**Weekly Seminar & Events Bulletin**  
January 9th, 2022 - January 15th, 2022

### Monday, January 10, 2022

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Integrable Systems and Random Matrix Theory</strong> -- Louise Gassot (ICERM) Zero-dispersion limit for the Benjamin-Ono equation on the torus -- ZOOM ID: 926 6491 9790 Virtual</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>RTG Seminar on Number Theory</strong> -- Alexandra Utiralova (MIT) Harish-Chandra bimodules in complex rank -- Virtual</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Student Combinatorics</strong> -- Everyone Literally (UM) Planning Meeting (REMOTE) -- <a href="https://umich.zoom.us/j/95088797965">https://umich.zoom.us/j/95088797965</a> Virtual</td>
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### Tuesday, January 11, 2022

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<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Student Commutative Algebra</strong> -- Planning meeting -- 3866 East Hall</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Colloquium Series</strong> -- Robert Hough (Stony Brook University) Covering systems of congruences -- 1360 East Hall</td>
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### Wednesday, January 12, 2022

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>10:00am-11:00am</td>
<td><strong>RTG Seminar on Number Theory</strong> -- Jialiang Zou (NUS, Singapore) Arthur’s multiplicity formula and local Langlands correspondence for (special) orthogonal and unitary groups via theta lifts -- Virtual</td>
</tr>
<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Financial/Actuarial Mathematics</strong> -- Lorant Nagy (Alfred Renyi Institute) Young, Timid, and Risk Takers -- Zoom Virtual</td>
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<tr>
<td>4:00pm-5:30pm</td>
<td><strong>Algebraic Geometry</strong> -- Andres Fernandez Herrero (Cornell University) Intrinsic construction of moduli spaces via affine grassmannians -- 4096 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Financial/Actuarial Mathematics</strong> -- Purba Das (Oxford) Rough volatility: fact or artefact? -- 1360 East Hall</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>RTG Seminar on Number Theory</strong> -- Elad Zelingher (Yale University) TBA -- Virtual</td>
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### Thursday, January 13, 2022

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<tr>
<td>12:00am-12:00am</td>
<td><strong>Arithmetic Geometry Learning</strong> -- Mirko Mauri (UM) P=W for compact hyperkaehler manifolds -- 4096 East Hall</td>
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<tr>
<td>1:00pm-2:30pm</td>
<td><strong>Teaching Mathematics</strong> -- LCIT Discussion -- 4866 East Hall</td>
</tr>
<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Topology</strong> -- Peter Johnson (University of Virginia) A zero surgery obstruction from involutive Heegaard Floer homology -- 3866 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Differential Equations</strong> -- Xiaoxu Wu (Rutgers University) L^p boundedness of the scattering wave operators of Schroedinger dynamics with time-dependent potentials and applications. -- Zoom 983 6567 6067 Virtual</td>
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### Friday, January 14, 2022

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<tr>
<td>4:00pm-5:30pm</td>
<td><strong>Preprint Algebraic Geometry</strong> -- Bhargav Bhatt -- Purity for flat cohomology -- 4096 East Hall</td>
</tr>
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Integrable Systems and Random Matrix Theory
Monday, January 10, 2022, 4:00pm-5:00pm
ZOOM ID: 926 6491 9790 Virtual
Louise Gassot (ICERM)

Zero-dispersion limit for the Benjamin-Ono equation on the torus

We discuss the zero-dispersion limit for the Benjamin-Ono equation on the torus given a single well initial data. We prove that there exist approximate initial data converging to the initial data, such that the corresponding solutions admit a weak limit as the dispersion parameter tends to zero. The weak limit is expressed in terms of the multivalued solution of the inviscid Burgers equation obtained by the method of characteristics. We construct our approximation by using the Birkhoff coordinates of the initial data, introduced by Gérard, Kappeler and Topalov. In the case of the cosine initial data, we completely justify this approximation by proving an asymptotic expansion of the Birkhoff coordinates.
Deligne tensor categories are defined as an interpolation of the categories of representations of groups $\text{GL}_n$, $\text{O}_n$, $\text{Sp}_{2n}$ or $\text{S}_n$ to the complex values of the parameter $n$. One can extend many classical representation-theoretic notions and constructions to this context. These complex rank analogs of classical objects provide insights into their stable behavior patterns as $n$ goes to infinity.

I will talk about some of my results on Harish-Chandra bimodules in Deligne categories. It is known that in the classical case simple Harish-Chandra bimodules admit a classification in terms of $W$-orbits of certain pairs of weights. However, the notion of weight is not well-defined in the setting of Deligne categories. I will explain how in complex rank the above-mentioned classification translates to a condition on the corresponding (left and right) central characters.

