### Weekly Seminar & Events Bulletin
January 7th, 2018 - January 13th, 2018

<table>
<thead>
<tr>
<th>Date</th>
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<tr>
<td>Monday, January 08, 2018</td>
<td>12:00pm-1:00pm</td>
<td><strong>Mathematical Biology</strong> -- Justin Eilertsen (UM Physiology) Geometric singular perturbation theory and the mathematical description of enzyme kinetics -- 335 West Hall</td>
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<td><strong>Differential Equations</strong> -- Sung-Jin Oh (Korea Institute for Advanced Study (KIAS), Seoul, South Korea) The Threshold Theorem for the hyperbolic Yang-Mills equation -- 3088 East Hall</td>
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<td><strong>Integrable Systems and Random Matrix Theory</strong> -- () Organizational meeting -- 1866 East Hall</td>
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<td><strong>Group, Lie and Number Theory</strong> -- Qirui Li (Columbia University) Intersection number formula on Lubin-Tate spaces (Note special day and room) -- 4096 East Hall</td>
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<td><strong>Applied Interdisciplinary Mathematics (AIM)</strong> -- Fernanda Valdivinos (University of Michigan) How can nonlinear dynamics and complex networks help us save our planet? -- 1084 East Hall</td>
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<td><strong>Student Algebraic Geometry</strong> -- Matt Stevenson (UM) Curves defined over the algebraic numbers, Belyi's theorem, and les dessins d'enfants. -- 3096 East Hall</td>
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<td><strong>Student AIM Seminar</strong> -- Alexander Zaitzeff (University of Michigan) Convolutional Neural Networks: Deep Learning on Images -- 1084 East Hall</td>
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Mathematical Biology
Monday, January 08, 2018, 12:00pm-1:00pm
335 West Hall
Justin Eilertsen (UM Physiology)

Geometric singular perturbation theory and the mathematical description of enzyme kinetics

Due to the prevalence of fast and slow timescales in enzyme-catalyzed reactions, geometric singular perturbation theory (GSPT) plays a pivotal role in the mathematical illustration of enzyme kinetics. I'll begin the talk by reviewing some of the earlier work that characterizes single-enzyme/single-substrate (SE/SS) reactions. At the same time, I'll introduce some of the principal theorems of GSPT and demonstrate their applicability to SE/SS reactions. Finally, I'll conclude with a description of my current work on coupled reactions. Coupled reactions generally consist of multiple fast timescales and multiple slow timescales; thus, they serve as a novel platform from which to study the applicability of GSPT in higher dimensional dynamical systems.

Differential Equations
Monday, January 08, 2018, 4:00pm-5:00pm
3088 East Hall
Sung-Jin Oh (Korea Institute for Advanced Study (KIAS), Seoul, South Korea)

The Threshold Theorem for the hyperbolic Yang-Mills equation

In this lecture, I will present the recent proof (joint with D. Tataru) of the Threshold Theorem for the energy critical hyperbolic Yang-Mills equation in (4+1) dimensions. This theorem provides a sharp criterion for global existence and scattering in terms of the energy of the initial data. Moreover, we prove that failure of global existence/scattering is characterized by "bubbling" of a solution to the harmonic Yang-Mills equation.

Our proof lies at the intersection of many recent developments, such as null form estimates and function spaces; parametrix construction via pseudodifferential gauge renormalization; induction on energy; monotonicity formulae arising from the normalized scaling vector field etc. Also of note is the use of the associated parabolic flow, namely the Yang-Mills heat flow, to construct a high quality global gauge (called the caloric gauge), extending the idea of Tao for the harmonic map heat flow.

Integrable Systems and Random Matrix Theory
Monday, January 08, 2018, 4:00pm-5:00pm
1866 East Hall

Organizational meeting
Student Combinatorics Seminar  
Monday, January 08, 2018, 4:00pm-5:00pm  
3866 East Hall  

Planning Meeting

We will brainstorm and vote for topics for this semester. There will be cookies!

Student Geometry/Topology  
Tuesday, January 09, 2018, 3:00pm-4:00pm  
3866 East Hall  

Organizational meeting

Student Representation Theory  
Tuesday, January 09, 2018, 3:00pm-4:00pm  
1866 East Hall  
Jacob Haley (University of Michigan)  
Nilpotent Orbits in Semisimple Lie Algebras

An algebraic group or Lie group G acts on itself by conjugation and, after taking differentials, descends to an action on the Lie algebra called the adjoint representation of G. The orbits of nilpotent elements under this action turn out to be of interest in several areas of representation theory. In this talk, we will first discuss how the representation theory of sl_2 can be used to classify nilpotent orbits. Then we will discuss the Springer correspondence, which relates nilpotent orbits to representations of Coxeter groups. Finally, we will briefly discuss orbital integrals and their connections to representation theory, with an emphasis on the special role played by nilpotent orbital integrals.

