**Weekly Seminar & Events Bulletin**  
_October 22nd, 2017 - October 28th, 2017_

### Monday, October 23, 2017

<table>
<thead>
<tr>
<th>Time</th>
<th>Seminar/Event</th>
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<tbody>
<tr>
<td>12:00pm-1:00pm</td>
<td><strong>Mathematical Biology</strong> -- Anthony Vecchiarelli (UM Molecular, Cellular and Developmental Biology) <strong>The ParA/MinD family of ATPases make waves to position DNA, cell division, and organelles in bacteria</strong></td>
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<td>4:00pm-6:00pm</td>
<td><strong>Geometry &amp; Physics</strong> -- Xin Wang (Shandong University/Columbia) <strong>Genus-2 G-function for semisimple Frobenius manifolds</strong></td>
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<td><strong>Student Combinatorics Seminar</strong> -- () <strong>No meeting</strong></td>
<td>3866 East Hall</td>
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<tr>
<td>4:10pm-5:30pm</td>
<td><strong>Group, Lie and Number Theory</strong> -- Michal Zydor (IAS) <strong>The relative trace formula of Jacquet-Rallis and applications to the Gan-Gross-Prasad conjecture</strong></td>
<td>4088 East Hall</td>
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<tbody>
<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Student Geometry/Toplogy</strong> -- Montek Gill (University of Michigan) <strong>Stable homotopy theory: spectra, generalized cohomology theories and higher algebraic structures</strong></td>
<td>1866 East Hall</td>
</tr>
<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Student Commutative Algebra</strong> -- Robert Walker (University of Michigan) <strong>Some instances of “Life hacking”</strong></td>
<td>4088 East Hall</td>
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<tr>
<td>4:10pm-5:00pm</td>
<td><strong>Colloquium Series</strong> -- Florian Pop (University of Penn) <strong>The Ihara/Oda-Matsumoto Conjecture (I/OM)</strong></td>
<td>1360 East Hall</td>
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### Wednesday, October 25, 2017

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<td><strong>RTG Seminar on Geometry, Dynamics and Topology</strong> -- Kevin Schreve (U Michigan) <strong>Smith Theory</strong></td>
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<td><strong>Algebraic Geometry</strong> -- Dave Anderson (Ohio State) <strong>New formulas for degeneracy loci, and applications to Brill-Noether theory</strong></td>
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<td><em>Categorifying quantum sl₂</em></td>
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Mathematical Biology
Monday, October 23, 2017, 12:00pm-1:00pm
335 West Hall

Anthony Vecchiarelli (UM Molecular, Cellular and Developmental Biology)

The ParA/MinD family of ATPases make waves to position DNA, cell division, and organelles in bacteria

Positional information in eukaryotic cells is mainly orchestrated by cytoskeletal highways and their associated motor proteins like Myosin, Kinesin, and Dynein. Bacteria don't have motors, so how are they spatially organized? I will be discussing three members of the ParA/MinD family of ATPases that are part of self-organizing systems that put things in their place in cells across the microbial world. I will first present the ATPase called ParA, which is part of the most common DNA-segregation system in bacteria. ParA proteins form dynamic waves on the nucleoid to position chromosomes and plasmids in opposite cell-halves so that they are faithfully inherited after cell division. I will then discuss the ATPase called MinD, which is part of a system that forms oscillatory waves on the inner membrane. The oscillation aligns cell division at mid-cell so that daughter cells are equal in size. Finally, I will introduce a new member of this ATPase family we call McdA, which is part of an organelle trafficking system in bacteria. Yes. Bacteria have organelles. Our work is shedding light on what seems to be a general mode of subcellular organization in bacteria - dynamic protein gradients surfing biological surfaces to impart positional information for a wide variety of fundamental biological processes. My new lab focuses on subcellular organization in bacteria with a strong emphasis towards reconstituting the self-organizing activities of these systems in a cell-free setup using purified and fluorescent labeled components. By visualizing the biochemistry driving self-organization outside the cell we are able to provide comprehensive molecular mechanisms that explain subcellular organization inside the cell.

Geometry & Physics
Monday, October 23, 2017, 4:00pm-6:00pm
4096 East Hall

Xin Wang (Shandong University/Columbia)

Genus-2 G-function for semisimple Frobenius manifolds

In 2012, Dubrovin, Liu and Zhang introduced the definition of genus-2 G-function for any semisimple Frobenius manifold. Via lots of verification, they conjectured the vanishing property of genus-2 G-function for some special cases, such as simple singularities and Fano orbifolds P1. In this talk, I will first review three formulas of genus-2 generating functions for semisimple CohFT, trying to match them term by term. Then I will give some background and some vanishing conditions for the genus-2 G-function. It is based on a joint work with Xiaobo Liu.
Complex Analysis, Dynamics and Geometry  
**Monday, October 23, 2017, 4:00pm-5:00pm**  
3096 East Hall  
**Luke Edholm (U(M))**  
*Constructing holomorphic L^p functions from L^p data*  

