### Monday, January 17, 2022

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Special Events</strong> -- Robert Megginson (University of Michigan) <strong>Marjorie Lee Browne Colloquium:</strong> <em>Indigenous Mathematics, Including an In-Depth Look at the Number Theory of the Maya</em> -- <a href="https://umich.zoom.us/j/94286704899">https://umich.zoom.us/j/94286704899</a> Meeting ID: 942 8670 4899 Passcode: 571357 Virtual</td>
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### Tuesday, January 18, 2022

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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Colloquium Series</strong> -- Maksym Radziwill (Caltech) <strong>Recent progress on Chowla's conjecture</strong> -- virtual</td>
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### Wednesday, January 19, 2022

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<tr>
<td>4:00pm-5:30pm</td>
<td><strong>Algebraic Geometry</strong> -- Noah Olander (Columbia University) <strong>Fully faithful functors and dimension</strong> -- 4096 East Hall</td>
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<td>4:00pm-5:00pm</td>
<td><strong>Financial/Actuarial Mathematics</strong> -- Paul Zhang (UCSD) <strong>McKean-Vlasov equations involving hitting times: blow-ups and global solvability</strong> -- Zoom Virtual</td>
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<td>4:00pm-5:00pm</td>
<td><strong>RTG Seminar on Number Theory</strong> -- Isabella Negrini (Mcgill University) <strong>A Shimura-Shintani correspondence for rigid analytic cocycles</strong> -- Virtual</td>
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### Thursday, January 20, 2022

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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Differential Equations</strong> -- Xiao Liu (Georgia Tech.) <strong>Capillary Gravity Water Waves Linearized at Monotone Shear Flows: Eigenvalues and Inviscid Damping</strong> -- zoom 934 2560 3181 Virtual</td>
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<tr>
<td>4:00pm-5:30pm</td>
<td><strong>Arithmetic Geometry Learning</strong> -- Siqing Zhang (Stony Brook) <strong>Non-Abelian Hodge Theorems in positive characteristics and implications for the P=W Conjecture</strong> -- 4096 East Hall</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Commutative Algebra</strong> -- Aida Maraj (UM) <strong>Staged Tree Models with Toric Structure</strong> -- <a href="https://umich.zoom.us/j/96274532499">https://umich.zoom.us/j/96274532499</a> (password: algebra) Virtual</td>
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### Friday, January 21, 2022

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<th>Time</th>
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<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Combinatorics</strong> -- Grant Barkley (Harvard University) <strong>Extended weak order in affine type</strong> -- 4088 East Hall</td>
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<td>3:00pm-12:00am</td>
<td><strong>Applied Interdisciplinary Mathematics (AIM)</strong> -- Jeff Eldredge (UCLA) <strong>Data assimilation for aerodynamic flow estimation</strong> -- Virtual</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Student Algebraic Geometry</strong> -- Hyunsuk Kim (UM) <strong>The Kodaira's Embedding Theorem and Applications</strong> -- 2866 East Hall</td>
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<tr>
<td>4:00pm-5:30pm</td>
<td><strong>Preprint Algebraic Geometry</strong> -- Jim Milne (UM) <strong>The Hodge and Tate conjectures for Abelian varieties, part I</strong> -- 4096 East Hall</td>
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Marjorie Lee Browne Colloquium: Indigenous Mathematics, Including an In-Depth Look at the Number Theory of the Maya

Robert Megginson (University of Michigan)

This talk, which will be broadly accessible to non-mathematicians, will begin by visiting such matters as the effect that cultural outlook can have on one’s attitude toward mathematics, and why there is an ugly myth that Native Americans and some other indigenous peoples of the world are intrinsically doomed to be bad at math. The talk will then take a fairly deep dive into the number theory of the Maya without becoming overly technical, and show some of the world’s first number-theoretic story problems, found engraved on Mayan steles. Some of the questions that will be addressed are:

1. Why did the U.S. Bureau of Indian Affairs remove algebra and geometry from the standard boarding school curriculum in the early part of the twentieth century?
2. What is the evidence that the linguistic in which mathematics is taught has an impact on student learning, particularly of indigenous peoples?
3. Did the Maya really make significant use of what we would recognize as number theory well over a thousand years ago? (Answer: At least one respected ethnomathematician believes so.)
4. Why would the speaker really like to know the source of the Maya symbol for 0 (particularly since the Maya were one of the few peoples to come up with the knowledge of zero as a true number)?
5. Did the world really come to an end on December 21, 2012, as the Maya predicted? (Spoiler alert: (a) There seems to be evidence that the world did not. (b) Furthermore, there really is no credible evidence that the Maya ever thought it would. (c) But we’ll see why some folks believe that the Maya did so predict.)
6. Did too much knowledge of number theory lead to the end of the Mejica (Aztec) empire? (Answer: maybe.)

