Workshop: Matrix Factorizations in Mathematics and Physics

Events for:
Monday, June 12 - Friday, June 16

Monday, June 12th

9:00am  David Berenstein - SCGP 102

Title: D-branes, categories and super-potential algebras

Abstract: I will describe some of the physics intuition that gives rise to a structure of categories of D-branes. I will then concentrate on the structure of the category of “point-like objects” near a singularity. This will use some examples of orbifolds and I will also show the concept of discrete torsion. I will then specialize further to situations that arise for the point-like branes that probe a Calabi-Yau singularity and use the physics intuition to show that one gets the notion of a “super potential algebra” and some of the properties they have for orbifolds.

10:00am  Break - SCGP Cafe

10:30am  David Berenstein - SCGP 102

Title: Regular super potential algebras

Abstract: I will show some examples of super potential algebras, some will be orbifolds and some that do not correspond to orbifold singularities. I will describe how one expects the corresponding super potential algebras to be regular. And I will give some techniques for proving such regularity. I will also talk about Seiberg -dualities and how they define equivalence classes of algebras. (The equivalence class is a Derived equivalence of categories)

11:30am  Lunch - SCGP Cafe

1:00pm  Johannes Walcher - SCGP 102

Title: Extended Frobenius manifolds and the Kapustin-Li formula

2:15pm  Antonella Grassi - SCGP 102
Title: Terminal singularities of Calabi-Yau threefolds, Milnor numbers and applications to physics

3:30pm  Tea - SCGP Lobby

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Tuesday, June 13th

9:00am  Matthew Ballard - SCGP 102

Title: Kernels for Orlov's theorem

10:00am  Break - SCGP Cafe

10:30am  Ludmil Katzarkov - SCGP 102

Title: Categories and Filtrations

Abstract: In this talk we will introduce a new notion - filtration of iterated logs. We will consider possible application of this notion to classical questions in Geometry.

11:30am  Lunch - SCGP Cafe

1:00pm  SCGP Weekly Talk: David Morrison - SCGP 102

Title: Matrix factorizations in physics: a mathematical perspective

Abstract: Matrix factorizations were introduced into mathematics in 1980, and found their first applications to physics in 2003. I will explain the nature of these applications from a mathematical perspective.

2:15pm  Kentaro Hori - SCGP 102

Title: An introduction to the hemisphere partition function

Abstract: I will talk about the hemisphere partition function of 2d (2,2) supersymmetric field theories and some of its applications, such as equivalences of categories, RG flow involving branes, and geometric/Landau-Ginzburg expansions.
Wednesday, June 14th

9:00am  Irena Peeva - SCGP 102

Title: Matrix factorizations and free resolutions

Abstract: Matrix factorizations can be interpreted as giving the minimal free resolutions of maximal Cohen-Macaulay modules ("high" syzygies) over a hypersurface ring both as a module over the ambient ring and as a module over the hypersurface. The talk will first provide background on free resolutions, and then introduce the theory of higher matrix factorizations which gives the analogous results for high syzygies over complete intersections. All this is joint work with David Eisenbud, who will deliver a second part of the talk.

10:15am  David Eisenbud - SCGP 102

Title: Layered Resolutions

Abstract: Layered resolutions include the resolutions derived from higher matrix factorizations that were described in the preceding talk. They are not defined equationally, but they are conceptually simpler as well as being more general. I will explain the necessary background -- the Auslander-Buchweitz theory of Cohen-Macaulay approximations -- and also the construction of layered resolutions. This is joint work with Irena Peeva.

11:15am  Break - SCGP Cafe

11:45am  David Morrison - SCGP 102

Title: Matrix factorizations in physics: a mathematical perspective II

Abstract: Matrix factorizations were introduced into mathematics in 1980, and found their first applications to physics in 2003. I will explain the nature of these applications from a mathematical perspective.

12:45pm  Lunch - SCGP Cafe

3:30pm  Tea - SCGP Lobby

Thursday, June 15th

9:00am  Andres Collinucci - SCGP 102
Title: Monopole operators, going beyond the Auslander-Reiten quiver

10:00am  Break - SCGP Cafe

10:30am  Hailong Dao - SCGP 102

Title: Some categorical aspects of matrix factorizations

Abstract: The category of matrix factorizations can be identified with certain category of maximal Cohen-Macaulay modules over the corresponding hypersurface (or complete intersections, as in the recent work of Eisenbud-Peeva). This point of view have been exploited heavily, and is still yielding surprising insights. In this talk I will survey some recent works in this direction. One part will focus on a certain pairing on the MCM modules which has interesting connections to K-theory and other cohomology theories. Another part will discuss Avramov-Buchweitz work on support varieties and a recent result that allows us to associate to certain tensor products of matrix factorization the geometric joint of the corresponding varieties.

11:30am  Lunch - SCGP Cafe

1:00pm  David Morrison - SCGP 102

Title: Matrix factorizations in physics: a mathematical perspective III

Abstract: Matrix factorizations were introduced into mathematics in 1980, and found their first applications to physics in 2003. I will explain the nature of these applications from a mathematical perspective.

2:15pm  Johanna Knapp - SCGP 102

Title: Deformation theory of matrix factorizations and physics applications

3:30pm  Tea - SCGP Lobby

Friday, June 16th

9:00am  David Favero - SCGP 102
Title: Crepant Categorical Resolutions and a Toric Orlov Theorem

Abstract: Desingularizing a variety is, of course, not unique. For example, there can be many crepant resolutions of a given space. However, in their pioneering work on derived categories, Bondal and Orlov conjectured that all such resolutions have equivalent derived categories. In this way, categorically resolving singularities may have some nicer properties that classical resolutions. I will discuss how a toric version of Orlov's theorem provides a method of obtaining categorical crepant resolutions can be given explicit geometric realizations as Landau-Ginzburg models. We will focus on some motivating examples such as Kuznetsov's categorical crepant resolution of the K3 category inside a singular cubic 4-fold. This is joint work with T. Kelly.

10:15am  Raffaele Savelli - SCGP 102

Title: F-theory on Singular Spaces

Abstract: F-theory is a strong coupling formulation of Type IIB string theory which unifies gravitational and gauge theory data of 7-branes in the geometry of elliptic fibrations. In all situations of interest such fibrations are singular spaces, and, in order to describe the low-energy physics, one typically removes the singularities either via resolutions or deformations. On the contrary, in this talk, I will show how Matrix Factorizations allow us to access part of the physical data while working on the singular spaces directly. Besides correctly reproducing known results, this treatment enables us to explore certain supersymmetric string vacua which are invisible in the smooth phase.

11:15am  Break - SCGP Cafe

11:45am  Ragnar Buchweitz - SCGP 102

Title: Matrix Factorizations and Tilting Objects

Abstract: Whenever a triangulated category admits a tilting object $T$, it identifies with the derived category of $E = \mathrm{End}(T)$. How does one get back from that derived category to the original one? We describe an algorithm for the case that $E$ is an artinian algebra of finite global dimension. As an example, we use this to identify all matrix factorizations of $y^d - x^d$ for $d \geq 2$, thus, answering a question raised several years ago by physicists. We will also discuss the case of cubic hypersurfaces, where some intriguing representation theoretic problems occur.

12:45pm  Lunch - SCGP Cafe

3:30pm  Tea - SCGP Comm Room 515