The Arithmetic Seminar

TOPICS: Arithmetic in the broadest sense that includes Number Theory (Elementary Arithmetic, Algebraic, Analytic, Combinatorial, etc.), Algebraic Geometry, Representation Theory, Lie Groups and Lie Algebras, Diophantine Geometry, Geometry of Numbers, Tropical Geometry, Arithmetic Dynamics, etc.

PLACE and TIME: This semester the seminar meets primarily on Tuesdays at 4:15 p.m. on Zoom, with possible special lectures on Mondays at 3:30 or other days. Zoom link

ORGANIZERS:
Regular Faculty: Alexander Borisov, Marcin Mazur, Adrian Vasiu,
Post-Docs: Vaidehee Thatte, Fikreab Solomon Admasu.


SEMINAR ANNOUNCEMENTS: To receive announcements of seminar talks by email, please join our mailing list.

Related seminar: Upstate New York Online Number Theory Colloquium (bi-weekly, online):
http://people.math.binghamton.edu/borisov/UpstateNYOnline/Colloquium.html

Related seminar: The student/postdoc “No Theory Seminar“:
https://sites.google.com/view/vaideheethatte/service-outreach/nts-bu

Previous Arithmetic Seminar Talks

- Spring 2020 —— Fall 2019
- Spring 2019 —— Fall 2018
- Spring 2018 —— Fall 2017
- Spring 2017 —— Fall 2016
- Spring 2016 —— Fall 2015
- Spring 2015 —— Fall 2014

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 $f(x) = bx + \text{(higher degree terms)}$ 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 $g(x) = cx + \text{(higher degree terms)}$. 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$((X \times \mathbb{F}_q)$, the category of coherent sheaves on a projective variety $X$ over $\mathbb{F}_q$, and Rep$((Q,\mathbb{F}_q)$, the category of representations of a quiver
Q over $\mathbb{F}_q$. 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 $\text{Coh}(X / \mathbb{F}_q)$ and $\text{Rep}(Q, \mathbb{F}_q)$ 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:** TBA
  **Abstract:** TBA

- **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 $\mathbb{Z}[1/p]$, which leads to the perfectoid version of algebraic geometry. In this paper the similarities and differences between the two distinct cases are discussed. The first part of the paper constructs schemes of rational degree and line bundles of degree $n \in \mathbb{Z}[1/p]$. The Čech cohomology of these line bundles is then computed. The second part of the paper constructs perfectoid spaces as formal schemes obtained as a p-adic completion of rational degree schemes, and the theorems about cohomology are transferred here. Furthermore, a modulo p analogue of Scholze's tilting functor is constructed. The third part of the paper considers rational degree algebraic geometry from an elementary point of view and proves the Nullstellensatz.

- **November 17**
  **Speaker:** Piotr Achinger (IMPAN)
  **Title:** TBA
  **Abstract:** TBA
**Speaker:** Julia Hartmann (UPenn)

**Title:** TBA

**Abstract:** TBA

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