Union College Math Conference: ALGEBRAIC TOPOLOGY/UNYTS

SEPTEMBER 18–20, 2026

Friday program

4:30–5:30pm: Reception and registration (Olin Rotunda)

5:30–6:30pm: Plenary talk I: Carina Curto: *Network Dominoes: Composable Building Blocks for Recurrent Networks* (Olin 115)

Saturday program

8:00–9:00am: Registration, coffee & light breakfast (Bailey 204)

9:00–10:30am: Session I (Bailey 207)

- 9:00–9:25 Kimball Strong: *Whitehead Products as Higher Eckmann-Hilton Arguments*
- 9:30–9:55 Valentina Zapata Castro: *The Combinatorics of Model Structures*
- 10:00–10:25 Arash Karimi: *Mac Lane ∞-Cubes*

10:30–11:00am: Coffee break (Olin Rotunda)

11:00am–12:00pm: Plenary talk II: Kristine Bauer: *The Categorical Derivative in Functor Calculus* (Olin 115)

12:00–1:30pm: Lunch break

1:30–3:30pm: Session II (Bailey 207)

- 1:30–1:55 Eleftherios Chatzitheodoridis: *Trees Associated with Unitary Partition Complexes*
- 2:00–2:25 Denali Relles: *An Indexed Monoidal Category of Global Equivariant Spectra*
- 2:30–2:55 Lorenzo Riva: *Decospanification*
- 3:00–3:25 Alexandra Ballow: *Hochschild Homology of Reedy Categories*

3:30–4:00pm: Coffee break (Olin Rotunda)

4:00–5:00pm: Plenary talk III: Julie Blackwood: *Nonlinear Leslie Matrix Models Across Scales: From the Evolution of Bird Song to Cicada Emergence* (Olin 115)

5:00–6:00pm: Reception (Olin Rotunda)

Sunday program

8:00–8:30am: Coffee & light breakfast (Bailey 204)

9:00–10:30am: Session III (Bailey 207)

- 9:00–9:25 David White: *When is a Model Category Equivalent to a Diagram Category?*
- 9:30–9:55 Elizabeth Tatum: *K-Theory Cooperations in Motivic and Equivariant Homotopy*
- 10:00–10:25 Krishnendu Kar: *Computing Khovanov Stable Homotopy Types by Iterated Homotopy Pushouts*

10:30–11:00am: Coffee break (Olin Rotunda)

11:00am–12:00pm: Plenary talk IV: Lan-Hsuan Huang: *Bartnik's Quasi-Local Mass in General Relativity* (Olin 115)

12:00–1:30pm: Lunch break

1:30–2:30pm: Session IV (Bailey 207)

- 1:30–1:55 Pedro Brunialti: *Involutions on (∞, n)-Categories of Bordisms*
- 2:00–2:25 Andrew Gill: *Thomason's Homotopy Colimit Theorem for Double Categories of Elements*

Abstracts

Kristine Bauer (University of Calgary)
Plenary talk: *The Categorical Derivative in Functor Calculus*
In algebraic topology and elsewhere in mathematics, functors serve as invariants: they let us tell objects apart even when those objects are linked by weak equivalences, which can otherwise obscure genuine differences. Such functorial invariants are frequently very hard to compute. Functor calculus, introduced by Goodwillie in the 1990s, gives a systematic way to attack this problem: to a functor it assigns a sequence of "degree n" approximations, in close analogy with the Taylor polynomials of a function of a real variable.

Given how far the analogy with Taylor series reaches, it is natural to ask whether functor calculus is genuinely an instance of some general notion of calculus. In this talk I will describe one precise answer. Category theorists — Blute, Cockett, Cruttwell, Rosický, Seely, and others — have developed an axiomatic theory of differentiation that generalizes the derivative of a smooth map between manifolds, organized around the notions of cartesian differential category and tangent category. Bauer, Johnson, Osborne, Riehl, and Tebbe showed that abelian functor calculus (one of several varieties of the theory) supplies the derivative making the category of abelian categories a cartesian differential category, up to homotopy. Building on this, Bauer, Burke, and Ching showed that the Goodwillie derivative provides exactly the structure needed to exhibit the ∞-category of ∞-categories as a tangent ∞-category.

I will give enough background on functor calculus and on these categorical notions, with examples throughout, to keep the talk accessible to a general mathematical audience.

