GSCAGT2016 Title and Abstract List

Keynote speaker 1 (9:20am - 10:20am)

Configurations, arithmetic groups, cohomology, and stability (SERC 116)

Jordan Ellenberg University of Wisconsin - Madison

Consider the following two objects:

- The congruence subgroup of level p in $SL_n(Z)$; that is, the group of integral matrices congruent to 1 mod p;
- The ordered configuration space of n points on a manifold M, which is to say, the space parametrizing ordered n-tuples of distinct points on M;

Each of these objects carries a natural action of the symmetric group S_n on n letters. (In the first case, this is by permuting the elements of the standard basis; in the second case, by permuting the points in the n-tuple.) What's more, each one is naturally described by cohomology groups H^i, which inherit the action and thus become representations of S_n.
Although these examples are quite different, it turns out there is a general notion of stability which applies to both of these cases (and many other examples in representation theory, algebraic geometry, and combinatorics.) In some sense, each H^i is "the same representation" but of different groups! The goal of the talk is to explain a framework, the category of FI-modules, in which this notion actually makes sense, and to use this framework to show (for example) that the dimensions of these cohomology groups are polynomials in n for sufficiently large n. The work discussed will include joint work with Tom Church, Benson Farb, Rohit Nagpal, and John Wiltshire-Gordon, as well as results of Andy Putman, Andrew Snowden, and Steven Sam. Some relevant papers: `http://arxiv.org/abs/1204.4533` `http://arxiv.org/abs/1210.1854` `http://arxiv.org/abs/1508.02430`

Keynote speaker 2 (4:30pm - 5:30pm)

Braids, complex geometry, and homology-type invariants (SERC 116)

Elisenda Grigsby, Boston College

It's been known for a while that closed braids arise naturally when studying the vanishing sets of complex 2-variable polynomials. On the other hand, it should come as no surprise that not every closed braid arises in this way. Indeed, Lee Rudolph has given us a clean topological characterization of those that do: they are precisely the braids whose associated mapping classes satisfy a condition he calls quasipositivity. I'll remind you what this means, then tell you a few things (some old, some new) that the Khovanov-Lee homology of braid closures can tell us about quasipositivity.

Keynote speaker 3 (11:15am - 12:15pm)

Representation theory and combinatorics of diagram algebras (SERC room116)

Zajj Daugherty, City College of New York

Classical Schur-Weyl connects the representation theory of the general linear group to that of the symmetric group via their commuting actions on a common tensor space. We will take a brief tour of other modern examples of Schur-Weyl duality, and the consequent combinatorial results for algebras of braids, tangles and other such families of diagrams.

Keynote speaker 4 (3:00pm - 4:00pm)

Arithmetic link complements (SERC room 116)

Alan Reid, University of Texas at Austin

In his 1982 Bulletin Article, Question 19 of the problem list, Thurston posed: "Find topological and geometric properties of quotient spaces of arithmetic subgroups of PSL(2,C). These manifolds often seem to have special beauty." Arithmetic link complements provide some particularly interesting examples of this. In this talk we take up this theme, compare and contrast with dimension 2, briefly report on some recent work and suggest some further directions.

Talks marked with a dagger (†) indicate expository talks

Graduate Student Session 1 (Saturday 10:50am - 11:20am)

Arithmetic cohomology (†) (SERC 108a)

Patrick Milano, Binghamton University

We will introduce Borisov's cohomology theory for Arakelov divisors on number fields, which is analogous to cohomology theory for divisors on complete algebraic curves. In order to define $H^0(D)$ and $H^1(D)$ for an Arakelov divisor D, we will first define objects that generalize locally compact abelian groups. Informally, these objects are locally compact abelian groups whose elements can "partly exist" and have "imprecise position." We will also mention the arithmetic analogues of the Riemann-Roch theorem and Serre duality in this context.

The interaction between Hermitian and Riemannian geometry (SERC 108b)

Gabriel Khan, Ohio State University

Given a compact Riemannian manifold (M^n, g), we can ask whether there exists a complex structure on M orthogonal to the metric. In general, the answer is "no" and there are quite a conditions on the metric that rule out the existence of a complex structure. Even if there is one, it may not be unique. In fact, in 2011, Borisov, Salamon, & Viaclovsky found that the flat six-dimensional torus admits an infinite-dimensional family of complex structures! Our research studies the complex structures on a given Riemannian manifold using the torsion, which is a measurement of how much Chern connection and Levi-Civita connection differ. We show how this can be used to prove various theorems in complex geometry. Furthermore, any estimate on the torsion solely in terms of the Riemannian geometry can be viewed as a theorem that controls the complex geometry solely in terms of the Riemannian metric.

