



**Virtual Workshop for Young Researchers**  
**Singular Foliations and Related Structures**

**ABSTRACTS**

**Organizers:**

Alfonso Garmendia

Leonid Ryvkin

October 1-2, 2020

**Potsdam University**

**Essen University**

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# SINGULAR FOLIATIONS AND RELATED STRUCTURES

OCTOBER 1-2, 2020

<b>Scientific Program</b>		
<b>Times (CEST)</b>	<b>Thursday 1st</b>	<b>Friday 2nd</b>
<i>Chair</i>	<i>Francesco Cattafi</i>	<i>Sylvain Lavau</i>
09:30	<b>Introduction</b>	
10:00–10:15	<b>Florian Zeiser</b>	<b>Sara Azzali</b>
10:20–10:35	<b>Oscar Cosserat</b>	<b>Lachlan MacDonald</b>
10:40–10:55	<b>Ralph Klaasse</b>	<b>Stephane Geudens</b>
	<b>Short Break</b>	
11:10–11:25	<b>Networking</b>	<b>Aldo Witte</b>
11:30–11:45	<b>Charlotte Kirchhoff-Lukat</b>	<b>Karandeep Singh</b>
12:05–12:20	<b>Discussions</b>	<b>Joel Villatoro</b>
12:25		<b>Discussions</b>
17:00	<b>Social Activities</b>	

About the conference:

- We want to connect young researchers and give an overview on singular foliations and related structures.
- Talks are short and informal, please be friendly and feel free post any question.

Practical information:

- All lectures will take place online in Zoom.
- We have parallel chat rooms for questions and further discussions.
- Details will be sent by mail.

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## Thursday 1st October

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### Florian Zeiser

10:00 Radboud University, The Netherlands

TITLE: **Poisson cohomology of  $\mathfrak{sl}_2^*$  using flat foliated cohomology.**

Every Poisson manifold  $(M, \pi)$  comes with a natural cohomology associated to it, its Poisson cohomology. In this talk we describe how we can compute Poisson cohomology using the complex of “foliated forms which vanish flatly along the singular leaf” for the linear Poisson structure associated with the Lie algebra  $\mathfrak{sl}_2$ . This is based on joint work with Ioan Marcu.

### Oscar Cosserat

10:20 University of La Rochelle, France

TITLE: **Existence and obstructions to the globalisation of action-angle coordinates.**

I plan to expose the Arnol’d-Liouville theorem that gives the existence of local action-angle coordinates of a completely integrable hamiltonian system on a symplectic manifold. It can be formulated in terms of a local normal form on a moment map foliation’s regular leaf . A natural question comes then, namely the globalisation of these coordinates, and I propose to explain the two obstructions that appear here : the Chern class related to the fiber of the moment map and the monodromy related to the periodic lattice of the moment map. They arise due to the singularities of the foliation. If I have time, I can shortly develop the example of the spherical pendulum, where we observe such a singularity and a non-trivial monodromy in a quite simple example.

#### Bibliography:

- On Global Action-Angle Coordinates, J. J. Duistermaat, University of Utrecht, 1980.
- Systèmes Intégrables Semi-classiques : du Local au Global, San Vu Ngoc, Université Joseph-Fourier - Grenoble I, 2003.

**Ralph Klaasse**

10:40 ULB, Belgium

**TITLE: Self-crossing stable generalized complex structures.**

In this talk we describe an extension of the notion of a (smooth) stable generalized complex structure to allow for an anticanonical section with normal self-crossing singularities. This weakening allows for several natural examples, and in dimension four we show that there are natural connected sum and smoothing operations for these structures. This leads us to construct large families of stable generalized complex manifolds. This is based on joint work with Gil Cavalcanti and Aldo Witte.

**Charlotte Kirchhoff-Lukat**

11:30 KU Leuven, Belgium

**TITLE: Coisotropic A-branes in symplectic manifolds.**

Generalized complex branes are a natural type of submanifold in generalized complex manifolds. Symplectic structures are among the simplest and most well-studied examples of generalized complex structures, and their Lagrangian submanifolds the simplest examples of generalized complex branes. But apart from Lagrangians, symplectic manifolds contain higher-dimensional generalized complex branes, coisotropic A-branes, which are much less understood. I will give an introduction to the theory of coisotropic A-branes and present a range of examples.

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## Friday 2nd October

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### Sara Azzali

10:00 Hamburg University, Germany

**TITLE: Some examples of the Baum—Connes isomorphism.**

The Baum–Connes conjecture can be seen as a far reaching generalisation of the Atiyah–Singer index theorem. Given a locally compact group  $G$ , the conjecture predicts an isomorphism between a topological and an analytic object constructed from  $G$ . We introduce the subject and describe some examples in the setting of discrete groups, in particular for certain braid groups. For this class of groups the conjecture is already known to be true in by results of Oyono-Oyono, Chabert—Echteroff, Schick.

This talk is based on joint work with Sarah Browne, Maria Paula Gomez Aparicio, Lauren Ruth and Hang Wang.

### Lachlan MacDonald

10:20 University of Adelaide, Australia

**TITLE: Holonomy groupoids via conservation laws.**

The holonomy groupoid of a singular foliation, given in complete generality by Androulidakis and Skandalis, has been an object of intense study since its inception. In this talk, I will describe a new perspective on the holonomy of singular foliations, which is expressed in terms of the parallel transport of local conservation laws along leafwise paths. In particular, I will introduce some new diffeological tools for the study of singular foliations, and discuss some open questions.

### Stephane Geudens

10:40 KU Leuven, Belgium

**TITLE: Deformations of a coisotropic submanifold with fixed characteristic foliation.**

A coisotropic submanifold of a symplectic manifold has an induced foliation, which plays an important role in the deformation theory of the coisotropic submanifold. While in general, the deformation problem of a coisotropic submanifold  $C$  is obstructed, I will show that it becomes unobstructed when restricting to coisotropic deformations that have the same characteristic foliation as  $C$ .

**Aldo Witte**

11:10 Utrecht University, The Netherlands

**TITLE: Normal forms for Lagrangian submanifolds of Poisson manifolds.**

We prove a normal form result for Lagrangian submanifolds of Poisson manifolds using integrability of the Poisson manifold by a 1-connected Hausdorff symplectic groupoid. This can be seen as a generalisation of Conn's linearisation theorem to submanifolds of positive dimension. Joint work with Marius Crainic.

**Karandeep Singh**

11:30 KU Leuven, Belgium

**TITLE: Stability criteria for singular points of Lie  $n$ -algebroids.**

M. Crainic and R. Fernandes provided sufficient conditions for the stability of symplectic leaves of Poisson structures and the leaves of Lie algebroids, followed by J.P. Dufour and A. Wade for higher order singular points. The topic of this talk will be a generalization of these results to singular points of Lie  $n$ -algebroids.

**Joel Villatoro**

12:05 KU Leuven, Belgium

**TITLE: Beyond Finitely Generated Foliations.**

In this talk I will describe a class of singular foliations which I call "Frobenius integrable." All finitely generated singular foliations are Frobenius integrable as well as many examples of infinitely generated foliations. I will show that many constructions, including the holonomy groupoid and fundamental groupoids make sense for the Frobenius integrable case.