# Weekly Seminar & Events Bulletin

**September 16th, 2018 - September 22nd, 2018**

## Monday, September 17, 2018

<table>
<thead>
<tr>
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<td>3:00pm-4:00pm</td>
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<td><strong>Complex Analysis, Dynamics and Geometry</strong> -- Linda Keen (CUNY) <em>Cycle Doubling, Merging And Renormalization in the Tangent Family</em> -- 3088 East Hall</td>
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<td><strong>Geometry &amp; Physics</strong> -- Xin Wang (Columbia/Michigan) <em>Modularity properties for twisted Gromov-Witten theory: some examples</em> -- 4096 East Hall</td>
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<td>4:00pm-5:00pm</td>
<td><strong>Student Combinatorics</strong> -- Francesca Gandini (University of Michigan) <em>Subspace Arrangements</em> -- 3866 East Hall</td>
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<td><strong>Student Geometry/Topology</strong> -- Harry Richman (University of Michigan) <em>A brief tour of outer space</em> -- 1866 East Hall</td>
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<td>3:00pm-3:50pm</td>
<td><strong>Student Commutative Algebra</strong> -- Robert Walker (University of Michigan) <em>Intro to Tight Closure</em> -- 4088 East Hall</td>
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<td>4:00pm-5:00pm</td>
<td><strong>Colloquium Series</strong> -- Yongbin Ruan (University of Michigan) <em>Counting holomorphic curves in Calabi-Yau 3-folds</em> -- 1360 East Hall</td>
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## Wednesday, September 19, 2018

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<td>1:00pm-2:30pm</td>
<td><strong>Student Homotopy Theory</strong> -- Ruian Chen (University of Michigan) <em>Kan spectra and Kan spectral sheaves</em> -- 2866 East Hall</td>
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<td><strong>Topology</strong> -- Rita Gitik () <em>On Tame Subgroups of Finitely Presented Groups</em> -- 3088 East Hall</td>
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<td><strong>Student AIM Seminar</strong> -- Alexander Zaitzeff (University of Michigan) <em>Mean curvature motion and application to image segmentation</em> -- 1084 East Hall</td>
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<td>4:00pm-5:00pm</td>
<td><strong>Special Events</strong> -- Ivo D Dinov (University of Michigan) <em>MIDAS Seminar - The Enigmatic Kime: Time Complexity in Data Science</em> -- Low Rise, Room 182 Weiser Hall</td>
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<tr>
<td>5:00pm-6:00pm</td>
<td><strong>Student Machine Learning</strong> -- Rishi Sonthalia (University of Michigan) <em>Natural Language Processing 1</em> -- 4088 East Hall</td>
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Student Dynamics
Monday, September 17, 2018, 3:00pm-4:00pm
1060 East Hall
Salman Siddiqi (University of Michigan)

How many geodesics are there?

I'll give an overview of a dynamical approach to (asymptotically) counting the number of closed geodesics on a closed surface of negative curvature. This talk will be generally accessible, though some knowledge of basic differential geometry will be assumed.

Complex Analysis, Dynamics and Geometry
Monday, September 17, 2018, 4:00pm-5:00pm
3088 East Hall
Linda Keen (CUNY)

Cycle Doubling, Merging And Renormalization in the Tangent Family

In this talk, based on joint work with Tao Chen and Yunping Jiang, we study the transition to chaos for the restriction to the real and imaginary axes of the tangent family $z \mapsto it\tan z$. Because tangent maps have no critical points but have an essential singularity at infinity and two symmetric asymptotic values, there are new phenomena: as $t$ increases, in addition to standard "period doubling", we find "period merging" where two attracting cycles of period $2n$ "merge" into one attracting cycle of period $2n+1$, and "cycle doubling" where an attracting cycle of period $2n+1$ "becomes" two attracting cycles of the same period. Describing these new phenomena involves adapting the concepts of "renormalization" and "holomorphic motions" to our context. The parameters where these bifurcations occur limit at an "infinitely renormalizable" tangent map with a "strange attractor" that has a Cantor set structure.
Integrable Systems and Random Matrix Theory  
Monday, September 17, 2018, 4:00pm-5:00pm  
1866 East Hall  
Zhipeng Liu (University of Kansas)  
Multi-point distribution of periodic TASEP with general initial condition

The height fluctuations of the models in the KPZ class are expected to converge to a universal process. The spatial process at an equal time is known to converge to the Airy process or its variations. However, the temporal process, or more generally the two-dimensional space-time fluctuation field, is less well understood. We consider this question for the periodic TASEP (totally asymmetric simple exclusion process). We evaluate the multi-time and multi-location distribution explicitly in terms of a multiple-integral involving a Fredholm determinant. With some assumptions on the initial condition, we evaluate the large time limit in the so-called relaxation time scale. This is joint with Jinho Baik.

