Fall 2021

- **August 31**
  Speaker: N/A
  Title: Organizational Meeting
  Abstract: We will discuss plans for this semester

- **September 14**
  Speaker: Sailun Zhan (Binghamton)
  Title: Counting rational curves on K3 surfaces with finite group actions
  Abstract: The Yau-Zaslow formula describes the number of rational curves in a linear system on a smooth projective K3 surface in terms of a modular form. In this talk, I will review the Yau-Zaslow formula with some examples and then discuss an equivariant version of the formula. When the K3 surface admits a finite group G-action, we can consider a linear system with the induced action. It turns out that the equivariant version of the formula will count G-rational curves and it will also provide interesting modular forms.

- **September 20 (Monday!), 4:15-5:15, by Zoom**
  Speaker: K. V. Shuddhodan (Purdue)
  Title: The (non-uniform) Hrushovski-Lang-Weil estimates
  Abstract: In 1996 using techniques from model theory and intersection theory, Hrushovski obtained a generalization of the Lang-Weil estimates. Subsequently, the estimate has found applications in group theory, algebraic dynamics, and algebraic geometry. We shall discuss an l-adic proof of the non-uniform version of these estimates and also the rationality of the associated generating function.

- **September 28**
  Speaker: Sailun Zhan (Binghamton)
  Title: Counting rational curves on K3 surfaces with finite group actions (continued)
  Abstract: The Yau-Zaslow formula describes the number of rational curves in a linear system on a smooth projective K3 surface in terms of a modular form. In this talk, I will review the Yau-Zaslow formula with some examples and then discuss an equivariant version of the formula. When the K3 surface admits a finite group G-action, we can consider a linear system with the induced action. It turns out that the equivariant version of the formula will count G-rational curves and it will also provide interesting modular forms.

- **October 5**
  Speaker: Alexander Borisov (Binghamton)
  Title: Bi-Euclidean spaces and coherent sheaves on Arakelov curves
  Abstract: It is well-known that lattices in Euclidean spaces are arithmetic analogs of locally free sheaves over the compactified spectrum of the ring of integers. The main obstacle to generalizing this analogy to coherent sheaves is to understand what to do at infinity. We propose a natural, and essentially elementary, construction, that has the potential to greatly enhance Arakelov Geometry in several ways. The main object at infinity is, roughly speaking, a pair of positive quadratic functions on a real vector space, one greater than the other. The morphisms are linear maps that are non-expanding with respect to both functions, and our objects are formal quotients of two Euclidean spaces. The resulting category is a natural target for the direct image map from the category of Hermitian sheaves on an Arakelov variety. This is work in progress, joint with Jaiung Jun.

- **October 19**
  Speaker: Sailun Zhan (Binghamton)
  Title: Counting rational curves on K3 surfaces with finite group actions (part 3)

Abstract: The Yau-Zaslow formula describes the number of rational curves in a linear system on a smooth projective K3 surface in terms of a modular form. In this talk, I will review the Yau-Zaslow formula with some examples and then discuss an equivariant version of the formula. When the K3 surface admits a finite group G-action, we can consider a linear system with the induced action. It turns out that the equivariant version of the formula will count G-rational curves and it will also provide interesting modular forms.

- **October 26**
  Speaker: Tian An Wong
  Title: Prehomogeneous vector spaces and the Arthur-Selberg trace formula
  Abstract: The Arthur-Selberg trace formula is a central tool in the theory of automorphic forms, and can be viewed as a nonabelian Poisson summation formula. Prehomogeneous vector spaces on the other hand, are arithmetic objects from which certain zeta functions can be defined. In this talk, I will give a gentle introduction to these ideas, then discuss an application of the theory of prehomogeneous vector spaces to the development of the trace formula, following earlier work of W. Hoffmann and P. Chaudouard.

- **November 2**
  Speaker: Sunil Chetty
  Title: Selmer groups and ranks of elliptic curves
  Abstract: In the theory of elliptic curves, understanding the behavior of rank is a central problem. In light of the Birch-Swinnerton-Dyer and Tate-Shafarevich Conjectures, there are three avenues for understanding rank of a given elliptic curve E/K: by the structure of the Mordell-Weil group E(K), by the vanishing of the associated L-function L(E/K,s), or by the structure of the associated Selmer group Sel{E}{K}. We will discuss some of the big ideas for attacking the rank problem over number fields via the Selmer group approach, as well as methods of comparing parallel tools in the L-function approach.

- **November 9, 4:30-5:30, by Zoom**
  Speaker: Joe Kramer-Miller
  Title: Ramification of geometric p-adic representations in positive characteristic
  Abstract: A classical theorem of Sen describes a close relationship between the ramification filtration and the p-adic Lie filtration for p-adic representations in mixed characteristic. Unfortunately, Sen's theorem fails miserably in positive characteristic. The extensions are just too wild! There is some hope if we restrict to representations coming from geometry. Let X be a smooth variety and let D be a normal crossing divisor in X and consider a geometric p-adic lisse sheaf on X-D (e.g. the p-adic Tate module of a fibration of abelian varieties). We show that the Abbes-Saito conductors along D exhibit a remarkable regular growth with respect to the p-adic Lie filtration.

- **November 16**
  Speaker: Guillermo Mantilla Soler
  Title: Applications of Higher composition laws to the classification of number fields
  Abstract: In this talk we will describe what natural invariants we have studied with the aim of characterizing number fields, and how some of those are related to the higher composition laws discovered by Bhargava at the beginning of this century.

- **November 30**
  Speaker: Alexander Borisov (Binghamton)
  Title: Bi-Euclidean spaces and coherent sheaves on Arakelov curves, Part 2
  Abstract: This will be a continuation (with some repetition) of the talk from October 5. It is well-known that lattices in Euclidean spaces are arithmetic analogs of locally free sheaves over the compactified spectrum of the ring of integers. The main obstacle to generalizing this analogy to coherent sheaves is to understand what to do at

infinity. We propose a natural, and essentially elementary, construction, that has the potential to greatly enhance Arakelov Geometry in several ways. The main object at infinity is, roughly speaking, a pair of positive quadratic functions on a real vector space, one greater than the other. The morphisms are linear maps that are non-expanding with respect to both functions, and our objects are formal quotients of two Euclidean spaces. The resulting category is a natural target for the direct image map from the category of Hermitian sheaves on an Arakelov variety. This is work in progress, joint with Jaiung Jun.

- **December 7**
  Speaker: Alex Best
  Title: A guided tour of Chabauty methods
  Abstract: Chabauty's method is a p-adic technique for determining the set of rational points on a projective curve that can be made computationally effective. In the 80 years since the inception of this method many variants have been introduced which apply more generally or give stronger results. We will give a guided tour of the method of Chabauty, its extensions and some of its many applications within arithmetic geometry. This will include some discussion of the original method of Chabauty, number field Chabauty, Chabauty–Kim and quadratic Chabauty.