IAS | SCHOOL OF MATHEMATICS

Workshop on Homological Mirror Symmetry: Emerging Developments and Applications

March 13-17, 2017

Agenda

** All talks will take place in Simonyi Hall

MONDAY, MARCH 13

10:00 am - 11:00 am Denis Auroux, IAS, "Towards homological mirror symmetry for complete intersections in toric varieties"

Abstract: In this talk we will report on joint work in progress with Mohammed Abouzaid concerning homological mirror symmetry for hypersurfaces in $(C*)^n$, namely, comparing the derived category of the hypersurface and the Fukaya category of the mirror Landau-Ginzburg model. We will then discuss the extension of these results to (essentially arbitrary) complete intersections in toric Fano varieties.

11:00 am – 11:30 am   BREAK

11:30 am - 12:30 pm Jake Solomon, IAS, "Open descendent integrals in arbitrary genus"

Abstract: I plan to discuss the definition of open descendent integrals. In genus g>0, this involves the moduli space of Riemann surfaces with boundary with an additional structure called a grading. *Joint work with R. Tessler.

12:30 pm - 2:30 pm LUNCH, Dining Hall

2:30 pm - 3:30 pm Xin Jin, Northwestern Univ, "Brane structures from the perspective of microlocal sheaf theory

Abstract: In this talk, I will present the following application of microlocal sheaf theory in symplectic topology. For every closed exact Lagrangian L in the cotangent bundle of a manifold

M, we associate a locally constant sheaf of categories on L, which we call Brane_L, whose fiber is the infinity-category of k-modules, for k any ring spectrum. I will discuss the relation of Brane_L with the usual brane structures in Floer theory, and its connection to the J-homomorphism in stable homotopy theory. I will also present a purely topological approach to the Nadler-Zaslow theorem based on Brane_L, namely, there is a fully faithful functor from local systems on L to constructible sheaves on M, when L admits a brane structure. *This is joint work with David Treumann.

3:30 pm - 4:00 pm TEA, Fuld Hall Common Room

4:00 pm - 5:00 pm Tobias Dyckerhoff, Univ Bonn, "Topological Fukaya categories with coefficients"

Abstract: Within an emerging approach to Fukaya categories via cohomology with categorical coefficients, I will outline a theory of a particularly nice class of nonconstant coefficient systems defined on Riemann surfaces. These are categorical analogues of perverse sheaves, called perverse schobers. We provide a definition of perverse schobers as categorical sheaves on a relative two-colored version of the unital Ran space of the surface. We explain how to describe perverse schobers locally in terms of a paracyclic upgrade of Waldhausen's relative S-construction applied to spherical functors. We conclude, time permitting, with some applications.

TUESDAY, MARCH 14   TALKS CANCELLED FOR THE DAY

WEDNESDAY, MARCH 15

10:00 am - 11:00 am Edward Witten, IAS, "From Gauge Theory to Khovanov Homology Via Floer Theory"

11:00 am – 11:30 am   BREAK

11:30 am - 12:30 pm Si Li, Tsinghua Univ, "Vertex algebras, quantum master equation and mirror symmetry."

Abstract: We study the effective BV quantization theory for chiral deformation of two dimensional conformal field theories. We establish an exact correspondence between renormalized quantum master equations for effective functionals and Maurer-Cartan equations for chiral vertex operators. The generating functions are proven to be almost holomorphic modular forms.   As an application, we construct an exact solution of quantum B-model (BCOV

theory) in complex one dimension that solves the higher genus mirror symmetry conjecture on elliptic curves. The talk is based on arXiv: 1612.01292[math.QA]

12:30 pm - 1:30 pm LUNCH, Dining Hall

1:30 pm – 2:30 pm Lauren Williams, IAS, "Cluster duality and mirror symmetry for Grassmannians"

Abstract: We use the cluster structure on the Grassmannian and the combinatorics of plabic graphs to exhibit a new aspect of mirror symmetry for Grassmannians in terms of polytopes. From a given plabic graph G we have two coordinate systems: we have a network chart for the A-model Grassmannian, and a cluster chart for the B-model (Landau-Ginzburg model) Grassmannian. On the A-model side, we use the network chart from G and an ample divisor D to define an associated Newton-Okounkov polytope NO_G(D). We give explicit formulas for the lattice points in NO_G(D) in terms of the combinatorics of Young diagrams.
We then reinterpret NO_G(D) in terms of the superpotential and the cluster chart for the B-model Grassmannian. *This is joint work with Konstanze Rietsch.

2:30 pm – 3:30 pm Nicolas Templier, Cornell, "Mirror symmetry for minuscule flag varieties"

Abstract: We prove cases of Rietsch mirror conjecture that the A-model of projective homogeneous varieties is isomorphic to the B-model of its mirror, which is a partially compactified Landau--Ginzburg model constructed from Lie theory and geometric crystals. The conjecture relates to deep objects in algebraic combinatorics. Our method of proof comes from Langlands reciprocity, and consists in identifying the quantum connection as Galois and the crystal as automorphic. I will mention further potential interactions between symplectic geometry and number theory that it suggests. Work with Thomas Lam.

