# Spring 2015

- **February 9**

  ***Speaker***: Alexander Borisov (Binghamton University)
  ***Title***: Riemann-Roch Theorem of Tate and van der Geer-Schoof, and Arakelov geometry

  ***Abstract***: Arakelov geometry provides a way to “compactify” arithmetic varieties, by using techniques from analysis “at infinity”. An older theory of Tate, refined by van der Geer and Schoof, provides similar, but deeper results in dimension one (i.e. algebraic number fields). I will give an introduction to both theories and make a case for the existence of a unified theory of “heat transfer on arithmetic varieties”.

- **February 16**

  ***Speaker***: Alexander Borisov (Binghamton University)
  ***Title***: Riemann-Roch Theorem of Tate and van der Geer-Schoof, and Arakelov geometry, Part 2

  ***Abstract***: This is the continuation of the February 9 talk, with the emphasis on the details of the arithmetic cohomology theory.

- **March 2**

  ***Speaker***: Alexander Borisov (Binghamton University)
  ***Title***: Stein factorizations of resolutions of Keller maps with the P^2 target

  ***Abstract***: Keller maps are polynomial self-maps of an affine complex space that have constant non-zero jacobian and are not invertible. The Jacobian Conjecture asserts that such maps do not exist, and most approaches it concentrate on studying various properties of these possible counterexamples. I will describe the results and proofs of my recent paper on the subject. A major part of the talk will be a crash course in the classical theory of curves on algebraic surfaces: divisor classes, intersection form, canonical class, adjunction formula, etc.

- **March 9**

  ***Speaker***: John R. Doyle (University of Rochester)
  ***Title***: Preperiodic portraits for unicritical polynomials

  ***Abstract***: In 1964, I. N. Baker showed that if f(z) is (almost) any polynomial map defined over an algebraically closed field K of characteristic zero, then f(z) admits periodic points of every period N > 0. One could then ask the following dual question: Given a point P in K, a positive integer N, and an integer d at least 2, does there exist a polynomial f(z) of degree d for which P is periodic of period N? It turns out to be a trivial consequence of Baker's theorem that the answer to this question is always “yes.” The question becomes more interesting, however, if we restrict which polynomials of degree d we are allowed to consider. I will therefore discuss the situation where we restrict our attention to the family of polynomials of the form z^d + c, and I will completely answer the question in this case. Finally, I will also state a more general result for strictly preperiodic points.

- **March 16**

***Speaker***: Lev Borisov (Rutgers University)
***Title***: Eisenstein series and equations of certain modular curves

***Abstract***: I will discuss properties of certain holomorphic Eisenstein series on the upper half plane and explain how they can be used to give explicit equations of the modular curves $\bar X_1(p)$ for prime $p$.

- **March 23**

***Speaker***: Andrew Bridy (University of Rochester)
***Title***: The Artin-Mazur Zeta Function of a Rational Map in Positive Characteristic

***Abstract***: The Artin-Mazur zeta function of a dynamical system is a generating function that captures information about its periodic points. In characteristic zero, the zeta function of a rational map from P^1 to P^1 is known to be a rational function. In positive characteristic, the situation is much less clear. I show that the zeta function can be understood for a family of maps in positive characteristic that come from endomorphisms of algebraic groups. Somewhat surprisingly, it usually fails to be rational and can be shown to be transcendental.

- **March 30**

***Speaker***: Alexander Borisov (Binghamton University)
***Title***: Stein factorizations of resolutions of Keller maps with the P^2 target (Rescheduled from March 2)

***Abstract***: Keller maps are polynomial self-maps of an affine complex space that have constant non-zero jacobian and are not invertible. The Jacobian Conjecture asserts that such maps do not exist, and most approaches it concentrate on studying various properties of these possible counterexamples. I will describe the results and proofs of my recent paper on the subject. A major part of the talk will be a crash course in the classical theory of curves on algebraic surfaces: divisor classes, intersection form, canonical class, adjunction formula, etc.

- **April 20**

***Speaker***: Daniel Vallieres (Binghamton University)
***Title***: Lorentzian Weyl groups inside Vahlen groups.

***Abstract***: This is work in progress with Alex Feingold. In this talk, we will explain our attempt to describe Weyl groups of certain Kac-Moody algebras. We will explain the notion of a Vahlen group which seems to give a nice conceptual framework to attack this problem.

- **April 24, 4:30 pm (Special Meeting: Dissertation Defense)**

***Speaker***: Jinghao Li (Binghamton University)
***Title***: Purity Results on F-crystals

***Abstract***: The first half of the talk will be an introduction to Rings of Witt vectors, F-crystals and a survey of purity results for stratifications of reduced locally Noetherian schemes in positive characteristic associated to F-crystals. In the second half, I will present our new purity result on F-crystals and prove that it implies all the previous purity results.

- **April 27**

***Speaker***: Patrick Milano (Binghamton University)
***Title***: Part 1: Effectivity of Arakelov divisors

***Abstract***: This talk will be based on parts of a paper by van der Geer and Schoof. We will introduce the notion of an Arakelov divisor D on a number field F, and define the effectivity of D. We will then define a real number h^0(D), which may be viewed as the analogue of the dimension of the space of global sections of a divisor on a complete algebraic curve. We'll use this to get an arithmetic version of the Riemann-Roch theorem.

***Title***: Part 2: Convolution structures and ghost-spaces

***Abstract***: This second talk will be based on a paper by Borisov, which builds on the work of van der Geer and Schoof. We'll define ghost-spaces and their dimensions, and then use those objects to define an appropriate notion of H^0(D) and H^1(D) for an Arakelov divisor D.

- **May 4**

***Speaker***: Nicolas Templier (Cornell University)
***Title***: Weyl’s law in the theory of automorphic forms

***Abstract***: We will introduce some of the conjectures and probabilistic models concerning the automorphic spectrum. In works with S.W.Shin, P.Sarnak, J.Matz we have generalized some of the classical results to higher rank groups. Consequences are refinements of the Katz-Sarnak heuristics and a result towards the Ramanujan conjecture on average for SL(n,R)/SO(n).