

Fall 2017

▪ **August 22 (Tuesday, 10:00 am - 12:00 pm)**

Speaker: Micah Loverro (Binghamton)

Title: Relating G -modules and $\mathrm{Lie}(G)$ -modules

Abstract: Given a fixed representation V of G_K over a field K , where K is the field of fractions of a Noetherian normal domain R , and the group scheme G over R is reductive, we investigate relations between $\mathrm{Lie}(G)$ -modules and G -modules inside V . If M inside V is a G -module, then M is always a $\mathrm{Lie}(G)$ -module. We have conditions in some cases which imply that if M is a $\mathrm{Lie}(G)$ -module, then it is also a G -module. In particular, we show that we can reduce the problem to the case where R is a complete discrete valuation ring with residue field algebraically closed.

▪ **August 22 (Tuesday, 2:00 am - 4:00 pm)**

Speaker: John Brown (Binghamton)

Title: Classifying finite hypergeometric groups, height one balanced integral factorial ratio sequences, and some step functions

Abstract: In this talk we will discuss some connections between hypergeometric series, factorial ratio sequences, and non-negative bounded integer-valued step functions. We will start with a finiteness criterion for hypergeometric groups by Beukers and Heckman, then show how this leads to the classification by Bober of integral balanced factorial ratio sequences of height one, and thus a proof that a conjectured classification of a certain class of step functions by Vasyunin is complete.

▪ **August 28**

Speaker: N/A

Title: Organizational Meeting

Abstract: We will discuss schedule and speakers for this semester

▪ **September 11**

Speaker: Jaiung Jun (Binghamton)

Title: Geometry over hyperfields

Abstract: In this talk, we illustrate how hyperfields can be used to show that certain topological spaces (underlying topological spaces of schemes, Berkovich analytification of schemes, and real schemes) are homeomorphic to sets of rational points of schemes over hyperfields.

▪ **September 18**

Speaker: Martin Ulirsch (Michigan)

Title: Realizability of tropical canonical divisors

Abstract: We solve the realizability problem for tropical canonical divisors: Given a pair (Γ, D) consisting of a stable tropical curve Γ and a divisor D in the canonical linear system on Γ , we develop a purely combinatorial condition to decide whether there is a smooth curve realizing Γ together with a canonical divisor that specializes to D . In this talk I am going to introduce the basic notions needed to understand this problem and outline a comprehensive solution based on recent work of Bainbridge-Chen-Gendron-Grushevsky-M\"oller on compactifications of strata of abelian differentials. Along the way, I will also develop a moduli-theoretic framework to understand the specialization of divisors to tropical curves as a natural tropicalization map in the sense of Abramovich-Caporaso-Payne.

This talk is based on joint work with Bo Lin, as well as on an ongoing project with Martin M\"oller and Annette Werner.

▪ September 25

Speaker: Jaiung Jun (Binghamton)

Title: Picard groups for tropical toric varieties.

Abstract: From any monoid scheme X (also known as an $\mathbb{F}_1$ -scheme) one can pass to a semiring scheme (a generalization of a tropical scheme) X_S by scalar extension to an idempotent semifield S . We prove that for a given irreducible monoid scheme X (with some mild conditions) and an idempotent semifield S , the Picard group $\text{Pic}(X)$ of X is stable under scalar extension to S . In other words, we show that the two groups $\text{Pic}(X)$ and $\text{Pic}(X_S)$ are isomorphic. We also construct the group $\text{CaCl}(X_S)$ of Cartier divisors modulo principal Cartier divisors for a cancellative semiring scheme X_S and prove that $\text{CaCl}(X_S)$ is isomorphic to $\text{Pic}(X_S)$.

▪ October 2

Speaker: Patrick Milano (Binghamton)

Title: Ghost spaces and some applications to Arakelov theory

Abstract: Arakelov theory provides a method for completing arithmetic curves like $\text{Spec}(\mathbb{Z})$ by adding formal points “at infinity.” There is an Arakelov divisor theory for such completed arithmetic curves that is analogous to the theory of divisors on projective algebraic curves. In order to describe the cohomology of an Arakelov divisor, Borisov introduced the notion of a ghost space. After some background and motivation, we will define ghost spaces and look at some of their applications.

▪ October 9

Speaker: Christian Maire (Cornell, Besançon)

Title: Fixed points in p-adic analytic extensions of number fields and ramification (joint work with Farhid Hajir)

Abstract: In this talk, I will present two arithmetic applications of the presence of fixed points in p-adic analytic extensions of number fields: (i) for the μ of the p-class group; (ii) for some evidences of the tame version of the Fontaine-Mazur conjecture. As we will see, the nature of the ramification (tame versus wild) is essential. The lecture will be accessible for non-specialists.

