# Weekly Seminar & Events Bulletin  
**December 6th, 2020 - December 12th, 2020**

## Monday, December 07, 2020

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker(s)</th>
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</thead>
<tbody>
<tr>
<td>11:00am-11:50am</td>
<td><strong>Student Analysis</strong></td>
<td>Katja Vassilev (University of Michigan) Littlewood-Paley Theory</td>
<td>Virtual East Hall</td>
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<td>3:00pm-4:00pm</td>
<td><strong>RTG Seminar on Number Theory</strong></td>
<td>Shubhodip Mondal (UM) Dieudonné theory via cohomology of classifying stacks</td>
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<td>4:00pm-5:00pm</td>
<td><strong>Algebraic Topology</strong></td>
<td>Peter Haine (MIT) Stratified étale homotopy theory</td>
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<td><strong>Integrable Systems and Random Matrix Theory</strong></td>
<td>Elliot Paquette (McGill University) The edge scaling limit of the Gaussian beta-ensemble characteristic polynomial</td>
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<td>Berkan Yilmaz (University of Michigan) Pathwise Interperations of Stochastic Integration</td>
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<td>Norbert Schappacher (Université de Strasbourg) How did the 1930s reshape global mathematics?</td>
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<td><strong>Complex Analysis, Dynamics and Geometry</strong></td>
<td>Alex Kapiamba (U(MI)) The (dis)continuity of quadratic filled Julia sets II</td>
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<td>Shreyasi Datta (U Michigan) The complete proof of quantitative nondivergence</td>
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Abstracts for the week of December 6th, 2020 - December 12th, 2020

**Student Analysis**
Monday, December 07, 2020, 11:00am-11:50am
Virtual East Hall
Katja Vassilev (University of Michigan)

*Littlewood-Paley Theory*

Littlewood-Paley Theory is a useful tool in Harmonic Analysis to examine functions in general $L^p$ spaces. In this talk, we will introduce the basics of Littlewood-Paley Theory by introducing Littlewood Paley Multipliers. I will provide an overview of the setup of the theory as well as some intuition to put it in context. We will also discuss the major results and estimates that one can discover. This talk will only assume knowledge of Real Analysis and will begin by reviewing some basic facts about the Fourier Transform.

**RTG Seminar on Number Theory**
Monday, December 07, 2020, 3:00pm-4:00pm
Virtual
Shubhodip Mondal (UM)

*Dieudonné theory via cohomology of classifying stacks*

Finite flat group schemes of $p$-power rank and $p$-divisible groups over perfect fields are classified by the classical Dieudonné theory, which associates a Dieudonné module to any such group scheme. Scholze and Weinstein generalized this classification result to $p$-divisible groups over mixed characteristic perfectoid base rings. More recently, this was further generalized by Anschutz and Le Bras which allowed more general mixed characteristic base rings, using recent developments in $p$-adic hodge theory, namely the theory of prismatic cohomology developed by Bhatt and Scholze. In this talk, we will describe a "geometric" way to reconstruct these classification results in terms of cohomology of the classifying stack associated to a finite group scheme or a $p$-divisible group.
Algebraic Topology  
Monday, December 07, 2020, 4:00pm-5:00pm  
online Virtual  
Peter Haine (MIT)  
Stratified étale homotopy theory

Étale homotopy theory was invented by Artin and Mazur in the 1960s as a way to associate to a scheme $X$, a homotopy type with fundamental group the étale fundamental group of $X$ and whose cohomology captures the étale cohomology of $X$ with locally constant constructible coefficients. In this talk we'll explain how to construct a stratified refinement of the étale homotopy type that classifies constructible étale sheaves of spaces. We'll also explain how this refinement gives rise to a new, concrete definition of the étale homotopy type. This is joint work with Clark Barwick and Saul Glasman.