https://umich.zoom.us/j/94286704899
Meeting ID: 942 8670 4899
Passcode: 571357
Colloquium Series  
Tuesday, January 18, 2022, 4:00pm-5:00pm  
virtual  
Maksym Radziwill (Caltech)  
Recent progress on Chowla's conjecture

I will describe recent progress on our understanding of the factorization of the integers, specifically consecutive integers. The main theme is the tension between the additive and multiplicative structure of the integers. This is a central topic in number theory, connected among others to problems of equidistribution of arithmetic objects (subconvexity) or more classical problems such as the twin prime conjecture (parity obstruction).  

The first significant result towards Chowla's conjecture goes back to my work with Matomaki from 2015. In the last six years this particular sub-area gave rise to several new ideas in analytic number theory, specifically ideas related to entropy, expander graphs and additive combinatorics. Among the recent achievements are results on local Fourier uniformity and expansion in thin graphs connected with prime divisors of integers.  

In turn progress on this basic question gave back various results beyond number theory in areas as distinct as combinatorics (Erdos discrepancy problem), mathematical physics (spacing betweens eigenfunctions of the Laplacian on generic rectangular tori), cryptography (smooth numbers in short intervals), ergodic theory (Sarnak's conjecture), etc.  

I will discuss various papers joint with Matomaki, Helfgott, Ziegler, Tao and Teravainen and also progress by others, e.g Tao, Walsh, Frantzikinakis and Host.  

https://umich.zoom.us/j/92876413255?pwd=UUs5MitnN1FhVVRCb3RIOTIWWThkdz09  
Meeting ID: 928 7641 3255  
Passcode: UMColloq

Algebraic Geometry  
Wednesday, January 19, 2022, 4:00pm-5:30pm  
4096 East Hall  
Noah Olander (Columbia University)  
Fully faithful functors and dimension

A conjecture of Orlov states that the Rouquier dimension of the derived category of a smooth projective variety is equal to its dimension. We'll discuss the meaning of the conjecture and some things we know about it, and then explain the proof of a weakened version. This weakened version implies a fact predicted by Orlov's conjecture: If X, Y are smooth projective varieties and there is a fully faithful functor from the derived category of X to the derived category of Y, then the dimension of X is at most the dimension of Y.
We study two McKean-Vlasov equations involving hitting times. Let $\{B(t); \ t \ge 0\}$ be standard Brownian motion, and $\tau:= \inf\{t \ge 0: X(t) \le 0\}$ be the hitting time to zero of a given process $X$. The first equation is $X(t) = X(0) + B(t) - \alpha \mathbb{P}(\tau \le t)$.

We provide a simple condition on $\alpha$ and the distribution of $X(0)$ such that the corresponding Fokker-Planck equation has no blow-up, and thus the McKean-Vlasov dynamics is well-defined for all time $t \ge 0$. We take the PDE approach and develop a new comparison principle.

The second equation is $X(t) = X(0) + \beta t + B(t) + \alpha \log \mathbb{P}(\tau \le t)$, $t \ge 0$, whose Fokker-Planck equation is non-local. We prove that if $\beta,1/\alpha > 0$ are sufficiently large, the McKean-Vlasov dynamics is well-defined for all time $t \ge 0$. The argument is based on a relative entropy analysis.

This is joint work with Erhan Bayraktar, Gaoyue Guo and Wenpin Tang.

In their paper Singular moduli for real quadratic fields: a rigid analytic approach, Darmon and Vonk introduced rigid meromorphic cocycles, i.e. elements of $H^1(SL_2(Z[1/p]), M^x)$ where $M^x$ is the multiplicative group of rigid meromorphic functions on the $p$-adic upper-half plane. Their values at RM points belong to narrow ring class fields of real quadratic fields and behave analogously to CM values of modular functions on $SL_2(Z) \backslash H$. In this talk I will present some progress towards developing a Shimura-Shintani correspondence in this setting.
Differential Equations  
Thursday, January 20, 2022, 4:00pm-5:00pm  
zoom 934 2560 3181 Virtual  
Xiao Liu (Georgia Tech. )  
Capillary Gravity Water Waves Linearized at Monotone Shear Flows: Eigenvalues and Inviscid Damping

