Homological Projective Duality and Quantum Gauge Theory

November 12 – 16, 2012

Schedule

November 12 (Monday)

	Coffee and Breakfast
09:30-10:30	Kentaro Hori (Kavli IPMU)
10:40-11:40	Alexander Kuznetsov (Steklov Mat. Inst.)
11:50-12:50	Mehmet Umut Isik (U Vienna)
	Lunch
	Earthquake evacuation drill
15:30-16:30	David Favero (U Vienna)
16:40-17:40	Matthew Ballard (U Vienna)

November 13 (Tuesday)

	Coffee and Breakfast
10:00-11:00	Kentaro Hori (Kavli IPMU)
11:10-12:10	Alexander Kuznetsov (Steklov Mat. Inst.)
	Lunch
14:00-15:00	Dragos Deliu (U Vienna)
	Coffee break
15:30-16:30	David Favero (U Vienna)
16:40-17:40	Eric Sharpe (Virginia Tech)

November 14 (Wednesday)

	Coffee and Breakfast
10:00-11:00	Kentaro Hori (Kavli IPMU)
11:10-12:10	Tony Pantev (U Penn)
	Lunch
14:00-15:00	Yukinobu Toda (Kavli IPMU)
	Coffee break
15:30-16:30	Fabian Haiden (U Vienna)
16:40-17:40	Ludmil Katzarkov (U Miami/Vienna)

November 15 (Thursday)

	Coffee and Breakfast
10:00-11:00	Johanna Knapp (TU Vienna)
11:10-12:10	Mauricio Romo (Kavli IPMU)
	Lunch
14:00-15:00	Colin Diemer (U Vienna)
	Coffee break
15:30-16:30	Daniel Halpern-Leistner (UC Berkeley)
16:40-17:40	Sergey Galkin (U Vienna/ Moscow Inst. of Physics and Technology)

November 16 (Friday)

	Coffee and Breakfast
10:00-11:00	Alexander Efimov (Steklov Math. Inst.)
11:10-12:10	Pranav Pandit (U Vienna)
	Lunch
14:00-15:00	Pawel Sosna (U Hamburg)
	Coffee break
15:30-16:30	Paul Horja (U Vienna)
16:40-17:40	Alexey Bondal (Kavli IPMU)

Titles and Abstracts

Matthew Ballard (U Wisconsin/Vienna)

Exceptional collections on moduli spaces of rational curves via phase change in the B-model

We use the work of Halpern-Leistner and B, Favero, Katzarkov on phase changes in the B-model to produce full exceptional collections on a range of moduli spaces of rational curves, including Hassett's moduli spaces of symmetricially-weighted stable rational curves. This is joint with D. Favero and L. Katzarkov.

Alexey Bondal (Steklov Math. Insti./Kavli IPMU)

Homotopical nature of the derived categories of coherent sheaves

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Dragos Deliu (U Vienna)

Homological Projective Duality via variation of GIT quotients

I will explain how, in some instances, homological projective duality appears naturally in the context of VGIT. I will illustrate this with an example, constructing a homological projective dual variety to the Veronese embedding of a projective space with a chosen Lefschetz decomposition.

Colin Diemer (U Vienna)

Toric Mirror Symmetry and Birational Geometry

There is a well-known correspondence between the Mori chamber decomposition of a Fano toric variety and certain degenerations of hypersurfaces of its Batyrev mirror, i.e. an

identification of Kahler and complex moduli. The compactified complex moduli space has the structure of a toric stack, a universal family, and a tautological hyperplane section. The one-dimensional strata give topologically interesting pencils of toric hypersurfaces. We consider these pencils from the perspective of (homological) mirror symmetry and their role as mirrors of the Mori program. This is joint with Katzarkov and Gabriel Kerr.

Alexander Efimov (Steklov Math. Inst.)

Derived categories of Grassmannians over integers and modular representation theory

We will show that Kapranov's construction actually gives an exceptional collection on Grassmannian over integers, which is no longer strong.
We will also explain how this is related to representation theory of $GL_n(¥mathbb{Z}),$ and to strict polynomial functors of Friedlander-Suslin.

