Group Symmetries and Equivariance in Algebra, Descent, Geometry, and Topology
Symétries de groupes et équivariance en algèbre, descente, géométrie et topologie
(Org: **Dorette Pronk**, **Deni Salja** and/et **Geoff Vooys** (Dalhousie University))

EMILY CLIFF, Université de Sherbrooke
Principal 2-group bundles and applications

A 2-group is a categorical generalization of a group: it's a category with a multiplication operation which satisfies the usual group axioms only up to coherent isomorphisms. A smooth 2-group is a categorical generalization of a Lie group. I will define principal bundles for such a smooth 2-group, and provide classification results that allow us work concretely with explicit bicategories of 2-group bundles. I will discuss applications of these ideas to the study of string structures and to Chern-Simons theory (in progress). This talk is based on joint work with Dan Berwick-Evans, Laura Murray, Apurva Nakade, and Emma Phillips.

ROBIN COCKETT, University of Calgary
Moore-Penrose Inverses in Dagger Categories

The notion of a Moore-Penrose inverse (M-P inverse) was introduced by Moore in 1920 and rediscovered by Penrose in 1955. The M-P inverse of a complex matrix is a special type of inverse which is unique, always exists, and can be computed using singular value decomposition. In a series of papers in the 1980s, Puystjens and Robinson studied M-P inverses more abstractly in the context of dagger categories. Despite the fact that dagger categories are now a fundamental notion in categorical quantum mechanics, the notion of a M-P inverse has not (to our knowledge) been revisited since their work. Thus, the purpose of this presentation is to recall and renew the study of M-P inverses in dagger categories.

(Joint work with Jean-Simon Lemay)

NICOLE KITT, University of Waterloo
Characterization of Cofree Representations of SL$_n \times$ SL$_m$

Given a finite dimensional representation V/k of a group G, we consider the space $k[V]^G$ of all polynomial functions which are invariant under the action of G. At its heart, invariant theory is the study of $k[V]^G$ and its interactions with $k[V]$. We are particularly interested in the situation where $k[V]$ is free as a $k[V]^G$-module, which is equivalent to V/G being smooth and the quotient map $V \to V/G$ behaving as nicely as possible. We call such representations *cofree*. The classification of cofree representations is a motivating problem for a field of research that has been active for over 70 years. In the case when G is finite, the Chevalley-Shephard-Todd theorem says that V is cofree iff G is generated by pseudoreflections. Several classifications of cofree representations have been found for certain connected reductive groups, but unlike the Chevalley-Shepard-Todd theorem, these results consist of a list of cofree representations, rather than a general group-theoretic characterization. In 2020, D. Edidin, M. Satriano, and S. Whitehead stated a conjecture which intrinsically characterizes irreducible cofree representations of connected semisimple groups and verified it for simple Lie groups and tori. In this talk, we will discuss this conjecture and the work towards verifying it for SL$_n \times$ SL$_m$.

JONATHAN SCOTT, Cleveland State University
Algebraic Factorization of Chain Algebra Morphisms

The algebraic factorization systems of Riehl provide for functorial solutions to the lifting problem in a given model category. Using a modified small objects argument, Riehl showed that any model category satisfying mild hypotheses has such a system. We will provide explicit constructions, using reasonably elementary techniques, of algebraic factorization systems for the category of chain (i.e. differential graded) algebras.

Our construction requires the use of strong homotopy morphisms in a fundamental way. Furthermore, we will discuss how our construc- tions may be carried out for algebras and coalgebras over an arbitrary Koszul operad/cooperad pair.

This is joint work with Kathryn Hess (EPFL) and Paul-Eugène Parent (U Ottawa).

JAMES STEELE, University of Calgary

Equivariant cohomology and the categorical local Langlands correspondence

The p-adic local Langlands correspondence currently posits a relationship between sets of simple objects of **Rep**(G), the category of smooth representations of a connected, reductive, p-adic group G, with sets of so-called Langlands parameters. In this talk, we discuss a conjectural interpretation of this correspondence given by a Koszul-like, algebraic relationship between certain full subcategories of **Rep**(G) and the equivariant cohomology of a geometerization of Langlands parameters. Furthermore, we demonstrate the implications that the conjecture has for the p-adic analogue of the Kazhdan-Lusztig conjecture.

JEAN-BAPTISTE VIENNEY, University of Ottawa

JORDAN WATTS, Central Michigan University

Weak equivalences between action groupoids

A result of Pronk and Scull states that a weak equivalence between two representable orbifold groupoids is isomorphic to the composition of weak equivalences given by a "quotient functor" and an "inclusion functor". Here, the bicategory within which the result holds is the localisation of representable orbifold groupoids at weak equivalences. This result was proved in two steps: the first shows that the weak equivalence is isomorphic to an equivariant one, and the second is the decomposition into the two special functors. In this talk, we generalise this result to the bicategory of action Lie groupoids for Lie group actions that satisfy any subset of the following properties: free, locally free, transitive, compact, discrete, or proper. This is joint work with Carla Farsi and Laura Scull.