PIMS Symposium on Hodge Theory, Arithmetic and Moduli

May 13- 17, 2019

University of British Columbia

Program

Getting Started

Get connected: Select the "ubcvisitor" wireless network on your wireless device. Open up a web browser, and you will be directed to the login page.

Locations

Earth Sciences Building Room 1012 and 2012

Schedule

	Monday 13	Tuesday 14	Wednesday 15	Thursday 16	Friday 17
Location	ESB 2012	ESB 1012*	ESB 2012	ESB 1012	ESB 2012
9:00 am	Colleen Robles	Christian Schnell	François Greer	Daniel Litt	Stefan Patrikis
10:00 am	**Break**				
10:15 am	Patricio Gallardo	Radu Laza	Luca Schaffer	Elham Izadi	Donu Arapura
11:15 am	**Break**				
11:30 am	Tokio Sasaki	Deepam Patel	Evangelia Gazaki	Souvik Goswami	Matt Ballard
Location	**All Afternoon session in ESB 2012**				
12:30 pm	**Lunch (Self- Hosted)**			Collaborative Work (unscheduled Time)	Collaborative Work (unscheduled Time)
2:00 pm	Humberto Diaz	Mark de Cataldo	Patrick Brosnan		
3:00 pm	**Tea**				
3:30 pm 5:00pm	Collaborative Work (unscheduled Time)	Collaborative Work (unscheduled Time)	Collaborative Work (unscheduled Time)		

* Please note changes in Room location:

Monday 13, Wednesday 15 & Friday 17 May, 2019:

- All day- ESB room 2012

Tuesday 14 and Wednesday 16 May, 2019:

- 9:00am - 12:30pm : ESB 1012
- 12:30pm- 5:00pm: ESB 2012

Speaker Abstracts

Donu Arapura, Purdue University

Hodge cycles on fibered fourfolds.

Let me say that the variety satisfies HC if all Hodge cycles on it are algebraic. As I will explain, for fourfolds, there is no harm in assuming that the variety is fibered in the sense that it maps onto a positive dimensional variety of lower dimension. I have some criteria for checking HC for fibered fourfolds. This yields a few new cases for HC, such as for universal families of genus 2 curves, and some elliptic fourfolds.

Matthew Ballard, University of South Carolina.

Derived categories and arithmetic.

The simplest building blocks for derived categories are exceptional collections. The existence of such collections has tantalizing ties to rationality. In this talk, we'll discuss exceptional collections for categories over non-closed fields.

Patrick Brosnan, University of Maryland

Volumes of definable sets and affne GAGA theorems.

I show that the Peterzil-Starchenko affne GAGA theorem for definable sets in an o-minimal expansion (as used in the recent preprint of Bakker, Brunebarbe and Tsimerman on the image of the period map) is an easy consequence of the much older Bishop-Stoll theorem. The main new step is to prove a volume estimate for the intersection S[r] of a definable subset S of (real) affne n-space with a ball of radius r centered at the origin. Using elementary techniques in o-minimal theory (mostly the o-minimal implicit function theorem), I show that, for d-dimension S, the volume is O(r^d). I will aim to make the talk self-contained and to explain the essentials of the o-minimal theory.

Mark de Cataldo, Stony Brook University

The Hodge numbers of OG10.

I report on joint work with A. Rapagnetta (U.Rome) and G. Saccà (Columbia U.) where we compute the Hodge numbers of the hyperkahler manifolds in the deformation class of O'Grady's 10-dimensional example.

Humberto Diaz, University of California, Riverside

Unramified cohomology and the integral Hodge conjecture.

The failure of the integral Hodge conjecture has been known since the famous counterexamples of Atiyah and Hirzebruch. Currently, several methods exist for producing other counter-examples. For instance, a seminal result of Colliot-Thélène and Voisin relates the failure of the integral Hodge conjecture in degree 4 to degree 3 unramified cohomology. After giving a quick overview of this method, I will discuss how it can be used to obtain new counterexamples to the integral Hodge conjecture.

Patricio Gallardo, Washington University in St Louis

On compact moduli of special Horikawa surfaces.