For a domain U in \( \mathbb{C}^n \), let \( A^p(U) \) denote the subset of functions belonging to \( L^p(U) \) that are holomorphic. Given a map \( f \) in \( L^p(U) \), can we use it to construct a "natural" function in \( A^p(U) \)? The Bergman kernel is a useful tool that can be used to investigate this question, but there are certain limitations. I will show that Hilbert space methods may still be employed to attack this problem, even when the Bergman kernel fails to do the job. I plan to focus on a class of model domains and introduce new family of integral kernels which avoid the issues that limit the Bergman kernel. This work is joint with Debraj Chakrabarti and Jeff McNeal.

Integrable Systems and Random Matrix Theory  
**Monday, October 23, 2017, 4:00pm-5:00pm**  
1866 East Hall  
**Baofeng Feng (The University of Texas Rio Grande Valley)**  
*The complex sine/sinh-Gordon equations and the complex short pulse equation*  

It is known that the complex sine-Gordon (csG) and sinh-Gordon (cshG) equations belong to the first negative flow of the AKNS hierarchy. It is worthy to note that the csG/cshG equations are also called coupled dispersionless equations of focusing and defocusing type in the literature. Recently, by hodograph transformation, above equations can be transformed into a focusing and defocusing complex short pulse equation, which is viewed as an analogue of the nonlinear Schroedinger equation in the ultrashort regime. In this talk, I will firstly present the bilinear forms and Darboux transformation, which both lead to multi-soliton solutions of bright and dark type. Then, the integrable semi-discrete and fully-discrete complex sine/sinh-Gordon equation equations will be constructed, their solutions will be touched. If time permits, we will discuss several future topics such as the coupled cSP equation and the inverse scattering transform for the cSP equation.

Student Combinatorics Seminar  
**Monday, October 23, 2017, 4:00pm-5:00pm**  
3866 East Hall  
()  
*No meeting*
Jacquet and Rallis proposed an approach via relative trace formula to the global Gan-Gross-Prasad (GGP) conjectures for unitary groups. The conjecture relates periods of automorphic forms on unitary groups to central values of Rankin-Selberg L-functions. The simple trace formula has been developed thanks to the work of Yun, Zhang and Beuzart-Plessis giving important cases of the GGP conjecture as well as the refined GGP conjecture as proposed by Ichino-Ikeda. I will present my joint work with Pierre-Henri Chaudouard that develops a full relative trace formula of Jacquet-Rallis and I will discuss the progress towards proving new cases of the GGP conjecture.

This talk will be an introduction to stable homotopy theory, in which we provide three viewpoints on the objects under study, namely spectra. We will first motivate the introduction of spectra and the stable homotopy category by considering stable properties, i.e. those properties that are stable under suspension. Second, we will describe Brown representability and the resulting connection between spectra and generalized cohomology theories. Third, we will describe the connection between spectra and infinite loop spaces, and more generally, we will describe how one can study higher algebraic structures, more specifically algebraic structures up to "coherent higher homotopies", via spectra. This talk should be accessible to anyone who has had a first course in algebraic topology.

To life hack means figuring out how to make some aspect of your daily life easier or more efficient. As mathematicians, we really want to life hack the study of an unwieldy abstract construction, or of some palatable numeric data, or whatever. I'll survey some cases of doing this in the ballpark of my research area, leveraging "ALGECOM" info (algebra-geometry-combinatorics), at the interface between asymptotic and combinatorial commutative algebra. While familiarity with notions in Math 614/631 is helpful, everyone is welcome to attend the talk.
Ihara asked in the 1980's and Oda-Matsumoto conjectured in 1996 that there should be a purely topological-combinatorial description of Aut(K), where K is the algebraic closure of the field of rational numbers. I/OM grew out of Grothendieck's famous "Dessins d'enfants" and ideas by Deligne, Ihara, Drinfel'd... In the talk I will review/explain the question and present the state of the art, in particular recent refinements of I/OM, based on the so called Bogomolov (birational anabelian) Program.

Financial/Actuarial Mathematics

Wednesday, October 25, 2017, 3:00pm-4:00pm

1866EH East Hall

Christian Keller (UM)

*Viscosity solutions for fully nonlinear stochastic partial differential equations - a rough path view*

We study viscosity solutions for a fairly large class of fully nonlinear stochastic PDEs. Those equations can also be viewed as forward path-dependent PDEs and will be treated under a unified framework as rough PDEs. Our definition of viscosity solutions gathers the spirit of the previous notions that use test functions along stochastic characteristics, which are, in our setting, determined by a system of first-order rough differential equations. We show that such a definition is equivalent to the alternative one that uses semi-jets and prove basic properties such as consistency with classical solutions, stability, and a partial comparison principle for fully nonlinear rough PDEs under natural conditions. Furthermore, when the diffusion coefficient is semilinear, we establish a complete theory including (global) existence and a comparison principle by transforming the rough PDE into a standard PDE via the method of characteristics.