David Favero (U Vienna)

Talk 1:
Variation of Geometric Invariant Theory for Derived Categories

Given a quasi-projective algebraic variety, X, with the action of a linear algebraic group, G, there are various (birational) incarnations of the quotient X/G coming from a choice of a G-equivariant ample line bundle. As we vary this choice, there is a semi-orthogonal relationship between the derived categories of the resulting quotients, A and B. Furthermore, if (X,w) is a Landau-Ginzburg model, and w is a G-invariant section of a line bundle on X, then the same holds for "coherent sheaves on" (A,w) and (B,w) (categories of matrix factorizations/categories of singularities/stable derived categories).
I will discuss this result and survey the applications.

Talk 2:
Homological Projective Duality via VGIT and the Rodland Example

Following work of Kuznetsov, Borisov, Caldararu, Rodland, Segal, Addington, Donovon, and Herbst, Hori, Page, and Tong, I will discuss the VGIT approach to Homological Projective

Duality for Grassmannians and Pffafians. I will describe the homological projective dual to a Grassmannian as a grade restriction window modulo noncommutative torsion and explain the appearance of the Pfaffian variety.

Sergey Galkin (U Vienna/Moscow Inst. of Physics and Technology)

Projective duality, quantum cohomology and exceptional approximations

With emphasis on special varieties I'll discuss what information about (homological) projective duality one can see from quantum cohomology, and other way around.

Fabian Haiden (U Vienna)

Measured foliations, t-structures, and wall-crossing

We will discuss a connection between the leaf space of the horizontal foliation on a flat surface with conical or infinite-angle singularities, and t-structures on certain Fukaya-type categories. This is in part inspired by ideas of Gaiotto-Moore-Neitzke on BPS spectra, and by Bridgeland's definition of the space of stability conditions.

Daniel Halpern-Leistner (UC Berkeley)

Fractional grade restriction rules and autoequivalences of derived categories

For a variety X acted on by a reductive group one can identify the derived category of coherent sheaves on a GIT quotient of X with subcategory of the equivariant derived category of X defined by a "grade restriction rule." I will apply this technique to construct "spherical twist" automorphisms of derived categories using a variation of GIT quotient. Homological mirror symmetry predicts more autoequivalences than initially result from this method, so with this motivation I will introduce a "fractional grade restriction rule" which leads to the expected number of autoequivalences. Although these phenomena are geometric, their investigation leads to a general relationship between spherical twist

autoequivalences, semiorthogonal decompositions, and mutations in arbitrary dg-categories.

Kentaro Hori (Kavli IPMU)

Talk 1:
Predictions on derived equivalences from 2d gauge theory

I will present predictions on equivalences of derived categories that come out of the study of N=(2,2) supersymmetric gauge theory in 1+1 dimensions.

Talk 2:
Introduction to linear sigma models

I will give an introduction to a class of 2d N=(2,2) supersymmetric gauge theories called linear sigma models. The parameter space of a model contains "phases" that correspond to non-linear sigma models or Landau-Ginzburg models. I may also discuss transport of B-branes from one phase to another.

Talk 3:
Duality in 2d (2,2) supersymmetric non-Abelian gauge theories

I will describe the low energy behaviour of 2d (2,2) supersymmetric gauge theories with classical gauge groups and N copies of fundamental matter representation. It exhibits supersymmetry breaking at small N, free composites at a critical N, and duality at larger N, like in similar supersymmetric gauge theories in 4 and 3 dimensions. These features play key role in finding the mathematical predictions.

Paul Horja (U Vienna)

Derived Categories of Coherent Sheaves on Toric Stacks

I will discuss an approach towards the understanding of the categories of coherent sheaves on toric stacks using the grade restriction rules of Herbst-Hori-Page for transport across moduli spaces. Examples and some conjectures will be presented.