Another interesting phenomenon arising in complex rank is that there are two ways to define Harish-Chandra bimodules. That is, one can either require that the center acts locally finitely on a bimodule $M$ or that $M$ has a finite $K$-type. The two conditions are known to be equivalent for a semi-simple Lie algebra in the classical setting, however, in Deligne categories that is no longer the case. I will talk about a way to construct examples of Harish-Chandra bimodules of finite $K$-type using the ultraproduct realization of Deligne categories.

This will be a short meeting for brainstorming talk topics and choosing speakers; we’ll also discuss how to proceed with remote vs. in-person meetings. Please come if you’re at all interested in attending this semester, and bring any subjects you’d like to hear or talk about!

(zoom Passcode: cookies )
A distinct covering system of congruences is a list of congruences
\[
\{ \mod m_i, \quad i = 1, 2, ..., k \}
\]
whose union is the integers. Erdős asked if the least modulus $m_1$ of a distinct covering system of congruences can be arbitrarily large (the minimum modulus problem for covering systems, $1000$) and if there exist distinct covering systems of congruences all of whose moduli are odd (the odd problem for covering systems, $25$). I'll discuss my proof of a negative answer to the minimum modulus problem, and a quantitative refinement with Pace Nielsen that proves that any distinct covering system of congruences has a modulus divisible by either 2 or 3. The proofs use the probabilistic method. Time permitting, I may briefly discuss a reformulation of our method due to Balister, Bollov, Morris, Sahasrabudhe and Tiba which solves a conjecture of Shinzel (any distinct covering system of congruences has one modulus that divides another) and gives a negative answer to the square-free version of the odd problem.

**RTG Seminar on Number Theory**
**Wednesday, January 12, 2022, 10:00am-11:00am**
**Virtual**
**Jialiang Zou (NUS, Singapore)**

Arthur's multiplicity formula and local Langlands correspondence for (special) orthogonal and unitary groups via theta lifts

It is expected that, in some cases, theta lifts realize Langlands functoriality lifts (cf. Adams conjecture and Prasad conjecture). Motivated by this, one can transfer the local Langlands correspondence and Arthur's multiplicity formula from one group to another group via theta lifts. This provides an efficient way to establish new cases of local Langlands correspondence and Arthur's multiplicity formula. In this talk, I will describe how to use this idea to establish the local Langlands correspondence and Arthur's multiplicity formula for (special) orthogonal and unitary groups, which extend the works of Arthur and Mok to non-quasi-split cases. This talk is based on joint work with Rui Chen.
Central tenets of modern portfolio theory suggest homogeneity of optimal strategies and turnpike theorems. In contrast with these common beliefs, the findings of the recent paper "Young, Timid, and Risk Takers" (Paolo Guasoni, Lóránt Nagy, Miklós Rásonyi) show that, in the regime of high risk aversion (i.e. exponential utility), the classical view is not at all universal.

Our framework figures a price process that follows a drifted diffusion that is a generalization of the well-known Ornstein-Uhlenbeck process, more precisely a nonlinear "power model" version of it.

Heuristic reasoning based on a model with discrete autoregressive price shows that, rather suprisingly, the limiting Ornstein-Uhlenbeck model displays an optimal growth of the certainty equivalent which is quadratic in the time horizon.

This result extends to the power model, with the growth rate depending on the strength of the nonlinearity in the mean reverting drift. Asymptotically optimal strategies exploit both dependence on the time horizon and the mean reversion of the price. Despite the ergodicity of the underlying model, the strategies do not converge in the limit.
Algebraic Geometry  
Wednesday, January 12, 2022, 4:00pm-5:30pm  
4096 East Hall  
Andres Fernandez Herrero (Cornell University)  
*Intrinsic construction of moduli spaces via affine Grassmannians*

Moduli spaces can be viewed as a geometric way of classifying objects of interest in algebraic geometry. For example, there exists a quasiprojective moduli space that parametrizes stable vector bundles on a smooth projective curve $C$. In order to further understand the geometry of this space, Mumford constructed a compactification by adding a boundary parametrizing semistable vector bundles. If the smooth curve $C$ is replaced by a higher dimensional projective variety $X$, then one can compactify the moduli problem by allowing vector bundles to degenerate to an object known as a "torsion-free sheaf". Gieseker and Maruyama constructed moduli spaces of semistable torsion-free sheaves on such a variety $X$. More generally, Simpson proved the existence of moduli spaces of semistable pure sheaves supported on smaller subvarieties of $X$. All of these constructions use geometric invariant theory (GIT).

