Binghamton University Graduate Conference in Algebra and Topology

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in

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Topology

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And of course, we thank all of our speakers and participants for making this unprecedented conference a success.

Saturday 11/7

8:50am	Introduction
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9:45am	Manjusha Gandhi, *Fixed Point Theory: Insight*
10:30am	Gage Martin, *Khovanov homology and link detection*
11:15am	Frasier Binns, *Link Detection Results for Knot Floer Homology*
12:00pm	Andromeda Sonea, *The Euler's totient function in complete hypergroup theory*
12:45pm	**Keynote:** Ben Steinberg, *A Lyndon's Identity Theorem for One-Relator Monoids*
1:45pm	Lunch break
2:45pm	Grant Kopitzke, *The Gini Index and Representations of the Symmetric Group*
3:30pm	Charlotte Aten, *Multiplayer rock-paper-scissors*
4:15pm	Aranya Lahiri, *Resolutions of locally analytic principal series representations of GL2*
5:00pm	Anthony Sanchez, *Gaps of saddle connection directions for some branched covers of tori*
5:45pm	Pawel Grzegrzolka, *Asymptotic Dimension of Fuzzy Metric Spaces*

Sunday 11/8

9:00am	Raj Yadav, *An Introduction to Algebraic Deformation Theory*
9:45am	Harsha Arora, *Probability of an automorphism of an abelian group fixing a group element.*
10:30am	Perumali Sundarayya, *on C-algebras*
11:15am	Eda Yildiz, *On Some Properties of (2,J)-Ideals*
12:00pm	Mehsin Jabel Atteya, (σ, τ)*-Homgeneralized derivations of Semiprime Rings*
12:45pm	Sam Hughes, *The unstable Gromov-Lawson-Rosenberg conjecture for certain S-arithmetic groups*
1:30pm	Lunch break
2:30pm	Garen Chiloyan, *A classification of isogeny-torsion graphs of* $\mathbb{Q}$*-isogeny classes of elliptic curves defined over* $\mathbb{Q}$
3:15pm	James Myer, *The alterations paradigm shift for the problem of resolution of singularities*
4:00pm	Caleb McWhorter, *Torsion Subgroups of Rational Elliptic Curves over Odd Degree Galois Fields*
4:45pm	Noah Riggenbach, *K-Theory of Double Points*
5:30pm	Marc Schilder, *The A-Polynomial and Knot Volume*
6:15pm	Subhankar Dey, *On a geography problem in knot Floer homology*

Saturday 11/14

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9:45am	Harishchandra Ramane, *Complementary Equienergetic Graphs*
10:30am	Nathan Uricchio, *Duality on collections of subsets*
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12:00pm	Ramy Yammine, *On actions of connected Hopf algebras*
12:45pm	**Keynote:** Emily Riehl, *infinity-category theory for undergraduates*
1:45pm	Lunch break
2:45pm	Mark Nieland, *Origamis Associated to Minimally-Intersecting Filling Pairs*
3:30pm	Sayantan Khan, *The strange dynamics of non-orientable surfaces*
4:15pm	Joshua Flynn, *Algebraic Aspects of Dunkl Theory*
5:00pm	Rob Spahn, Σ*-invariants of Brown-Stein groups*
5:45pm	Amrita Acharyya, *Intermediate rings of complex valued continuous functions*

Sunday 11/15

9:00am	Thodsaporn Kumduang, *Regular relations and quotient Menger hyperalgebras*
9:45am	Niko Schonsheck, *TQ-completion: fibration theorems and connections to functor calculus*
10:30am	Duncan Clark, *An operad structure for the Goodwillie derivatives of the identity functor in structured ring spectra*
11:15am	Dasha Poliakova, *On* A_∞*-comodules over Hopf DG algebras*
12:00pm	Sophia Restad, *Gluing DG Categories*
12:45pm	**Keynote:** Moshe Cohen, *Randomness in low-dimensional topology*
1:45pm	Lunch break
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4:15pm	Tim Tribone, *Matrix Factorizations*
5:00pm	Andrew Tawfeek, *Enumeration of Forman Equivalence Classes on Simplicial Complexes*
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A Lyndon's Identity Theorem for one-relator monoids

Ben Steinberg (CUNY)

