Journées Physique-Mathématique

Rapport sur les contributions

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

The universal central extension of the Lie algebra of exact divergence-free vector fields

lundi 23 septembre 2024 09:30 (1 heure)

The goal of the talk is proving a conjecture of Claude Roger about the universal central extension of the Lie algebra of volume-preserving vector fields. In the beginning we will briefly review the notion of central extensions of Lie algebras and their link to Chevalley-Eilenberg-cohomology. We will then proceed to Roger's conjecture, which lies in the (continuous) infinite-dimensional setting. To solve it we will need a combination of analytical and geometrical methods, and maybe even a bit of representation theory.

Based on an ongoing collaboration with Bas Janssens and Cornelia Vizman.

Orateur: RYVKIN, Leonid (University of Göttingen)

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

A correspondence between quantum error correcting codes and gauge theories

mercredi 25 septembre 2024 15:30 (1 heure)

I will introduce a correspondence between the language of quantum error correcting codes and that of gauge theory. I will focus more specifically on the well-studied family of \emph{stabilizer codes}, which can be interpreted as Abelian gauge theories with gauge group a product of $\mathbb{Z}_2$. This class of codes includes repetition codes such as the elementary three-qubit code, and topological codes such as Kitaev's toric code, which I will use as illustrative examples. Based on on-going work with A. Chatwin-Davies, P. Höhn, and F. M. Mele.

Orateur: CARROZZA, Sylvain (Université de Bourgogne)

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

Asymptotic computation of form factors and overlaps for the spin chains

mardi 24 septembre 2024 15:30 (1 heure)

In this talk I will give a brief overview of the computation of the form factors of integrable spin chains from the Algebraic Bethe Ansatz in the thermodynamic limit. As an illustration I'll show how to compute boundary overlaps for the open spin chains after a change of one boundary parameter.

Orateur: KITANINE, Nikolai (Université de Bourgogne)

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

The 2-plectic structure and the inherent dynamic on the six-sphere

jeudi 26 septembre 2024 14:00 (1 heure)

After some brief reminders on the octonions and the exceptional Lie group G_2, we will be interested in the 2-plectic structure on the 6-sphere induced by the octonions and the links with the almost complex structure. In a second part of the talk, we will discuss the dynamic in the two possible cases : vector field and bivector field, and we shall study in more detail the multisymplectic structure.

Orateur: WAGNER, Maxime (Université de Lorraine)

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

From the Hamilton-Volterra equations to multisymplectic dynamics

jeudi 26 septembre 2024 11:30 (1 heure)

Orateur: WURZBACHER, Tilmann (Université de Lorraine)

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

Different approaches to the inverse problem of variational calculus

jeudi 26 septembre 2024 10:00 (1 heure)

Motivated by classical mechanics and classical field theory, I will give an elementary introduction to two different approaches
to the inverse problem of variational calculus (for systems of differential equations
and systems of partial differential equations).
In doing so, I will try to indicate the state of the art and mention some other approaches that have been considered.

Orateur: GIERES, Francois (Université Claude Bernard Lyon 1)

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

K-theory boundary maps in solid state physics

mardi 24 septembre 2024 09:30 (1 heure)

Using K-theory and cyclic cohomology to describe topological phases for solids gives us the possibility to describe various topological relations between physical systems by means of the boundary map in K-theory. The perhaps best known example of that is the bulk edge correspondence which equates the quantised Hall conductivity with the edge conductivity. I will try to give an overview of that.

Orateur: KELLENDONK, Johannes (Université Claude Bernard Lyon 1)

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

Poisson algebra bundles over configuration spaces and covariant multilocal observables (Part 1)

lundi 23 septembre 2024 14:30 (1 heure)

In relativistic field theory, fields are sections of a vector bundle over spacetime and observables are functionals of the fields generated by distributional sections of the bundle. Observables form a well-known Poisson algebra (induced by a given Lagrangian), which is then quantized by deformation. The algebra structure breaks the covariant dependence on the bundle, because there is no nice bundle description of (symmetric) multilocal observables defined on many spacetime points (products of local observables).

In an joint work of A. Frabetti, O. Kravchenko and L. Ryvkin, we restore the covariance of multilocal observables by considering bundles over the space of unordered configurations of points as a base manifold and Poisson algebra bundles with respect to two suitable tensor products of bundles (the usual one, called Hadamard, and a new one similar to the external tensor product, called Cauchy). This Poisson bundle induces the known deformation quantization by Laplace pairing in QFT [Brouder, Fauser, Frabetti, Oekl 2004, Herscovich 2017], fits both covariant and multisymplectic approaches to field theory, and is an example of the 2-monoidal category setting developed on species [Aguiar, Mahajan 2009].

This talk is divided in two parts: in Part I we explain the algebraic background (Poisson algebra bundles on configuration spaces) and in Part II the applications in field theory.

The content of Part I is available at https://arxiv.org/abs/2407.15287, Part II is coming soon.

Orateur: KRAVCHENKO, Olga (Université Claude Bernard Lyon 1)

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

Lie-Poisson equations: from quantum liquids to gravity

mardi 24 septembre 2024 11:15 (1 heure)

Orateur: OBLAK, Blagoje (Université Claude Bernard Lyon 1)

ID de Contribution: **10** Type: **Non spécifié**

The Phi43 quantum field theory on de Sitter space

mardi 24 septembre 2024 14:30 (1 heure)

I will report on work in very slow progress with Ferdinand-Lin-To where we try to implement rigorously the Wick rotation on curved space time. Our ultimate goal would be the construction of a nonperturbative Phi43 theory on de Sitter space which gives a non trivial example of analytic state. I will emphasize the difficulties that we have not been able to overcome and stress the central role played by reflection positivity and symmetries.