We describe GIT and KSBA compactifications of particular loci within the moduli space of special Horikawa surfaces with $p_g = 2$ and $K^2 = 1$. These surfaces are bidouble covers of the projective planebranched along a quintic and two lines, and they are relevant because they satisfy a generic global Torelli theorem. We will focus on the particular case where the quintic decomposes as the union of lines. All the results are joint work with L. Schaffer, G. Pearlstein and Z. Zhang.

Evangelia Gazaki, University of Michigan

A structure theorem for zero-cycles on products of elliptic curves over p-adic fields.

In the mid 90's Colliot-Thélène formulated a conjecture about zero-cycles on smooth projective varieties over p-adic fields. A weaker form of this conjecture was recently established, but the general conjecture is only known for very limited classes of varieties. In this talk I will present some recent joint work with Isabel Leal, where we prove this conjecture for products of elliptic curves, under some assumptions on their reduction type. Our methods often allow us to obtain very sharp results about the structure of the group of zero-cycles on such products and also give us some promising global-to-local information.

Souvik Goswami, Texas A&M University

Height pairing between Bloch's higher cycles.

Higher Chow groups have been introduced by Spencer Bloch as a concrete way to represent motivic cohomology. In this talk I will explain how to define a height pairing between higher cycles in complimentary codimensions, and give a mixed Hodge theoretic interpretation of it. This is joint work in progress with G. Pearlstein and José Burgos Gil.

François Greer, Stony Brook University

Quasi-modularity from Noether-Lefschetz theory.

We present a program for showing quasi-modularity of the Gromov-Witten generating series of an elliptically fibered projective manifold, using the homogeneous structure of period domains. The modularity comes from the theta correspondence of Kudla-Millson, and the holomorphic anomaly comes from the boundary of a toroidal compactification. As an application, we compute a genus 0 potential for a broken K3 fibration.

Elham Izadi, University of California, San Diego

Twistor path connectivity for complex tori.

It is well-known that the moduli spaces of irreducible hyperkhler manifolds are twistor path connected. This was used in the recent proof by Markman of the Hodge conjecture for infinitely many families of abelian fourfolds of Weil type, via a parametrization due to OGrady of these abelian fourfolds by irreducible hyperkhler manifolds of Kummer type. Here, in joint work with Nikolay Buskin, we prove twistor path connectivity for moduli spaces of complex tori of arbitrary even dimension.

Radu Laza, Stony Brook University

Title and Abstract: TBA

Daniel Litt, Institute for Advanced Study.

Integral monodromy representations and niteness.

Let X be a quasiprojective complex variety. Which representations of the fundamental group of X arise from geometry? What is the structure of this set of geometric representations? I'll discuss new results on this topic (for example, a generalization of Deligne's finiteness theorem and some results on the integral structure of such representations) arising from arithmetic.

Deepam Patel, Purdue University

Hypergeometric Motives.

Abstract: TBA

Stefan Patrikis, University of Utah

Motives with l-adic monodromy group E6.

I will explain the construction, in joint work with G. Boxer, F.Calegari, M. Emerton, B. Levin, and K. Madapusi Pera, of motives over number fields whose l-adic realizations have monodromy group of type E6; these are the first such exam- ples. The construction—in contrast, for instance, to the work of Dettweiler-Reiter and Yun on motives with monodromy groups of type G2, E7, and E8—rests on a combination of tools from automorphic forms and the deformation theory of Galois representations; I will spend much of the talk putting these methods in context and discussing related examples.

Colleen Robles, Duke University

What representation theory can tell us about the cohomology of a hyperkahler manifold.

The cohomology (with complex coefficients) of a compact kahler manifold M admits an action of the algebra $sl(2, \mathbb{C})$, and this action plays an essential role in the analysis of the cohomology. In the case that M is a hyperkahler manifold Verbitsky and Looijenga--Lunts showed there is a family of such $sl(2, \mathbb{C})$s generating an algebra isomorphic to so(4, $b_2 - 2$), and this algebra similarly can tell us quite a bit about the cohomology of the hyperkahler. I will describe some results of this nature for both the Hodge numbers and Nagais conjecture on the nilpotent logarithm of monodromy arising from a degeneration. This is joint work with Mark Green, Radu Laza and Yoonjoo Kim.