Abstract

Magnus solved the word problem for one-relator groups in the early 1930s. This spurred quite a bit of work into the study of one-relator Lie Algebras, rings and monoids. Adian and his school made a number of breakthroughs on the word problem for one-relator monoids in the sixties and seventies, but the problem remains wide open. In 2000 Kobayashi asked whether the word problem for one-relator monoids can be solved using the theory of finite complete rewriting systems. A necessary condition for a monoid to have a finite complete rewriting system is the homological finiteness condition FP_∞. Kobayashi asked in 2000 whether every one-relator monoid is of type FP_∞. Note that one-relator groups are of type FP_∞ as a consequence of Lyndon's identity theorem. In this talk we sketch some techniques in the the proof that all one-relator monoids are of type FP_∞. The main technique involves constructing actions of monoids on contractible CW complexes. Adian's machinery from his work on the word problem is reinterpreted from a more geometric viewpoint to build these complexes. This is joint work with Robert Gray from the University of East Anglia.

∞-category theory for undergraduates

Emily Riehl (Johns Hopkins University)

Abstract

At its current state of the art, ∞-category theory is challenging to explain even to specialists in closely related mathematical areas. Nevertheless, historical experience suggests that in, say, a century's time, we will routinely teach this material to undergraduates. This talk describes one dream about how this might come about — under the assumption that 22nd century undergraduates have absorbed the background intuitions of homotopy type theory/univalent foundations.

WOLFGANG AND LUISE-CHARLOTTE KAPPE ALUMNI LECTURE

Randomness in low-dimensional topology

Moshe Cohen (SUNY New Paltz)

Abstract

Combinatorialists have been using randomness to study properties of large objects like graphs since the 1960s, but only recently have these methods become more widespread in topology. I will highlight some of these results for manifolds in 2 and 3 dimensions before arriving at the topic of knot theory. After discussing surprising recent work by Malyutin, I will give a summary of older results in this area and tie these into my own work.

Relative hyperbolic structures and Thurston's earthquake theorem

Chaitanya Tappu (Cornell University) 9:00am

Thurston defined earthquakes on general hyperbolic surfaces, and proved that any two continuous relative (marked) hyperbolic structures on a surface are related by a left earthquake map. This is an expository talk based on paper by W.P. Thurston, 'Earthquakes in two-dimensional hyperbolic geometry', 1986, Chapter III in Low-dimensional topology and Kleinian groups, LMS Lecture Note Series 112.

Fixed Point Theory: Insight

Manjusha Gandhi (Yeshwantrao Chavan College of Engineering, Nagpur, India) 9:45am

The Fixed Point theory is a beautiful mixture of analysis (pure and applied), topology and geometry. Over the last century or so the theory of fixed points has been revealed as a very powerful and important tool in the study of nonlinear phenomena.

The theorems concerning the properties and existence of fixed points are known as fixed point theorems. The roots of fixed point theory lie in the method of successive approximations for proving existence of solutions of differential equations.

The thought of this classical theory is the revolutionary work of the great Polish mathematician Stefan Banach, published in 1922 which provides a beneficial method to find the fixed points of a map.

The origin of the metric fixed point theory itself started with the method of successive approximations for proving existence and uniqueness of solutions of differential equations.

In 1965, Browder established that every non-expansive self-mapping of a closed convex and bounded subset of a uniformly convex Banach space has a fixed point.

The same result was also proved by Kirk, under assumptions slightly weaker in a methodological sense, whereas the proof given by Goebel is more geometric and elementary in nature for the above.

Further fixed point theorems are developed in various spaces like: Normed space, Hilbert space, 2-metric spaces, quasi semi 2-metric spaces, D-metric spaces, b metric space, G metric space, Cone metric space, m- metric space and fuzzy space.

In this way a tremendous amount of research work has been carried on the literature of metric fixed point theory using different classes of contraction type conditions. The excellent comparison of various contraction conditions is specified by B. E. Rhoades.

Some common coupled, tripled, quadruple fixed point theorems, coincidence point theorem are also developed by researchers.

During the last few years, many branches of science have been benefited from the fixed point theory and many generalizations of it are emerging.

In particular fixed point techniques have been applied in such diverse fields as biology, chemistry, economics, engineering, game theory, and physics.

Khovanov homology and link detection

Gage Martin (Boston College) 10:30am

Khovanov homology is a combinatorially defined link homology theory. Due to the combinatorial definition, many topological applications of Khovanov homology arise via connections to Floer theories. A specific topological application is the question of which links Khovanov homology detects. In this talk, we will give an overview of Khovanov homology and link detection, mention some of the connections to Floer theoretic data used in detection results, and sketch a proof that Khovanov homology detects the torus link T(2,6).