3:30 pm – 4:00 pm TEA, Fuld Hall Common Room

4:00 pm – 5:00 pm Clelia Pech, Kent Univ, "Mirror symmetry for homogeneous varieties"

Abstract: In this talk reporting on joint work with K. Rietsch and L. Williams, I will explain a new version of the construction by Rietsch of a mirror for some varieties with a homogeneous Lie group action. The varieties we study include quadrics and Lagrangian Grassmannians (i.e., Grassmannians of Lagrangian vector subspaces of a symplectic vector space). The mirror takes the shape of a rational function, the superpotential, defined on a Langlands dual homogeneous variety. I will show that in the mirror manifold has a particular combinatorial structure called a cluster structure, and that the superpotential is expressed in coordinates dual to the cohomology classes of the original variety.

I will also explain how these properties lead to new relations in the quantum cohomology, and a conjectural formula expressing solutions of the quantum differential equation for LG(n) in terms

of the superpotential. If time allows, I will also explain how these results should extend to a larger family of homogeneous spaces called `cominuscule homogeneous spaces'.

THURSDAY, MARCH 16

10:00 am - 11:00 am Tony Yue Yu, IAS, "The Frobenius conjecture in dimension two"

Abstract: We apply the counting of non-Archimedean holomorphic discs to the construction of the mirror of log Calabi-Yau surfaces. In particular, we prove the Frobenius structure conjecture of Gross-Hacking-Keel in dimension two. *This is joint work with Sean Keel.

11:30 am - 12:30 pm Mauricio Romo, IAS, "Central charges of B-branes at non-geometric phases"

Abstract: I'll give an overview of basic concepts about B-branes and their central charges and how they arise in physics and mathematics. In particular I'll present the gauge linear model approach which allows for defining quantities in the full stringy Kahler moduli M of certain Calabi-Yaus (CY). Then, I'll show some examples and motivate an intrinsic definition of the central charges on phases (some sub-regions of M), based on field theory data. I'll put particular emphasis on Landau-Ginzburg (orbifold) phases of CY hypersurfaces and comparison with results in FJRW theory. If time allows I'll comment on applications to not complete intersections and non-CY cases.

12:30 pm - 1:30 pm LUNCH, Dining Hall

1:30 pm - 2:30 pm Daniel Halpern-Leistner, Columbia, "Equivariant geometry and Calabi-Yau manifolds"

Abstract: Mirror symmetry has led to deep conjectures regarding the geometry of Calabi-Yau manifolds. One of the most intriguing of these conjectures states that various geometric invariants, some classical and some more homological in nature, agree for any two Calabi-Yau manifolds which are birationally equivalent to one another. I will discuss how new methods in equivariant geometry have shed light on this conjecture over the past few years, ultimately leading to a proof of the conjecture for compact Calabi-Yau manifolds which are birationally equivalent to a moduli space of sheaves on a K3 surface. This represents the first substantial progress on the conjecture in dimension > 3 in several years. The key technique is the new theory of ``Theta-stratifications,'' which allows one to bring ideas from equivariant Morse theory into the setting of algebraic geometry.

2:30 pm – 3:30 pm Dhruv Ranganathan, IAS, "Moduli spaces of elliptic curves in toric varieties"

Abstract: The moduli spaces of stable maps to toric varieties occur naturally in enumerative geometry and mirror symmetry. While they have several pleasing properties, they are often quite singular, reducible, and non-equidimensional. When the source curves have genus 0, the situation is markedly improved by adding logarithmic structure to the moduli problem. This produces irreducible and non-singular moduli spaces of rational curves in toric varieties, whose geometry is tightly controlled by a tropical moduli problem. When the source curves have genus 1, logarithmic structures alone do not suffice to produce a smooth and compact moduli space. However, by combining modern advances in logarithmic Gromov-Witten theory (due to Abramovich, Chen, Gross, Siebert, and Wise) with heuristics from a 2005 theorem of Speyer in tropical geometry, these moduli spaces can be desingularized "combinatorially". The result is a smooth and irreducible compactification of the space of elliptic curves in any toric variety, carrying an "honest" fundamental class, and whose intersection theory encodes "honest" counts of elliptic curves. This generalizes work of Vakil and Zinger.

 3:30 pm - 4:00 pm TEA, Fuld Hall Common Room

4:00 pm - 5:00 pm Tony Pantev, UPenn, "Descent and equivalences in non-commutative geometry"

Abstract: I will describe 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.

FRIDAY, MARCH 17

10:00 am - 11:00 am Bernd Siebert, Univ Hamburg, "Real Lagrangians in toric degenerations"

Abstract: Real loci of the canonical toric degenerations constructed from integral affine manifolds with singularities in the joint work with Mark Gross, provide an ample source of examples of Lagrangians that conjecturally are amenable to algebraic-geometric versions of Floer theory. In the talk I will discuss joint work with Hülya Argüz on how the topology of the real locus can be understood by means of the affine geometry and by Kato-Nakayama spaces associated to log spaces.

11:30 am - 12:30 pm Ludmil Katzarkov, IAS, "Lattices, Filtrations and some Applications"

Abstract: In this talk we will combine classical mathematical structures and we will look at them from a new prospective. Applications to geometry will be considered.

12:30 pm - 2:30 pm   LUNCH, Dining Hall

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