We consider the 2-dim capillary gravity water wave problem -- the free boundary problem of the Euler equation with gravity and surface tension -- of finite depth $x_2 \in (-h,0)$ linearized at a uniformly monotonic shear flow $U(x_2)$. Our main results consist of two aspects, eigenvalue distribution and inviscid damping. We first prove that in contrast to finite channel flow and gravity wave, the linearized capillary gravity wave has two unbounded branches of eigenvalues for high wave numbers. Under certain conditions, we provide a complete picture of the eigenvalue distribution. Assuming there are no singular modes, we obtain the linear inviscid damping. We also identify the leading asymptotic terms of velocity and obtain the stronger decay for the remainders. This is a joint work with Chongchun Zeng.

Arithmetic Geometry Learning  
Thursday, January 20, 2022, 4:00pm-5:30pm  
4096 East Hall  
Siqing Zhang (Stony Brook)  
Non-Abelian Hodge Theorems in positive characteristics and implications for the P=W Conjecture

Commutative Algebra  
Thursday, January 20, 2022, 4:00pm-5:00pm  
https://umich.zoom.us/j/96274532499 (password: algebra) Virtual  
Aida Maraj (UM)  
Staged Tree Models with Toric Structure

A staged tree model is a discrete statistical model encoding relationships between events. These models are realised by directed trees with coloured vertices. In algebro-geometric terms, the model consists of points inside a toric variety. For certain trees, called balanced, the model is in fact the intersection of the toric variety and the probability simplex. We will see that its defining toric ideal is Kosul, normal, and it has a generating set with binomials of degree one and two. Most importantly, the class of staged tree models with a toric structure extends far outside of the balanced case, if we allow a change of coordinates. The talk is based on the preprint, "Staged tree models with toric structure" (arXiv:2107.04516) with Christiane Gorgen and Lisa Nicklasson.
The extended weak order is a partial order associated to a Coxeter system \((W,S)\). It is the containment order on "biclosed" sets of positive roots in the (real) root system associated to \(W\). When \(W\) is finite, this order coincides with the (right) weak order on \(W\), but when \(W\) is infinite, the weak order on \(W\) is a proper order ideal in the extended weak order. It is well-known that the weak order on \(W\) is a lattice if and only if \(W\) is finite. In contrast, it is a longstanding conjecture of Matthew Dyer that the extended weak order is a lattice for any \(W\), which is open in the case that \(W\) is infinite. I will present joint work with David Speyer where we prove this conjecture for the affine Coxeter groups.
Small flight vehicles are more agile but also more strongly affected by unexpected disturbances ('gusts') than larger vehicles. The non-linear aerodynamics of these gust encounters remains a principal challenge in controlling the vehicle's flight. In particular, it is likely that an effective flight control strategy will depend on an estimate of the disturbed flow around the vehicle, rather than just the vehicle's own state. In this talk, I will discuss our work on dynamic estimation of vortical flows from limited sensor data. I will first discuss the characteristics of the Ensemble Kalman Filter, which enables the practical assimilation of sensor data into an ensemble of large-dimensional, non-linear physics-based models. The assimilation of these data can correct for the physics that are unrepresented in the models. In the examples I will show, we use a vortex model to predict the fluid dynamics of the separated flow, and rely on the surface pressure measurements to inform the model of disturbances to that flow. I will discuss various improvements we have made, including a novel rank-reduction technique that greatly reduces the spurious correlations that arise in finite ensembles between measurements and states. The overall estimation algorithm is applied to several disturbed aerodynamic flows in which measurement data are obtained from a high-fidelity Navier-Stokes simulation. I will show that the data-assimilating vortex model efficiently and accurately predicts the evolving flow as well as the normal force in the presence of strong disturbances, without any knowledge of the disturbance characteristics.

We will discuss the proof of Kodaira's embedding theorem which gives us an answer whether a complex manifold can be embedded into a projective space. The statement of the theorem is as follows. A complex manifold $X$ is projective if and only if $X$ admits an integral Kähler class. The key algebraic input of this proof is using Kodaira's vanishing theorem and the blowup to mimic the proof of projectivity when $X$ is a curve. Time abiding, I will give one interesting application of this theorem which says that the torus $\Pic^0(X)$ of a projective manifold $X$ is again projective.

I'll explain the Hodge, Tate, and (Grothendieck) standard conjectures, especially for abelian varieties, where there has been some recent progress for fourfolds.