Mehmet Umut Isik (U Vienna)

Sigma Model to Landau-Ginzburg Model Correspondences for B-Branes

I will discuss two statements which relate the derived category of coherent sheaves on a space to the matrix factorization category (or singularity category) of a Landau-Ginzburg pair. One is a correspondence based on Koszul duality, the other is a version of Orlov's theorem for the family of hypersurfaces of a given degree, based on the first correspondence and variation of geometric invariant theory quotients.

Ludmil Katzarkov (U Miami/Vienna)

Stability conditions and Horikawas

In this talk we will make a parallel betweeen FQHE and some categorical structures. We will consider potential applications to classical questions in Symplectic Geometry.

Johanna Knapp (TU Vienna)

New Calabi-Yaus from non-abelian 2D Theories

We discuss explicit examples of Calabi-Yau spaces with h^11=1, and h^11=2 which arise as phases of non-abelian gauged linear sigma models.

Alexander Kuznetsov (Steklov)

Talk 1:
Homological projective duality

I will explain the basic definitions and constructions of Homological Projective Duality, such as Lefschetz decompositions, universal linear sections, splitting functors, base change for semiorthogonal decompositions etc.

Talk 2:
Homological projective duality, examples

I will describe some examples of Homological Projective Duality ---
projective bundles, double Veronese embeddings and Grassmannians of lines.

Pranav Pandit (U Vienna)

Moduli of Branes

The branes occurring in topological string theory are naturally organized into linear infinity categories. I will begin by recalling how derived algebraic geometry provides a natural framework for constructing a moduli space of objects in a given linear infinity category. We will then see how the formalism of higher categorical algebra makes manifest the relation between finiteness conditions on a category, and the geometricity of the associated moduli space.

Tony Pantev (U Penn)

Formality, shifted quantization, and Landau-Ginzburg models

I will describe a shifted version of Kontsevich's formality theorem and will discuss its relation to the quantization for shifted Poisson manifolds.
I will also describe applications to categories of matrix factorizations and higher order derived critical loci.

Mauricio Romo (Kavli IPMU)

Two-Sphere Partition Functions and Gromov-Witten Invariants

Many N=(2,2) two-dimensional nonlinear sigma models with Calabi-Yau target spaces admit ultraviolet descriptions as N=(2,2) gauge theories (gauged linear sigma models). We conjecture that the two-sphere partition function of such ultraviolet gauge theories -- recently computed via localization by Benini et al. and Doroud et al. -- yields the exact K¥"ahler potential on the quantum K¥"ahler moduli space for Calabi-Yau threefold target spaces. In particular, this allows one to compute the genus zero Gromov-Witten invariants for any such Calabi-Yau threefold without the use of mirror symmetry. The conjecture can be checked against examples already in the literature and also can be used to make new predictions for GW invariants for Calabi-Yaus whose mirrors are not yet known.

Eric Sharpe (Virginia Tech)

Abelian GLSM's, gerbes, and homological projective duality

In this talk I'll outline some old work on examples of abelian gauged linear sigma models (GLSMs) realizing examples of homological projective duality. These examples will typically relate complete intersections of quadrics to (nc resolutions of) branched double covers. These GLSM's have exotic properties that `broke the rules' for GLSM's, and also gave some of the first realizations of nc resolutions in physics.
Understanding the origin of a branched double cover will involve understanding the behavior of strings on gerbes, which we will briefly outline. We will also outline more recent work on D-brane probes of the noncommutative resolutions appearing in phases of these GLSMs.

Pawel Sosna (U Hamburg)

On the Jordan-H¥"older property for geometric derived categories

I will report on joint work with C. B¥"ohning and H.-C. Graf von Bothmer in which we show that semiorthogonal decompositions of the derived category of the classical Godeaux surface do not satisfy the Jordan-H¥"older property.

Yukinobu Toda (Kavli IPMU)

Stability condition at the Gepner point

I will talk about a work in progress on a conjectural construction of a Bridgeland stability condition on a quintic 3-fold corresponding to the Gepner point.