The moduli problem of sheaves on $X$ is naturally parametrized by a geometric object $M$ called an "algebraic stack". In this talk I will explain an alternative GIT-free construction of the moduli space of semistable pure sheaves which is intrinsic to the moduli stack $M$. This approach also yields a Harder-Narasimhan stratification of the unstable locus of the stack. Our main technical tools are the theory of Theta-stability introduced by Halpern-Leistner, and some recent techniques developed by Alper, Halpern-Leistner and Heinloth. In order to apply these results, one needs to prove some monotonicity conditions for a polynomial numerical invariant on the stack. We show monotonicity by defining a higher dimensional analogue of the affine Grassmannian for pure sheaves. If time allows, I will also explain some applications of these ideas to some other moduli problems. This talk is based on joint work with Daniel Halpern-Leistner and Trevor Jones.
We investigate the statistical evidence for the use of `rough' fractional processes with Hurst exponent $H< 0.5$ for the modelling of the volatility of financial assets, using a model-free approach.

We introduce a non-parametric method for estimating the roughness of a function based on a discrete sample, using the concept of normalized $p$-th variation along a sequence of partitions, and discuss the consistency of the estimator in a pathwise setting. We investigate the finite sample performance of our estimator for measuring the roughness of sample paths of stochastic processes using detailed numerical experiments based on sample paths of Fractional Brownian motion and other fractional processes. We then apply this method to estimate the roughness of realized volatility signals based on high-frequency observations. Detailed numerical experiments based on stochastic volatility models show that, even when the instantaneous volatility has diffusive dynamics with the same roughness as Brownian motion, the realized volatility exhibits rough behaviour corresponding to a Hurst exponent significantly smaller than $0.5$, which suggests that the origin of the roughness observed in realized volatility time-series lies in the microstructure noise rather than the volatility process itself.

Comparison of roughness estimates for realized and instantaneous volatility in fractional volatility models with different values of Hurst exponent shows that whatever the value of $H$, realized volatility always exhibits `rough' behaviour with an apparent Hurst index $\hat{H}<0.5$ but this is not necessarily indicative of a similar rough behavior of the spot volatility process which may have $H\geq 1/2$.

**RTG Seminar on Number Theory**  
**Wednesday, January 12, 2022, 4:00pm-5:00pm**  
**Virtual**  
**Elad Zelingher (Yale University)**  
**TBA**

**Arithmetic Geometry Learning**  
**Thursday, January 13, 2022, 12:00am-12:00am**  
**4096 East Hall**  
**Mirko Mauri (UM)**  
$P=W$ for compact hyperkaehler manifolds
Teaching Mathematics  
Thursday, January 13, 2022, 1:00pm-2:30pm  
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LCIT Discussion ()

Topology  
Thursday, January 13, 2022, 3:00pm-4:00pm  
3866 East Hall  
Peter Johnson (University of Virginia)  

A zero surgery obstruction from involutive Heegaard Floer homology

A fundamental result in 3-manifold topology due to Lickorish and Wallace says that every closed oriented connected 3-manifold can be realized as surgery on a link in the 3-sphere. One may therefore ask: which 3-manifolds can be obtained by surgery on a link with a single component, i.e. a knot, in the 3-sphere? More specifically, one can ask: which 3-manifolds are obtained by zero surgery on a knot in the 3-sphere? In this talk, we give a brief outline of some known results to this question in the context of small Seifert fibered spaces. We then sketch a new method, using involutive Heegaard Floer homology, to show that certain 3-manifolds cannot be obtained by zero surgery on a knot in the three sphere. In particular, we produce a new infinite family of weight 1 irreducible small Seifert fibered spaces with first homology Z which cannot be obtained by zero surgery on a knot in the 3-sphere, extending a result of Hedden, Kim, Mark and Park.

Differential Equations  
Thursday, January 13, 2022, 4:00pm-5:00pm  
Zoom 983 6567 6067 Virtual  
Xiaoxu Wu (Rutgers University)  

$L^p$ boundedness of the scattering wave operators of Schroedinger dynamics with time-dependent potentials and applications.

The Dispersive estimates of Nonlinear equations, or more generally, equations with time dependent potentials is a challenging problem, with no general theory. We approach this problem by proving $L^p$ boundedness of wave operators for linear Schrödinger equations with time-dependent potentials. The proofs are based on new Cancellation Lemmas. $L^p$ decay estimates and Strichartz estimates are applications. Typical nonlinear applications include NLS and Hartree type equations.

Zoom Link: https://umich.zoom.us/j/98365676067

Meeting ID: 983 6567 6067
Preprint Algebraic Geometry
Friday, January 14, 2022, 4:00pm-5:30pm
4096 East Hall
Bhargav Bhatt ()
\textit{Purity for flat cohomology}

https://arxiv.org/abs/1912.10932 by Cesnavicius and Scholze