Homological Mirror Symmetry and Applications

Virtual Conference
IMSA Miami, 19-22 January 2021

Program

Tuesday 19 January 2021

9:00 am – 10:00 am	**Maxim Kontsevich**
10:30 am – 11:30 am	**Maxim Kontsevich**
1:00 pm – 2:00 pm	**Tony Yue Yu**
2:30 pm – 3:30 pm	**Ludmil Katzarkov**
4:00 pm – 5:00 pm	**Alex Perry**

Wednesday 20 January 2021

9:00 am – 10:00 am	**Ailsa Keating**
10:30 am – 11:30 am	**Tony Pantev**
1:00 pm – 2:00 pm	**Yuri Tschinkel**
2:30 pm – 3:30 pm	**Andrew Harder**
4:00 pm – 5:00 pm	**Matthew Ballard**

Thursday 21 January 2021

9:00 am – 10:00 am	**Denis Auroux**
10:30 am – 11:30 am	**David Favero**
1:00 pm – 2:00 pm	**Mark McLean**
2:30 pm – 3:30 pm	**Mohammed Abouzaid**
4:00 pm – 5:00 pm	**Melissa Chiu-Chu Liu**

Friday 22 January 2021

9:00 am – 5:00 pm	**Discussions**

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Abstracts

On the Fukaya Categories
Mohammed Abouzaid

TBA

Structural Aspects of Fukaya Categories of LG Models
Denis Auroux

In this largely expository talk, we review several perspectives on Fukaya categories of Landau-Ginzburg models, monodromy, and functors relating them to other flavors of Fukaya categories. (This will touch on work of Abouzaid-Seidel, Hanlon, Sylvan, Jeffs, and others).

Some Comments on Quantum Eigenvalues and Semiorthogonal Decompositions for Toric Varieties
Matthew Ballard

We will discuss how to produce semiorthogonal decompositions corresponding to the eigenvalues of quantum multiplication with K_X on smooth toric DM stacks with projective coarse moduli.

CoFTs for GLSMs
David Favero

I will discuss the construction of enumerative invariants for a GLSM based on joint work with Bumsig Kim (see arXiv:2006.12182) where we proved these invariants form a Cohomological Field Theory. This should be a generalization of both Gromov-Witten (for GIT quotients of affine space) and FJRW theory. The invariants are obtained by forming the analogue of a virtual fundamental class which lives in the twisted Hodge complex over a certain "moduli space of maps to the GLSM". This virtual fundamental class roughly comes as the Atiyah class of a "virtual matrix factorization" associated to the GLSM data, for which I will outline the construction.

On the P=W Conjecture II
Andrew Harder

I will continue discussing the mirror P=W conjecture, which predicts how the weight filtration on the cohomology of a log Calabi-Yau pair behaves under mirror symmetry. I will briefly review the statement of this conjecture and I will discuss evidence in low dimensions; in particular, it can be proved for 1) complements of smooth elliptic curves in del Pezzo surfaces and their mirrors 2) complements of smooth K3 surfaces in Fano threefolds and weak Fano toric threefolds. Finally, I will explain how the weight and perverse Leray filtrations can be interpreted in terms of Lagrangian torus fibrations, and how this might be used to verify the mirror P=W conjecture in greater generality. This is based on work in progress with Katzarkov-Przyjalkowski and Katzarkov-Pantev.

NC Spectra
Ludmil Katzarkov

This talk is continuation of the short course by M. Kontsevich. We will offer some examples and applications to nonrationality questions. Generalizations will be considered. The talk is based on joint works with Kontsevich and Pantev.

Homological Mirror Symmetry for Log Calabi-Yau Surfaces
Ailsa Keating

Given a log Calabi-Yau surface Y with maximal boundary D, I'll explain how to construct a mirror Landau-Ginzburg model, and sketch a proof of homological mirror symmetry for these pairs when (Y,D) is distinguished within its deformation class (this is mirror to an exact manifold). I'll explain how to relate this to the total space of the SYZ fibration predicted by Gross--Hacking--Keel, and, time permitting, explain ties with earlier work of Auroux--Katzarkov--Orlov and Abouzaid. Joint work with Paul Hacking.

Blow Up Formulae and Invariants I - Blow-up Formula for Quantum Cohomology
Maxim Kontsevich

I will explain heuristics behind the conjectural formula expressing genus zero Gromov-Witten invariants of a blown up complex algebraic variety in terms of GW-invariants for the initial variety, and for the center. I'll also propose an approach to the proof via an equivariant localization.