Joint work with Rainer Buckdahn, Jin Ma, and Jianfeng Zhang.
Student Arithmetic  
**Wednesday, October 25, 2017, 3:00pm-4:00pm**  
3866 East Hall  
**Gilyoung Cheong (UM)**  
*Using equi-characteristic zeta functions in practice*

Anyone who played with any kind of zeta functions (i.e., some combinatorial generating function) would agree that they are useful in computing some arithmetic invariants. If not, this talk would be an introduction on how to use some zeta functions in practice.

Classical zeta functions such as the Riemann zeta function are of "mixed characteristic", and I will explain what this terminology means. Zeta functions I will focus on are much easier to think about and they are "of equi-characteristic" and I will explain this terminology means. This is an extremely elementary talk, so in theory, anyone who has taken Math 116 and got an A+ should be able to follow most of it.

RTG Seminar on Geometry, Dynamics and Topology  
**Wednesday, October 25, 2017, 4:00pm-5:30pm**  
3866 East Hall  
**Kevin Schreve (U Michigan)**  
*Smith Theory*

If a p-group acts on a manifold or simplicial complex Smith theory compares the homology of the complex with the homology of the fixed point set, and shows that in this sense the fixed set becomes simpler. I will first talk about some exotic group actions, where the fixed point set becomes more complicated with respect to other invariants (such as fundamental group), then try to prove some of beginning theorems in Smith theory, then give some applications.

Algebraic Geometry  
**Wednesday, October 25, 2017, 4:10pm-5:30pm**  
4096 East Hall  
**Dave Anderson (Ohio State)**  
*New formulas for degeneracy loci, and applications to Brill-Noether theory*

A basic problem from the 19th century asks for the degree of the locus of matrices of bounded rank; the answer is given by Giambelli’s determinantal formula. Over the last 25 years, many extensions of this formula have been found, including versions related to classical groups, as well as formulas valid in K-theory or other generalized cohomology theories.

I will describe some of these new formulas, as well as an application: computing the genus of a Brill-Noether variety parametrizing special divisors on a curve. Much of this is joint work with William Fulton, Linda Chen and Nicola Tarasca.
Commutative Algebra  
**Thursday, October 26, 2017, 3:00pm-4:00pm**  
4088 East Hall  
**Javier Carvajal Rojas (University of Utah)**  
*Finite torsors over strongly F-regular singularities*

We will present an extension of the work by K. Schwede, K. Tucker and myself on local etale fundamental groups of (strongly) F-regular singularities. We will discuss the existence of finite torsors over the regular locus of these singularities that do not come from restricting a torsor over the whole spectrum. In the process we will prove that canonical covers of F-regular (resp. F-pure) local rings are F-regular (resp. F-pure), as well as bounding the torsion of: (locally) the Picard group of F-regular singularities and (globally) the divisor class group of globally F-regular varieties.

Differential Equations  
**Thursday, October 26, 2017, 4:00pm-5:00pm**  
4088 East Hall  
**Zaher Hani (Georgia Institute of Technology)**  
*Nonlinear dispersive equations on large domains and wave turbulence*

In this talk, we will be mainly concerned with the following question: Suppose we consider a nonlinear dispersive or wave equation on a large compact domain of characteristic size L. What is the effective dynamics when L is very large? This question is relevant for equations that are naturally posed on large domains (like the water waves equation on the ocean), and in turbulence theories for dispersive equations. It is not hard to see that the answer is intimately related to the particular time scales at which we study the equation, as one often obtains different effective dynamics on different timescales. After discussing some relatively "trivial" time scales (and their corresponding effective dynamics), we shall attempt to access longer times scales and try to describe the effective equations that govern the dynamics there. The ultimate goal is to reach the so-called the "kinematic time scale" over which it is conjectured that the effective dynamics are described by a kinetic equation called the "wave kinetic equation". This is the main claim of wave turbulence theory. We will discuss several results that are aimed at addressing the above problematic for the nonlinear Schrodinger equation. Recent results are joint works with Tristan Buckmaster, Pierre Germain, and Jalal Shatah.
Logic
Thursday, October 26, 2017, 4:00pm-5:30pm
3096 East Hall
David Fernandez-Breton (University of Michigan)
Higher degree versions of the Central Sets Theorem, II

The Central Sets Theorem is a Ramsey-theoretic result due to Furstenberg, from 1981, and multiple generalizations of it (in a variety of different directions) have been proved afterwards (to the best of my knowledge, the currently most general statement is due to De, Hindman and Strauss in 2008, but there are also many relevant results due to Bergelson). This is the second of a series of two talks, where we will explain how to interpret the Central Sets Theorem as a statement about linear polynomials in a polynomial ring with countably many variables, and prove a couple of natural generalizations involving polynomials of higher degree. The main tool that we use in our proof is the algebra of the Cech--Stone compactification (that is, these are "ultrafilter proofs").