Link Detection Results for Knot Floer Homology

Fraser Binns (Boston College) 11:15am

Knot Floer homology is a powerful knot invariant which generalises the Alexander polynomial. In this talk I will discuss some recent results showing that knot Floer homology can recognize various simple links. This is joint work with Gage Martin.

The Euler's totient function in complete hypergroup theory

Andromeda Sonea (University "Alexandru Ioan Cuza", Iasi, Romania) 12:00pm

The main goal of this paper is to analyze the periodicity of an element and using this concept to define the well-known Euler's totient function in complete hypergroup theory.

The Gini Index and Representations of the Symmetric Group

Grant Kopitzke (University of Milwaukee) 2:45pm

The Gini index is a number that attempts to measure how equitably a resource is distributed throughout a population, and is commonly used in economics as a measurement of inequality of wealth or income. The Gini index is often defined as the area between the Lorenz curve of a distribution and the line of equality, normalized to be between zero and one. In this fashion, we define a Gini index on the set of integer partitions and discuss how this function relates to the irreducible representations of the symmetric group.

Multiplayer rock-paper-scissors

Charlotte Aten (University of Rochester) 3:30pm

The game of rock-paper-scissors may be viewed as an algebra arising from a tournament digraph. In a recent paper I introduced a family of algebras which we can think of as generalized rock-paper-scissors games for many players. These algebras arise from a hypergraph analogue of tournaments. I will describe some of my results on the structure of these algebras. In particular, I will discuss how these algebras generate the variety generated by all tournament algebras and produce an infinite family of finite simple algebras.

Resolutions of locally analytic principal series representations of GL2

Aranya Lahiri (Indiana University) 4:15pm

For a finite field extension $F/\mathbb{Q}_p$ we associate a coefficient system attached on the Bruhat-Tits tree of $G := GL_2(F)$ to a locally analytic representation V of G. This is done in analogy to the work of Schneider and Stuhler for smooth representations. This coefficient system furnishes a chain-complex which is shown, in the case of locally analytic principal series representations V, to be a resolution of V. This talk will be based on the work in https://arxiv.org/abs/2008.04503.

Gaps of saddle connection directions for some branched covers of tori

Anthony Sanchez (University of Washington) 5:00pm

Consider the class of translation surfaces given by gluing two identical tori along a slit. Every such surface has genus two and two cone-type singularities of angle 4π. There is a distinguished set of geodesics called saddle connections that are the geodesics between cone points. We can recover a vector in the plane representing the saddle connection by keeping track of the amount that the saddle connection moves in the vertical and horizontal direction. How random is the set of saddle connections? We answer this question by computing the gap distribution of slopes of saddle connections.

Asymptotic Dimension of Fuzzy Metric Spaces

Pawel Grzegrzolka (Stanford University) 5:45pm

In this talk, we will discuss the asymptotic dimension of fuzzy metric spaces. After a short introduction to fuzzy metric spaces and large-scale geometry, we will show how fuzzy metric spaces can be studied from a large-scale point of view. In particular, we will define asymptotic dimension of fuzzy metric spaces and show a few of its interesting consequences. We will also explain the relationship between asymptotic dimension of metric spaces and asymptotic dimension of fuzzy metric spaces. We will conclude the talk with explicit computations of asymptotic dimension of several fuzzy metric spaces.

An Introduction to Algebraic Deformation Theory

Raj Yadav (Sikkim University, Gangtok, Sikkim, India) 9:00am

One of the more prominent, specifically modern, and pervasive trends in mathematics has to do with perturbations and deformations. Instead of studying one particular model, e.g. one differential equation, or one particular algebra of operators, one is as least as interested in families of these things, and the question of how various properties change as the object under consideration is varied. One reason of this is no doubt the modem emphasis on the tenuous relation (logically speaking) between a mathematical model and the phenomena it is designed to deal with. Algebraic deformation theory was -introduced for associative algebras by Gerstenhaber and was extended to Lie algebras by Nijenhuis and Richardson. Their work closely parallels the theory of deformations of complex analytic structures, initiated by Kodaira and Spencer.

Probability of an automorphism of an abelian group fixing a group element.