Group, Lie and Number Theory  
Monday, September 17, 2018, 4:00pm-5:20pm  
4088 East Hall  
Michal Zydor (University of Michigan)  
Periods and special values of L-functions

Periods of automorphic forms play a big role in number theory through their link with special values of L-functions. Many important examples have been discovered, but it was only recently that Sakellaridis and Venkatesh proposed a general framework to explain this phenomenon. In this talk I will discuss some known periods as well as new examples of automorphic periods that arise from studying the conjectures of Sakellaridis and Venkatesh. This is a joint work with Aaron Pollack and Chen Wan.

Geometry & Physics  
Monday, September 17, 2018, 4:00pm-6:00pm  
4096 East Hall  
Xin Wang (Columbia/Michigan)  
Modularity properties for twisted Gromov-Witten theory: some examples

In this talk, I will prove the quasi modularity properties satisfied by several twisted Gromov-Witten theory of Calabi-Yau type. In particular, we focus on some interesting examples.
Subspace arrangements are objects easy to define but that can be studied from several points of view. From the combinatorics side, they lead to the study of polymatroids. Algebraically, one can define the idea of a subspace arrangement. A result of Derksen and Sidman gives us a resolution for J and allows us to study it homologically. When we apply the "tensor trick" to the ideal J, we obtain a new ideal J(W) with an action of the general linear group. So J(W) can be studied using techniques from representation theory. If time allows, we will introduce a functor on polynomials functors that produces a new ideal J(W)' which lies in the exterior algebra but has similar homological properties to J(W).

IBL Workshops/Lectures
Tuesday, September 18, 2018, 11:30am-1:00pm
4866 East Hall

IBL Lunch

IBL lunch from 11:30am to 1:00pm. It will take place in the faculty lounge (4866 EH), and you should feel free to come for any length of time. Lunch will be provided.

Student Geometry/Topology
Tuesday, September 18, 2018, 3:00pm-4:00pm
1866 East Hall
Harry Richman (University of Michigan)

A brief tour of outer space

“Outer space” is a 1-dimensional analogue of Teichmuller space where instead of studying metrics on surfaces we consider metrics on graphs. This space has a natural quotient which is the moduli space of tropical curves. I will introduce the basics of outer space roughly following Brad's talk last week, emphasizing examples.
The goal of this talk is to cover enough background to discuss an example of a Noetherian ring of prime characteristic whose tight closure ideal is smaller than its integral closure ideal. As time allows, we may discuss some signature properties that lend tight closure theory a lot of its power in applications in commutative algebra and algebraic geometry. We may also discuss by example how problems for which positive characteristic methods lend (possibly partial) tight proofs have analogues that are open for rings of mixed characteristic.

Counting holomorphic curves in algebraic varieties is an ancient subject of algebraic geometry under the name of enumerative algebraic geometry. Thirty years ago, it appeared in physics as a key physical invariant in so-called topological string. Since then, there has been a tremendous amount of effort to compute them by both mathematician and physicists. The genus zero computation in 90's leaded to the birth of mirror symmetry as a mathematical subject. However, the computation in higher genus turns out to be one of most difficult problems in geometry and physics. For the quintic 3-fold (simplest example of Calabi-Yau 3-fold), our knowledge stops at genus one despite of many hard work during last twenty years. Nevertheless, physicist have proposed a zoo of incredible conjectures for both the structure and explicit formula. Working with a group of talented young mathematician, we made a breakthrough on the problem recently. I will give an overview of the program in the talk.
Student Arithmetic  
**Wednesday, September 19, 2018, 3:00pm-3:50pm**  
4096 East Hall  
Angus Chung (University of Michigan)  
*Function Field Analogy*

There is an old saying that it is easier to work on function fields than on number fields. A very hot research direction in number theory is to translate hard problems over number fields to function fields, and the problems generally become easier. It is then worthwhile to understand some basics of the number field - function field analogy, so as to have a glimpse on this growing area of research.

