Algèbres de Hopf combinatoires et Analyse

Rapport sur les contributions

https://indico.math.cnrs.fr/e/13845

ID de Contribution: **1** Type: **Non spécifié**

Aspects combinatoires de la théorie des algèbres de Novikov

jeudi 27 novembre 2025 09:00 (50 minutes)

Dominique Manchon a récemment mis en évidence le rôle des algèbres de Novikov pour la théorie des équations aux dérivées partielles stochastiques. L'intérêt pour la théorie s'est rapidement développé, à la fois d'un point de vue algébrique et d'un point de vue probabiliste. L'exposé, basé sur un travail en cours avec Ruggero Bandiera (Sapienza Univ. Roma), abordera certains aspects combinatoires de la théorie, dont, par exemple, des phénomènes statistiques sur les permutations, à l'image de la formule de Baker-Cambell-Hausdorff.

Orateur: PATRAS, Frédéric (CNRS - Université Côte d'Azur)

ID de Contribution: **2** Type: **Non spécifié**

Homological properties of braided Hopf algebras

jeudi 27 novembre 2025 10:00 (50 minutes)

The global dimension is an important homological invariant of an algebra, often serving as a good analogue of the dimension of a smooth affine algebraic variety. However, there are examples where the global dimension does not align with geometric intuition. This often leads to consider the Hochschild cohomological dimension rather than the global dimension. It is thus a natural question to determine classes of algebras for which the global dimension and the Hochschild cohomological dimension coincide, and this is a well-known fact when our algebra is graded connected or is a Hopf algebra.

In this talk, I will discuss several properties of braided Hopf algebras and explain a result showing that the equality between global and Hochschild dimensions still holds for a braided Hopf algebra in the category of comodules over a cosemisimple coquasitriangular Hopf algebra. I will then examine finer homological properties of braided Hopf algebras, such as smoothness and the twisted Calabi–Yau property. Finally, I will show that under a suitable criterion, a braided Hopf algebra in a comodule category is twisted Calabi–Yau (without assuming cosemisimplicity). The example of the two-parameter braided quantum SL_2 will be presented in detail.

This presentation is based on joint work with Julien Bichon.

Orateur: NGUYEN, Thi Hoa Emilie (Université Clermont Auvergne)

ID de Contribution: **3** Type: **Non spécifié**

Deformation quantization with branes and coloured MZVs

jeudi 27 novembre 2025 11:30 (50 minutes)

Kontsevich celebrated universal deformation quantization formula involves certain coefficients, that are periods. Banks, Panzer and Pym have shown that these coefficients are linear combinations of multiple zeta values (MZVs). We explain a generalization to the setting of deformation quantization in the presence of branes (in the sense of Cattaneo-Felder), where MZVs are replaced by coloured MZVs.

Orateur: CALAQUE, Damien (Université de Montpellier)

ID de Contribution: **4** Type: **Non spécifié**

Operad theory for singular SPDEs

jeudi 27 novembre 2025 13:45 (50 minutes)

In this talk, we will review some recent applications of operad theory to singular SPDEs. It is an essential tool for characterising the chain rule symmetry in the full subcritical regime which leads to renormalising quasilinear SPDEs with local counterterms. Also, it provides negative results about the existence of another combinatorial set lying between multi-indices and decorated trees for encoding expansions of solutions of singular SPDEs.

Orateur: BRUNED, Yvain (Université de Lorraine)

ID de Contribution: **5** Type: **Non spécifié**

Magnus Expansion···Old and New

jeudi 27 novembre 2025 14:45 (50 minutes)

The Magnus expansion was introduced by Wilhelm Magnus in his 1954 paper "On the Exponential Solution of Differential Equations for a Linear Operator"(CPAM 7 (1954) 649), where he addressed a central problem in applied mathematics: computing the logarithm of the operator- or matrix-valued solution of a linear initial value problem. Since then, the Magnus expansion has evolved into a versatile and widely used tool with applications in physics, chemistry, engineering, and beyond. Over the past 25 years, significant mathematical developments have revealed deep connections between algebra, combinatorics, and geometry in the study of the Magnus expansion. A key driver of these modern advances has been the work of Dominique Manchon, whose contributions have been essential in uncovering the pre- and post-Lie algebraic structures that underpin today's understanding of the subject. These structural insights have substantially broadened the scope of the Magnus expansion and opened the door to a variety of extensions and applications. In this presentation, we will first review these developments, with a particular emphasis on the roles of pre-Lie and post-Lie algebras. We will then discuss an application of the pre-Lie Magnus expansion to the derivation of a Chen–Strichartz formula for stochastic differential equations driven by Lévy processes. The results presented are based on joint works with D. Manchon, and with F. Patras and A. Wiese.

