



IME - Instituto de  
Matemática e Estatística

## 2nd Workshop of the São Paulo Journal of Mathematical Sciences: J.-L. Koszul in São Paulo, His Work and Legacy

*Auditorium Antônio Gilioli  
Instituto de Matemática e Estatística  
Universidade de São Paulo  
13–14 November 2019*

### PROGRAM

#### Wednesday, November 13th

9:30-10am	REGISTRATION
10-10:50am	<b>C. Gorodski:</b> <i>Koszul in São Paulo, an historic view</i>
10:50-11:10am	COFFEE-BREAK
11:10am-Noon	<b>M. N. Boyom:</b> <i>Geometry of Koszul and the Information Geometry. Correspondence from Jean-Louis Koszul</i>
Noon-2pm	LUNCH
2-2:50pm	<b>R. L. Fernandes:</b> <i>Prequantization, differential cohomology and the genus integration</i>
3-3:50pm	<b>J. C. Baez:</b> <i>From classical to quantum and back*</i>
3:50-4:20pm	COFFEE-BREAK
4:20-5:10pm	<b>I. Struchiner:</b> <i>Structure equations for <math>G</math>-structures and <math>G</math>-structure algebroids</i>

#### Thursday, November 14th

9-9:50am	<b>U. Bruzzo:</b> <i>The extension problem for Lie algebroids on schemes</i>
9:50-10:10am	COFFEE-BREAK
10:10-11am	<b>D. Töben:</b>
11:10-Noon	<b>L. A. B. San Martin:</b>
Noon-2:10pm	LUNCH
2:10-3pm	<b>A. Wade:*</b>
3-3:30pm	COFFEE-BREAK
3:30-5pm	ROUND-TABLE WITH EDITORIAL BOARD

\*Skype conference.

END OF ACTIVITIES

## LIST OF ABSTRACTS OF TALKS

**John Baez** (UNIVERSITY OF CALIFORNIA AT RIVERSIDE, USA): *From classical to quantum and back*

Edward Nelson famously claimed that quantization is a mystery, not a functor. In other words, starting from the phase space of a classical system (a symplectic manifold) there is no functorial way of constructing the correct Hilbert space for the corresponding quantum system. In geometric quantization one gets around this problem by equipping the classical phase space with extra structure: for example, a Kähler manifold equipped with a suitable line bundle. Then quantization becomes a functor. But there is also a functor going the other way, sending any Hilbert space to its projectivization. This makes quantum systems into specially well-behaved classical systems! In this talk we explore the interplay between classical mechanics and quantum mechanics revealed by these functors going both ways.

baez@math.ucr.edu

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**Michel Nguiffo Boyom** (UNIVERSITÉ DE MONTPELLIER, FRANCE): *Geometry of Koszul and the Information Geometry. Correspondence with Jean-Louis Koszul*

In many mails he sent to me by 2011-2012, Jean-Louis Koszul often wondered that the Information Geometry may be linked with the Hessian Geometry. On 3 February 2012 he wrote:

*Ce qui reste par contre un mystère absolu pour moi c'est ce que signifie au juste "Géométrie de l'Information". Et quand en plus elle est Hessienne, cela n'arrange rien. Notez que je suis habitué depuis longtemps à voir naître des terminologies bizarres et à assister à des détournements de sens audacieux, voire criminels.*

In this talk I aim to point out the fundamental role played by both the Geometry of Koszul and the Topology of Koszul in the theory of statistical models of measurable sets. The (algebraic) foundation of the Information Geometry is the KV cohomology of locally flat manifolds, (KV stands for Koszul-Vinberg.) The current Information Geometry as in works of I-S Amari and alias as well as the Hyperbolic Geometry after Kaup, Koszul, Vey and others, are local vanishing theorems in the KV cohomology of locally flat manifolds. From the combinatorial wording, a structure of statistical model is a leaf of a tree whose root is a cohomology class in a 2nd KV cohomology space.

boyom@math.univ-montp2.fr

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**Ugo Bruzzo** (SCUOLA INTERNAZIONALE SUPERIORE DI STUDI AVANZATI, ITALY, AND FEDERAL UNIVERSITY OF PARAÍBA, BRAZIL): *The extension problem for Lie algebroids on schemes*

We study the extension problem in the general nonabelian case for Lie algebroids in the category of schemes.

bruzzo@sissa.it

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**Rui Loja Fernandes** (INSTITUTO SUPERIOR TÉCNICO, LISBON, PORTUGAL): *Prequantization, differential cohomology and the genus integration*

In the work of J.-L. Koszul, Lie theory and cohomology are often blended together in unexpected ways. This talk follows the same spirit: I will survey the genus integration of a Lie algebroid  $A$  introduced recently by Ivan Contreras and myself. It is related to the canonical integration of  $A$  through abelianization, in the same way that singular homology and homotopy are related. I will discuss in some detail the special case of the prequantization Lie algebroid associated with a closed 2-form, showing how our results recover the well-known prequantization condition and that they give a slight improvement of the usual description of principal  $S^1$ -bundles with connection via differential characters. Based on joint works with Ivan Contreras and Alejandro Cabrera.

ruiloja@illinois.edu

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**Luiz Antônio Barrera San Martin** (STATE UNIVERSITY OF CAMPINAS, BRAZIL):

smartin@ime.unicamp.br

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**Ivan Struchiner** (UNIVERSITY OF SÃO PAULO, BRAZIL): *Structure equations for  $G$ -structures and  $G$ -structure algebroids*

The infinitesimal data attached to a  $G$ -structure with connection is its structure equations. These equations can be interpreted as determining a Lie algebroid with extra symmetries, known as a  $G$ -structure algebroid. This correspondence is a special instance of the correspondence between degree 1 derivations of the exterior algebra of a vector bundle, and Lie algebroid structures on the vector bundle which is obtained from the Koszul formula for the exterior derivative.

In this talk I will discuss the  $G$ -structure algebroid associated to a family of  $G$ -structures with connections and how the Lie theory for  $G$ -structure algebroids can be used to understand the moduli space of  $G$ -structures in the family.

The talk is based on joint work with Prof. Rui Loja Fernandes (UIUC), available at

<https://arxiv.org/abs/1907.13614>

ivanstru@ime.usp.br

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**Dirk Töben** (FEDERAL UNIVERSITY OF SÃO CARLOS, BRAZIL):

dirktoben@dm.ufscar.br

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**Aïssa Wade** (PENNSYLVANIA STATE UNIVERSITY, USA):

wade@math.psu.edu