### Weekly Seminar & Events Bulletin

**September 8th, 2019 - September 14th, 2019**

**Monday, September 09, 2019**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>12:00pm-12:50pm</td>
<td><strong>Mathematical Biology</strong> -- Jae Kyoung Kim (Dept of Mathematical Sciences, KAIST, Korea) <em>Timeseries analysis of stochastic systems with hidden components</em> -- 335 West Hall</td>
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<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Student Combinatorics</strong> -- () <strong>Student Combinatorics Planning Meeting</strong> -- 3096 East Hall</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Student Dynamics</strong> -- () <strong>Planning Meeting</strong> -- 3866 East Hall</td>
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<td>4:00pm-5:00pm</td>
<td><strong>Complex Analysis, Dynamics and Geometry</strong> -- Mikhail Hlushchanka (UCLA) <em>Invariant graphs and their applications in complex dynamics</em> -- 3866 East Hall</td>
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<td>4:00pm-5:00pm</td>
<td><strong>Integrable Systems and Random Matrix Theory</strong> -- Guilherme Silva (University of Michigan) <em>Spectral curves and variational problems - an update</em> -- 1866 East Hall</td>
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<td>5:00pm-6:00pm</td>
<td><strong>Operators in Complex Analysis</strong> -- Debraj Chakrabarti (Central Michigan University) <em>An Alexander-Pontrjagin type duality in the $\mathcal{L}^2$ theory of the $\overline{\partial}$-operator.</em> -- 3096 East Hall</td>
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**Tuesday, September 10, 2019**

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<td>11:30am-1:00pm</td>
<td><strong>Teaching Mathematics</strong> -- LCIT <em>Discussion</em> () <strong>Learning Community on Inclusive Teaching Discussion</strong> -- 4866 East Hall</td>
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<td><strong>Student Commutative Algebra</strong> -- Farrah Yhee (University of Michigan) <strong>Planning Meeting</strong> -- 4088 East Hall</td>
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<td><strong>Student Geometry/Topology</strong> -- () <strong>Planning Meeting</strong> -- 3866 East Hall</td>
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<td><strong>Algebraic Geometry</strong> -- Emanuel Reinecke (UM) <em>The cohomology of moduli spaces of curves at infinite level</em> -- 4096 East Hall</td>
</tr>
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<td>4:00pm-5:30pm</td>
<td><strong>RTG Seminar on Geometry, Dynamics and Topology</strong> -- Thang Nguyen (U Michigan) <em>Ricci curvature for graphs and groups</em> -- 3866 East Hall</td>
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**Thursday, September 12, 2019**

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<td><strong>Arithmetic Geometry Learning</strong> -- Bhargav Bhatt (UM) <em>Introduction to Condensed Mathematics</em> -- 4096 East Hall</td>
</tr>
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<td>4:00pm-5:00pm</td>
<td><strong>Differential Equations</strong> -- Tarek Elgindi (UC San Diego) <em>Singularity formation for some Euler flows</em> -- 4088 East Hall</td>
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**Friday, September 13, 2019**

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<td><strong>Combinatorics</strong> -- Brendon Rhoades (UC San Diego) <em>Spanning subspace configurations</em> -- 4096 East Hall</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Applied Interdisciplinary Mathematics (AIM)</strong> -- Evgueni Filipov (Civil and Environmental Engineering, UM) <em>Simulating elasticity and contact in origami-inspired structures</em> -- 1084 East Hall</td>
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<td><strong>Geometry</strong> -- Jeffrey Meyer (CSUSB) <em>Systole Growth Up Congruence Covers</em> -- 3866 East Hall</td>
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Mathematical Biology  
Monday, September 09, 2019, 12:00pm-12:50pm  
335 West Hall  
Jae Kyoung Kim (Dept of Mathematical Sciences, KAIST, Korea)  
*Timeseries analysis of stochastic systems with hidden components*

Despite dramatic advances in experimental techniques, many facets of intracellular dynamics remain hidden, or can be measured only indirectly. In this talk, I will describe two strategies to analyze stochastic timeseries data from biological systems with hidden parts: replacement of multi-step process with a time delay distribution or quasi-steady-state. Then, I will illustrate how these strategies are applied to understand the processes of protein synthesis, which involves multiple steps such as transcription, translation, folding and maturation, but typically whose intermediates proteins cannot be measured. Furthermore, drugs are also cleared out from our body in multiple steps of metabolism. To estimate the rate of drug clearance, which is a critical factor determining the dose level, a canonical approach has been used in more than 65,000 published papers for last 30 years. I will point out the critical limitation of the canonical approach and propose an alternative approach, which leads to accurate and precise estimation of drug clearance rate.

Student Combinatorics  
Monday, September 09, 2019, 3:00pm-4:00pm  
3096 East Hall  
()  
*Student Combinatorics Planning Meeting*

Come help brainstorm topics and sign up for talks for the Student Combinatorics Seminar this semester! There will be snacks too!

