Workshop on Loop space and Higher category

Title and Abstract

- **Daniel Berwick-Evans**
  Title: The geometry of twisted equivariant K-theory and elliptic cohomology
  Abstract: The language of twisted equivariant K-theory concisely describes fundamental objects in representation theory, differential geometry, mathematical physics, and analysis. Twisted equivariant elliptic cohomology is a generalization that is expected to illuminate even deeper connections between these areas. Although a complete picture has yet to emerge, higher-categorical symmetries are known to play an important role. This talk will revisit the geometry of twisted equivariant K-theory before describing some features of twists in equivariant elliptic cohomology. This is based on joint work with Emily Cliff, Meng Guo, Laura Murray, and Arnav Tripathy.

- **Severin Bunk**
  Title: Two-dimensional parallel transport and symmetries for categorified line bundles
  Abstract: A line bundle is a smooth assignment of a one-dimensional vector space to each point in a manifold. Bundle gerbes are a categorification of this principle: one can think of them as assigning to each point a one-dimensional 2-vector space. In this talk I will discuss a description of the parallel transport for bundle gerbes with connection and its relation to the transgression of bundle gerbes to the free loop space of the base manifold. In the context of symmetry groups acting on the base manifold this has interesting applications to non-associative magnetic translations in physics and the String group in topology.

- **Chi-Kwong Fok**
  Title: Equvariant twisted KK-theory of noncompact Lie groups
  Abstract: The Freed-Hopkins-Teleman Theorem asserts a canonical link between the equivariant twisted K-theory of a compact Lie group equipped with the conjugation action by itself and the representation theory of its loop group. Motivated by this, we will present results on the equivariant twisted KK-theory of a noncompact semisimple Lie group G. We will give a geometric description of generators of the equivariant twisted KK-theory of G with equivariant correspondences, which are applied to formulate the geometric quantization of quasi-Hamiltonian manifolds with proper G-actions. We will also show that the Baum-Connes assembly map for the C^*-algebra of sections of the Dixmier-Douady bundle which realizes the twist is an isomorphism, and discuss a conjecture on representations of the loop group LG. This talk is based on joint work with Mathai Varghese.

- **Derek Krepski**
  Title: Bundles gerbes and Lie 2-algebras in 2-plectic geometry
  Abstract: In this talk, we'll review the notion of a bundle gerbe on a manifold M, and show how multiplicative vector fields naturally model the infinitesimal symmetries of bundle gerbes. These infinitesimal symmetries form Lie 2-algebras that are closely related to Lie 2-algebras appearing in 2-plectic geometry—namely, the Poisson Lie 2-algebra of observables on a 2-plectic manifold (M, χ), where χ is a closed 3-form, and the Lie 2-algebra associated to the χ-twisted Courant algebroid on M.

- **Peter Kristel**
  Title: Approaching string geometry through loop spaces
  Abstract: I will introduce the idea of string geometry, using motivation from both geometry and physics. Then, I will explain how quantization of the free fermionic string can be approached through string geometry. In particular, the basic central extension of the loop group of $Spin(d)$ arises naturally in this setting. Moreover, this leads to a "fusive" spinor bundle on loop space, which fits neatly in the general philosophy that higher geometrical objects on a manifold M can be described in terms of "fusive" geometry on the loop space LM.

- **Matthias Ludewig**
  Title: The stringor bundle of a string manifold
  Abstract: A spinor bundle on the loop space of a Riemannian spin manifold can be constructed

if the loop space is "spin", meaning that its structure group $LSpin(d)$ lifts to its universal central extension. This is equivalent to the condition that the transgression of the fractional Pontrjagin class $\frac{p_1}{2}$ vanishes. In this talk, we show that — as predicted in a famous 2005 preprint of Stolz and Teichner — the vanishing of this class itself (i.e., the "string" condition on M) is equivalent to the existence of another structure, called fusion product, on the spinor bundle. We explain how this structure allows to regress the spinor bundle to a higher structure — a 2-vector bundle — on M, called the stringor bundle. This uses the language of 2-vector bundles recently developed together with Kristel and Waldorf.

- **Urs Schreiber**
  Title: Cyclic loop spaces via higher topos theory in high energy physics
  Abstract: One may observe [CMP 371 (2019)] that the construction of cyclified ("twisted") free loop spaces, when regarded in higher topos theory, turns out to be nothing but the "right base change" to the context of the moduli stack of the circle. This fundamental fact implies at once good formal properties and lifts the construction to all kinds of higher generalized geometries, such as to orbifolds – where we claim it reproduces Z. Huan's inertia construction –, and to super-rational homotopy types – where we showed that it witnesses the rules of topological T-duality acting on the super D-brane charges. I explain how these cyclified loop stack adjunctions formalize exactly what physicists mean by "double dimensional reduction" in its effect on brane charges/fluxes; and I close with an outlook on using these insights to define T-folds in the generality of twisted equivariant differential (TED) KR-theory. This is joint work with Hisham Sati. Slides will be available at: `http://ncatlab.org/schreiber/show/cyclic+loop+spaces+2022`

- **Konrad Waldorf**
  Title: Transgression of higher structures to loop spaces
  Abstract: Transgression is a duality between higher structure on a manifold M and lower, typically infinite-dimensional structure on the loop space LM. I will talk about the motivation of transgression, and discuss some examples and applications.