

Derived categories and Chow groups of hyperkaehler and Calabi-Yau varieties

workshop Talk Schedule

Events for:
Monday, September 19th - Friday, September 23rd

Monday, September 19th

9:30am **Ulrike Riess - SCGP 102**

Title: On Beauville's conjectural weak splitting property

Abstract: This talk should serve as an overview on Chow rings of irreducible symplectic varieties. We start by recalling the results of Beauville and Voisin on the Chow ring of K3 surfaces, and present Beauville's conjectural "weak splitting property", and Voisin's generalization: Both conjectures predict the injectivity of the restriction of the cycle class map to certain subalgebras in the Chow ring. After listing the known results on these conjectures, we discuss Chow rings of birational irreducible symplectic varieties and the connection to derived categories. Finally, we show how to reduce Beauville's weak splitting property to varieties with small Picard rank.

10:30am **Coffee Break**

11:00am **Yin Qizheng - SCGP 102**

Title: Decomposition of the small diagonal for families of K3 surfaces

Abstract: Using ideas and techniques from Gromov-Witten theory, we obtain a decomposition of the third small diagonal for the universal (quasi-)polarized K3 surface, thus generalizing a theorem of Beauville-Voisin for a fixed K3 surface. As a result, we prove a conjecture of Marian-Oprea-Pandharipande: that the tautological ring of the moduli of (quasi-)polarized K3 surfaces is generated by (the classes of) the Noether-Lefschetz loci. Joint work with Rahul Pandharipande.

12:00pm **Lunch**

2:15pm **Lie Fu**

Title: Motivic Hyper-Kähler resolution conjecture

3:30pm **Tea Time**

4:00pm **Nick Addington**

Title: Some new rational cubic 4-folds

Abstract: I will begin by recalling the beautiful story of cubic 4-folds containing a plane: the quadric surface fibration over P^2 , the K3 surface of degree 2 with the Brauer class of order 2, the countable union of 18-dimensional families of rational cubics, etc. Then I will discuss some new work, joint with Hassett, Tschinkel, and Várilly-Alvarado, which yields a similar story for cubics containing an elliptic ruled surface: there is a sextic del Pezzo fibration over P^2 , and a K3 surface of degree 2 with a Brauer class of order 3, and a countable union of 18-dimensional families of rational cubics. These are the first new rational cubic 4-folds to come along in in two decades.

Tuesday, September 20th

9:30am **Claire Voisin**

Title: Torsion points of sections of Lagrangian fibrations

10:30am **Coffee Break**

11:00am **Radu Laza**

Title: Cubic fourfolds and O'Grady 10 Hyperkahler manifolds

Abstract: The construction of compact Hyperkahler (HK) manifolds is a notoriously difficult problem. Currently, all the known examples are: two infinite series (deformations of Hilbert schemes of points on K3s, and generalized Kummer varieties) and two exotic examples due to O'Grady in dimension 6 (OG6) and dimension 10 (OG10). While O'Grady's construction of OG10 is based on Mukai's approach via moduli of sheaves on K3s, we propose here a new "Lagrangian" construction for OG10. Specifically, we start with a general cubic fourfold X , and consider the Intermediate Jacobian fibration J associated to the universal family of hyperplane sections on X . This is well defined and algebraic (cf. Donagi-Markman) over the locus U of smooth hyperplane sections of X . As previously conjectured by Markushevich, we prove that J/U admits a smooth, flat compactification, which is a Hyperkahler manifold, deformation equivalent to OG10. Our main tool here is the construction of a relative compactified Prym. This is joint work with G. Sacca and C. Voisin.

12:00pm **Lunch**

2:15pm **Kieran O'Grady**

Title: Covering families of lagrangian subvarieties of hyperkaehler varieties.

3:30pm **Tea Time**

4:00pm **Misha Verbitsky**

Title: Perverse coherent sheaves on hyperkahler manifolds and Weil conjectures

Abstract: In Beilinson-Bernstein-Deligne (BBD), Weil conjectures were interpreted as a theorem about purity of a direct image of a pure perverse sheaf. Coherent sheaves on a general (non-algebraic) deformation of hyperkahler manifold have all singularities in codimension 2, which allows one to define a self-dual middle perversity on this category. However, the category of coherent sheaves on a general hyperkahler variety admits a full embedding to the category of coherent sheaves on any its deformation (and is essentially independent on the deformation), hence the notion of "perverse coherent sheaf" makes sense on algebraic hyperkahler manifolds as well. Instead of fixing the Frobenius action, as in the BBD setup, one should fix the lifting of the sheaf to the twistor space. The role of weight filtration is played by the $O(i)$ -filtration on the sheaf restricted to the rational curves in the twistor space. The hyperkahler version of "Weil conjectures" predicts that the weights are increased under pushforwards, and the pushforwards of pure perverse sheaves remain pure, which is actually true, at least in smooth case. This talk is based on non-published (and non-finished) paper written back in 1990-ies, so it is essentially a string of conjectures with some evidence through in.