Mapping class groups of surfaces and quantization (SERC 116)

Sasha Patotski, Cornell University

I will explain two constructions of certain (projective) representations of mapping class groups of surfaces, called quantum representations. One construction of these quantum representations is via the Kauffman bracket skein modules. Another one is via the geometric quantization of character varieties of surface groups. In 2012, Andersen and Ueno proved that the two constructions give isomorphic representations. I will not say anything about the proof, but I will say a few words about another approach to quantization of character varieties, which hopefully can give a more algebraic proof of Andersen-Ueno theorem.

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Graduate Student Session 2 (Saturday 11:30am - 12:00pm)

Random hypersurfaces and embedding curves over finite fields (SERC 108a)

Joseph Gunther, CUNY Graduate Center

We'll present two new applications of Poonen's closed point sieve over finite fields. The first is that the obvious local obstruction to embedding a curve in a smooth surface is the only global obstruction. The second is a proof of a recent conjecture of Vakil and Wood on the asymptotic probability of hypersurface sections having a prescribed number of singularities.

Non-positive sectional curvature under Ricci flow (SERC 108b)

Anusha Krishnan, University of Pennsylvania

We show that non-negative sectional curvature on closed 4-manifolds is not preserved under the Ricci flow. This is joint work with Renato Bettiol.

Topology and arithmetic geometry of elliptic Lefschetz fibration moduli space (SERC 116)

Jun Yong Park, University of Minnesota

We consider the moduli space $\mathcal{L}_n$ of elliptic Lefschetz fibrations over S^2 with n number of singular fibers. We relate the topology of elliptic fibration moduli as an algebraic variety to its arithmetic geometry by the interplay of singular cohomology, topological stability theorem, étale cohomology and the associated eigenvalues of the Frobenius. In particular, we compute the cardinality of its set of F_q–points.

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Graduate Student Session 3 (Saturday 12:10pm - 12:40pm)

Counting local systems on supersingular abelian varieties (†) (SERC 108a)

Brett Frankel, University of Pennsylvania

In a 2008 paper, Hausel and Rodriguez-Villegas studied the moduli space of (twisted) local systems on a Riemann surfaces by computing the number of representations of the fundamental group in $GL_n(q)$. We will discuss some situations where instead of a Riemann surface, one considers an abelian variety defined over an algebraically closed field of characteristic p. For a supersingular abelian variety A, we count the number of representations of the étale fundamental group of A to $GL_n(q)$, where q is a power of p. This count (for fixed n) turns out to be a polynomial in q. The space of such representations is not a scheme, but does have the structure of a constructible set. We give an explicit formula for this polynomial, then state a few theorems which elucidate its features. In particular, we state a new result which generalizes to cosets a theorem of Frobenius about the number of solutions to $x^n = 1$ in a finite group.

Rational differential characters and Fivebrane structures (SERC 108b)

Matthew Wheeler, University of Pittsburgh

In geometry, topology and physics, there is a collection of geometric structures that arise out of the Whitehead tower over BO, which can be ascribed to vector bundles. A great deal of research has been done on understanding and classifying Spin and String structures. I will discuss the concept of Fivebrane structures, which can be considered as a higher connected analog of a String structure, and I will introduce the concept of a rational geometric structure. The main goal will be to frame these ideas in the setting of differential cohomology.

On Thurston's Euler class one conjecture (SERC 116)

Mehdi Yazdi, Princeton University

In 1976, Thurston proved that taut foliations on closed hyperbolic 3-manifolds have Euler class of norm at most one, and conjectured that, conversely, any Euler class with norm equal to one is Euler class of a taut foliation. We construct counterexamples to this conjecture and suggest an alternative conjecture.

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Graduate Student Session 4 (Saturday 2:20pm - 2:50pm)

Noncommutative projective schemes (SERC 108a)

Blake Farman, University of South Carolina

Noncommutative projective schemes were introduced by M. Artin and J. J. Zhang in their 1994 paper, *Noncommutative Projective Schemes*, as a generaliztion of usual projective schemes. In this talk, we'll discuss the method of forming the quotient of an abelian category by an *epaisse* subcategory introduced by Grothendieck in his famous "Tohoku" paper, *Sur quelques points d'algèbre homologique*. We will use this to define the projective scheme of a noncommutative graded algebra due to Artin and Zhang, and present some results from their 1994 paper.