Christian Schnell, Stony Brook University

Extending holomorphic forms from the regular locus of a complex space to a resolution.

Suppose we have a holomorphic differential form, defined on the smooth locus of a complex space. Under what conditions does it extend to a holomorphic differential form on a resolution of singularities? In 2011, Greb, Kebekus, Kovacs, and Peternell proved that such an extension always exists on algebraic varieties with klt singularities. I will explain how to solve this problem in general, with the help of Hodge modules and the Decomposition Theorem. This is joint work with Kebekus.

Tokio Sasaki, Washington University in St. Louis

A construction of non trivial elements of Griffiths groups on Calabi-Yau threefolds.

From a given reflexive Laurent polynomial in three variables, one can construct a degenerating family of K3 surfaces, so that the associated three dimensional Newton polytope exhibits the combinatorial geometry of the singular fiber. If a four dimensional reflexive polytope is the Minkowski sum of this polytope and another one, it defines a nef partition, and hypersurface sections of the associated toric variety provide an example of a Tyurin degeneration, which is a degeneration of Calabi-Yau threefolds to a union of quasi-Fano varieties. We construct some examples of the families of these CY threefolds together with non-trivial elements of their Griffiths groups. These elements arise from specific indecomposable cycles on the intersection K3 surface of the irreducible components on the singular fiber. This construction is based on going down by the K-theory elevator, and we expect that generally nef partitions of reflexive polytopes encode the combinatorial method to construct such a CY threefold.

Luca Schaffler, University of Massachusetts Amherst

Compactifications of the moduli space of K3s with order 4 purely non- symplectic automorphism.

We consider the moduli space of K3s with order 4 purely non-symplectic automorphism and a specific lattice polarization. Kondo constructed these sur- faces as double covers of $\mathbb{P}1 \times \mathbb{P}1$. Work of Deligne-Mostow implies that the GIT compactification of this moduli space is isomorphic to the Baily-Borel. We show that Kirwan's partial desingularization of the GIT compactification has a modular interpretation in terms of KSBA stable pairs. This is joint work with Han-Bom Moon.

Participants

1. Karem Abdelgali, University of Alberta.
2. Donu Arapura, Purdue University.
3. Soumya Sinha Babu, Washington University in St. Louis.
4. Matt Ballard, University of South Carolina.
5. Patrick Brosnan, University of Maryland.
6. Samir Canning, University of California, San Diego
7. Ben Castor, Washington University in St. Louis.
8. Xiaojiang Cheng, Washington University in St. Louis.
9. Yu Chenglong, University of Pennsylvania
10. Jonathan Conder, University of California, San Diego.
11. Mark de Cataldo, Stony Brook University.
12. Haohua Deng, Washington University in St. Louis.
13. Humberto Diaz, University of California, Riverside.
14. Patricio Gallardo, Washington University in St. Louis.
15. Evangelia Gazaki, University of Michigan.
16. Souvik Goswami, Texas A&M University.
17. Françoise Greer, Stony Brook University.
18. Elham Izadi, University of California, San Diego.
19. Matt Kerr, Washington University in St. Louis.
20. Yoonjoo Kim, Stony Brook University.
21. Radu Laza, Stony Brook University.
22. James Lewis, University of Alberta.
23. Hongshan Li, Purdue University.
24. Daniel Litt, Institute for Advanced Study, Princeton.
25. Eric Pasewark, Washington University in St. Louis.
26. Deepam Patel, Purdue University.
27. Stefan Patrikis, University of Utah.
28. Gregory Pearlstein, Texas A&M University.
29. Colleen Robles, Duke University.
30. Tokio Sasaki, Washington University in St. Louis.
31. Justin Scarfy, University of British Columbia.
32. Luca Schaffler, University of Massachusetts, Amherst.
33. Christian Schnell, Stony Brook University
34. Avi Steiner, Purdue University.
35. Zhang Yilong, Ohio State University.

Organizers

- Charles Doran, University of Alberta.
- Matt Kerr, Washington University in St. Louis.
- Matilde Lalín, Université de Montréal.
- James Lewis, University of Alberta.
- Gregory Pearlstein, Texas A&M University.

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