Alexandra Ballow (Montana State University)
Hochschild Homology of Reedy Categories
The Dold-Kan correspondence establishes a relationship between Hochschild homology and the factorization homology over the circle. This relationship can be leveraged to define the Hochschild homology of a category. We will motive this definition in more depth before calculating the Hochschild homology of the category of finite sets (Fin). We will see that this calculation only relies on the (generalized) Reedy structure of Fin. We can therefore quickly calculate the Hochschild homology of other Reedy categories such as the simplex category or the category of finite vectorspaces.

Pedro Brunialti (University of Virginia)
Involutions on (∞, n)-Categories of Bordisms
Formally, a topological quantum field theory (TQFT) is a symmetric monoidal functor from a category of bordisms into an appropriate target category. Depending on the choice of category of bordisms, we have extra structure that is compatible with the monoidal structure, namely we can have involutions. By involution, we mean a $\mathbb{Z}/2$ action on the bordism category which is compatible with the monoidal structure. In this talk, I will outline how to get these actions on the (∞, n)-categories of bordisms defined by Calaque and Scheimbauer, and I will explain how these actions relate to reflection TQFTs in the sense of Freed and Hopkins.

Eleftherios Chatzitheodoridis (Virginia Commonwealth University)
Trees Associated with Unitary Partition Complexes
In a recent paper, Heuts and Moerdijk develop a poset of trees whose classifying space is homotopy equivalent to the n-th partition complex, that is, the classifying space of the poset of partitions of a set with n elements. The latter poset features in work of Arone, Dwyer, and Lesh, and it finds a unitary analog introduced by Arone and Lesh. In joint work with Julie Bergner, Pedro Brunialti Lima de Andrade, and Josh Turner, we develop a topological poset of trees whose classifying space is homotopy equivalent to the n-th unitary partition complex, that is, the classifying space of the topological poset of partitions of n-dimensional complex space in pairwise orthogonal subspaces. Our work builds on the study of unitary partition complexes by Bergner, Joachimi, Lesh, Stojanoska, and Wickelgren, and it also entails some new results in the theory of topological categories that may be of independent interest.

Andrew Gill (Cornell University)
Thomason's Homotopy Colimit Theorem for Double Categories of Elements
Thomason's homotopy colimit theorem provides a categorical tool for calculating the homotopy colimit of a functor $\mathcal{C} \to \mathbf{Cat}^{\mathrm{op}}$: instead of directly calculating the homotopy colimit, we may equivalently compute the nerve of the functor's category of elements. Generalizing this to a 2-functor into $\mathbf{Cat}^{\mathrm{op}}$, we have a similar "recipe" for homotopy colimits, this time involving the functor's 2-category of elements. Unfortunately, the 2-category of elements lacks some desirable properties of the 1-dimensional category of elements. In this talk we will discuss the existing homotopy colimit theorems, then demonstrate an alternative homotopy colimit theorem for 2-functors, replacing the 2-category of elements with the better-behaved double category of elements.

Krishnendu Kar (Louisian State University)
Computing Khovanov Stable Homotopy Types by Iterated Homotopy Pushouts
Khovanov spectra refine Khovanov homology to the level of stable homotopy theory: each link determines a spectrum whose cohomology recovers its Khovanov homology. In their paper *Khovanov homotopy type, Burnside category, and products*, Lawson, Lipshitz, and Sarkar realize this spectrum as the total homotopy cofiber of a cube-shaped homotopy-coherent diagram of spaces/spectra built from a link diagram. In this talk I recast their construction through punctured cubes and iterated homotopy pushouts, using the cubical homotopy theory, the total cofiber and iterated pushout formula of Munson and Volić. Working through explicit examples, I show that the resulting spectra can be assembled by gluing spheres along a handful of elementary maps: identities, pinches, and folds. The reformulation turns the stable homotopy type underlying Khovanov homology into something concrete and computable, and brings the topology of individual quantum gradings directly within reach.

Arash Karimi (Florida State University)
Mac Lane ∞-Cubes
We extend McCarthy's Q-construction from exact categories to exact ∞-categories. McCarthy's construction uses iterated S_2-constructions to form cubical diagrams whose face maps determine a chain complex related to the spectrum homology of algebraic K-theory. For an exact ∞-category $\mathcal{C}$, we define $S_2^{(n)}(\mathcal{C})$ as an ∞-category of exact n-cubes and prove that it is exact and naturally equivalent to the n-fold iteration of S_2. Given a functor $F : \mathrm{Exact}_\infty \to \mathcal{A}$, where $\mathcal{A}$ is stable, we construct a coherent chain complex by introducing a filtered object built from cubical skeleta. When $\mathcal{A}$ has a t-structure, the associated chain complex in its heart recovers the classical chain complex introduced by Mac Lane in the ordinary categorical setting. We conclude the talk with several relevant examples and applications.

