3rd Upstate New York Topology Seminar

October 22, 2022 at Syracuse University

9:30-10:00	Breakfast (+Additional Registration)
10:00-10:10	Welcome
10:10-11:10	Francesco Lin (Columbia University)
11:10-11:30	Coffee
11:30-12:30	Martina Rovelli (University of Massachusetts - Amherst)
12:30-2:00	Lunch
2:00-3:00	Allison Miller (Swarthmore University)
3:00-3:30	Coffee
3:30-5:30	Parallel Sessions
6:00	Dinner/Reception

*The **main talks** will take place in **Life Sciences Building, Room 105**.

*The **parallel sessions** will take place in the **Carnegie Building (Math Department)**.

Francesco Lin: Monopole Floer homology and theta characteristics

In the past thirty years, Floer theoretic invariants of three-manifolds have had a tremendous success in addressing problems in low-dimensional topology. Despite this, their geometric and topological meaning is still very mysterious. In this talk, I will describe for a special family of fibered three-manifolds an interpretation of the invariants in term of theta characteristics, a classical object of study in the theory of algebraic curves, and discuss some consequences.

Martina Rovelli: Limits and colimits in higher categories

The universal properties of many objects in mathematics are encoded as those of limits and colimits of certain diagrams valued in an ordinary category. With the rising growth of fields that rely on the language of higher categories – such as derived algebraic geometry, higher topos theory, categorification of knot invariants, homotopy type theory – it becomes necessary to develop a useable and consistent theory of limits and colimits for diagrams valued in an n-category or an (∞, n)-category. We'll recall what has been done for $n = 1$, and describe work in progress with Moser and Rasekh towards addressing the case of $n = 2$ or higher.

Allison Miller: Satellite operators and knot concordance

The classical satellite construction associates to any pattern P in a solid torus and companion knot K in the 3-sphere a satellite knot $P(K)$, the image of P when the solid torus is 'tied into' the knot K. This operation descends to a well-defined map on the set of (smooth or topological) concordance classes of knots. We will discuss a number of natural questions about these maps: when are they surjective, injective, or bijective? How do they behave with respect to measures of 4-dimensional complexity? How do they interact with additional group or metric space structure on the concordance set?

Parallel Session Talks

Carnegie 115

3:30 **Malkiewich:** A Farrell-Jones Isomorphism for Scissors Congruence K-theory
4:00 **Slone:** Pullbacks and the Slice Filtration
4:30 **McMahon:** From Cutting Polygons to K-theory

Carnegie 100

3:30 **Thompson:** Knot Polynomials from Quantum Groups
4:00 **Cohen:** The Average Genus of a 2-bridge Knot is Asymptotically Linear
4:30 **Solanki:** Plat Representations of the Unknot
5:00 **Binns:** Cables, Annuli and Link Detection

Carnegie 119

3:30 **Swain:** Idempotents in Quandle Rings
4:00 **Tawfeek:** On Discrete Gradient Vector Fields and Laplacians of Simplicial Complexes
4:30 **Siu:** Detection of Small Cycles in Data by the Scale-Invariant RDAD Filtration

Carnegie 122

3:30 **Ruffoni:** Strict Hyperbolization and Special Cubulation
4:00 **Tshishiku:** Nielsen Realization for 3-manifolds
4:30 **Hozoori:** Symplectic Geometry of Anosov Flows and their Invariant Volume Forms
5:00 **Zeng:** Elliptic Involutive Structures on Smooth Manifolds

	Session 1	**Session 2**	**Session 3**	**Session 4**
	(Room 115)	(Room 100)	(Room 119)	(Room 122)
3:30-3:55	Malkiewich	Thompson	Swain	Ruffoni
4:00-4:25	Slone	Cohen	Tawfeek	Tshishiku
4:30-4:55	McMahon	Solanki	Siu	Hozoori
5:00-5:25		Binns		Zeng

3:30 - 3:55

Carnegie 115
Cary Malkiewich: A Farrell-Jones Isomorphism for Scissors Congruence K-theory

Scissors congruence K-theory is an algebraic object that captures solutions to variants of Hilbert's Third Problem, in other words, when one polytope can be cut into pieces and rearranged to form another. In this talk I will describe a new trace map from scissors congruence K-theory to group homology. It turns out that a refinement of this map provides an inverse to the assembly map, proving the Farrell-Jones isomorphism for this form of K-theory. This allows us to make the first computations of scissors congruence K-theory groups above K_1. Much of this is joint work with Mona Merling and Inna Zakharevich.