Student Dynamics  
Monday, September 09, 2019, 3:00pm-4:00pm  
3866 East Hall  
()  
*Planning Meeting*
Invariant graphs and curves appear naturally in various aspects of complex dynamics. For instance, Hubbard trees are used to classify all postcritically finite polynomials, while Thurston obstructions, which are certain invariant multicurves, appear in the celebrated Thurston characterization of rational maps. Concentrating on specific families of postcritically finite rational maps, I will discuss how invariant graphs can be used to analyze dynamics of simple closed curves under the pullback by the map as well as algebraic properties (such as growth and amenability) of the associated iterated monodromy groups.

Integrable Systems and Random Matrix Theory
Monday, September 09, 2019, 4:00pm-5:00pm
1866 East Hall
Guilherme Silva (University of Michigan)
Spectral curves and variational problems - an update

In this talk, we will consider a hermitian matrix model with external source, discussing the connection between this model, a class of algebraic curves (a.k.a. spectral curves) and a variational problem that describes the limiting eigenvalue distribution of the matrix model.

This was already the topic of a seminar during the last term, and we start reviewing what was then discussed. As the novelty for this talk, we discuss how some simple ideas from integrable systems can be used to rigorously prove the existence of a spectral curve for matrices of finite size. Further imposing some natural conditions on the underlying recurrence coefficients, we can thus extract a large matrix size limit of this spectral curve, with a structure fine enough to provide a variational problem for the limiting eigenvalue distribution of the matrix model, connecting back to the topics from the previous talk.
Operators in Complex Analysis  
Monday, September 09, 2019, 5:00pm-6:00pm  
3096 East Hall  
Debraj Chakrabarti (Central Michigan University)  
An Alexander-Pontrjagin type duality in the $L^2$ theory of the $\overline{\partial}$-operator.  

Hörmander's $L^2$ estimates on the $\overline{\partial}$-equation on bounded pseudoconvex domains is a cornerstone of modern complex analysis. Subsequently, attempts were made by Folland-Kohn, Mei-Chi Shaw, Hörmander and others to extend these $L^2$ methods to appropriate classes of nonpseudoconvex domains. In this talk, we discuss an approach to the $\overline{\partial}$-problem on an annulus between two weakly pseudoconvex domains which is inspired by Alexander-Pontrjagin duality in topology. This is ongoing joint work with Phil Harrington of Arkansas.

Student Analysis  
Monday, September 09, 2019, 5:00pm-6:00pm  
2866 East Hall  

Planning Meeting  

This seminar is open to math graduate students at all levels. In our planning meeting, we will decide which analysis topics to focus on this semester. Are there particular things that you would like to learn and/or present to the group? Come share your ideas (and enjoy free snacks)! Topics that have been suggested thus far are random matrix theory, PDEs, complex analysis, and anything else that you are interested in. First year students are especially encouraged to participate!

Teaching Mathematics  
Tuesday, September 10, 2019, 11:30am-1:00pm  
4866 East Hall  

LCIT Discussion ()  

Learning Community on Inclusive Teaching Discussion  

In this meeting of the LCIT we will discuss the readings Living Proof (Henrich, Lawrence, Pons, Taylor, eds.; MAA Press), focusing on Part II; and the article "Want to Reach All of Your Students? Here’s How to Make Your Teaching More Inclusive" (Chronicle of Higher Education). Details about the Learning Community may be found at http://www.math.lsa.umich.edu/~glarose/dept/teaching/lcit.html.
Student Commutative Algebra  
**Tuesday, September 10, 2019, 3:00pm-3:50pm**  
4088 East Hall  
Farrah Yhee (University of Michigan)  
*Planning Meeting*

This will be a planning meeting where we draft a tentative schedule of talks for the fall semester. If you have any topics in or related to Commutative Algebra you are interested in hearing about and/or are interested in giving a talk, please come to our planning meeting!

First-year students are highly encouraged to attend! We try very hard to make seminar talks accessible and interesting to graduate students at all levels. There will also be cookies (or other baked goods) and tea at each talk, so if you want to chill out, eat some cookies, and hear about some cool math, please come to our seminar!

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Student Geometry/Topology  
**Tuesday, September 10, 2019, 3:00pm-4:00pm**  
3866 East Hall  
*Planning Meeting*

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Student Arithmetic  
**Wednesday, September 11, 2019, 3:00pm-4:00pm**  
3866 East Hall  
*Planning meeting*

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Algebraic Geometry  
**Wednesday, September 11, 2019, 4:00pm-5:30pm**  
4096 East Hall  
Emanuel Reinecke (UM)  
*The cohomology of moduli spaces of curves at infinite level*

