Modern Moduli Theory
September 25-29, 2017

Abstracts of Talks

Dario Beraldo (University of Oxford)

Title: The center of the monoidal category of "higher differential operators"

Abstract: For *Y* an algebraic stack (satisfying some mild technical conditions), we consider the DG category $IndCoh(Y \times_{Y_{dR}} Y)$ of ind-coherent sheaves on the formal completion of the diagonal of *Y*, equipped with the convolution monoidal structure. Within $IndCoh(Y\times_{Y_{dR}} Y)$, we single out a monoidal full subcategory *H(Y)* of interest in several future applications. By definition, an object of $IndCoh(Y \times_{Y_{dR}} Y)$ belongs to *H(Y)* if its pullback along the diagonal $\Delta: Y \to Y \times_{Y_{dR}} Y$ is quasi-coherent. As suggested to me by many people, *H*(*Y*) can be regarded as a categorification of the ring of differential operators on *Y*, in the same way as $QCoh(Y)$ is a categorification of the ring of functions. In the talk, we identify the Drinfeld center of *H(Y)* with "$D-mod(LY)$", a certain tweak of the category of left *D*-modules on the loop stack $LY := Y \times_{Y \times Y} Y$.

Yalong Cao (University of Oxford)

Title: Gopakumar-Vafa type invariants for Calabi-Yau 4-folds

Abstract: As an analogy of Gopakumar-Vafa conjecture for CY 3-folds, Klemm-Pandharipande proposed GV type invariants on CY 4-folds using GW theory and conjectured their integrality. In this talk, we propose a sheaf theoretical interpretation to these invariants using Donaldson-Thomas theory on CY 4-folds. This is a joint work with Davesh Maulik and Yukinobu Toda.

Ben Davison (IST Vienna)

Title: BPS sheaves and Lie algebras

Abstract: I will explain a definition of "BPS sheaves" on coarse moduli spaces of objects in 3CY categories, and motivate the definition via noncommutative Donaldson-Thomas theory. The definition, in conjunction with the Maulik-Toda approach to GV invariants, and Joyce and others' work on DT sheaves before it, suggests how to define categorified GV invariants for non-primitive characteristic classes. In the ncDT case at least, the definition enables us to "categorify" the usual BPS numbers, in the sense that they become the graded dimensions of a Lie algebra, for which the Kontsevich-Soibelman cohomological Hall algebra is a deformed universal enveloping algebra. For example for any finite quiver, there is a simple recipe for producing another finite quiver, with potential, for which the resulting Lie algebra is the positive part of the Kac-Moody Lie algebra of the original quiver. This is joint work with Sven Meinhardt.

Chris Dodd (Illinois)

Title: A k-valued cohomology theory for varieties over k

Abstract: In this talk we will discuss a way of extending the de Rham cohomology for smooth proper varieties over a field to all varieties. For a field of characteristic zero this is nothing new, but in positive characteristic we obtain a “compactified” deRham cohomology theory which has a number of expected properties; including finiteness over k.

Barbara Fantechi (SISSA Trieste)

Title: DGLA and deformations of log orbifolds

Abstract: This is report on joint work in progress with Donatella Iacono. We extend to smooth Deligne Mumford stacks, including non-separated ones, the construction of differential graded Lie algebras governing their deformation theory. As an application, we prove unobstructedness of the locally trivial deformation functor in the log Calabi Yau case (with a different argument from that outlined by Katzarkov-Konstevich-Pantev).

Elham Izadi (University of California, San Diego)

Title: A uniformization of the moduli space of abelian sixfolds

Abstract: For any principally polarized abelian sixefold, we show that 6 times the minimal cohomology class is represented by an algebraic curve by exhibiting a structure of a Prym-Tyurin- Kanev variety of exponent 6 on the abelian variety. The main construction uses covers of the projective line whose monodromy group is the Weyl group of E_6. This is joint work with Alexeev, Donagi, Farkas and Ortega.

Frances Kirwan (University of Oxford)

Title: Applications of non-reductive geometric invariant theory

Abstract: Geometric invariant theory (GIT) for non-reductive linear algebraic group actions is in general much less well behaved than in the reductive case developed by Mumford. However when the unipotent radical U of a linear algebraic group H is graded, in the sense that a Levi subgroup has a central one-parameter subgroup which acts by conjugation on U with all weights strictly positive, then GIT for a linear action of H on a projective scheme is almost as well behaved as in the reductive setting, provided that we are willing to multiply the linearisation by an appropriate rational character. This has potential applications for the construction of moduli spaces of 'unstable' objects of prescribed type, such as sheaves of fixed Harder-Narasimhan type or unstable curves.

Kobi Kremnizer (University of Oxford)

Title: Differentiable chiral algebras

Abstract: I will describe how to develop a theory of quasi-coherent sheaves and D-modules in the context of C^∞-schemes. Using this I will define differentiable chiral and factorisation algebras. I will also discuss differentiable versions of the Beilinson-Drinfeld Grassmannian and chiral algebras related to them. This is joint work with Dennis Borisov.