Preprint Algebraic Geometry Seminar
Thursday, October 26, 2017, 4:10pm-5:30pm
1866 East Hall
Emanuel Reinecke (UM)
Hodge theory for classifying stacks (following Totaro)


Applied Interdisciplinary Mathematics (AIM)
Friday, October 27, 2017, 3:00pm-4:00pm
1084 East Hall
John Schotland (University of Michigan)
Inverse problems in optical imaging

One of the grand challenges in biomedical science is to develop effective methods for optical imaging. In this talk I will review recent work on related inverse scattering problems for the radiative transport equation and fast image reconstruction algorithms for large data sets. Numerical simulations and experiments in model systems are used to illustrate the results.
Student Representation Theory  
Friday, October 27, 2017, 3:00pm-4:00pm  
1866 East Hall  
Nicholas Wawrykow (University of Michigan)  
*Categorifying quantum sl2*

The action of quantum sl2 on one of its finite dimensional irreducible representations can be lifted to a categorical action on an additive category whose Grothendieck group is the original representation. This action on the categorification lead Frenkel to conjecture that quantum sl2 could be categorified. In 2008, Aaron Lauda verified this conjecture by categorifying quantum sl2 through the cohomology rings of flag varieties. In this talk I will present the Lauda's categorification, which arose from a bilinear pairing on quantum sl2. I will also introduce the diagrams that accompany the resulting 2-category.

Student Algebraic Geometry  
Friday, October 27, 2017, 3:10pm-4:00pm  
3096 East Hall  
Devlin Mallory (UM)  
*Flatness in algebraic geometry*

Flatness, originally introduced by Serre for purely algebraic reasons, has found powerful applications to algebraic geometry; in particular, it turns out flatness gives a suitable notion of a family of algebraic varieties, and thus plays an important role in questions of deformations, moduli spaces, and beyond. In this talk, we'll review the algebraic concept of flatness, and use it to define the flatness of a morphism of algebraic varieties. We'll then sketch some basic examples and properties of flat maps, and explore the ways in which algebraic and geometric data behaves in flat families. In particular, we'll attempt to convince the audience that the somewhat unintuitive notion of flatness actually clarifies, rather than obscures, many geometric questions. The focus will be on examples, intuition, and motivation, rather than on formal proof. The talk will be accessible for students currently in 631.

Arithmetic Geometry Learning Seminar  
Friday, October 27, 2017, 4:00pm-5:30pm  
1866 East Hall  
Matt Stevenson (UM)  
*Uniformization on Drinfeld modular curves*
Combinatorics  
Friday, October 27, 2017, 4:10pm-5:00pm  
4088 East Hall  
Steven Karp (U. Michigan)  
*Topology of totally positive spaces*

Total positivity is the study of spaces and their positive parts. For example, the positive part of the space of $n \times n$ real matrices is formed by those matrices whose every submatrix has positive determinant. Such spaces often have interesting combinatorial properties as well as diverse applications. In this talk, I will discuss two motivations for studying the topology of positive spaces: one comes from poset combinatorics, the other from new developments in high-energy physics. I will then present joint work with Pavel Galashin and Thomas Lam, which shows that the closure of the positive part of a Grassmannian is homeomorphic to a closed ball. The proof exploits the cyclic symmetry of the positive Grassmannian.

Student AIM Seminar  
Friday, October 27, 2017, 4:10pm-5:00pm  
1084 East Hall  
Andrew Melfi (University of Michigan)  
*An introduction to coalescent theory*

Since the success of the human genome project in sequencing the entire human genome in 2003, the costs associated with sequencing have fallen dramatically. In the last 10 years they have outpaced Moore’s law (a decrease in cost of a factor of 2 every 2 years). As a result, methods from the originally highly theoretical field of population genetics can be verified and applied to real world populations to make inferences about population structures, selection, recombination rates, etc.

In this talk, I will introduce the site frequency spectrum, or SFS (the distribution of allele frequencies for a set of genetic loci). I will then introduce two models which can be used to generate an expected SFS, the Wright-Fisher model and Kingman's coalescent. I will discuss the benefits and drawbacks to both models as well as the coalescent's ability to approximate Wright-Fisher. Time permitting, I will then discuss a basic case of Ewens' sampling formula and its proof.

This talk will be accessible to all graduate students.