Orateur: DANG, Nguyen Viet (Université de Strasbourg)

ID de Contribution: **11** Type: **Non spécifié**

Steinberg symbol clusters and central extensions

mercredi 25 septembre 2024 09:30 (1 heure)

Steinberg symbol is a function of two elements of a ring satisfying very simple conditions. It's main application so far is in number theory and algebraic K-theory. We will show that it is a very transparent construction and it gives the central extension giving just infinite Heisenberg group. The same symbol can be used to define an explicit formula for central extension of affine Lie groups, but for this purpose one can use special (cluster) coordinates for simple Lie groups.

Orateur: FOCK, Vladimir (Université de Strasbourg)

ID de Contribution: **12**   Type: **Non spécifié**

Symmetries and Reduction of Multisymplectic Manifolds

lundi 23 septembre 2024 11:30 (1 heure)

Multisymplectic manifolds provide a natural generalization of symplectic manifolds by considering closed, non-degenerate k-forms in place of 2-forms. A central theme in the study of (multi)symplectic structures is the investigation of the relationship between symmetries, encoded by group actions that preserve the differential form, and reduction procedures. These reduction schemes yield a lower-dimensional space that retains the essential geometric structure of the original manifold.

In the symplectic case, the Marsden–Weinstein–Meyer theorem demonstrates that the geometric structure of a symplectic manifold can be analyzed via the orbits in a regular level set of a momentum map. Sniatycki and Weinstein have extended this result to encompass singular momentum maps, enabling a broader framework for reduction in the symplectic category.

The scope of this talk is to review some relevant algebraic structures related to multisymplectic manifolds, namely the higher version of the observables algebra and moment maps, and to discuss how the regular and singular reduction schemes extend to the multisymplectic framework.

This talk is based on joint work with Casey Blacker and Leonid Ryvkin.

Orateur: MITI, Antonio Michele (University of Rome 1)

ID de Contribution: **13**   Type: **Non spécifié**

The Calogero-Ruijsenaars family of classical integrable systems

mercredi 25 septembre 2024 14:30 (1 heure)

There is a plethora of classical integrable systems that are named after Toda, Calogero, Moser, Sutherland, Ruijsenaars, and many other researchers. These are toy models of interacting particles which have appeared since the late 1960s, and which have been related to many areas in mathematics and theoretical physics. My aim is to provide a historical account of these systems (biased towards my personal point of view), and explain some challenging questions regarding these systems.

Orateur: FAIRON, Maxime (Université de Bourgogne)

ID de Contribution: **14**   Type: **Non spécifié**

Dynamical principal bundles and Kaluza-Klein models

jeudi 26 septembre 2024 15:00 (1 heure)

I will present a family of models, based on variational problems defined on fields on manifolds, the classical solutions of which lead to an at least locally principal bundle structure on the given manifold. Moreover each critical point of such models allows us to recover solutions of gauge fields theories such as Yang-Mills or Einstein gravity equations. The 'discovery' of these models followed from a multisymplectic approach to gauge theories.

In this talk I will focus on a Lagrangian action, the critical points of which lead to solutions of the Einstein-Yang-Mills equations, in the spirit of Kaluza-Klein theories. The novelty is that the a priori fiber bundle structure hypothesis is not required: fields are defined on a "space-time" Y of dimension $4 + r$ without any a priori principal bundle structure, where r is the dimension of the structure group. If the latter group is compact and simply connected, to each solution of the Euler-Lagrange equations it corresponds a 4-dimensional pseudo-Riemannian manifold X (which can be interpreted as our usual space-time) in such a way that Y acquires a principal bundle structure over X equipped with a connection. Moreover the metric on X and the connection on Y are solutions of the Einstein-Yang-Mills system. If the structure group is $U(1)$ (the case which corresponds to the Einstein-Maxwell system) the situation is slightly degenerated and supplementary hypotheses are necessary.

Orateur: HÉLEIN, Frédéric (Université Paris Cité, IMJ-PRG)

ID de Contribution: **15**   Type: **Non spécifié**

Poisson algebra bundles over configuration spaces and covariant multilocal observables (Part 2)

lundi 23 septembre 2024 15:30 (1 heure)

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In an joint work of A. Frabetti, O. Kravchenko and L. Ryvkin, we restore the covariance of multilocal observables by considering bundles over the space of unordered configurations of points as a base manifold and Poisson algebra bundles with respect to two suitable tensor products of bundles (the usual one, called Hadamard, and a new one similar to the external tensor product, called Cauchy). This Poisson bundle induces the known deformation quantization by Laplace pairing in QFT [Brouder, Fauser, Frabetti, Oekl 2004, Herscovich 2017], fits both covariant and multisymplectic approaches to field theory, and is an example of the 2-monoidal category setting developed on species [Aguiar, Mahajan 2009].

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Orateur: FRABETTI, Alessandra (Université Claude Bernard Lyon 1)

ID de Contribution: **16** Type: **Non spécifié**

Discussion session

mardi 24 septembre 2024 17:00 (1 heure)

ID de Contribution: **17** Type: **Non spécifié**

Open problem session

mercredi 25 septembre 2024 17:00 (1 heure)

ID de Contribution: **18**   Type: **Non spécifié**

Modular deformations of Lie algebras - from sl(2) to Virasoro

mercredi 25 septembre 2024 11:30 (1 heure)

In this talk, I introduce new q-deformations of Lie algebras linked to the modular group and the q-rational numbers of Morier-Genoud and Ovsienko. In particular, a deformation of the Lie algebra sl(2), the Witt algebra and a glimpse on the Virasoro algebra will be presented. These deformations are realized through concrete differential operators and lead to a new understanding of q-rationals.

Orateur: THOMAS, Alexander (Université Claude Bernard Lyon 1)