Integrable Systems and Random Matrix Theory  
Monday, December 07, 2020, 4:00pm-5:00pm  
Zoom Meeting: 91617339235  Passcode: 651935 Virtual  
Elliot Paquette (McGill University)  
The edge scaling limit of the Gaussian beta-ensemble characteristic polynomial

The Gaussian beta-ensemble (GbetaE) is a 1-parameter generalization of the Gaussian orthogonal/unitary/symplectic ensembles which retains some integrable structure. Using this ensemble, in Ramirez, Rider and Virag constructed a limiting point process, the Airy-beta point process, which is the weak limit of the point process of eigenvalues in a neighborhood of the spectral edge. They constructed a limiting Sturm-Liouville problem, the stochastic Airy equation with Dirichlet boundary conditions, and they proved convergence of a discrete operator with spectra given by GbetaE to this limit.

Jointly with Gaultier Lambert, we give a construction of a new limiting object, the stochastic Airy function (SAi); we also show this is the limit of the characteristic polynomial of GbetaE in a neighborhood of the edge. It is the solution of the stochastic Airy equation, which is the usual Airy equation perturbed by a multiplicative white noise, with specified asymptotics at time $\pm\infty$. Its zeros are given by the Airy-beta point process, and the mode of convergence we establish provides a new proof that Airy-beta is the limiting point process of eigenvalues of GbetaE. In this talk, we survey what new information we have on the characteristic polynomial; we show from where the stochastic Airy equation arises; we show how SAi is constructed; and we leave some unanswered questions.
MCAIM Graduate Seminar
Monday, December 07, 2020, 4:00pm-5:00pm
Virtual
Alana Huszar (University of Michigan)
Non-commutative Rank and the Null Cone

How would we figure out what the rank of a matrix is, when we're considering its rank over a free skew field? This non-commutative version of the "Edmonds' problem", tackled by many computer scientists, has rich connections to invariant theory. In this example based talk, we'll go through different formulations of non-commutative rank, and tools we can use from invariant theory, like the "null cone", to determine this rank. No previous familiarity (besides linear algebra) is required.

Join Zoom Meeting
https://umich.zoom.us/j/5122504956?pwd=SkdWK21XRHN0MFBOVmlLem5PaW1lZz09

Meeting ID: 512 250 4956
Passcode: 814827

Student Math Finance
Monday, December 07, 2020, 7:00pm-8:00pm
https://umich.zoom.us/j/99487325343  Virtual
Berkan Yilmaz (University of Michigan)
Pathwise Interperations of Stochastic Integration

We will demonstrate an approximation procedure for the Itou integral that is very similar to Riemann Integration. We will also touch upon a probability measure-free interpretation of the Itou formula if there is time.
Colloquium Series
Tuesday, December 08, 2020, 4:00pm-5:00pm
Zoom East Hall
Norbert Schappacher (Université de Strasbourg)

How did the 1930s reshape global mathematics?

For historians, the thirties are arguably the most difficult decade of the twentieth century to capture. Crisis and consolidation coexisted. The talk will illustrate this general impression with respect to the international mathematical community and the development of mathematics. A broad variety of events will be discussed, such as the beginning of the IAS in Princeton, two brilliant ICMs (1932 in Zurich and 1936 in Oslo), a memorable conference in Moscow; the axiomatization of probability, the beginning of Bourbaki, the rewriting of Algebraic Geometry; politically motivated migrations, the fate of international mathematical review journals, etc. Many of these events have left their mark on mathematics as we know it today.

Zoom Link: https://umich.zoom.us/j/99980730858
Passcode: 201877

Complex Analysis, Dynamics and Geometry
Tuesday, December 08, 2020, 5:00pm-6:00pm
Virtual
Alex Kapiamba (U(M))

The (dis)continuity of quadratic filled Julia sets II

Associated to every polynomial is a compact subset of the complex plane, called the filled Julia set, which is a fundamental object in understanding they dynamics of that polynomial. Douady showed that when a polynomial without parabolic cycles is perturbed, the corresponding filled Julia sets vary continuously. Over the course to two talks we will examine this phenomenon. In the first talk we will give an introductory overview of the continuity of filled Julia sets and parabolic implosion, the obstruction to continuity caused by parabolic cycles. In the second talk we will discuss the space of compact sets which arise as limits of quadratic polynomials and ongoing efforts to describe its topology.
Student Combinatorics
Tuesday, December 08, 2020, 5:00pm-6:00pm
Virtual
Anna Brosowsky ()
Spectral Properties of Graph Laplacians

By turning graphs into linear algebra, we discover that eigenvalues carry interesting information about our original graph. This talk will start by defining the graph laplacian, then working our way through some easy properties. Our end goal is to cover enough background to motivate and state some facts relating eigenvalues to the sparsity of the graph, such as Cheeger's inequality.