By work of Harer, the Betti cohomology of the moduli space of smooth, complex curves of genus $g > 1$ vanishes in degrees above $4g-5$. In my talk, I give a new perspective on this result which is inspired by recent developments in p-adic geometry. The approach also yields statements about moduli of stable curves and curves of compact type that are not covered by Harer’s methods.
RTG Seminar on Geometry, Dynamics and Topology  
**Wednesday, September 11, 2019, 4:00pm-5:30pm**  
3866 East Hall  
**Thang Nguyen (U Michigan)**  
*Ricci curvature for graphs and groups*

Ricci curvature on Riemannian manifolds has been well studied while there is no satisfied parallel notion for graphs or more general metric spaces. There are curvature notions defined on graphs by Ollivier, and on finitely generated groups by Bar-Natan - Duchin - Kropholler, which behaves like Ricci curvature in many senses. In this talk, I will explain the notions, some examples, some analog results, and some unanswered questions. No advanced background knowledge is needed.

**Commutative Algebra**  
**Thursday, September 12, 2019, 3:00pm-4:00pm**  
4088 East Hall  
**Eamon Quinlan (University of Michigan)**  
*Bernstein-Sato theory in positive characteristic*

**Arithmetic Geometry Learning**  
**Thursday, September 12, 2019, 4:00pm-5:30pm**  
4096 East Hall  
**Bhargav Bhatt (UM)**  
*Introduction to Condensed Mathematics*

The topic for this semester is "Condensed mathematics" following Clausen-Scholze. Our main goal is to develop the 6 functor formalism for coherent cohomology in algebraic geometry, culminating in a local (!) proof of Serre duality and finiteness of coherent cohomology. The primary source is https://www.math.uni-bonn.de/people/scholze/Condensed.pdf.

The first talk will have dual purposes: we'll see an introduction to condensed mathematics, and we'll also divide up talks for the rest of the semester.
We will discuss a recent construction of self-similar blow-up for $C^{1,a}$ solutions to the incompressible Euler equation for small $a>0$. This is done by isolating a simple non-linear equation that encodes the leading order dynamics of solutions to the Euler equation in certain regimes. The model also has explicit stable self-similar solutions. The self-similar solutions to the Euler equation also turn out to be stable with respect to certain perturbations. This allows us to deduce finite-time singularity formation for localized (finite-energy) $C^{1,a}$ solutions. A part of what we will discuss is joint work with T. Ghoul and N. Masmoudi.

Let $V$ be a finite-dimensional complex vector space. A tuple $(W_1, \ldots, W_n)$ of subspaces of $V$ is a spanning configuration if $W_1 + \cdots + W_n = V$ as vector spaces. We present the cohomology of the moduli space of spanning configurations with a fixed dimension vector and describe a relationship between our work and the \textit{Delta Conjecture} of symmetric function theory. Joint with Brendan Pawlowski.
Applied Interdisciplinary Mathematics (AIM)
Friday, September 13, 2019, 3:00pm-4:00pm
1084 East Hall
Evgueni Filipov (Civil and Environmental Engineering, UM)
Simulating elasticity and contact in origami-inspired structures

Thin sheets folded into origami can create a rich variety of deployable, reconfigurable, and adaptable three-dimensional structures. The principles can be used in practical applications ranging from metamaterials and biomedical micro-robotics, to large-scale deployable architecture. This talk will present my group’s work in creating mechanics based numerical models for simulating and designing origami-inspired structures at multiple scales. The models are computationally efficient because they use a simplified bar and hinge framework to capture the geometry of the origami, yet they are capable of simulating kinematics, elastic deformations, multi-stability, stiffness properties, and contact in the structures. Capturing contact within the origami is especially important because contact can interfere with the folding kinematics, and can change the mechanical characteristics of the structures. Finally, the talk will present scenarios of how we apply these analytical tools. For example, simulating the self-assembly of micro-robots, evaluating the high stiffness-to-weight ratio in origami tubes, and capturing the complex stiffness anisotropy in origami with curved creases.

Geometry
Friday, September 13, 2019, 4:00pm-5:00pm
3866 East Hall
Jeffrey Meyer (CSUSB)
Systole Growth Up Congruence Covers

The systole of a closed hyperbolic manifold is the minimal length of a nontrivial closed geodesic. The systole of such a manifold says something deep about how symmetric, and conversely how pinched, the manifold is. Question: How does the systole grow up a tower of covers? For an arithmetic hyperbolic manifold and its covers, the systole can be analyzed using number theoretic techniques. In this talk, I will outline the history of the problem, the relevant connections between hyperbolic geometry and number theory, and then discuss recent joint work with Benjamin Linowitz and Sara Lapan in which we show that for all arithmetic hyperbolic manifolds, the systole growth up a p-congruence tower is at least logarithmic in volume. This result adds to the heuristic that, in some sense, congruence covers are the most symmetric of covers. In particular, this result can be understood as a sort of dual to the result that the Cheeger constant up a p-congruence tower is uniformly bounded from below.

Preprint Algebraic Geometry
Friday, September 13, 2019, 4:00pm-5:30pm
2866 East Hall

Organizational meeting