▪ October 23

Speaker: Max Kutler (Yale)

Title: Faithful tropicalization of hypertoric varieties

Abstract: A hypertoric variety is a “hyperkähler analogue” of a toric variety. Each hypertoric variety comes equipped with an embedding into a toric variety, called the Lawrence toric variety, and hence has a natural tropicalization. We explicitly describe the polyhedral structure of this tropicalization. Using a recent result of Gubler, Rabinoff, and Werner, we prove that there is a continuous section of the tropicalization map.

▪ October 30

Speaker: Alina Vdovina (CUNY, Newcastle)

Title: Buildings, quaternions and fake quadrics

Abstract: We'll present construction of buildings as universal covers of certain complexes. A very interesting case is when the fundamental group of such a complex is arithmetic, since the construction can be carried forward to get new algebraic surfaces, namely fake quadrics. Fake projective planes are already classified following series of works of D. Mumford, G. Prasad, S.-K. Young, D. Cartwright, T. Steger, but the fake quadrics remain mysterious.

▪ November 6

Speaker: Micah Loverro (Binghamton)

Title: G-modules and Lie(G)-modules with examples from SL_2

Abstract: Given a fixed representation V of a simply-connected semisimple group G_K over a field K , we

seek to determine which $\mathrm{Lie}(G)$ -modules M inside V are also G -modules, where G is a smooth affine group scheme of finite type over a Noetherian normal domain R whose field of fractions is K . Previously we showed that we can assume R is a complete discrete valuation ring with algebraically closed residue field. In this talk, we will go through the details of the case when G is SL_2 , and then show how the Frobenius map could be used in a more general setting to produce $\mathrm{Lie}(G)$ -modules which are not G -modules under certain conditions depending on the weights of the representation.

▪ November 13

Speaker: Tom Price (Toronto)

Title (tentative): A global sections functor for Arakelov bundles

Abstract: We exhibit a class of real-valued functions on Abelian groups, which have some non-trivial properties generalizing the behaviour of indicator functions of subgroups, such as the Regev Stephens-Davidowitz inequality. We construct a category of groups equipped with these functions, use this to create an analogue of a global sections functor for Arakelov bundles, and demonstrate that this functor has some properties we should expect.

▪ November 20

Speaker: Patrick Carney (Binghamton)

Title: Geometry and divisors on rational curves and surfaces

Abstract: In his 2014 paper A. Borisov constructed two invariants of divisorial valuations at infinity. We will discuss some algebraic geometry notions and constructions used in that paper, specifically the theory of divisors and linear equivalence on the projective line, the projective plane, and other compactifications of the affine plane. The blow-up of a point construction will also be presented in detail. This is the first of two talks, that deals with the prerequisites for the paper. It will be followed by the second talk that discusses the combinatorial methods and results of that paper.

▪ November 27

Speaker: Sayak Sengupta (Binghamton)

Title: Valuations

Abstract: The main topic of the talk is how to recover the valuation function from a valuation ring of a field. The talk starts with the definition of a valuation ring and an idea of how to construct valuation ring from any given field followed by a short discussion about valuation functions and discrete valuation functions leading to the final part of the talk i.e to establish the main topic of the talk.

▪ December 4

Speaker: Philipp Jell (Georgia Tech)

Title: Non-archimedean Arakelov theory and cohomology of differential forms on Berkovich spaces

Abstract: Arakelov theory studies varieties over number fields by combining analytic geometry over the complex numbers (representing the infinite places) with algebraic intersection theory on suitable models over the ring of integers (representing the finite places). However, due to lack of resolution of singularities in mixed characteristic, such models are hard to come by. It has always been a goal to unify the approaches and replace intersection theory on models by analytic geometry over the finite places.

In 2012, Chambert-Loir and Ducros made a promising step in this direction, introducing real-valued differential forms and currents on Berkovich analytic spaces and proving among other things a Poincaré-Lelong formula and existence of Chern classes for line bundles.

In this talk, we will give a brief introduction to Arakelov theory and introduce the forms defined by Chambert-Loir and Ducros. We will then discuss the cohomology theory defined by these forms for varieties over non-archimedean fields. In particular we explain a Poincaré lemma result and results on duality for curves.

▪ **December 6** (Room: WH 329)**Speaker:** Patrick Carney (Binghamton)**Title:** Geometry and divisors on rational curves and surfaces, Part 2

Abstract: This is a continuation of the November 20 talk. We will discuss the structure of the divisor class group on arbitrary compactifications of the affine plane that are obtained from the projective plane by a sequence of blowups. We will discuss the intersection form on this group and define the two invariants of the divisorial valuations at infinity studied in that 2014 paper by Borisov. We will explain the properties of these invariants and the main results regarding them.

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