Harsha Arora (Guru Jambheshwar University of Science and Technology, Hisar (India)) 9:45am

In the present paper, we consider the probability of an automorphism of an abelian group fixing a group element. Explicit computations are made in terms of fusion classes to derive the value of the probability. Bounds of probability are also obtained for groups having some particular structures.

on C-algebras

Dr Perumali Sundarayya (Gitam (deemed to be University)) 10:30am

Different partial orders on a C-algebra and their properties are studied. First we define a partial ordering on C-algebra by $x \leq y$ if and only if $y \wedge x = x$ and we study the properties of this partial ordering. We give a number of equivalent conditions in terms of this partial ordering for a C-algebra to become Boolean Algebra. Later it is proved that for any $a \in B(A)$, A is isomorphic to $AaXAa'$. Using the decomposition theorem we prove that for any $a, b \in B(A)$ with $a \wedge b = F$, Aa is isomorphic to Ab if and only if there exists an isomorphism on A which sends the element a to the element b.

On Some Properties of (2,J)-Ideals

Eda Yildiz (Yildiz Technical University) 11:15am

Let R be a commutative ring with nonzero identity. In this talk, we introduce the concept of $(2, J)$-ideal as a generalization of J-ideal. A proper ideal P of R is said to be a $(2, J)$-ideal if whenever $abc \in P$ and $a, b, c \in R$, then $ab \in P$ or $ac \in Jac(R)$ or $bc \in Jac(R)$ where Jac(R) denotes the Jacobson radical of R. We investigate many properties of $(2, J)$-ideals and give various illustrated examples.

(σ, τ)**-Homgeneralized derivations of Semiprime Rings**

Mehsin Jabel Atteya (University of Leicester) 12:00pm

The main purpose of this paper is to construct the formula of the (σ, τ)-Homderivations and (σ, τ)-Homgeneralized derivation (resp., (σ, τ)-AntiHomderivations and (σ, τ)-AntiHomgeneralized derivation) of any ring and investigate some properties about that. In fact, this article divided into two sections, in the first section, we emphasize on the formula of the (σ, τ)-Homderivations of prime and semiprime rings. In the second section, we study commutativity with centralizer of (σ, τ) - Homgeneralized derivation satisfying certain identities. In the second section, we study commutativity with centralizer of (σ, τ) - Homgeneralized derivation satisfying certain identities. Examples of various results have also been included.

The unstable Gromov-Lawson-Rosenberg conjecture for certain S-arithmetic groups

Sam Hughes (University of Southampton) 12:45pm

In this talk we will introduce the unstable Gromov-Lawson-Rosenberg conjecture relating a K-theoretic invariant of compact spin manifolds to the non-existence of metrics of positive scalar curvature. If time permits we will discuss a proof of the conjecture for manifolds with fundamental group isomorphic to certain low dimensional S-arithmetic lattices.

A classification of isogeny-torsion graphs of $\mathbb{Q}$-isogeny classes of elliptic curves defined over $\mathbb{Q}$

Garen Chiloyan (University of Connecticut) 2:30pm

An isogeny graph is a nice visualization of the isogeny class of an elliptic curve. A theorem of Kenku shows sharp bounds on the number of distinct isogenies that a rational elliptic curve can have (in particular, every isogeny graph has at most 8 vertices). In this talk, we classify what torsion subgroups over $\mathbb{Q}$ can occur in each vertex of a given isogeny graph of elliptic curves defined over the rationals. This is joint work with Álvaro Lozano-Robledo.

The alterations paradigm shift for the problem of resolution of singularities

James Myer (The CUNY Graduate Center) 3:15pm

Heisuke Hironaka solved the problem of resolution of singularities for a variety over a field of characteristic zero in 1964, although the story goes that his proof was so complicated as to stump Alexander Grothendieck! Efforts have been made since then to simplify the proof and see if it can be made to work for positive characteristic, but to no avail.

Regardless of characteristic:

- The singularities of a curve are resolved in one fell swoop by the normalization, a powerful tool hailing from algebra made to work for us in geometry, by Jean-Pierre Serre's Criterion for Normality, and we owe much to Oscar Zariski for teaching us about the normalization.
- Joseph Lipman dealt with surfaces in as much generality as one could hope for.
- Threefolds are rumored to have been handled by Vincent Cossart and Olivier Piltant, although their proof is quite long.
- Fourfolds and up are uncharted territory for the most part.