Assignments for Bott-Samelson manifolds (SERC 108b)

Gouri Seal, Northeastern University

Polynomial assignments for torus actions on a smooth manifold was introduced in Ginzburg-Guillemin-Karshon in the context of abstract moment maps and recently undertaken by Guillemin-Sabatini-Zara for a large class of manifolds satisfying the Goresky-Kottwitz-MacPherson(GKM) property. We provide an inductive construction of a combinatorial and Morse-theoretic basis of assignment cohomology for Bott-Samelson manifolds (BS^I), that may or may not have the GKM property, depending on the defining word I. We show that as a result of out construction, when BS^I is GKM, we recover an explicit basis in equivariant cohomology and equivariant K-theory. This is joint work with Catalin Zara.

Alternating knots and their generalization (†) (SERC 116)

Seungwon Kim, CUNY Graduate center

Recently, Joshua Greene and Joshua Howie independently give a new topological characterization of an alternating knot. In this talk, we will talk about this characterization and its generalization.

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Graduate Student Session 5 (Saturday 3:00pm - 3:30pm)

The adjoint action of a Hopf algebra (SERC 108a)

Adam Jacoby, Temple University

The talk will recall basic properties of the adjoint representation of a group algebras and discuses their generalizations to wider classes of Hopf algebras. In particular it will focus on the Hopf annihilator of the adjoint representation.

Twisted generalized cohomology (†) (SERC 108b)

Alex Yarosh, University of Pittsburgh

In the first part of this talk we will introduce a framework for describing twistis of generalized cohomology theories via generalized Thom spectra, and show how the classical twisted cohomologies like twisted K-theory can be interpreted in that context. In the second part of the talk, we will discuss recent work of Sati and Westerland on twisted Morava K-theory and E-theory, who showed, in particular, that $K(n)$ admits a non-trivial twist by $K(Z, m)$ only for $m = n + 2$. We will also establish some properties of twisted Morava K-theory, including twisted Atiyah-Hirzebruch spectral sequence and a universal coefficient theorem that relates twisted Morava K-theory to the untwisted ones.

Concordance of fibered knots (†) (SERC 116)

Maggie Miller, Princeton University

I will review the definition and construction of fibered links, which naturally occur in the study of knot theory. We will discuss methods of detecting fibered links and attempt to understand a 2015 conjecture of Ken Baker: If K_0 and K_1 are fibered knots in S^3 supporting the tight contact structure, then K_0 and K_1 are concordant only if $K_0 = K_1$. Using a result of Miyazaki, Baker showed that either this conjecture is true or the slice-ribbon conjecture is false.

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Graduate Student Session 6 (Saturday 3:30pm - 4:00pm)

Topological structure for cluster algebra quivers for Kac-Moody algebras (SERC 108a)

Maitreyee Kulkarni, Louisiana State University

In this talk, I will describe Berenstein-Fomin-Zelevinsky cluster structures on Schubert cells of symmetrizable KM algebras. Geiss-Leclerc-Schroer found an additive categorification of these cluster algebras via Frobenius categories constructed from representations of preprojective algebras. The talk will introduce the construction of quivers by building cylinders over Dynkin graphs, oriantability of its faces, and the construction of nondegenerate potentials for categorification of these algebras with frozen variables via brane tilings.

A smooth variant of Hopkins-Singer differential K-theory (SERC 108b)

Byungdo Park, CUNY Graduate Center

Various models of differential extensions of complex K-theory have been known, but it is often technically intricate to show whether two models are isomorphic. In this talk I will introduce differential K-theory, comparison problems, and new results using a smooth variant of Hopkins-Singer model of differential K-theory.

On the braid index of alternating braids (SERC 116)

Pengyu Liu, University of North Carolina Charlotte

We define that a braid diagram is alternating if its closure is an alternating link diagram and an oriented link L is an alternating braid on n strands if L can be represented by a reduced alternating braid diagram on n strands. In this talk, we show that the braid index of this class of alternating links, alternating braids on n strands, is exactly n.