Carnegie 100
Benjamin Thompson:
Knot Polynomials from Quantum Groups

The Alexander and Jones polynomials are some of the most well-studied invariants of knots, but where do they come from? A pathway connecting certain deformations of Hopf algebras known as quantum groups to certain embeddings of 1-manifolds known as tangles provides a partial answer. In this expository talk we provide a sketch of this pathway, using the Jones polynomial as an example.

Carnegie 119
Dipali Swain: Idempotents in Quandle Rings

We work on idempotents in quandle rings and relate them with quandle coverings. We prove that integral quandle rings of non-trivial involutory coverings over nice base quandles have infinitely many non-trivial idempotents and give their complete description. We show that the set of all these idempotents forms a quandle in itself. We consider free products of quandles and prove that integral quandle rings of free quandles have only trivial idempotents, giving an infinite family of quandles with this property.

Carnegie 122
Lorenzo Ruffoni: Strict Hyperbolization and Special Cubulation

Gromov introduced some "hyperbolization" procedures, i.e. some procedures that turn a given polyhedron into a space of non-positive curvature. Charney and Davis developed a refined "strict hyperbolization" procedure that outputs a space of strictly negative curvature. This has been used to construct examples of manifolds and groups that exhibit various pathologies, despite having negative curvature. In joint work with J. Lafont, we construct actions of the resulting groups on CAT(0) cube complexes. As an application, we obtain that they are virtually special, hence linear over the integers and residually finite.

4:00 - 4:25

Carnegie 115
Carissa Slone: Pullbacks and the Slice Filtration

The slice filtration focuses on producing certain spectra, called slices, from a genuine G-spectrum X over a finite group G. There are several constructions which inflate a G/N-spectrum $X$to a G-spectrum, which generally do not coincide. We will examine three such constructions, when they coincide, and how this relates to slices of Eilenberg-Mac Lane spectra over C_4 and Q_8

Carnegie 100
Moshe Cohen: The Average Genus of a 2-bridge Knot is Asymptotically Linear

Experimental work suggests that the Seifert genus of a knot grows linearly with respect to the crossing number of the knot. In this article, we use a billiard table model for 2-bridge or rational knots to show that the average genus of a 2-bridge knot with crossing number c asymptotically approaches $\frac{c}{4} + \frac{1}{12}$. This is joint work with Adam Lowrance.

Carnegie 119
Andrew Tawfeek: On Discrete Gradient Vector Fields and Laplacians of Simplicial Complexes

Discrete Morse theory, a cell complex-analog to smooth Morse theory, has been developed over the past few decades since its original formulation by Robin Forman in 1998. In particular, discrete gradient vector fields on simplicial complexes capture important features of discrete Morse functions. We prove that the characteristic polynomials of the Laplacian matrices of a simplicial complex are generating functions for discrete gradient vector fields of discrete Morse functions when the complex is either a graph or a triangulation of an orientable manifold. Furthermore, we provide a full characterization of the correspondence between rooted forests in higher dimensions and discrete gradient vector fields.

Carnegie 122
Bena Tshishiku: Nielsen Realization for 3-manifolds

Given a manifold M, the Nielsen realization problem asks when a finite subgroup of the mapping class group $\mathrm{Mod}(M)$ lifts to the diffeomorphism group $\mathrm{Diff}(M)$ under the natural projection $\mathrm{Diff}(M) \to \mathrm{Mod}(M)$. In this talk we consider the Nielsen realization problem for 3-manifolds and give a solution for subgroups of $\mathrm{Mod}(M)$ generated by sphere twists. This is joint work with Lei Chen.