Sven Meinhardt (University of Sheffield)

Title: Integrality in Donaldson-Thomas theory

Abstract: Proving the conjectured integrality of BPS numbers was considered to be one of the hardest problems in Donaldson-Thomas theory for many years. It was believed that a suitable categorification of the whole story based on the Cohomological Hall algebra defined by Kontsevich and Soibelman would provide new insight into the integrality conjecture. In collaboration with Ben Davison and Markus Reineke I was able to prove these conjectures in the context of quivers with potential, and these results form the starting point for more general situations as discussed in Ben Davison's talk. Contrary to the obvious conclusion that a categorification provides a proof of integrality, we had to

prove integrality first in order to obtain a categorification. During my talk I will sketch the sequence of our arguments and provide some insight into integrality and categorification.

Tom Nevins (University of Illinois)

Title: Compactifications, cohomology, and categories associated to moduli spaces

Abstract: Many moduli spaces (for example, of instantons or vacua) appearing in supersymmetric field theories admit modular compactifications with especially good properties. I will outline a general strategy, built on pioneering work of Beauville, Markman, and others, for describing generators of topological and categorical invariants associated to such moduli spaces. To illustrate, I will describe joint work with K. McGerty that applies the strategy to prove "Kirwan surjectivity" for Nakajima quiver varieties. Work in progress with McGerty derives general statements (of which the quiver variety results are a special case) applicable to many 3d N=4 settings.

Georg Oberdieck (Massachusetts Institute of Technology)

Title: Curve counting on elliptic Calabi-Yau threefolds: K3xE and the Schoen Calabi-Yau

Abstract: The Donaldson-Thomas/Gromov-Witten theory of elliptic Calabi-Yau threefolds is conjecturally governed by Jacobi forms. I will discuss recent progress towards this conjecture in two examples: the product of a K3 surface and an elliptic curve, and the Schoen Calabi-Yau. Both DT and GW theory yield modular constraints. The former by Fourier-Mukai transforms with kernel the Poincare sheaf of the fibration (joint work with Junliang Shen), and the latter by holomorphic anomaly equations (joint with Aaron Pixton).

Andrei Okounkov (Columbia University)

Title: Gauge theories and Bethe eigenfunctions

Abstract: The talk will be based on a joint paper https://arxiv.org/abs/1704.08746 with Mina Aganagic. In this paper, we essentially complete the program of Nekrasov and Shatashvili who explained the meaning of Bethe roots, Bethe equations, etc. of quantum integrable systems via their correspondence with supersymmetric gauge theories. We explain the meaning of offshell Bethe eigenfunctions (which also give solutions of the quantum Knizhnik-Zamolodchikov equations and related difference equations). Our formulas may be seen from a geometric, representation-theoretic, combinatorial, and other angles.

Tony Pantev (University of Pennsylvania)

Title: Gluing in nc geometry and applications

Abstract: I will describe a descent formalism in categorical non-commutative geometry which is geared towards constructions of Fourier–Mukai functors. The formalism allows one to carry out descent constructions in general algebraic and analytic frameworks without resorting to generators. I will discuss various applications, such as the connection to the classical Zariski and flat descents, constructions of Fukaya categories, and homological mirror symmetry. This is a joint work with Katzarkov and Kontsevich.

Jørgen Rennemo (University of Oslo and University of Oxford)

Title: Homological projective duality and the birational Torelli problem for Calabi-Yau 3-folds

Abstract: Kuznetsov's theory of homological projective duality is a very useful tool for proving relations between the derived categories of coherent sheaves of different varieties. In particular, it has been used to prove derived equivalences between non-birational Calabi-Yau 3-folds.

I'll explain how a recent generalisation of the main theorem of HP duality, due to Jiang-Leung-Xie, yields new such pairs which are deformation equivalent, and how this gives a counterexample to the birational Torelli problem for Calabi-Yau 3-folds. In particular, a counterexample is provided by the intersection of two translates of Gr(2,5) inside P^9, which is both derived equivalent and deformation equivalent to the intersection of their projective duals. This is joint work with J.C. Ottem.

Nick Rozenblyum (University of Chicago)

Title: Quantization of moduli spaces and counting

Abstract: Many moduli spaces, such as those appearing in Donaldson-Thomas theory, are equipped with anatural derived symplectic structure. I will describe a general framework for quantization of such symplectic structures and some applications such as to study counting problems via a version of the theory of vanishing cycles.

Yukinobu Toda (IPMU, Tokyo)

Title: Gopakumar-Vafa invariants and wall-crossing

Abstract: I will talk about a generalization of Gopakumar-Vafa invariants introduced by Maulik and myself last year, and show that these invariants are independent of Bridgeland stability conditions, assuming some condition on orientation data of moduli stacks of one dimensional sheaves. As an application, I will show the flop invariance of Gopakumar-Vafa invariants.

Bertrand Toën (Université Toulouse)

Title: Shifted symplectic structures and exponential motives.

Abstract: In this talk I will present some speculations about (-1)-shifted symplectic structures and an hypothetical theory of "exponential motives". This is an attempt to understand the perverse sheaf associated to a (-1)-shifted symplectic scheme with orientation data of Joyce and al. from the motivic point of view.