Classically, the easiest function field analogy of the Riemann zeta function is the Hasse-Weil zeta function, a complex meromorphic function encoding number of points of a curve over finite fields. In recent years, another type of analogy arises, which investigates objects called Carlitz modules and Drinfeld modules, as well as L-functions defined on them.

In this talk, we will discuss some simple analogies between number fields and function fields. We will first review basic interesting properties of Riemann zeta function. Then We will see what analogies we can say on function field, for both the Hasse-Weil zeta function and the Carlitz zeta function. This talk does not assume knowledge in number theory or algebraic geometry, though we may use some complex analysis.

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Financial/Actuarial Mathematics  
**Wednesday, September 19, 2018, 4:00pm-5:00pm**  
1360 East Hall  
Martin Herdegen (Warwick)  
*Equilibrium asset pricing with transaction costs*

We study the impact of quadratic transaction costs on risk-sharing economies. Mathematically, this leads to coupled systems of forward backward stochastic differential equations (FBSDEs), which are linear in the case of exogenous volatility and quadratic in the case of endogenous volatility. We address the existence, uniqueness, and characterization of equilibria in this context. In particular, we discuss the effects trading costs have on equilibrium asset prices and their dynamics. The talk is based on joint works with Bruno Bouchard, Masaaki Fukasawa, Johannes Muhle-Karbe, and Dylan Possamai.
RTG Seminar on Geometry, Dynamics and Topology  
Wednesday, September 19, 2018, 4:00pm-5:30pm  
3866 East Hall  
Alex Wright (U(M))  
*The moduli space of spatial polygons*

This will be a continuation of last week's talk.

Abstract of last week's talk: Consider a polygon in $\mathbb{R}^3$. We will explore the moduli space of deformations of this polygon that keep the lengths of the edges constant. The deformations are considered up to orientation preserving isometries of $\mathbb{R}^3$. Over several lectures, we'll reveal that these moduli spaces are typically Kahler manifolds that are morally and literally related to moduli spaces of Riemann surfaces. We'll study their symplectic geometry, as well Euler classes of natural circle bundles over them, and we'll see that they are isomorphic to seemingly more sophisticated moduli spaces. Prerequisites will be kept to a minimum. One of the many motivations is that these moduli spaces provide an elementary and friendly setting to first encounter a number of important ideas useful all over mathematics. The first talk will begin with hands on exercise using polygons made of straws and string; come by my office (East Hall 5848) if you’d like to borrow a polygon to play with ahead of time. Rough notes are available at:  
https://www.dropbox.com/s/4eiq97tf54tqx19/polygons%20stable.pdf?dl=0

Algebraic Geometry  
Wednesday, September 19, 2018, 4:00pm-5:20pm  
4096 East Hall  
Tim Ryan (Stony Brook)  
*The birational geometry of (nested) Hilbert schemes of points on surfaces*

Hilbert schemes of points on surfaces are some of the most classically studied varieties in algebraic geometry and have also proven to be important objects in representation theory, combinatorics, and symplectic geometry. In this talk, I will introduce (nested) Hilbert schemes and cover the relevant background material from birational geometry. Then, I will focus on two results: the computation of the class of Severi divisors in the Hilbert scheme and the computation of the ample cone of the nested Hilbert scheme including an application to syzygies.
Kan spectra are a stabilization of simplicial sets, just as May spectra are of spaces, and they both provide "point-set" level models for the stable homotopy category. Moreover, being the Eckmann-Hilton dual of May spectra, Kan spectra admit a co-localization (rather than a localization) with respect to naive homotopy equivalences and weak equivalences; this makes possible a fully functional sheaf theory on Kan spectra.

In this talk, we will define Kan spectra, construct a homotopy theory on the category of Kan spectra and their sheaves, and prove that these categories admit co-localization. We will see that the right-derivability criteria boil down to preservation of naive homotopy, and that right derived functors can be constructed and computed via the Godement resolution. In particular, we can construct "higher" direct images functors $Rf_*$, including generalized sheaf cohomology, as well as $Rf_!$, via Kan spectral sheaves.