Orateur: EBRAHIMI-FARD, Kurusch (Norwegian University of Science and Technology)

ID de Contribution: **6** Type: **Non spécifié**

Strange pre- and post-Lie structures on rooted trees

jeudi 27 novembre 2025 16:30 (50 minutes)

We present a construction of pre-Lie on rooted trees whose edges and vertices are decorated, with a grafting product twisted by an action of a map acting on both edges and vertices. We show that this construction indeed gives a pre-Lie algebra if, and only if, a certain commutation relation is satisfied. Then, this pre-Lie algebra can be extended as a post-Lie algebra through a semi-direct product.

A particular example is used for normal forms in the study of stochastics PDEs. Here, the set of decorations of edges and vertices is $\mathbb{N}^{d+1}$ and the acting map is the exponentiation of a simpler map.

Orateur: FOISSY, Loïc (Université du Littoral Côte d'Opale)

ID de Contribution: **7** Type: **Non spécifié**

On shuffles and permutations

vendredi 28 novembre 2025 09:00 (50 minutes)

Shuffle permutations appear in many different contexts, such as Hopf algebras, shift registers in coding theory and kryptology, symbolic dynamics for chaotic dynamical systems, card tricks, and in the design of efficient permutation networks for parallel computing.

I will give a leisurely discussion of shuffles in various contexts, and in particular discuss the problem of designing interconnection networks for massively parallel computers.

The classical Shuffle-Exchange (SE) network is built around the basic operations of card shuffling and bipartite Exchange swaps. SE networks can perform any permutation of n items in $2\log_2(n)$ steps, with only $3n$ interconnection wires, yielding an optimal 'cost' $c = 6n\log_2(n)$. SE networks are, however, difficult to construct due to their complicated non-recursive structure.

A class of generalised Shuffle-Exchange (GSE) networks is introduced. As permutation networks these have the same functionality as SE, but some of them possess recursive structures lacking in the classical SE net. This makes them possibly very attractive from a hardware-designers point of view.

Based on the theory of linear recurrences over Galois Fields and linear shift registers, we develop the theory of GSE networks and present general theorems showing how to construct such networks built up recursively by using identical (or a small number of different) building blocks.

Orateur: MUNTHE-KAAS, Hans (University of Bergen)

ID de Contribution: **8** Type: **Non spécifié**

Orders and shuffles on nestohedra

vendredi 28 novembre 2025 10:00 (50 minutes)

In the 1990s, two Hopf algebras were defined in terms of shuffles: shuffles of permutations for Malvenuto-Reutenauer Hopf algebras and shuffles of rooted binary trees for Loday-Ronco Hopf algebras. Permutations and binary trees label the vertices of the permutohedron and the associahedron respectively. The 1-skeletons of these polytopes correspond moreover to two well-known posets: the weak Bruhat order (for the permutohedron) and the Tamari lattice (for the associahedron). In 2002, Loday and Ronco established a "magic formula" linking the Tamari order to the shuffle product on binary trees and the weak Bruhat order to the shuffle product on permutations.

These shuffle products were then extended to the faces of the permutohedron (surjections) and of the associahedron (planar trees) by Burgunder-Ronco and Loday-Ronco respectively. Palacios and Ronco then extended the Tamari order and the Bruhat order to all faces of the corresponding polytopes. They extended the correspondance of Loday-Ronco between the shuffle product and the order on the vertices to all the faces of these polytopes. Carr and Devadoss introduced an order on the vertices of a subclass of polytopes called graph associahedra. Forcey and Ronco extended this order to the faces of a subclass of these polytopes.

In a recent work with Pierre-Louis Curien and Jovana Obradovic, we introduce a condition on families of nestohedra to get a shuffle product (more precisely, tridendriform products) on its faces. This condition includes the previous works and new examples. In this framework, we define an order on faces of the nestohedra and link it with the shuffle product.

Orateur: DELCROIX-OGER, Bérénice (Université de Montpellier)

ID de Contribution: **9** Type: **Non spécifié**

A Solution to the Zariski-Closure Conjecture for Exponential Lie Groups: A Longstanding Program with D. Manchon II

vendredi 28 novembre 2025 11:30 (50 minutes)

In this talk, I will focus on the Zariski-Closure Conjecture for coadjoint orbits of exponential solvable Lie groups, a central open question in the orbit method and the deformation theory of unitary representations. This emphasizes the interplay between representation theory, quantization, and Poisson geometry. The aim is to introduce a new dequantization approach that links the theory of primitive ideals in the universal enveloping algebra to the algebraic geometry of coadjoint orbits, investigating the correspondence between generating families of primitive ideals and the ideals of polynomial functions vanishing on the Zariski closure of the associated orbits. This approach not only yields a complete proof of the Zariski-Closure Conjecture for exponential Lie groups but also allows us to characterize the family of quasi-Frobenius Lie algebras, providing a unifying framework that connects their algebraic and geometric properties.

Orateur: BAKLOUTI, Ali (Université de Sfax)