4:30 - 4:55

Carnegie 115
Elise McMahon: From Cutting Polygons to K-theory

Hilbert's third problem asks when two polytopes can be cut up and the parts rearranged to produce equal polytopes. This notion of equivalence is called "scissors congruence". An invariant of scissors congruence is the Dehn invariant, which is a tensor product of the faces in the polytope and the angles between those faces. Goncherov constructed a cube of iterations of these Dehn invariants, and conjectured that the total cofiber of the cube is related to the complex algebraic K-theory of the isometry group of the underlying space. Johnathan Campbell and Inna Zakharevich constructed a map between them when the underlying geometry is spherical or hyperbolic. My research has been to generalize their work to quadratic spaces of signature (p, q).

Carnegie 100
Deepisha Solanki: Plat Representations of the Unknot

The main result is a version of Birman's theorem about equivalence of plats, which does not involve stabilisation, for the unknot. We introduce the 'pocket move' and the 'flip move' which modify a plat without changing its link type or bridge index. The main result shows that the pocket and the flip moves are the only obstruction to reducing a closed n-plat representative of the unknot to the standard 0-crossing unknot, through a sequence of plats of nonincreasing bridge index.

Carnegie 119
Chunyin (Alex) Siu: Detection of Small Cycles in Data by the Scale-Invariant Robust Density-Aware Distance (RDAD) Filtration

Topological data analysis refers to the analysis of the study the homology of a family of simplicial complexes constructed from a dataset. Traditional wisdom suggests homology classes with big cycles are more important, but in practice, small cycles could be statistically important too. A novel method, namely the use of the Robust Density-Aware Distance (RDAD) filtration, is proposed to distinguish, from noise, small cycles formed by high-density points. The proposed method is robust against additive noise and outliers. In particular, sample points are allowed to be perturbed away from the manifold. Significance of homology classes may be estimated by bootstrapping. Small cycles are promoted by weighting the distance function by the density in the sense of Bell et al. Distance-to-measure is incorporated to enhance stability and mitigate noise due to the density estimation. In the talk, I will discuss different properties of the proposed method with synthetic and real-world examples. The talk is based on the work atDetection of Small Holes by the Scale-Invariant Robust Density-Aware Distance (RDAD) Filtration https://export.arxiv.org/abs/2204.07821.

Carnegie 122
Surena Hozoori: Symplectic Geometry of Anosov Flows and their Invariant Volume Forms

Since their introduction in the early 1960s, Anosov flows have defined an important class of dynamics, thanks to their many interesting chaotic features and rigidity properties. Moreover, their topological aspects have been deeply explored, in particular in low dimensions, thanks to the use of foliation theory in their study. Although the connection of Anosov flows to contact and symplectic geometry was noted in the mid 1990s by Mitsumatsu and Eliashberg-Thurston, such interplay has been left mostly unexplored. I will present some recent results on the contact and symplectic geometric aspects of Anosov flows in dimension 3, including in the presence of an invariant volume form, which is known to have grave consequences for the dynamics of these flows. Time permitting, the interplay of Anosov flows with Reeb dynamics, Liouville geometry and surgery theory will be briefly discussed as well.