Special Events
Tuesday, December 08, 2020, 5:40pm-7:00pm
Virtual
Various ()
LoG(M) Poster Session

Information for posters can be found here: https://sites.lsa.umich.edu/logm/fall2020poster/

Financial/Actuarial Mathematics
Wednesday, December 09, 2020, 4:00pm-5:00pm
https://umich.zoom.us/j/95407665241 Virtual
Zhenhua Wang (UM)
The Coin-turning Walk and Its Scaling Limit

Let S be the random walk obtained from "coin turning" with some sequence \( \{p_n\}_{n=2}^{\infty} \), where \( \{p_n\}_{n=2}^{\infty} \) is a given sequence of the probabilities to "turn the coin" at step n. In this paper we investigate the scaling limits of S in the spirit of the classical Donsker invariance, both for the heating and for the cooling dynamics.

We prove invariance principles, albeit with a non-classical scaling, holds for "not too small" sequences. The order \( \text{const} \cdot n^{-1} \) (critical cooling regime) being the threshold. At and below this critical order, the scaling behavior is dramatically different from the one above it. The same order is also the critical one for the Weak Law of Large Numbers to hold.

In the critical cooling regime, an interesting process emerges: it is a continuous, piecewise linear, recurrent process, for which the one-dimensional marginals are Beta-distributed.
Algebraic Geometry
Wednesday, December 09, 2020, 4:00pm-5:00pm
Zoom
Laure Flapan (Michigan State University)
Fano manifolds associated to hyperkähler manifolds

Many of the known examples of hyperkähler manifolds arise from geometric constructions that begin with a Fano manifold whose cohomology looks like that of a K3 surface. In this talk, I will focus on a program whose goal is to reverse this process, namely to begin with a hyperkähler manifold and from it produce geometrically a Fano manifold. This is joint work in progress with K. O’Grady, E. Macrì, and G. Saccà.

RTG Seminar on Geometry, Dynamics and Topology
Wednesday, December 09, 2020, 4:00pm-5:30pm
3866 East Hall
Shreyasi Datta (U Michigan )
The complete proof of quantitative nondivergence

We will discuss the proof of quantitative nondivergence for the \( n>2 \) case. We will mainly follow the paper "Flows on Homogeneous Spaces and Diophantine Approximation on Manifolds" (1998, Annals of Mathematics) by D. Y. Kleinbock and G. A. Margulis.

Join Zoom Meeting
https://umich.zoom.us/j/91734725787
There is no password required at this point.

Representation Stability
Friday, December 11, 2020, 11:00am-11:50am
Online
Andrew Snowden (UM)
K-L theory VI: Calculations in special cases
Combinatorics
Friday, December 11, 2020, 3:00pm-4:00pm
Virtual
Patricia Klein (University of Minnesota)

Geometric vertex decomposition, liaison, and degenerations of matrix Schubert varieties

Geometric vertex decomposition and liaison are two frameworks that have been used to produce similar results about similar families of algebraic varieties. In this talk, we will describe an explicit connection between these approaches. In particular, we describe how each geometrically vertex decomposable ideal is linked by a sequence of elementary G-biliaisons of height 1 to an ideal of indeterminates and, conversely, how every G-biliaison of a certain type gives rise to a geometric vertex decomposition. This connection gives us a framework for implementing with relative ease Gorla, Migliore, and Nagel's strategy of using liaison to establish Gröbner bases. We describe an approach to understanding diagonal degenerations of matrix Schubert varieties along these lines.

This talk is based on joint work with Jenna Rajchgot and with Anna Weigandt.