In his 1996 paper Smoothness, Semi-Stability, and Alterations, Johan de Jong introduces a paradigm shift for solving the problem of resolution of singularities by relaxing a resolution of singularities to what he calls an alteration. The distinction is that a resolution is a birational morphism (generically one-to-one), whereas an alteration is a generically finite morphism (generically finite-to-one). Every variety can be altered to a nonsingular variety regardless of the characteristic. In fact, de Jong's technique paired up with Dan Abramovich's geometric insight yields a proof that every variety over a field of characteristic zero admits a resolution of its singularities in a paper consisting of only twelve pages, see Smoothness, Semi-Stability, and Toroidal Geometry. de Jong's technique relies on (at least) two ingenious ideas:

- The first is the statement that there is a simple blowup of any variety that admits a morphism to a projective space of one less dimension whose fibers are curves ˜intuitively, any variety can be modified to be a family of curves.
- The second is that the curves in the family of curves that results can be marked so as to become stable (in the sense of Pierre Deligne and David Mumford) so that it gives rise to a morphism into the moduli space of stable curves, where we may take advantage of established facts about the moduli space of stable curves, including the fact that its compactification has curves with at-worst nodal singularities.

My talk has the goal of introducing Johan de Jong's paradigm shift, and indicating, to the extent that I can, the idea of the proof that every variety may be altered to a nonsingular variety. An emphasis will be placed on the picture that demonstrates that there is a simple blowup of any variety that admits a morphism to a projective space of one less dimension whose fibers are curves.

Torsion Subgroups of Rational Elliptic Curves over Odd Degree Galois Fields

Caleb McWhorter (Syracuse University) 4:00pm

An elliptic curve, E, is a smooth, projective, algebraic curve of genus one (with a distinguished point). A famous theorem of Mordell-Weil states that if E is defined over a number field K, then $E(K) \cong \mathbb{Z}^r \oplus T$, where r is the rank of the curve and T is the set of torsion points. Recently, there has been an explosion in the progress for classifying torsion subgroups of elliptic curves over number fields. This is especially true for CM elliptic curves and rational elliptic curves. This talk will overview some of the recent progress, and then discuss the possible torsion subgroups for rational elliptic curves base extended to odd degree Galois fields.

K-Theory of Double Points

Noah Riggenbach (Indiana University) 4:45pm

This talk is based on the paper arXiv:2007.01227. In this talk, I will explain how the new methods introduced by Nikolaus and Scholze lead to a recalculation of $K_*(A_d)$, where $A_d := k[x_1, \ldots, x_d]/(x_1, \ldots, x_d)^2$, k a finite field of characteristic $p \neq 2$. This calculation is originally due to Lindenstrauss and McCarthy using completely different methods. If time permits, I will explain how to extend the above calculation to perfectoid rings for $p \neq 2$, at least relatively and after p-completing..

The A-Polynomial and Knot Volume

Marc Schilder (University at Buffalo, SUNY) 5:30pm

The A-polynomial is a knot invariant which has interesting connections to the hyperbolic geometry of a knot exterior, though computing the A-polynomial remains difficult in many cases. I will provide formulas for computing A-polynomials of graph knots, as well as winding number zero satellites of graph knots in terms of other A-polynomials. We then discuss a conjectured relationship between the logarithmic Mahler measure of the A-polynomial and hyperbolic knot volume.

On a geography problem in knot Floer homology

Subhankar Dey (University at Buffalo, SUNY) 6:15pm

We prove that knot Floer homology of a certain class of knots is non-trivial in next-to-top Alexander grading. This gives a partial affirmative answer to a question posed by Baldwin and Vela-Vick which asks if the same is true for all non-trivial knots in S^3.

Seidel spectra and energy of iterated line graphs with only negative eigenvalues -2

B. Parvathalu (Karnatak University's Karnatak Arts College) 9:00am

Graphs with all equal negative eigenvalues are special kind in spectral graph theory. Recently, we have characterized several iterated line graphs $\mathcal{L}^k(G)$ having all negative eigenvalues equal to -2 for $k \geq 1$. Seidel studied strongly regular graphs having the eigenvalue 3 in 1968. Interestingly, if a line graph has the eigenvalue -2 then 3 is the eigenvalue of its Seidel matrix. In this talk, we will discuss Seidel eigenvalues and Seidel energy of iterated line graphs with only negative eigenvalues -2. It is observed that many graphs have exactly two positive Seidel eigenvalues with different multiplicities. On this class of graphs it is to construct Seidel equienergetic graphs which generalize the existing results.

