimal to guarantee the finiteness. In this talk, after recalling the notion of hyperbolicity of group due to Gromov in geometric group theory and their importance and interest (in our view), I would like to explain first why the non-elementary hyperbolicity of K3 surface automorphism group is a problem of the Néron-Severi lattices and then how one can deduce the finiteness, via geometrically finiteness of automorphism groups of K3 surfaces due to Professors Kikuta and Takatsu and our new study of genus one fibrations on K3 surfaces.

Kawamata, Yujiro (Tokyo): A deformation of a coherent sheaf over a non-commutative base

When we consider a deformation of a sheaf, it is natural not to assume that the parameter ring is commutative. This is because the DG algebra controlling the deformations is non-commutative. The existence of a versal formal NC deformation

is easily proved, but it is difficult to describe it for a specific problem. I will review some cases where versal formal NC deformations are known. I will also talk about a global moduli space.

Saccà, Giulia (Columbia): Lagrangian fibrations and Gushel-Mukai manifolds

Generalizing a construction of Laza-Saccà-Voisin, we associate to every 6-dimensional Gushel-Mukai manifold a 20-dimensional Lagrangian fibered irreducible symplectic variety. This is joint work in progress with K. O'Grady and E. Macrì.

Yamagishi, Ryo (Kyushu): Duality involution on symplectic moduli spaces

We consider a birational symplectic involution on a moduli space of sheaves on a K3 surface induced by taking dual sheaves and discuss when this involution becomes regular. We also see that the involution quotient of a singular moduli space with Mukai vector (3,0,-3) gives rise to an irreducible symplectic variety of dimension 20 with only isolated singularities. This talk is based on joint work with Hsueh-Yung Lin.

Bellamy, Gwyn (Glasgow): Hamiltonian Cox spaces

An important approach to the study of conic symplectic singularities is via their Poisson deformations. This is possible because of the fundamental result by Namikawa proving the existence of a universal (graded) Poisson deformation. Moreover, he has shown that the universal Poisson deformation is compatible, in a precise sense, with the universal Poisson deformation of any Q-factorial terminalization of the singularity. Based on this theory, I will describe a construction that associates to the conic symplectic singularity X a space Z, called the Hamiltonian Cox space, that is (conjecturally) a conic Q-factorial terminal symplectic singularity with Hamiltonian T-action such that the original singularity X, together with all its Q-factorial terminalizations, can be recovered from Z by suitable Hamiltonian reductions with respect to the torus T. This is based on joint work in progress with Alastair Craw and Travis Schedler. In the second part of the talk, I will describe how to explicitly identify the Hamiltonian Cox space in the special case of the Springer resolution. Here one can check that the conjectured properties of the Hamiltonian Cox space are indeed true. This is based on joint work with Tom Gannon.

Schedler, Travis (Imperial): Building blocks of symplectic singularities and resolutions

One approach to the classification of symplectic singularities is to reduce them to the most fundamental building blocks: Q-factorial (isolated) singularities with trivial local fundamental group. I will recall the motivation for this and explain how to

construct isolated examples by Hamiltonian reductions $V///SL_2$, with V one of four infinite families of representations; two of these appear to be new. I will explain how we fit standard examples such as singularities of quiver varieties (hence of moduli spaces of 2D Calabi–Yau algebras and categories) into this picture, by taking finite and torus quotients of fundamental building blocks.

In general, these building blocks are conjecturally obtainable by the Hamiltonian Cox ring construction, discussed in Bellamy's parallel lecture. I will discuss how this is related to the classification of symplectic (partial) resolutions via the ordinary Cox ring of a symplectic resolution (or Q-factorial terminalisation), and how to compute this ring in many cases.

Hwang, Jun-Muk (IBS): Holomophic symplectic geometry of elliptic surfaces

When a complex surface X admits a nowhere vanishing holomorphic 2-form, it determines a (holomorphic) symplectic structure on X. We consider the case when X is an elliptic surface and study how the symplectic geometry is related to the underlying complex geometry of the elliptic fibration. This is based on a joint work with Guolei Zhong.

