Arend Bayer

Title "Bridgeland stability conditions and birational geometry of moduli spaces"

Abstract: I will explain how one can use wall-crossing for Bridgeland stability conditions to deduce the most important aspects of the birational geometry of moduli spaces of sheaves on K3 surfaces. There is a piece-wise linear, almost surjective map from the space of stability conditions to the moveable cone of the moduli spaces; Bridgeland walls get mapped to walls in the moveable cone inducing flops or divisorial contractions. As applications, we obtain:

1. A description of the nef, moveable and effective cone of the moduli space in terms of the algebrai Mukai lattice on the K3, and
2. a proof of the Hassett-Tschinkel/Huybrechts/Sawon conjecture about the existence of Lagrangian fibrations for moduli of Gieseker-stable sheaves. (or Bridgeland-stable complexes) on K3 surfaces.

This is based on joint work with Emanuele Macri.

Richard Eager

Title: Quiver Gauge Theories and Calabi-Yau Algebras

Abstract:
In this introductory talk I will review the necessary generalization of mathematics to super-mathematics needed to define the Lagrangians of supersymmetric quiver gauge theories. Next I will explain the conditions under which the low energy dynamics of a supersymmetric quiver gauge theory can describe a superconformal field theory. Finally I will describe the relationships between quiver gauge theories, superconformal field theories, and Calabi-Yau algebras.

Title: Cyclic Homology and the Superconformal Index

Abstract: The superconformal index of many interesting superconformal field theories can be computed using the index of a weakly coupled quiver gauge theory. I will explain how the superconformal index can naturally be interpreted in terms of the cyclic homology of the Ginzburg DG algebra associated to the quiver gauge theory. If the quiver gauge theory has a holographic dual description, then we will see that the superconformal index of the gauge theory and its dual gravitational description agree. The proof makes crucial use of the invariance of cyclic homology under derived equivalence.

Alexander Efimov

Title: "Homotopy finiteness of the derived categories of coherent sheaves"

Abstract: I will briefly recall the notion of homotopy finiteness of enhanced triangulated categories. Then it will be explained how to show that derived categories of coherent sheaves on any separated scheme of finite type over C are homotopically finite, as well as categories of matrix factorizations.

The proof uses Kuznetsov-Lunts construction of categorical resolution of singularities, which in turn uses Hironaka's theorem.

Anton Fonarev

Title: "Minimal Lefschetz decompositions for Grassmannians"

Abstract: We construct two Lefschetz decompositions of the derived category of coherent sheaves on the Grassmannian. One of the main technical tools will be a new interesting class of exact complexes of vector bundles. We will discuss a couple of ways to obtain them an possible further generalizations to other rational homogeneous spaces.

Sergey Galkin

Title: Exceptional collections of four line bundles on Beauville's quotient-product surface.

Beauville constructed surface of general type with p_g = 0, $K^{\hat{}2}$ = 8 and hence Euler number four. We show that exactly 39 line bundles on this surface are acyclic. Moreover, up to twist there are 6 exceptional collections of four line bundles. An orthogonal to any such collection is yet another example of quasi-phantom - non-trivial category with vanishing Hochschild homology. This is joint work with Evgeny Shinder.

Kentaro Hori

Title: "Introduction to string theory and its relation to gauge theories, Part I and II"

Abstract: I will try to give an overview of string theory and describe the ways how gauge theories emerge. Branes, singularities, and duality play important roles.

Title: "Prediction on derived equivalences from linear sigma models"

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

Ludmil Katzarkov

Title: “Stability Hodge structures and phantoms”

Abstract: In this talk, we will introduce two notions: Phantoms and Stability Hodge Structures. We discuss connection of these notions to long standing problems in Algebraic Geometry.

Alexander Kuznetsov

Title: Homological Projective Duality

Abstract: I will review the definition of homological projective duality and will try to illustrate it with as many examples as possible.

Mauricio Andres Romo Jorquera

Title: Introduction Gauge Linear Sigma Models

Abstract: Gauge Linear Sigma Models (GLSMs) are certain class of two-dimensional supersymmetric gauge theories whose low energy dynamics are dictated by the choice of physical parameters of the model (coupling constants). For a given GLSM depending on the values of these parameters they can be described (at low energies) by a nonlinear sigma model (NLSM) whose target space is Calabi-Yau, or a Landau-Ginzburg model or other types of supersymmetric theories. These are known as the "phases" of the GLSM. We will review the pioneering work of Witten for the construction of GLSMs with at least one geometric phase and how they can be used to describe different classes of Calabi-Yau threefolds, such as complete intersections as well as more general ones of determinantal type.

Title: Two-Sphere Partition Functions and Gromov-Witten Invariants

Abstract: 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. We compute these quantities for several examples giving us strong evidence for our conjecture.

Kyoji Saito

Title: "Partition Functions associated with cancellative Monoids."

Abstract: Inspired by the classical study of the partition function in Ising model, we introduce the space of partition functions associated with any cancellative monoid. Precisely, we replace the square lattice in the Ising model by the Cayley graph of a monoid, and replace the sum over states on the square lattice by the sum over configurations in the Cayley graph. Then, the space of partion functions (and free energies) forms a compact set in a certain complete Hopf algebra generated by configurations. Our goal is to give a presentation of these partition functions as proportions of the residues of the generating growth (Poincare) series of the monoid (if they are meromorphic functions). We calculate some examples of the partion functions, including the cases of Artin and braid monoids and the monoids of integral square matrices.

Yukinobu Toda

Title: Bogomolov-Gieseker type inequality and OSV conjecture.

Abstract: The conjectural Bogomolov-Gieseker (BG) type inequality among Chern characters of certain semistable objects in the derived category of coherent sheaves on projective 3-folds was proposed by Bayer, Macri and myself. Originally it was proposed in order to construct a Bridgeland stability condition on projective 3-folds, while it turned out that our conjecture has applications to the study of Fujita conjecture on 3-folds. (Bayer-Bertram-Macri-T.)
In this talk, I explain that our BG inequality conjecture is also related to Denef-Moore's approach towards Ooguri-Strominger-Vafa conjecture predicted in string theory. I will try to include both math and physics aspects of this subject in two talks, as far as possible.

Michele Del Zotto

Title: "N=2 Supersymmetric Field Theories, and Quivers"

Abstract: In these two lectures, I will review some of the relations between representation theory and the physics of N=2 supersymmetric gauge theories. In particular, I will discuss the concepts of gauge functor and perturbative (or light) subcategories, categorical Higgs mechanism, and categorical quantization. If time permits, I would like to discuss also the relation in between cluster algebras, Coxeter combinatorics and finite N=2 BPS mass spectra, and to formulate some of the open questions and conjectures. Based on joint work with S. Cecotti.