Fall 2020

- **September 1**
  Speaker: N/A
  Title: Organizational Meeting
  Abstract: We will discuss plans for this semester

- **September 8** (Joint with Algebra Seminar, at 2:50 -4:00 pm, Zoom link: https://binghamton.zoom.us/j/95069915454)
  Speaker: Fikreab Solomon Admasu
  Title: Composition laws from Gauss to Bhargava
  Abstract: One of the fundamental objects of interest in number theory is the composition law of binary quadratic forms. In this talk, we will start with a review of the original complicated formulation due to Gauss and then discuss subsequent simplifications by Dirichlet, et al. Another approach involves identifying equivalence classes of binary quadratic forms with ideal classes in a quadratic ring and using the natural group structure of the ideal class group to formulate the composition law of binary quadratic forms. After about 200 years, M. Bhargava gave a new perspective on Gauss' composition law using so-called 2x2x2 cubes of integers and derived more composition laws. We will discuss the main theorems in 'Higher Composition Laws I' by Bhargava and mention the applications if time permits.

- **September 15** (Joint with Algebra Seminar, at 2:50 -4:00 pm, Zoom link: https://binghamton.zoom.us/j/95069915454)
  Speaker: Fikreab Solomon Admasu
  Title: Composition laws from Gauss to Bhargava, part 2
  Abstract: Continuation of the talk from September 8, with focus on the newer Bhargava approach.

- **September 22**
  Speaker: Sayak Sengupta
  Title: Polynomial Maps
  Abstract: We will cover a couple topics in this talk.
  (a) Polynomial maps over finite fields &
  (b) Geometrically nilpotent subvarieties.
  We will start with exploring quasi-fixed points of an affine algebraic variety, how they are, what they look like etcetera and then we will identify the difference between nilpotent subvarieties and geometrically nilpotent subvarieties with the help of an example.
  All the topics in this talk are based on Prof. Borisov's papers with the same names.

- **September 29**
  Speaker: Caroline Matson
  Title: The commutant monoid of a higher-dimensional power series map
  Abstract: In a 1994 paper, Lubin examined nonarchimedean dynamical systems, or families of power series that commute under composition. He defined a stable power series to be a power series f(x) = bx + (higher degree terms) such that the linear coefficient b is neither zero nor a root of unity and showed that if f(x) is stable then for any constant c there exists a unique power series g(x) such that f(g(x) = g(f(x)) and g(x) = cx + (higher degree terms). In this talk we will generalize this problem to multiple dimensions and will explore the notion of stability in this more complicated setting.

- **October 6**

Speaker: Jaiung Jun (SUNY New Paltz)
Title: Hall algebras in a non-additive setting
Abstract: To an abelian category A satisfying some conditions, one may attach an associative algebra H_A, called the Hall algebra of A. Two interesting examples of such abelian categories are Coh(X / F_q), the category of coherent sheaves on a projective variety X over F_q, and Rep(Q,F_q), the category of representations of a quiver Q over F_q. In fact, Dyckerhoff and Kapranov introduced the notion of proto-exact categories, and generalized the construction of Hall algebras to the non-additive setting. This allows one to define and study the Hall algebras for Coh(X / F_q) and Rep(Q,F_q) in the setting of ``the field with one element''. I will explain some of my recent work in this direction. This is joint work with Matt Szczesny.

- **October 13**
  Speaker: Alexander Borisov (Binghamton)
  Title: Projective geometry approach to the Jacobian Conjecture
  Abstract: Jacobian Conjecture is one of the oldest unsolved problems in Algebraic Geometry, going back to a 1939 paper by Keller. It says that if a polynomial self-map of a plane is locally invertible (that is, unramified) then it is globally invertible. This conjecture is infamous for the large number of incorrect proofs that have been proposed over the years. In fact, it is quite possible that the conjecture is false, even in dimension two and especially in higher dimensions. I will explain this and some related conjectures and describe my approach to it in dimension two using methods of projective geometry. This is work in progress, since about 2005.

- **October 20**
  Speaker: Leo Herr (Utah)
  Title: Log Intersection Theory and the Log Product Formula
  Abstract: Kato: Log structures are “magic powder” that makes mildly singular spaces appear smooth. Log schemes literally lie between ordinary schemes and tropical geometry, and are related to Berkovich Spaces. Problems in Gromov-Witten Theory demand intersection theoretic machinery for slightly singular spaces. Log structures have solved similar problems in Hodge Theory, D-modules, Connections and Riemann-Hilbert Correspondences, Abelian Varieties (esp. Elliptic Curves), etc. How can they be used to define a reasonable intersection theory for curve counting on singular spaces? We'll give a product formula as proof-of-concept for a whole toolkit under development to tackle these types of problems.

- **October 27**
  Speaker: Juan Diego Rojas (Uniandes, Colombia)
  Title: Global Field Totients
  Abstract: We define the Euler's totient function for a global field and recover the essential analytic properties of the classical arithmetical function, namely the product formula and holomorphicity of the associated zeta function. As applications, (1) we recover the global analog of the mean value theorem of Erdős, Dressler and Bateman via the Wiener-Ikehara theorem and, (2) a function field analogue of Mertens’ mean value theorem. Joint work with Santiago Arango-Piñeros

- **November 10**
  Speaker: Harpreet Bedi (Alfred University)
  Title: Perfectoid Algebraic Geometry
  Abstract: Elementary Algebraic Geometry can be described as the study of zeros of polynomials with integer degrees, this idea can be naturally carried over to ‘polynomials’ with degree in Z[1/p], which leads to the perfectoid version of algebraic geometry. In this talk the similarities and differences between integer and rational degree are discussed. We will construct line bundles of rational degree and compute their cohomology. The formal schemes are then obtained via p-adic completion. Finally, we talk about zeros of rational degree polynomials and

prove the Nullstellensatz.

- **November 17**
  Speaker: Piotr Achinger (IMPAN)
  Title: Regular connections on log schemes and rigid analytic spaces
  Abstract: I will describe an extension of Deligne's results on regular connections to log schemes over C. This is part of a project in progress whose goal is to obtain a Riemann–Hilbert type correspondence for smooth rigid-analytic spaces over C((t)).

- **December 1**
  Speaker: Julia Hartmann (UPenn)
  Title: Local-global principles for linear algebraic groups over arithmetic function fields
  Abstract: We consider linear algebraic groups over arithmetic function fields, i.e., over one variable function fields over complete discretely valued fields. Such function fields naturally admit several collections of overfields with respect to which one can study local-global principles. We will recall results about local-global principles for rational linear algebraic groups, and then focus on new results concerning certain classes of non-rational groups.