Fu, Baohua (Chinese Academy of Sci.): Symplectic singularities arising from cotangent bundles

I'll report joint works with Jie Liu (AMSS) which give a systematic investigation of a geometric construction of symplectic varieties through cotangent bundles.

Mukai, Shigeru (RIMS): Cubic fourfolds with many cusps and associated symplectic manifolds

Over the complex number field, the maximal number of cusps of a cubic fourfold is 10 and attained by the cyclic triple covering of the projective 4-space with branch the Segre cubic. We observe that its modulo 3 reduction has an extra cusp, and discuss the following: (1) Birational automorphism groups of associated symplectic manifolds both in characteristic 0 and 3. (2) Construction of another cubic 4-fold with 11 cusps to obtain a geometric realization of one of 26 sporadic finite simple groups (RIMS preprint # 1987). (3) Analogous construction in characteristic 2 and 5 (if time permits).

Nakajima, Hiraku (IPMU): Involutions on quiver varieties and bow varieties

We consider symplectic involutions on quiver and bow varieties and their fixed point subsets. They produce examples of symplectic varieties, which may or may not have

symplectic resolutions. People start to study their relations to geometric representation theory. I will survey a few recent results in this direction.

Lehn, Christian (Bochum): Nonvanishing and semiampleness results for irreducible holomorphic symplectic manifolds

Nonvanishing theorems are central to birational geometry as they link numerical data to geometric properties and form a key step toward abundance and semiampleness. General results remain rare, especially in the Kähler setting. We present nonvanishing and semiampleness results for irreducible holomorphic symplectic manifolds. For isotropic line bundles on hyperkähler manifolds, we prove a dichotomy: either nonvanishing holds, or every closed positive current in the first Chern class of the bundle has maximal Lelong components of highly constrained geometry. Assuming nonvanishing, we give a roadmap to proving semiampleness for irreducible holomorphic symplectic manifolds in dimension four. This is joint work with Höring and Lazić.

Lehn, Manfred (Mainz): On the discriminant locus of Lagrangian fibrations

I will report on joint work with Czaplinski, Krug and Rollenske on the construction of Lagrangian fibrations with many components in the discriminant locus.

Namikawa, Yoshinori (RIMS): Towards a characterization of toric hyperkaehler varieties among symplectic singularities

Let (X, ω) be a conical symplectic variety of dimension 2n which has a projective symplectic resolution. Assume that X admits an effective Hamiltonian action of an n-dimensional algebraic torus T^n, compatible with the conical $\mathbb{C}^*$-action. In this talk we prove that (X, ω) is isomorphic to a toric hyperkahler variety studied by Goto, Bielawski-Dancer, Hausel-Sturmfels, Konno, Proud-foot and others. This result can be regarded as a holomorphic symplectic analogue of Delzant's theorem on toric varieties.

Laza, Radu (Stony Brook): Hodge Theory and Moduli

Moduli theory has seen remarkable advances in recent years, driven first by the Minimal Model Program (via KSBA theory) and, more recently, by the theory of K-stability. In this talk, I will present a third perspective on the construction and compactification of moduli spaces, based on Hodge theory, period maps, and the Baily–Borel compactification. I will discuss both the strengths and the intrinsic limitations of this approach, and highlight the striking progress achieved in recent work of Bakker–Filipazzi–Mauri–Tsimerman, which resolves a conjecture of Griffiths–Green–Laza–Robles and fits into the broader, long-standing program

initiated by Griffiths. This Hodge-theoretic approach is particularly powerful for K-trivial varieties, with notable applications to the moduli of Calabi–Yau varieties.

Hubbard, Austin (Imperial): Classifying toric hyperkähler varieties

Like toric varieties, toric hyperkähler varieties have a combinatorial construction and an abstract characterisation. Whether the classes of varieties arising combinatorially/abstractly are equal is still conjectural. Proudfoot has divided the proof into two conjectures. Recent work of Namikawa has made much progress on the first conjecture, which deals with affine toric hyperkähler varieties. In this talk we discuss recent joint work with Kaplan, Schedler, and Proudfoot on the second conjecture, which states that all crepant partial resolutions of 'standard' affine toric hyperkähler varieties arise combinatorially via tilings of zonotopes.