5:00 - 5:25

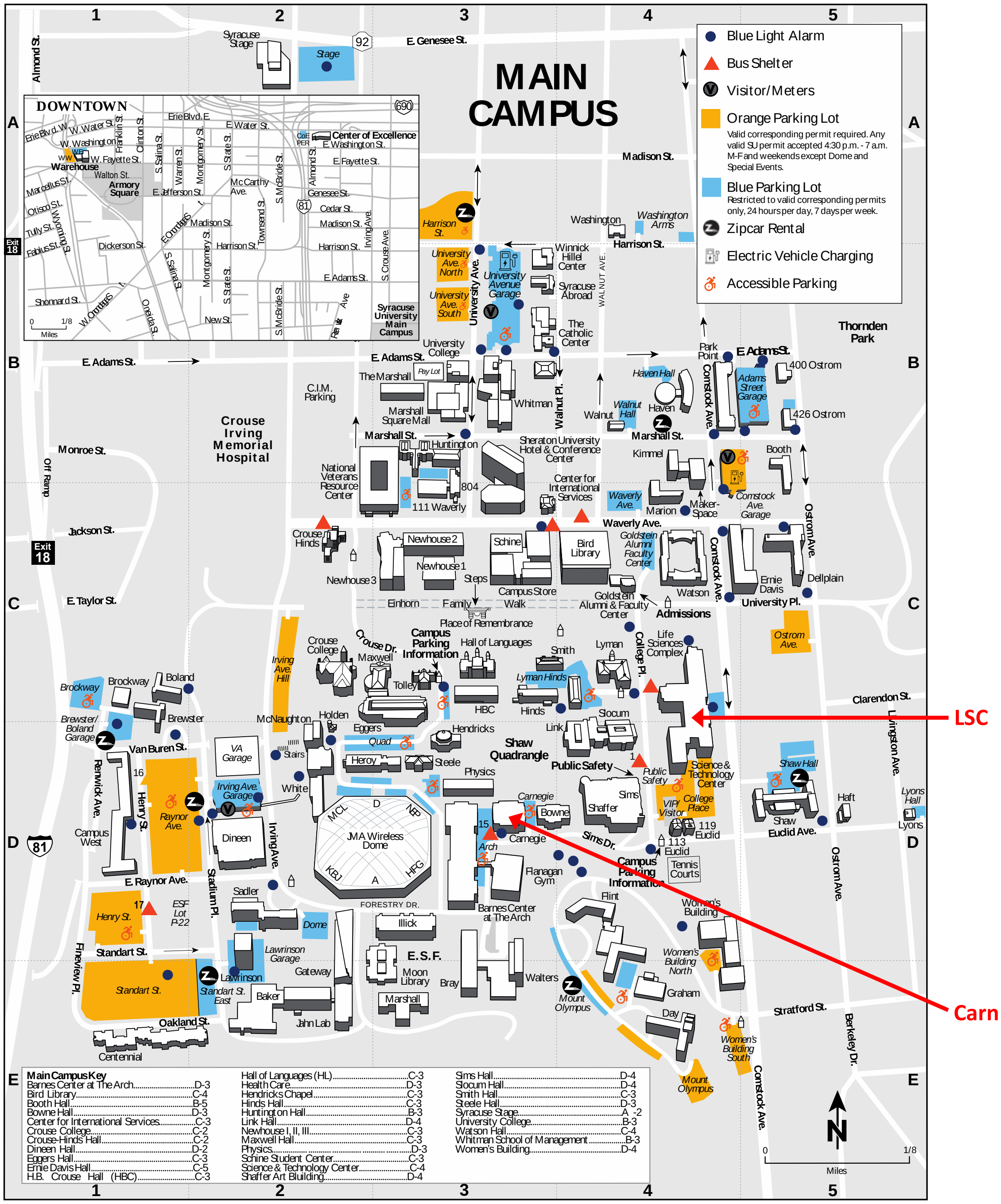
Carnegie 100
Fraser Binns: Cables, Annuli and Link Detection

Knot Floer homology is a powerful link invariant due independently to Ozsváth-Szabó and J.Rasmussen. In this talk I will discuss recent work with Subhankar Dey showing that knot Floer homology is indeed powerful enough to detect various families of links, including $(2, 2n)$-cables of the right handed trefoil, for n at least 2.

Carnegie 122
Andy Zeng: Elliptic Involutive Structures on Smooth Manifolds

Elliptic Involutive Structures (EIS) are interpolations between two most important involutive structures: complex structures and foliations. In this talk, we will define modules over EIS and show equivalence of $\overline{\partial}$-V coherent sheaves over EIS and cohesive modules introduced by J. Block, and investigate how to use EIS to study the topology of smooth manifolds.

Campus Map



The main talks will take place in the Life Sciences Center (Room 105) and the parallel sessions in the Carnegie Building. An interactive map is available at www.syracuse.edu/about/map/

Parking

Parking on main campus is free on weekends and does not require a visitor pass. We recommend that you use the College Place Lot south of the Life Sciences Center. More parking space is available on Carnegie Lot (between Carnegie and Bowne) and on Quad 1 (south of Eggers Hall).