Exploring new arrows in the BGW-groupoid

Higher structures PhD retreat

Book of Abstracts

Bielefeld, Germany
25th – 28th of October, 2024

Contents

1 Scientific Program Schedule

Time	Friday 25.10.24	Saturday 26.10.24	Sunday 27.10.24	Monday 28.10.24
08:00-09-30		Breakfast	Breakfast	Breakfast
09:30-10:30		Lory Aintablian	Annika Tarnowsky	Round table discussion
10:30-11:00		Questions	Questions	
11:00 -12:00		David Miyamoto	Hao Xu	Closing
12:00-12:30		Questions	Questions	
12:30-13:30		Lunch	Lunch	
13:30-14:30		Social activity & Free Discussion	Milena Weiershausen	
14:30-15:00			Questions	
15:00-15:30			Break	
15:30-16:00		Tea and cake	Tea and cake	
16:00-17:00		Short talks	Kalin Krishna	
17:00-17:30			Questions	
17:30-18:00		Individual Mentoring	Mentoring	
18:00-18:30	Opening			
18:30-19:30	Dinner	Dinner	Dinner	
19:30-20:00	Break	Break		
20:00-21:00	Welcome Group mentoring	Individual mentoring		

2 Abstracts: 1 hour talks

2.1 Differentiable groupoids and their abstract Lie algebroids

Speaker: Lory Aintablian
Abstract: The infinitesimal counterpart of a Lie group(oid) is its Lie algebra(oid). I will show that the differentiation procedure works in any category with an abstract tangent structure in the sense of Rosicky. Mainly, I will construct the abstract Lie algebroid of a differentiable groupoid in a cartesian tangent category C with a scalar R-multiplication, where R is a ring object in C. Examples include differentiation of infinite-dimensional Lie groups, elastic diffeological groupoids, etc. This is joint work with Christian Blohmann.

2.2 A diffeological approach to integrating Lie algebras

Speaker: David Miyamoto
Abstract: By Lie's third theorem, a Lie algebra integrates to a Lie group if it is finite-dimensional. This otherwise fails; there are even Banach Lie algebras without an integrating Banach Lie group. However, these Lie algebras often integrate to *elastic diffeological* groups. In this talk, we will show how the tangent category of Banach (more generally convenient, in the sense of Frölicher, Kriegl, and Michor) manifolds embeds into the tangent category of elastic diffeological spaces, and how this embedding allows us to integrate certain Banach Lie algebras. This is joint work-in-progress with Christian Blohmann.

2.3 Computing Differentiable Stack Cohomology

Speaker: Annika Tarnowsky
Abstract: Differentiable stacks describe geometric spaces more general than manifolds: orbifolds, classifying spaces and many moduli spaces can be expressed in their framework. The cohomology (with real coefficients) of a differentiable stack can be interpreted as a generalisation of equivariant cohomology, meaning that in special cases, there are efficient models, the Weil and Cartan models, to compute it. In my PhD project, I have studied how to use and adapt these existing methods to compute differentiable stack cohomology for a certain class of differentiable stacks that are related to proper and regular Lie groupoids. In my talk, I will survey the progress of my research with respect to both results and difficulties that have emerged.

2.4 Character Theory for Finite 2-Groups

Speaker: Hao Xu
Abstract: The character plays an important role in the representation theory of finite groups. In this talk, I will introduce the notion of 2-character of 2-representations of a finite 2-group $\mathcal{G}$. The conjugation invariance implies that the 2-characters can be viewed as objects in the Drinfeld center $\mathcal{Z}_1(\mathbf{Vect}_{\mathcal{G}})$. I will also introduce a topological quantum field theory (TQFT) point of view on the 2-characters and show that they are Lagrangian algebras in $\mathcal{Z}_1(\mathbf{Vect}_{\mathcal{G}})$. If time permits, I will also discuss the orthogonality of 2-characters, which categorifies the classical orthogonality of characters. This talk is based on arXiv:2404.01162, joint with Mo Huang and Zhi-Hao Zhang.

2.5 Shifted Symplectic Lie n-Groupoids

Speaker: Milena Weiershausen
Abstract: After a reminder on Lie groupoids, stacks, and simplicial Lie n-groupoids as back-

ground, I will describe shifted symplectic Lie n-groupoids based on the article by Miquel Cueca and Chenchang Zhu. This will lead me to talk about the current goals in my master thesis:

(1) Writing down a proof for the invariance of shifted symplectic structures under Morita equivalence.