Denali Relles (Vanderbilt University)
An Indexed Monoidal Category of Global Equivariant Spectra
Duality is an important notion across mathematics, including in stable homotopy theory. Ponto and Shulman investigate types of duality that can occur in the context of indexed categories. We apply their framework to an indexed category of spectra with group action indexed on the category of finite groups. It turns out to be more convenient to work with global equivariant homotopy categories, so as part of our work we construct global equivariant model structures on the categories of spectra with group actions, following Lenz.

Lorenzo Riva (Harvard University, CMSA)
Decospanification
For any n, there is a construction that takes as input an ∞-category C with pushouts and outputs an (∞, n)-category $\mathrm{Cospan}^n(C)$: its k-morphisms are cospans between cospans between …between cospans in C, and composition is given by taking iterated pushouts. To date, this "cospanification" is one of the few procedures that allow us to construct (∞, n)-categories from reasonably manageable data. In this talk we will explore a reverse operation, tentatively called "decospanification", which takes an (∞, n)-category to an ∞-category with (some) pushouts from which the original higher category can be recovored by taking iterated cospans. In short, we are giving a new model for (∞, n)-category. Time permitting we will also cover monoidal structures, the n-category of bordisms, and applications to the cobordism hypothesis.

Kimball Strong (Cornell University)
Whitehead Products as Higher Eckmann-Hilton Arguments
The Eckmann-Hilton argument asserts that if two monoid operations on a set distribute over each other, then they must be identical and abelian. Its most common usage is in a slick proof that for any space X, the homotopy group $\pi_2(X)$ is abelian. When one works with explicit maps and keeps track of particular homotopies between them, we find that for any two $\alpha, \beta : S^2 \to X$, a topologized Eckmann-Hilton argument produces an element of $\pi_3(X)$. In this talk, we will explain how this homotopy recovers the Whitehead bracket $[\alpha, \beta]$. Then, we will explain how to use the E_n-algebra structure on the n-fold loop space $\Omega^n X$ to write arbitrary Whitehead brackets in $\pi_*(X)$ as "higher Eckmann-Hilton arguments," and comment on why one might view all the resulting homotopy group elements as "coherence laws in ∞-groupoids."

Elizabeth Tatum (University of Rochester)
K-Theory Cooperations in Motivic and Equivariant Homotopy
In the 1980s, Mahowald and Kane used integral Brown-Gitler spectra to construct splittings of the cooperations algebras for ko, connective real K-theory, and ku, connective complex K-theory. These splittings helped make it feasible to do computations using the ko-and ku-based Adams spectral sequences.

These spectral sequences have proven to be powerful tools for better understanding the structure of the stable homotopy groups of the sphere, with a variety of interesting applications. For example, Mahowald used them to verify the Telescope Conjecture at height one, and Gonzalez later used them to classify stunted lens spaces. In this talk, I will discuss progress towards developing analogues of these tools in the C_2-equivariant and motivic settings. This is joint work with Guchuan Li, Jackson Morris, and Sarah Petersen.

David White (Queen's University)
When is a Model Category Equivalent to a Diagram Category?
Building on work of Marta Bunge in the one-categorical case, we characterize when a given model category is Quillen equivalent to a presheaf category with the projective model structure. This involves introducing a notion of homotopy atoms, generalizing the orbits of Dwyer and Kan. Apart from the orbit model structures of Dwyer and Kan, our examples include the classification of stable model categories after Schwede and Shipley, isovariant homotopy theory after Yeakel, and Cat-enriched homotopy theory after Gu. As an application, we give a classification of polynomial functors (in the sense of Goodwillie calculus) from finite pointed simplicial sets to spectra, and compare it to the previous work by Arone and Ching. This is joint work with Boris Chorny.

Valentina Zapata Castro (University of Massachusetts Amherst)
The Combinatorics of Model Structures
Model categories provide a powerful framework for doing homotopy theory in abstract mathematical settings, but extracting a full model structure on an arbitrary category often requires navigating a large amount of structure: three interacting classes of morphisms, multiple lifting and factorization axioms, and subtle coherence conditions. In contrast, posets offer a combinatorial environment where these complexities become more transparent while still retaining rich homotopical behavior.

In this talk, I will discuss recent work aimed at understanding exactly which model structures can arise on finite posets. We characterize the possible choices of weak equivalences

and show how transfer systems from homotopical combinatorics can be used to describe the corresponding homotopical structure. This perspective leads to a complete description of the model structures supported by a given poset. If time permits, I will also discuss recent results on left and right Bousfield localizations and how they interact with these model structures.