Program "Singular foliations and higher structures" in Würzburg

17-18 July 2025

1 Schedule

Thursday 17 July 2025:

13:00 - 13:30 Arrival
13:30 - 14:10 Anastasios Fotiadis
14:10 - 14:50 Nicolas Tribouillard
14:50 - 15:30 Coffee/discussion
15:30 - 16:10 Annika Kraasch-Tarnowsky
16:10 - 16:50 Clément Cren
19:30 - 21:30 Conference dinner

Friday 18 July 2025:

09:00 - 09:40 Christoph Balcerzak
09:40 - 10:20 David Aretz
10:20 - 11:00 Coffee/discussion
11:00 - 11:40 Rosa Marchesini
11:40 - 12:20 Alfonso Garmendia
12:20 - 14:00 Lunch

All talks take place in the seminar room 41.00.06 in the Humboldt building on Emil-Fischer-Straße 41, 97074 Würzburg.

Abstracts

17 July 2025

13:30 – 14:10: Anastasios Fotiadis (Université Claude-Bernard-Lyon-I) - Universal central extensions of the Lie algebra of contact vector fields

Central extensions of Lie algebras play a fundamental role in mathematics and physics, appearing in areas such as geometric quantization, projective represen-

tations of Lie groups, and conformal field theory. A key result in this context is that central extensions are classified by the second Lie algebra cohomology with trivial coefficients. In this talk, we will review previous work dealing with central extensions of Hamiltonian and divergence-free vector fields, and focus on the case of contact vector fields where we will prove that the Lie algebra of contact vector fields is centrally closed.

14:10 – 14:50: Nicolas Tribouillard (KU Leuven) - The holonomy groupoid of singular structures

Holonomy groupoids allow to use algebra and pseudodifferential calculus to study differential object (e.g. regular foliations). The holonomy of a large class of singular objects was defined by Zambon in 2022, but he needed to assume an integrability condition for that. We currently work together to remove this condition, i.e. construct the holonomy groupoid in full generality, without giving up its interesting properties. I will first introduce our main tool, namely local Lie groupoids. In a second time, I will define the singular objects we work with and explain how the holonomy groupoid can be defined for every such object.

15:30 – 16:10: Annika Kraasch-Tarnowsky (MPIM Bonn) - Orbit foliations and Differentiable Stack Cohomology

An orbit foliation, i.e. a foliation induced by the orbits of a Lie groupoid, is an example of foliations that occurs very naturally. Orbit foliations are singular in many, many examples. When considering the differentiable stack cohomology associated to a Lie groupoid, this is unfortunate, as there were recent advances in finding models for the computation in the case that the orbit foliation of the Lie groupoid is regular. However, as differentiable stack cohomology generalises equivariant cohomology, there is a second class of examples, namely action Lie groupoids, in which models exist despite the fact that the foliations are singular in many of these cases as well. In this talk, we will take a look at both models (for regular orbit foliations and for action Lie groupoids), and we will explore the open question on how they might be generalised to a model that computes differentiable stack cohomology in the case of a singular orbit foliation.

16:10 – 16:50: Clément Cren (Georg-August-Universität Göttingen) - Tangent groupoid and pseudodifferential calculus

The tangent groupoid was invented by A. Connes as a nice gadget to prove the index theorem. It appears as the holonomy groupoid of a certain singular foliation. In the last decade, following the work of Debord and Skandalis, people realized that it it not a mere coincidence, as one can define the whole pseudodifferential calculus using this tangent groupoid and its geometry. I will explain these new techniques in different contexts, and try to stress the importance of the corresponding singular foliation.

19:30–21:30: Conference dinner

Conference dinner at Pepe im Cosmo (Peterstraße 12, 97070 Würzburg).

18 July 2025

9:00 – 9:40: Christoph Balcerzak (Universität zu Köln) - The Linearization of Poisson Structures and the Poisson Cohomology of $\mathfrak{sl}_2^*(\mathbb{R})$

Due to Weinstein's Splitting Theorem, the local study of Poisson structures reduces to the study of Poisson structures around zeros. This gives rise to the linearization problem and the question of Poisson non-degeneracy of a Lie algebra. In the first part of my talk, I will give a brief overview of past results and open questions I will work on. Since the Poisson cohomology plays an important role in proving the Poisson non-degeneracy of a Lie algebra, I will discuss in the second part of my talk how Ioan Marcut and Florian Zeiser calculated the Poisson cohomology of $\mathfrak{sl}_2^*(\mathbb{R})$.

9:40 – 10:20: David Aretz (MPIM Bonn) - Functoriality of Lie Groupoid Convolution Algebras

I will discuss the following guiding slogan: *The noncommutative differential geometry of a differentiable stack is encoded in the convolution algebra of smooth functions on a Lie groupoid presentation.* I will introduce the bornological convolution algebra associated to a Lie groupoid and show how this construction assembles into a 2-functor. In particular, this functorial perspective implies Morita invariance. I will also describe several examples illustrating how aspects of the transverse geometry of a Lie groupoid manifest algebraically in the convolution algebra. This is joint work with Christian Blohmann.

11:00 – 11:40: Rosa Marchesini (Georg-August-Universität Göttingen) - LA-homotopy and explicit computations for the twisted Lie algebroid cohomology

The definition of homotopy as a smooth curve of Lie algebroid morphisms does not guarantee the homotopy invariance of Lie algebroid cohomology. Balcerzak first proved that the desired property holds for homotopies in the category of Lie algebroids, also called LA-homotopies. We present a systematic study of LA-homotopies and prove the LA-homotopy invariance of the more general twisted Lie algebroid cohomology. In particular, we explain how to construct LA-homotopies and use them to explicitly compute the (twisted) Lie algebroid cohomology of some families of Lie algebroids. The results are a joint work with Madeleine Jotz.

11:40 – 12:20: Alfonso Garmendia (MPIM Bonn) - Tepui fibrations and singular foliations

This is joint work with Prof. Dr. Leonid Ryvkin and Dr. David Miyamoto. We study spaces equipped with a generalized notion of smooth structure, modeled by diffeologies, under the additional assumption that for each X of such spaces there exists a fibration $X \to M$ over a smooth manifold M, where the fibers are manifolds that may vary in dimension.

On such spaces, we define a tangent functor that enables us to perform differential calculus despite the presence of singularities. Our approach is inspired by the work of Androulidakis and Skandalis, who construct a diffeological groupoid integrating a singular foliation. The source map of this groupoid gives rise to a space of the kind we consider, and our tangent functor allows us to recover the original singular foliation from this structure.

We also investigate the notion of vector bundles in this context and establish a generalized version of the Serre–Swan theorem adapted to this singular setting.