Student Arithmetic  
Wednesday, January 10, 2018, 3:00pm-4:00pm  
1866 East Hall  

Planning Meeting
Financial/Actuarial Mathematics  
**Wednesday, January 10, 2018, 4:00pm-5:00pm**  
1360 East Hall  
Ibrahim Ekren (UM)  
*A dynamic equilibrium model for brokerage fees*

We develop a dynamic equilibrium model for market liquidity. To wit, we solve for the equilibrium prices at which liquidity takers’ demands are absorbed by liquidity providers, who can in turn gradually transfer these positions to a group of end users.

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**RTG Seminar on Geometry, Dynamics and Topology**  
**Wednesday, January 10, 2018, 4:00pm-5:30pm**  
3866 East Hall  
Sarah Koch (U(M))  
*Rational maps and Kleinian groups: overview and organizational meeting*

Over the next month, the RTG group will discuss the Sullivan Dictionary between rational maps and Kleinian groups. This will be an organizational meeting where we first present an overview of the topics involved and then decide on upcoming presentations for the weeks that follow.

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**Group, Lie and Number Theory**  
**Wednesday, January 10, 2018, 4:10pm-5:30pm**  
4096 East Hall  
Qirui Li (Columbia University)  
*Intersection number formula on Lubin-Tate spaces (Note special day and room)*

We consider a moduli space classifying deformations of a formal module over the algebraic closure of the finite field $F_q$. Those spaces are called Lubin Tate deformation spaces. We will construct some CM cycles on this space. By adding Drinfeld level structures, we proved a formula for the intersection number between these CM cycles. As an application, this formula gives a new proof of Keating's results on endomorphism lifting problems for formal modules over the algebraic closure of $F_q$.

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**Commutative Algebra**  
**Thursday, January 11, 2018, 4:00pm-5:00pm**  
3866 East Hall  
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*No seminar -- JMM*
Representation Stability  
Thursday, January 11, 2018, 5:00pm-6:00pm  
3866 East Hall  
Snowden Andrew (University of Michigan)  
*Stability in the homology of unipotent groups*

Applied Interdisciplinary Mathematics (AIM)  
Friday, January 12, 2018, 3:00pm-4:00pm  
1084 East Hall  
Fernanda Valdovinos (University of Michigan)  
*How can nonlinear dynamics and complex networks help us save our planet?*  
This seminar will provide the state of the art of how Ecology uses Nonlinear Dynamics and Complex Networks to better understand the rules behind the function of terrestrial, aquatic and marine ecosystems and predict their responses to current and future environmental crises. It will start with a brief overview of the evolution of ecological modelling from linear to nonlinear dynamics and from random to non-random network structures, followed by a description of the cutting-edge nonlinear models of complex ecological networks. I will present two main applications: 1) Impacts of overfishing on marine food-webs and 2) Impacts of species extinctions and invasions on pollination systems. I will finish explaining how these more mechanistic models stimulate fruitful interaction between empirical and theoretical research, while generating new challenges and opportunities for sensitivity analyses and predictability.

Student Algebraic Geometry  
Friday, January 12, 2018, 3:10pm-4:00pm  
3096 East Hall  
Matt Stevenson (UM)  
*Curves defined over the algebraic numbers, Belyi’s theorem, and les dessins d’enfants.*  
In the study of smooth, projective curves over the complex numbers, a natural arithmetic question arises: which such curves are defined over the algebraic numbers? Said differently, which such curves are cut out by homogeneous polynomials with coefficients in some number field?

A fantastic result of Belyi asserts that there is a purely algebro-geometric criterion for this arithmetic problem and, in addition, it can be rephrased purely in terms of combinatorial objects (known as un dessin d’enfants).

Our goal is to describe the relationship between the arithmetic, algebro-geometric, and combinatorial facets of this problem (largely through examples), and explain some of the ideas behind Belyi’s theorem. This talk will be accessible to anyone who has taken 631.
**Student AIM Seminar**  
**Friday, January 12, 2018, 4:10pm-5:00pm**  
1084 East Hall  
**Alexander Zaitzeff (University of Michigan)**  
*Convolutional Neural Networks: Deep Learning on Images*

Convolutions Neural Networks (CNNs) have taken the computer vision community by storm. The mathematical ideas behind them are quite simple and beautiful. In this talk I will present the basics of CNNs as well as a couple applications including to my own research in material science.

**Combinatorics**  
**Friday, January 12, 2018, 4:10pm-5:00pm**  
4088 East Hall  
**Hailun Zheng (University of Michigan)**  
*A lower bound theorem for centrally symmetric simplicial polytopes*

An important invariant in the study of face numbers of simplicial d-polytopes is the g-vector. The generalized lower bound theorem states that $g_i$ is nonnegative for any simplicial polytope and characterizes the case of equality. Much less is known for centrally symmetric polytopes. A seminal work is established by Stanley thirty years ago, where he proved that for any centrally symmetric simplicial d-polytope $P$ with $d$ at least 3 and $i$ between 1 and $d/2$, we have $g_{-i}(P) \geq \binom{d}{i}-\binom{d}{i-1}$.

In this talk, I will introduce the rigidity theory of frameworks, and show how to apply this machinery to give a characterization of centrally symmetric d-polytopes with which satisfy $g_2=\binom{d}{2}-d$. This is joint work with Steve Klee, Eran Nevo and Isabella Novik.