Wye, Ruth (Bath): Hilbert schemes of crepant partial resolutions

The Hilbert scheme of n points on any projective crepant partial resolution of an ADE singularity is a quiver variety. Here we identify the relevant GIT cone defining the variety, provide a moduli description of its unique projective crepant resolution and discuss some of the birational geometry of these varieties. These examples illustrate Namikawa's observation that minimal models of symplectic singularities are Mori Dream Spaces.

Hikita, Tatsuyuki (RIMS): Canonical bases for conical symplectic resolutions

Kaledin conjectured that there exists a $\mathbb{G}_m$-equivariant tilting bundle on any conical symplectic resolution such that its endomorphism ring is non-negatively graded with respect to the $\mathbb{G}_m$-action. In this talk, I will explain two approaches to characterize the K-theory classes of the indecomposable summands of such a tilting bundle, which we call canonical bases after Lusztig. The first approach uses the (abelian) K-theoretic stable envelope defined by Okounkov, and works for conical symplectic resolutions with a good torus action. The second approach uses the nonabelian stable envelope also defined by Okounkov and applies Hamiltonian reductions of symplectic vector spaces such as quiver varieties.

Gross, Mark (Cambridge): Relative quantum cohomology and vector fields on intrinsic mirrors

This is an interim report on work begun at RIMS in 2024 with Daniel Pomerleano and Bernd Siebert. Quantum cohomology of a non-singular projective variety is

a deformation of the ordinary cup product on cohomology to a product which incorporates counts of rational curves on the projective variety. There should be a "relative" version, associated to a pair (X, D) with X a smooth projective variety and D a normal crossings divisor. In the case that (X, D) is log Calabi-Yau, the degree 0 part of this ring was constructing previously by myself and Siebert, leading to a general mirror construction. In this talk, I will talk about constructing degree 1 relative quantum cohomology and explain how there is a map from this group to the space of vector fields on the mirror to the pair (X, D).

Mizuno, Yuki (Waseda): Bondal–Orlov's reconstruction theorem in noncommutative projective geometry

The (derived) category of coherent sheaves on a scheme encodes rich information about the underlying geometry. P. Gabriel showed that for noetherian schemes X and Y, if $\mathrm{Coh}(X)$ and $\mathrm{Coh}(Y)$ are equivalent as abelian categories, then X and Y are isomorphic. Furthermore, A. Bondal and D. Orlov proved that for smooth projective schemes X and Y with (anti-) ample canonical bundles, if $D^b(\mathrm{Coh}(X))$ and $D^b(\mathrm{Coh}(Y))$ are equivalent as triangulated categories, then X and Y are isomorphic. On the other hand, J.-P. Serre showed that the category of coherent sheaves on a projective scheme can be described as the quotient category of finitely generated graded modules over the homogeneous coordinate ring by the subcategory of torsion modules. Motivated by the results of Gabriel and Serre, the quotient category of finitely generated graded modules over a (not necessarily commutative) graded ring by the subcategory of torsion modules is called a noncommutative projective scheme. In this talk, I will present an analogue of Bondal–Orlov ' s reconstruction theorem in the setting of noncommutative projective geometry. I will also describe examples of noncommutative Calabi–Yau (NC CY) manifolds previously constructed by Kanazawa and the speaker, and touch on the associated reconstruction problems. If time permits, I will also mention properties relating noncommutative crepant resolutions and Hochschild (co)homology of these NC CY manifolds that are currently being uncovered.

Moriwaki, Atsushi (Chubu): Adelic structures of countable fields

This is a joint work with Huayi Chen. The most important target for the theory of adelic curves is a variety over a countable field of characteristic zero. In this talk, I would like to give the standard way to adelic structures of such fields. As applications, I will propose a generalized Fermat conjecture for a finitely generated field over the rational number field.