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Graduate Student Session 7 (Sunday 9:00am - 9:30am)

Hermitian structure of the square root of the inverse different (SERC 108a)

Cindy (Sin Yi) Tsang , University of California Santa Barbara

Let L/K be a Galois extension of number fields with group G. A normal basis of L over K is a basis of the form $\{\sigma(x) : \sigma \in G\}$. Such a basis always exists by the normal basis theorem. It is then natural to ask whether the ring of integers $\mathcal{O}_L$ in L also has a basis of this form over the ring of integers $\mathcal{O}_K$ in K. This is a classical problem in number theory. More recently, instead of $\mathcal{O}_L$, people have also looked at this question for other G-invariant ideals in L, one of which is called the square root of the inverse different $A_{L/K}$. This ideal is special because it is self-dual with respect to the trace, and one can ask whether it admits a self-dual normal basis $\{\sigma(x) : \sigma \in G\}$ over $\mathcal{O}_K$. I will explain what all these mean in more detail and present some new results.

Stable and unstable homology of configuration spaces (SERC 108b)

Megan Maguire, University of Wisconsin Madison

In it's weakest form, we say that a family of topological spaces is homologically stable if for fixed i the i^{th} homology groups of X_n and X_{n+1} are isomorphic for n sufficiently large. Notions of homological stability have been investigated for a wide range of topological families, including Hurwitz spaces, moduli of curves, and configuration spaces. Arnol'd first proved integral homological stability for the unordered configuration spaces of $\mathbb{R}^2$. This was extended to open (connected, orientable, finite type) manifolds by McDuff and Segal (independently), and recently Church (via the method of representation stability), followed by Randal-Williams (via a method more akin to Segal), proved rational homological stability for all (connected, orientable, finite type) manifolds. Using the tools of Totaro, we compute the Betti numbers, both stable and unstable, of the unordered configuration spaces of some example spaces, such as a genus 1 Riemann surface and $\mathbb{CP}^3$, and prove a vanishing theorem about the unstable homology a la Church, Farb, and Putman (joint with Melanie Matchett Wood).

An introduction to acylindrical hyperbolicity (†) (SERC 116)

Burns Healy, Tufts University

Since the beginning of the study of negatively curved groups, many generalizations of the concept of a hyperbolic group have emerged, including the notion popularized by Bowditch of relative hyperbolicity. Recently much work has been done by Osin who has developed a number of tools for studying what are called 'acylindrically hyperbolic groups', which generalizes even relatively hyperbolic groups. Notably, this class of groups includes most mapping class groups, groups of punctured closed surfaces, $Out(F_n)$ for $n \geq 2$, indecomposable RAAGs of rank ≥ 3 and many 3-manifold groups.The condition for being acylindrically hyperbolic seems weak a priori, but actually yields suprisingly strong results for this class of groups. We look at some examples of these tools and the nature of acylindrically hyperbolic groups, and time permitting, will examine their relationship to CAT(0) groups.

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Graduate Student Session 8 (Sunday 9:40am - 10:10am)

Cofree objects in the centralizer and the center categories (SERC 108a)

Adnan Abdulwahid, University of Iowa

We study cocompleteness, co-wellpoweredness and generators in the centralizer category of an object or morphism in a monoidal category, and the center or the weak center of a monoidal category. We explicitly give some answers for when colimits, cocompleteness, co-wellpoweredness and generators in these monoidal categories can be inherited from their base monidal categories. Most importantly, we investigate cofree objects of comonoids in these monoidal categories.

Real 3-manifolds through surgery (SERC 108b)

Merve Cengiz, Koc University, Turkey

A real 3-manifold is a smooth 3-manifold together with an orientation preserving smooth involution, called a real structure. It is possible to give definitions of contact structures and open book decompositions compatible with the real structure, which are too in one to one correspondence in the sense of Giroux. I will give equivariant surgery descriptions of real 3-manifolds by showing that every real 3-manifold can be obtained via equivariant surgeries along recursively invariant knots starting from the standard real S^3. Then I will talk about real contact 3- manifolds and possible ways to construct them.

The Brauer complex and decomposition numbers of symplectic groups (SERC 116)

Ian Hogan, Kent State University

We follow the development of Chastkofsky and Humphreys to construct the Brauer Complex of $Sp_4(q)$ and $Sp_6(q)$. The complex is an open simplicial complex derived from the alcove geometry of the associated affine Weyl group together with Deligne-Lusztig character labels. The Deligne-Lusztig characters of $Sp_4(q)$, odd q, were computed by Srinivasan and of $Sp_6(q)$ even q by Lübeck. As a consequence we gain information about the decomposition matrices for these groups in defining characteristic. Namely, we compute some columns of the decomposition matrix in the rank two case and gain some information about the rank three case which may decomposition numbers with more work.