(2) Constructing a shifted symplectic model for the classifying stack BG that uses the free loop group LG instead of based loops.

2.6 Bundles Bundles Everywhere

Speaker: Kalin Krishna

Abstract: Principal bundles play a fundamental role in differential geometry, topology, and gauge theory, providing a framework for understanding symmetry and connections on manifolds. However, when extending to higher categorical settings, new structures, such as principal 2-bundles, or principal n-bundles emerge. These higher bundles allow us to capture more intricate geometric and information. By extending classical theory, higher principal bundles provide a richer framework for understanding symmetries and fields, which are crucial in areas like string theory and the study of higher structures. We will discuss various definitions of higher principal bundles in its different incarnations. We will also provide a way of generalizing all of them in a single framework. We will also touch up on some ongoing projects to understand the notion of higher connection on these principal bundles.

3   Short talks

3.1   Tate K-theory and transgression of 2-vector bundles.

Speaker: Alessandro Nanto

Abstract: Recently, Konrad Waldorf started a project aiming at using the language of vector 2-bundles to describe cohomology classes in Tate K-theory, an example of elliptic cohomology. This project is inspired, among other things, by the work of Brylinski, who showed that one can construct classes in Tate K-theory of a manifold X, by looking at vector bundles over its loop space LX together with an action by the Virasoro group which is compatible with the action by order preserving diffeomorphisms of S^1 on LX. In my talk, I'll briefly present my tasks within this project and what results we expect in the end.

3.2   PB-groupoids vs VB-groupoids

Speaker: Francesco Cattafi

Abstract: It is well known that the collection of linear frames of a smooth n-manifold M defines a principal $GL(n)$-bundle over M (called the frame bundle); more generally, this construction makes sense for any vector bundle over M. Conversely, any principal bundle together with a representation induces an associated vector bundle; these processes establish therefore a correspondence between vector bundles on one side, and principal bundles with representations on the other side. In this short talk, I will quickly recall the notions mentioned above and sketch how to associate to any given vector bundle groupoid (VB-groupoid) a diagram of Lie groupoids and principal bundles, together with the action of a (strict) Lie 2-groupoid $GL(l,k)$; this will lead to the general notion of a principal bundle groupoid (PB-groupoid) and to the correspondence between VB-groupoids and PB-groupoids. This is joint work with Alfonso Garmendia.

3.3 The map of my Mathematical Research

Speaker: Oscar Cosserat
Abstract: I will sketch in a few minutes the interactions occurring in between my different research fields.

3.4 Cutting vs Glueing

Speaker: David Aretz
Abstract: In this expository talk I will show how all kinds of bordism categories can naturally be defined in terms of cutting laws. This will naturally lead us to introduce Segal spaces as a model for higher categories.

4 Mentoring sessions

For this retreat, each attendee has been assigned one of Christian, Madeleine, Ioan, or Chenchang as a mentor. We have scheduled a sub-group mentoring session, and individual mentoring sessions. Participation in each session is entirely voluntary.

We do not specify a singular purpose or topic for these sessions. Instead, for your inspiration we give below some possible discussion points, some general and some [specific].

Jobs

- How, where, and when to apply?

- How to determine if a job is suitable for me?

- What are the strengths or weaknesses of my CV?

- What are the different paths in academia?

Networking

- How to find, or what is, my precise area or community?

- Feedback on your presentation and communication skills

- What talks to give, and where to give them?

- Imposter syndrome and insecurities

Academia

- Minorities, hierarchies, and discrimination in academia

- How do I choose a project?

- How do I move beyond my PhD project?

- When and how should I seek collaborations?

- Where to find help if bullied at work or in the community?

- Building mental resilience against psychological violence within academia

- Navigating the publishing process

Life

- Balancing work, life, and family

- Managing geographic uncertainty in the early stages of a career

This list is non-binding and non-exhaustive! What you discuss is between you and your mentor. We encourage discussions ranging from the concrete to the philosophical, and from the short-term to long. Details will also be given at the retreat.

For more information, visit the website: BGW Official Website.
You can reach us at: bgw-retreat@mpim-bonn.mpg.de.