Wednesday, September 21st

9:30am **Dulip Piyaratne**

Title: Stability conditions and Fourier-Mukai theory

10:30am **Coffee Break**

11:00am **Daniel Halpern-Leistner**

Title: Derived equivalences between moduli spaces of coherent sheaves on a K3 surface

12:00pm **Lunch**

2:15pm **Izzet Coskun**

Title: The birational geometry of moduli spaces of sheaves on surfaces

3:30pm **Tea Time**

4:00pm **Arend Bayer - SCGP 102**

Title: Algebraic Geometry Seminar: More applications of stability conditions

Abstract: I will explain new applications of stability conditions on surfaces (and of tilt-stability on higher-dimensional varieties). These include Brill-Noether theory for curves on generic abelian surfaces, and Bogomolov-type restriction theorems for vector bundles.

5:00pm **Nikolay Buskin - SCGP 102**

Title: Every Rational Hodge Isometry Between Two K3 Surfaces is Algebraic

Abstract: Associated to a rational Hodge isometry between any two (not necessarily projective) complex K3 surfaces S_1 and S_2 is a rational Hodge class in the fourth cohomology of the product $S_1 \times S_2$. We prove that any such class is a polynomial in Chern classes of coherent analytic sheaves. Consequently, such a Hodge class is algebraic whenever S_1 and S_2 are algebraic. This proves a conjecture of Shafarevich announced at the ICM in 1970.

Thursday, September 22nd

9:30am **Yuri Tschinkel**

Title: Rationality problems

10:30am **Coffee Break**

11:00am **Kota Yoshioka**

Title: Moduli spaces of stable sheaves on Enriques surfaces.

Abstract: For the moduli spaces of stable sheaves on Enriques surfaces, Nuer proved the irreducibility based on Kim's result on the rank 2 case. I will explain another proof of the irreducibility of the moduli space of rank 2 sheaves.

12:00pm **Lunch**

2:15pm **Hsueh-Yung Lin**

Title: Zero-cycles and constant cycle subvarieties in some hyper-Kähler varieties.

3:30pm **Tea Time**

4:00pm **Daniel Huybrechts**

Title: Math Colloquium: K3 surfaces and lattices

Friday, September 23rd

9:30am **Brendan Hassett - SCGP 102**

Title: Cubic fourfolds, K3 surfaces, and derived equivalences

Abstract: We discuss how K3 surfaces may be obtained from certain special cubic fourfolds and analyze the derived equivalences between them.

10:30am **Coffee Break**

11:00am **Ludmil Katzarkov**

Title: Categories and filtrations

12:00pm **Lunch**

1:15pm **Xiaolei Zhao**

Title: Birational geometry of moduli spaces of sheaves on the projective plane via wall-crossing

Abstract: In this talk, I will explain how to use Bridgeland stability to study the birational geometry of moduli spaces of sheaves on the projective plane. I will show that wall-crossing naturally provides smooth projective birational models of these moduli spaces, and induces the MMP for them. Moreover a numerical criterion of potential walls being actual walls will be given, and used to compute several cones of these moduli spaces. This is based on a recent joint work with Chunyi Li.

2:30pm **Giulia Sacca**

Title: Geometry of O'Grady's 6 dimensional example

Abstract: There are not many known examples of compact irreducible hyperkähler manifolds. Two series of examples appear in dimension $2n$, for every $n > 1$, and are related to the Hilbert scheme of points on a K3 or an abelian surface; and in dimension 6 and 10 there is one extra, or exceptional, deformation class, each of which was found by O'Grady. While considerable work has been devoted to studying hyperkähler manifolds belonging to the first two deformation classes, not much is known for the exceptional deformation classes. In this talk I will present joint work with Giovanni Mongardi and Antonio Rapagnetta, regarding the geometry of O'Grady's six dimensional example. By realizing these examples as "quotients" of another hyperkähler manifold by a birational involution, we are able to compute the Hodge numbers and, in work in progress, also study properties of their moduli spaces/deformation class.

3:30pm **Tea Time**