Complementary Equienergetic Graphs

Harishchandra Ramane (Karnatak University) 9:45am

The energy of a graph G, denoted by $\mathcal{E}(G)$, is defined as the sum of the absolute values of the eigenvalues of the adjacency matrix of G. The energy of a graph has a close approximation to the total π-electron energy of a molecule, calculated with Hückel molecular orbital method in quantum chemistry.

Two non-cospectral graphs G_1 and G_2 of same order are said to be equienergetic if $\mathcal{E}(G_1) = \mathcal{E}(G_2)$. Several equienergetic graphs have been designed. A graph G is said to be complementary equienergetic if $\mathcal{E}(G) = \mathcal{E}(\overline{G})$, where $\overline{G}$ is the complement of G. In this paper we designed the graphs, which are complementary equienergetic. Further, we characterized the complementary equienergetic strongly regular graphs.

Duality on collections of subsets

Nathan Uricchio (Syracuse University) 10:30am

A matroid (not to be confused with Metroid or a metoroid) abstracts the notion of linear independence in vector spaces. We'll describe some of the axiomatic definitions of a matroid; in terms of independent sets, bases, and circuits. We will then give a definition for the dual of a matroid and state a fundamental relation between the circuits and cocircuits (circuits of the dual) of a matroid. Expanding on this relation we give a definition of duality on an arbitrary collection of subsets of the ground set E. Lastly, we'll introduce the idea of dual stability and provide a few examples.

The polytope algebra of generalized permutahedra

Jose Bastidas (Cornell University) 11:15am

McMullen endowed the collection of polytopes on a fixed vector space, modulo some "valuation" relations, with the structure of an algebra. The product of this algebra arises from the Minkowski sum of polytopes. In this talk, we will consider the subalgebra generated by the classes of generalized permutahedra and endow it with an additional structure: that of a module over the Tits algebra of the braid arrangement. We fully describe the simple constituents in a composition series of this module and explore its generalization to the "type B" case.

On actions of connected Hopf algebras

Ramy Yammine (Temple University) 12:00pm

Let H be a connected Hopf algebra, over a field of characteristic 0, acting on an algebra A. We investigate the relationship between an ideal I of A and its H-core (I:H), the largest H-stable ideal of A contained in I. We prove that primeness, semiprimeness and complete primeness are preserved.

Origamis Associated to Minimally-Intersecting Filling Pairs

Mark Nieland (Rochester Institute of Technology) 2:45pm

Lochack (2005) defined an *origami* as a surface built from finitely-many squares according to three simple rules: 1) Every left edge is glued to a right edge; 2) Every top edge is glued to a bottom edge; 3) The surface is connected. Such a surface can also be understood as a branched covering space of the torus, ramified over a single point. Let α and β be essential simple closed curves (scc's) on the closed surface S_g of genus g; the pair $\{\alpha, \beta\}$ is a *filling pair* if $S_g \setminus (\alpha \cup \beta)$ is a union of topological disks. It can be shown that, on S_g, the geometric intersection number of a filling pair is at least $2g - 1$. We present a construction that produces a collection of distinct (i.e., mutually-nonhomeomorphic) filling pairs which intersect minimally and naturally give rise to origamis. The number of pairs in this collection grows factorially in g. Joint work with T. Aougab and W. Menasco.

The strange dynamics of non-orientable surfaces

Sayantan Khan (University of Michigan) 3:30pm

A lot of topological and geometric results about compact orientable hyperbolic surfaces carry over with little or no change to the non-orientable setting. However, many theorems of a dynamical flavour, either in their statement, or their proof, are spectacularly different in the non-orientable setting. In this talk, we'll see how the dynamics of the mapping class group action and the Teichmüller geodesic flow differ between the orientable and non-orientable setting, and state some known theorems, as well as open problems.

Algebraic Aspects of Dunkl Theory

Joshua Flynn (University of Connecticut) 4:15pm

In the 80s, C. Dunkl developed a way of obtaining orthogonal polynomials which respect the representation theory and symmetries of a finite Coxeter group associated with a given root system. This theory provided a generalization of spherical harmonics tied to root systems, and eventually found application in, among other things, harmonic analysis on symmetric spaces, hypergeometric function theory, and quantum many-body problems. Moreover, the so-called Dunkl operators in this theory may be realized in the rational degeneration of double affine Hecke algebras. In this talk, I will introduce Dunkl theory and many of its algebraic aspects.