Blow Up Formulae and Invariants II - Dimension Theory

Maxim Kontsevich

I will introduce an numerical invariant ("dimension") for a meromorphic connection over formal disc, with the second order pole singularity. In the case of Landau-Ginzburg models associated with isolated singularity, it coincides with an invariant considered originally by V.Arnold. In analogy with singularity theory, one conjectures certain semi-continituity of this invariant. Combination of the semi-continuity with the blow-up formula leads to a new strong criterion for non-rationality of higher-dimensional Fano varieties.

Crepant Transformation Conjecture for Toric Calabi-Yau 3-Orbifolds

Melissa Chiu-Chu Liu

In this talk, I will describe four versions of Crepant Transformation Conjecture (CTC) relating Gromov-Witten (GW) invariants of K-equivalent toric Calabi-Yau 3-orbifolds: (1) CTC for equivariant genus-zero descendant GW invariants, (2) CTC for genus-zero open GW invariants (i.e. disk invariants) relative to Aganagic-Vafa Lagrangian branes, (3) CTC for equivariant all-genus descendant GW invariants, and (4) CTC for all-genus open GW invariants relative to Aganagic-Vafa Lagrangian branes. (1) is a special case of work of Coates-Iritani-Jiang on K-equivalent toric Deligne-Mumford stacks of any dimension; (2) is based on work of Song Yu; (3) and (4) are based on work in progress with Bohan Fang, Song Yu, and Zhengyu Zong. The proofs of the four versions of CTC rely on four versions of mirror theorems.

Birational Calabi-Yau's and Floer Cohomology

Mark McLean

Given two birational Calabi-Yau manifolds or orbifolds one can ask, how are their Gromov-Witten invariants related? I will explain two partial results that use Hamiltonian Floer theoretic techniques. The first result, joint with Ritter, gives an alternative proof of the generalized McKay correspondence for isolated quotient singularities. The second result proves that birational Calabi-Yau manifolds have the same small quantum products. Finally I will comment on possible further directions.

On the P=W Conjecture I

Tony Pantev

I will recall the P=W conjecture of Hausel-de Cataldo-Migliorini for character varieties and will discuss known results, generalizations, and application. After that I will discuss the mirror version of the P=W conjecture in the context of Fano mirror symmetry and its relationship to the Hodge theory of Landau-Ginzburg models. I will also discuss briefly refinemenents of the mirror P=W problem in the context of SYZ mirror symmetry. More details and examples supporting the refined conjecture will be covered in Andrew Harder's talk. I will finish with a review of recent work of Sukjoo Lee applying gluing in relative mirror symmetry to the mirror P=W conjecture and the Hodge and deformation theory of hybrid Landau-Ginzburg models. Most of the talk will be based on a joint work in progress with Harder and Katzarkov.

Surfaces on Cubic Fourfolds via Stability Conditions

Alex Perry

Any cubic fourfold has an associated K3 category, defined by Kuznetsov as a semiorthogonal component of the derived category. I will explain some geometric applications of stability conditions on this K3 category, in particular the construction of special surfaces on cubic fourfolds and relations to the rationality problem. This is based on joint work with Arend Bayer, Aaron Bertram, and Emanuele Macri.

Equivariant Birational Types

Yuri Tschinkel

I will describe some recent results and constructions in equivariant birational geometry.

Secondary Fan, Theta Functions, and Moduli of Calabi-Yau Pairs

Tony Yue Yu

We conjecture that any connected component Q of the moduli space of triples $(X,E=E_1+\dots+E_n,\Theta)$ where X is a smooth projective variety, E is a normal crossing anti-canonical divisor with a 0-stratum, every E_i is smooth, and Θ is an ample divisor not containing any 0-stratum of E, is unirational. More precisely, we conjecture that the compactification of Q inside the moduli space of Kollár-Shepherd-Barron-Alexeev stable pairs admits a finite cover by a complete toric variety. We construct the associated complete toric fan, generalizing the Gelfand-Kapranov-Zelevinski secondary fan for reflexive polytopes. Inspired by mirror symmetry, we speculate a synthetic construction of the universal family over this toric variety, as the Proj of a sheaf of graded algebras with a canonical basis, whose structure constants are given by counts of non-archimedean analytic disks. In the Fano case and under the assumption that the mirror contains a Zariski open torus, we construct the conjectural universal family, generalizing the families of Kapranov-Sturmfels-Zelevinski and Alexeev in the toric case. In the case of del Pezzo surfaces with an anti-canonical cycle of (-1)-curves, we prove the full conjecture. The reference is arXiv:2008.02299 joint with Hacking and Keel.