

## Spring 2025 Colloquia

- Speaker: Kenny Blakey (MIT)  
Title: Bounding Lagrangian Intersections Using Floer Homotopy Theory  
Date: Wednesday, February 12, 2025, 4:00 - 5:00pm

*A classical question in symplectic geometry asks, "what is a lower bound on the number of intersection points of a pair of Lagrangian submanifolds?", and one version of the Arnol'd conjecture specifies a still sought-after answer. Floer proved a special case of the Arnol'd conjecture, provided the Lagrangians are (Hamiltonian) isotopic and transversely intersecting, with his newly invented namesake Lagrangian Floer cohomology. Shortly after, improved lower bounds were given independently by Hofer and Floer, now in the degenerate isotopic case, using the  $\mathbb{Z}/2$ -cuplength of the Lagrangians. Recent work of Hirshi-Porcelli upgrades this  $\mathbb{Z}/2$ -cuplength lower bound to an  $R$ -cuplength lower bound for any ring spectrum  $R$ . In this talk I will explain recent work which provides a new lower bound, now in the degenerate non-isotopic case, using stable cohomology operations on Lagrangian Floer cohomology (namely, Steenrod squares) defined via a Floer homotopy type, where the latter object refines Lagrangian Floer cohomology to a stable homotopy type.*

- Speaker: Miguel Moreira (MIT)  
Title: Enumerative Geometry and Virasoro Constraints  
Date: Wednesday, February 26, 2025, 4:00 - 5:00pm

*Enumerative geometry is a branch of algebraic geometry; its goal is to "count" geometric objects with certain properties, for example curves on some fixed ambient space. In this talk, we will see how a good part of modern enumerative geometry is about understanding moduli spaces and numerical invariants extracted out of them via intersection theory. A major problem in the field are the Virasoro constraints, which are some mysterious universal relations among enumerative invariants. The study of Virasoro constraints started in the early 90s, with a conjecture of Witten. I will explain how, more recently, we have found a new version of the constraints for a different kind of moduli spaces, and how we now know a lot about this new version. I will mention joint works with Oblomkov, Okounkov, Pandharipande, Bojko and Lim.*

- Speaker: Semon Rezchikov (Princeton University)  
Title: Lightfields: From Geometry to Machine Vision  
Date: Wednesday, March 5, 2025, 4:00 - 5:00pm

*The space of rays in Euclidean space is a famous manifold -- the cotangent bundle of the two-sphere. When we take all possible camera pictures of a bounded scene from a distance, we get a function on the space of rays, which turns out to contain much of the data of the three-dimensional scene at hand. In the past, this observation has been used to develop a type of 3D camera, called a 'lightfield camera'; more recently, the lightfield representation of three-dimensional scenes has been found to be advantageous for modern applications in machine vision, in part due to work of myself, Vincent Sitzmann, and collaborators. I will review the geometry of lightfields and its applications, and describe some still open questions in this area which have a mathematical flavor.*

- Speaker: Andrew Hanlon (Dartmouth College)  
Title: The Cox Category and Homological Mirror Symmetry  
Date: Wednesday, March 12, 2025, 4:00 - 5:00pm

*In recent joint work with Ballard, Berkesch, Brown, Cranton Heller, Erman, Favero, Ganatra, and Huang, we introduced the Cox category of a toric variety in order to realize a modification of King's conjecture. I will explain how this construction relates to homological mirror symmetry and Fukaya categories.*

- Speaker: Dawei Chen (Boston College)  
Title: Flat Surfaces  
Date: Wednesday, April 9, 2025, 3:00 - 4:00pm

*A polygon with parallel opposite sides folded on a plane forms a flat surface with cone points. The study of such flat surfaces is related to many fields, including complex analysis, dynamical systems, algebraic geometry, combinatorics, representation theory, and surface meshing simulations. In this talk, I will provide a comprehensive and accessible introduction to this topic, focusing on the interactions between these fields.*

- Speaker: Dario Antolini (Brown University)  
Title: Hadamard Products in Algebraic Geometry and Combinatorics  
Date: Wednesday, April 16, 2025, 3:00 - 4:00pm

*Originally introduced in the study of Restricted Boltzmann Machines in Algebraic Statistics, Hadamard products of algebraic varieties appear in Rigidity Theory in the study of Cayley-Menger varieties and in Tensor Decomposition, where Hadamard powers of a variety play the role of its secant varieties. I will first introduce the related algebra-geometric language and then focus on algebraic matroids of Hadamard products of linear spaces and on Hadamard ranks of algebraic varieties.*