Fall 2015

- **September 4**

  Speaker: FirstName LastName (Some University)
  Title: Organizational Meeting

  Abstract: We will discuss schedule and speakers for this semester

- **September 11**

  Speaker: Jaiung Jun (Binghamton University)
  Title: Algebraic geometry over semi-structures and hyper-structures of characteristic one (Part 1)

  Abstract: Algebraic geometry over the “field with one element” (F_1-geometry) is the recent field of mathematics. In this talk, we introduce motivations and the meaning of working in characteristic one as well as recent developments. If time permits, I will also introduce a rather exotic algebraic structure called hyperfield.

- **September 18**

  Speaker: Jaiung Jun (Binghamton University)
  Title: Algebraic geometry over semi-structures and hyper-structures of characteristic one (Part 2)

  Abstract: This is the second part of the talk given at Sep 11. In this talk, we introduce a notion of algebraic geometry over semifield and hyperfield in connection to tropical geometry.

- **September 25**

  Speaker: Jaiung Jun (Binghamton University)
  Title: Algebraic geometry over semi-structures and hyper-structures of characteristic one (Part 3)

  Abstract: We introduce basic notions of tropical geometry and semiring schemes. Then we generalize $\hat{\textrm{C}}$ech cohomology theory and invertible sheaves to semiring schemes. In particular, when $X=\mathbb{P}^n_M$, a projective space over a totally ordered idempotent semifield M, we show that $\hat{\textrm{H}}^n(X,\mathcal{O}_X)$ is in agreement with the classical computation for all n. Finally, we classify all invertible sheaves on $X=\mathbb{P}^n_M$ by computing $\textrm{Pic}(X)$ explicitly.

- **October 2**

  Speaker: Kalina Mincheva (Johns Hopkins University)
  Title: Nullstellensatz for tropical polynomials

  Abstract: We improve on a result of A. Bertram and R. Easton which can be regarded as a Nullstellensatz for tropical polynomials. In order to do that we give a new definition of prime congruences in additively idempotent semiring using twisted products. This class turns out to exhibit some analogous properties to the prime ideals of commutative rings. In order to establish a good notion of radical congruences we show that the intersection of all primes of a semiring can be characterized by certain twisted power formulas. We give a complete description of

prime congruences in the polynomial and Laurent polynomial semirings over the tropical semifield $\mathbb{R}_{max}$, the semifield $\mathbb{Z}_{max}$ and the Boolean semifield $\mathbb{B}$. The minimal primes of these semirings correspond to monomial orderings, and their intersection is the congruence that identifies polynomials that have the same Newton polytope. We show that the radical of every finitely generated congruence in each of these cases is an intersection of prime congruences with quotients of Krull dimension 1.

- **October 9**

Speaker: Alexander Borisov (Binghamton University)
Title: Labeled trees, divisorial valuations at infinity, and two-dimensional Jacobian Conjecture

Abstract: Starting from a projective plane and performing several blowups of points at infinity, one can get various smooth compactifications of the affine plane. Each irreducible component of the complement of the affine plane gives a valuation on the field of rational functions in two variables. These valuations are called divisorial valuations, and they play an important role in many geometric approaches to the two-dimensional Jacobian Conjecture. We will introduce two discrete invariants of these valuations, and discuss their significance and limitations for the Jacobian Conjecture. Despite the algebro-geometric motivation, our methods are essentially combinatorial, based on the (dual) intersection graph of curves at infinity.

- **October 16**

Speaker: Wushi Goldring (Washington University, St. Louis)
Title: Group-theoretical Hasse invariants

Abstract: I will explain some aspects of my joint work with J.-S. Koskivirta that I will not have time to discuss in my colloquium talk. Specifically, I will talk about our construction of what we call “group-theoretical Hasse invariants”. I will recall the classical Hasse invariant of elliptic curves in characteristic p>0 and explain how our construction offers both a generalization in several directions and a group-theoretic reinterpretation of the classical Hasse invariant. Time permitting, I will sketch how we apply these group-theoretical Hasse invariants to answer questions both about the geometry and about the cohomology of certain Shimura varieties modulo a prime p.