Topology
Thursday, September 20, 2018, 3:00pm-4:00pm
3088 East Hall
Rita Gitik ()
On Tame Subgroups of Finitely Presented Groups

We describe several examples of tame subgroups of finitely presented groups and prove that the fundamental groups of certain finite graphs of groups are locally tame.

Commutative Algebra
Thursday, September 20, 2018, 3:00pm-4:00pm
4088 East Hall
Mel Hochster (University of Michigan)
A survey of recent breakthroughs and remaining conjectures

This is the first of two talks that will discuss recent progress on the direct summand conjecture, existence of big Cohen-Macaulay modules and algebras, the local homological conjectures more generally, Stillman's conjecture, the Eisenbud-Goto conjecture, and the Buchsbaum-Eisembud-Horrocks conjecture. I will present what is known, and, in each case, a substantial question or set of questions that remains open.
**Student Algebraic Geometry**  
**Thursday, September 20, 2018, 4:00pm-5:00pm**  
3866 East Hall  
Nawaz Sultani (UM)  
*Quotients in algebraic geometry*

I'll introduce the basic ideas behind quotients in algebraic geometry, with a focus on computations. Time permitting, we can see an application of these techniques to moduli space constructions.

**Applied Interdisciplinary Mathematics (AIM)**  
**Friday, September 21, 2018, 3:00pm-4:00pm**  
1084 East Hall  
Adam Larios (University of Nebraska)  
*Silly ideas In data assimilation that still work*

A major difficulty in accurately simulating turbulent flows is the problem of determining the initial state of the flow. For example, weather prediction models typically require the present state of the weather as input. However, the state of the weather is only measured at certain points, such as at the locations of weather stations or weather satellites. Data assimilation eliminates the need for complete knowledge of the initial state. It incorporates incoming data into the equations, driving the simulation to the correct solution. The objective of this talk is to discuss innovative computational and mathematical methods to test, improve, and extend a promising new class of algorithms for data assimilation in turbulent flows and related systems. We will look at classical and modern approaches, and then examine, via live simulations, a few new ideas which are a little different, but which in many cases give better results with fewer resources.

**Combinatorics**  
**Friday, September 21, 2018, 3:00pm-4:00pm**  
2866 East Hall  
Anna Weigandt (University of Michigan)  
*Bumpless Pipe Dreams and Alternating Sign Matrices*

Lam, Lee, and Shimozono introduced bumpless pipe dreams to study back stable Schubert calculus. In particular, Schubert polynomials can be expressed as a weighted sum over bumpless pipe dreams in a square grid. Working from a different perspective, Lascoux gave a formula for Grothendieck polynomials as a sum over alternating sign matrices. We show that alternating sign matrices are in natural bijection with bumpless pipe dreams. Restricting to the lowest degree terms of Lascoux's formula recovers the LLS formula for Schubert polynomials. We also discuss how to use the pipe dream perspective to compute keys of ASMs.
Mean curvature motion is where a surface moves proportional to the curvature at the point. This can be viewed as gradient descent on the parameter of a curve. One application is the computer vision problem of image segmentation, or finding different objects in an image. In this presentation, I will unfold the governing mathematics equations of the above processes.

We will provide a constructive definition of “Big Biomedical/Health Data” and provide examples of the challenges, algorithms, processes, and tools necessary to manage, aggregate, harmonize, process, and interpret such data. In data science, time complexity frequently manifests as sampling incongruency, heterogeneous scales, and intricate dependencies. We will present the concept of 2D complex-time (kime) and illustrate how the kime-order (time) and kime-direction (phase) affect advanced predictive analytics and scientific inference based on Big Biomedical Data. Kime-representation solves the unidirectional arrows of time problems, e.g., psychological arrow of time reflects the irrevocable past to future flow and thermodynamic arrow of time reflecting the relentless growth of entropy. Albeit kime-phase angles may not always be directly observable, we will illustrate how they can be estimated and used to improve the resulting space-kime modeling, trend forecasting, and predictive data analytics. Simulated data, clinical observations (e.g., neurodegenerative disorders), and multisource census-like datasets (e.g., UK Biobank) will be used to demonstrate time-complexity and inferential-uncertainty.

In this talk I will go over some standard NLP techniques (pre deep learning) such as n-gram models and syntax tress. I will show demonstrate a few uses of these.