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Graduate Student Session 9 (Sunday 10:20am - 10:50am)

Twisted logarithmic modules of free field vertex algebras (SERC 108a)

Sullivan McKay, North Carolina State University

Vertex algebras have been useful in several applications, arguably the most famous of which is the proof of the monstrous moonshine conjectures. They also have important applications to physics. We will discuss the recently defined notion of twisted logarithmic modules of vertex algebras. In particular, we will consider twisted logarithmic modules of free field vertex algebras. Explicit examples of such modules are obtainable as highest weight representations of affine Lie algebras on a Fock space. We will use the symplectic fermions (odd super bosons) to demonstrate this construction.

Fixed point properties of nilpotent and solvable Lie group actions on non-positively curved compact manifolds (SERC 108b)

Mehrzad Monzavi, University of Texas at Arlington

We will prove the following theorems:
The first theorem posits the existence of a fixed point for the actions of nilpotent Lie groups on nonpositively curved compact manifolds.
The second theorem states that actions of solvable Lie groups on nonpositively curved compact manifolds have either a fixed point or a 2-periodic point.

Effective separability of nilpotent groups (SERC 116)

Mark Pengitore, Purdue University

In this talk, we give the precise asymptotic behavior of residual finiteness for finitely generated nilpotent groups. Similarly, we give polynomial upper and lower asymptotic bounds for conjugacy separability for finitely generated nilpotent groups.

Talks marked with a dagger (†) indicate expository talks

Graduate Student Session 10 (Sunday 1:40pm - 2:10pm)

Non-commutative discriminants and Poisson geometry part I (SERC 108a)

Kurt Trampel, Louisiana State University

We will present a general method for computing discriminants of noncommutative algebras. This method will build a connection with Poisson geometry and will express the discriminants as products of Poisson primes. The method will be applicable to algebras obtained by specialization from families. The 2 dimensional quantum Weyl algebra will be considered as an example. This will be on work in collaboration with Bach Nguyen and Milen Yakimov.

The augmentation category map induced by exact Lagrangian cobordisms (SERC 108b)

Yu Pan, Duke University

To a Legendrian knot, one can associate an $\mathcal{A}_\infty$category, the augmentation category. An exact Lagrangian cobordism between two Legendrian knots gives a functor of the augmentation categories of the two ends. We study the functor and establish a long exact sequence relating the corresponding Legendrian cohomology categories of the two ends. As applications, we prove that the functor between augmentation categories is injective on objects, and find new obstructions to the existence of exact Lagrangian cobordisms. The main technique is a recent work of Chantraine, Dimitroglou Rizell, Ghiggini and Golovko on Cthulhu homology.

Working with the square model of random groups (†) (SERC 116)

Yen Duong, University of Illinois at Chicago

Special cube complexes have been a hot topic for a few years now for their versatility and usefulness. Following a construction of Sageev we can cubulate all sorts of groups, and specifically I'll explain Gromov's density model of random groups, the square model of random groups, and examples of Sageev's cubulation with random groups, and why we would want to do all this.

Talks marked with a dagger (†) indicate expository talks

Graduate Student Session 11 (Sunday 2:20pm - 2:50pm)

Non-commutative discriminants and Poisson geometry part II (SERC 108a)

Bach Nguyen, Louisiana State University

In this talk, we will apply the general methods as described in K. Trampel's talk, to calculate the discriminant of algebras obtained by specialization from families, such as the algebras of quantum matrices at roots of unity. If time permits, we'll also discuss a more general case, the quantum Schubert cell algebras. This is a joint work with Milen Yakimov and Kurt Trampel.

A-infinity algebras for Legendrians from generating families (SERC 108b)

Ziva Myer, Bryn Mawr College

The study of Legendrian submanifolds is central to the field of contact topology, and invariants of these submanifolds have been obtained through a variety of techniques. In my talk, I will discuss how I am extending one such method, that of Generating Family Cohomology, to a larger A-infinity algebraic structure. The construction uses moduli spaces of Morse flow trees – spaces of intersecting gradient trajectories of functions whose critical points encode Reeb chords of the Legendrian.

CAT(0) HNN extensions and their visual boundaries (SERC 116)

Michael Ben-Zvi, Tufts University

It is well known that whenever a hyperbolic group acts geometrically on two spaces, then the spaces have homeomorphic visual boundary. The same is not true for CAT(0) groups. In this talk we will provide a family of HNN extensions which act on quasi-isometric spaces but have non-homeomorphic boundary. This work does not follow from Croke and Kleiner's result on graph manifolds.