Σ-invariants of Brown-Stein groups

Rob Spahn (University at Albany) 5:00pm

We will begin by defining finiteness properties and discuss some examples. From there we will talk about Thompson's group F and its variation the Brown-Stein group F_S where $S = \{n_1, ..., n_s\}$ for $s \geq 1$. For these groups we will discuss invariants including finiteness properties, finiteness length, and Σ-invariants. We will state conclusive results of Stein on finiteness properties of F_S, and discuss a special case of S used in work of Wladis in which Zaremsky and I can compute the Σ-invariants of F_S. In particular they reveal in this case that every finitely presented normal subgroup of F_S is of type F_∞. We conjecture that the results hold outside the special case as well.

Intermediate rings of complex valued continuous functions

Amrita Acharyya (University of Toledo) 5:45pm

We investigate on the rings $P(X, C)$ that lie between the ring $C^*(X, C)$ of all bounded complex valued continuous functions on a Tychonoff topological space X and the ring $C(X, C)$ of all complex valued continuous functions on X. We found a natural correlation existing between various types of ideals namely absolutely convex ideals/prime ideals/maximal ideals/ z-ideals/ z^0 ideals in the two rings $P(X, C)$ and its real counterpart $P(X, C) \bigcap C(X)$. We exploit this correlation to prove that the set of all maximal ideals of any such ring $P(X, C)$ equipped with the familiar hull-kernel topology is βX, the Stone-Cech compactification of X. For any ideal I of $C(X, C)$. it is realized that the linear sum $C^*(X, C) + I$ is isomorphic to a ring of the type $C(Y, C)$ and furthermore these are the only C-type intermediate rings if and only if X is pseudocompact. If M is a maximal ideal of $C(X, C)$ then the residue class field $C(X, C)/M$ turns out to be an algebraically closed field which is indeed the algebraic closure of $(C(X)/M) \bigcap C(X)$.

Regular relations and quotient Menger hyperalgebras

Thodsaporn Kumduang (Chiang Mai University, Thailand) 9:00am

The paper is devoted to the investigation of algebraic hyperstructures. The concept of Menger hyperalgebras, which is a canonical generalization of semihypergroups, is introduced. The emphasis of this work is on the algebraic nature of such structure concerning subhyperalgebras, homomorphisms and quotient hyperstructures, that allows for a rich algebraic theory

TQ-completion: fibration theorems and connections to functor calculus

Niko Schonsheck (Ohio State University) 9:45am

By considering algebras over an operad $\mathcal{O}$ in one's preferred category of spectra, we can encode various flavors of algebraic structure (e.g. commutative ring spectra). Topological Quillen (TQ) homology is a naturally occurring notion of homology for these objects, with analogies to both singular homology and stabilization of spaces. For a given $\mathcal{O}$-algebra X, there is a canonical way to "glue together" iterates $\mathsf{TQ}^n(X)$ of the TQ-homology spectrum of X to construct "the part of X that TQ-homology sees," namely its TQ-completion. A natural question to ask is, "When can X be 'recovered from' $\mathsf{TQ}(X)$ in this way?" One step towards answering this question is to understand the behavior of fibration sequences under TQ-completion. In this talk, we will discuss just that: a fibration theorem which shows that TQ-completion preserves fibration sequences in which the base and total $\mathcal{O}$-algebra are connected. Time permitting, we will also discuss a few preliminary results that hint towards an intrinsic connection between TQ-completion and the convergence of the Taylor tower of the identity functor in the category of $\mathcal{O}$-algebras.

An operad structure for the Goodwillie derivatives of the identity functor in structured ring spectra

Duncan Clark (Ohio State University) 10:30am

A long standing slogan in Goodwillie's functor calculus is that the derivatives of the identity functor on a suitable model category should come equipped with a natural operad structure. A result of this type was first shown by Ching for the category of based topological spaces. It has long been expected that in the category of algebras over a reduced operad $\mathcal{O}$ of spectra that the derivatives of the identity should be equivalent to $\mathcal{O}$ as operads.

In this talk I will discuss my recent work which give a positive answer to the above conjecture. My method is to induce a "highly homotopy coherent" operad structure on the derivatives of the identity via an pairing of underlying cosimplicial resolutions with respect to the box product. Time permitting, I will also describe how a similar box product pairing may be utilized to provide a new description of an operad structure on the derivatives of the identity in spaces.