- **November 2**

Speaker: Alexander Borisov (Binghamton University)
Title: Labeled trees, divisorial valuations at infinity, and two-dimensional Jacobian Conjecture (Part 2)

Abstract: This is a continuation of the October 9 talk. I will remind of the two invariants of divisorial valuations introduced then, and explain their importance for the study of hypothetical counterexamples to the Jacobian Conjecture. Besides purely combinatorial arguments, I will introduce some algebraic geometry techniques, like adjunction inequalities and inversion of adjunction.

- **November 9**

Speaker: Alexander Borisov (Binghamton University)

Title: The abc-polynomials

Abstract: If a=b+c is a coprime triple of natural numbers, one can define a polynomial $f(x)=\frac{bx^a-ax^b+c}{(x-1)^2}$. The motivation behind this definition is a naive approach to the Masser-Oesterle abc conjecture: attempt to follow the proof in the geometric case by using quantum deformation of integers instead of differentiation of polynomials. I introduced these polynomials in a 1998 paper, and proved some results about them (in particular that most of them are irreducible). Not much happened, until these polynomials unexpectedly reappeared around 2004 in a graduate course problem by Joe Harris, that turned out to be unexpectedly hard. After several months of attempts by Jason Starr, Izzet Coskun and others, it was ultimately solved by Noam Elkies by a short and beautiful argument. A particular case of this problem appeared on 2014 Putnam exam, most probably by Elkies's suggestion, and, unsurprisingly, turned out to be unsolvable “in real time”. While the significance of these polynomials is unclear, I hope to convince you that they are interesting. In particular, I will present the Elkies's beautiful proof.

- **November 30**

Speaker: Dan Collins (Cornell)
Title: Anticyclotomic p-adic L-functions and Ichino's formula I

Abstract: A p-adic L-function is an analytic function of a p-adic variable, which is characterized by interpolating special values of a classical (complex analytic) L-functions. I will give an introduction to where p-adic L-functions come from and why they are studied. I will then discuss about a certain type of “anticyclotomic p-adic L-function” of Bertolini-Darmon-Prasanna associated to a pair consisting of a classical modular form and a Hecke character of an imaginary quadratic field. Finally, I'll talk about recent work of Skinner that uses this p-adic L-function to obtain new results towards the Birch and Swinnerton-Dyer conjecture for elliptic curves of rank 1.

- **December 7**

Speaker: Dan Collins (Cornell)
Title: Anticyclotomic p-adic L-functions and Ichino's formula II

Abstract: In this talk I will discuss how one actually constructs p-adic L-functions: the definition as “a p-adic analytic function with certain specified values” provides no clue as to whether such an analytic function actually exists! I'll discuss constructions of the “anticyclotomic p-adic L-function” of my previous talk - the classical Rankin-Selberg unfolding argument comes close to giving a direct construction, but it fails in the most interesting cases. In my thesis I use a different automorphic identity (from a triple-product formula of Ichino) to carry out a different construction that always works; I will talk about my result and some arithmetic consequences to it.

- **December 8, 11:00 am** Special talk - Ph.D. Defense

Speaker: Ding Ding (Binghamton)
Title: Canonical Barsotti–Tate Groups of Finite Level

Abstract: Let k be an algebraically closed field of characteristic $p>0$. Let c, d be positive integers and

$h=c+d$. Let H be a p-divisible group of codimension c and dimension d over k . For a positive integer m let $H[p^m]$ be the kernel of multiplication by $p^m.$ It is a finite commutative group scheme over k of p power order, called a Barsotti–Tate group of level $m.$ We study a particular type of p-divisible groups H_π called canonical Barsotti–Tate groups, where π is a permutation on the set ${1,2,\ldots,h}.$ We obtain new formulas of combinatorial nature for the dimension of $Aut(H_\pi[p^m])$ and for the number of connected components of $End(H_\pi[p^m]).$