On A_∞-comodules over Hopf DG algebras

Dasha Poliakova (University of Copenhagen) 11:15am

For us, a derived algebraic group is a Hopf DG algebra. Then A_∞ comodules over this coalgebra are homotopy representations of our group (firstly this definition was given by Abad-Crainic for non-derived groups). In collaboration with Arkhipov we obtained the subcategory of homotopy characters a model for the homotopy limit of the cosimplicial diagram corresponding to the classifying space construction. Abad-Crainic-Dherin have constructed a monoidal structure on the homotopy category of the DG category of homotopy representations. We expect to enhance their construction to DG level and to obtain a weakly monoidal structure with all the higher coherences.

Gluing DG Categories

Sophia Restad (Kansas State University) 12:00pm

Semi-orthogonal decompositions are an important tool used for breaking down triangulated categories into smaller, more manageable parts. In recent years it has become popular to study triangulated categories via differential graded (dg) enhancements. After some preliminary motivation and definitions, I will introduce the notion of a dg gluing of two dg categories along a bimodule. This is in some sense the analog of a semi-orthogonal decomposition in the dg setting. More precisely, I will show that a dg gluing induces a semi-orthogonal decomposition of the homotopy category; conversely, if a dg-enhanceable triangulated category admits a semi-orthogonal decomposition, that decomposition can be expressed as a dg gluing.

Homotopy groups of equivariant algebraic K-theory

Thomas Brazelton (University of Pennsylvania) 2:45pm

Given a finite group G acting on a ring R, Merling constructed an equivariant algebraic K-theory G-spectrum, and work of Malkiewich and Merling, as well as work of Barwick, provide an interpretation of this construction as a spectral Mackey functor. This construction is highly categorical, and as a result, the Mackey functors comprising the homotopy do not have computationally tractable formulas. In this work, we provide a computation of the homotopy groups of equivariant algebraic K-theory in terms of a purely algebraic construction. In particular, we construct Mackey functors out of the nth algebraic K-groups of group rings whose multiplication is twisted by the group action. Restrictions and transfers for these functors admit a tractable algebraic description in that they arise from restriction and extension of scalars along module categories of twisted group rings. In the case where the group action is trivial, our construction recovers work of Dress and Kuku from the 1980's which constructs Mackey functors out of the algebraic K-theory of group rings.

Conjugacy classes of polystable unimodular commuting matrices over finite fields

Cigole Thomas (George Mason University) 3:30pm

In this talk, I will focus on computing the conjugacy classes of pairs of commuting matrices in $SL_3(\mathbb{F}_q)$ and the cardinality of each conjugacy class where $\mathbb{F}_q$ is a finite field of order q. This result can be generalized to r-tuples of pairwise commuting matrices in $SL_3(\mathbb{F}_q)$. I will end the discussion by mentioning how this gives the E-polynomial of the polystable points in the abelian $SL_3(\mathbb{C})$-character variety of a torus with one boundary component.

Matrix Factorizations

Tim Tribone (Syracuse University) 4:15pm

Originally introduced by Eisenbud in 1980, matrix factorizations have since played an important role in commutative algebra and more specifically in the representation theory of hypersurface rings. The aim of this talk is to give an elementary introduction to the subject, with an emphasis on constructing examples, as well as discuss a generalization for which many questions remain unanswered.

Enumeration of Forman Equivalence Classes on Simplicial Complexes

Andrew Tawfeek (Amherst College) 5:00pm

Discrete Morse theory, a simplicial complex-analogue to smooth Morse theory, has been developed over the past few decades since its original formulation by Forman in 1998. We provide a novel approach to enumerating the Forman equivalence classes of discrete Morse functions on finite simple graphs and explicitly show that their generating function is given by the characteristic polynomial of the graph Laplacian Δ. We then provide a discussion of our current research on generalizing our results to higher-dimensional simplicial complexes and how notions of higher dimensional forests come into play, as well as what can be said about the generating function in the general case.

Infinite-type surfaces and the mapping class group of the plane minus a Cantor set

Garrett Proffitt (Binghamton University) 5:45pm

There have been many recent developments in the study of so-called "big" mapping class groups of infinite-type surfaces. Notably, in 2016, J. Bavard showed that the mapping class group of a plane minus a Cantor set acts by isometry on a certain infinite diameter, Gromov hyperbolic graph. We present her results, including her joint work with A. Walker on the graph's Gromov boundary. Both papers offer new strategies in the study of "big" mapping class groups.

Note: This concludes the conference; thank you for attending!