Mathematical Physics in Bahia

Algebraic analysis, quantization and representations

Salvador, Brazil 5–10 July, 2012

ABSTRACTS

Nathan Berkovits
Universidade Estadual Paulista

Pure spinors, supersymmetry and string theory

Abstract: Ten-dimensional supersymmetric field theories are naturally described using superspace variables (x, θ) together with a bosonic pure spinor. These variables arise for quantization of the superstring where the bosonic pure spinor is a worldsheet ghost coming from gauge-fixing a local fermionic symmetry.

Frank Michael Forger
Universidade de São Paulo

Multiphase spaces and multisymplectic geometry

Abstract: We give a qualitative survey of various approaches to setting up a covariant first order hamiltonian formalism for classical field theory. All of them are based on a notion of "multiphase space" whose global construction leads straight into a new area of differential geometry that may be called "multisymplectic geometry". We discuss the pros and cons of some of the main proposals that can be found in the literature and comment on the relation with the functional approach employing "covariant phase space".

Vyacheslav Futorny
Universidade de São Paulo

Representations of Lie algebra of vector fields on a torus

Abstract: We will discuss representations of the Lie algebra of vector fields on N-dimensional torus induced from tensor modules, their character formula and corresponding free field realizations of Affine Kac-Moody algebras. The talk is based on recent joint results with Y. Billig (Carleton University, Canada).

Elizabeth Gasparim
Universidade Estadual de Campinas

BPS state counting on singular varieties

Abstract: This is a report of joint work with T. Koppe, P. Majumdar, and K. Ray. I will define new partition functions for theories with targets on toric singularities via products of old partition functions on crepant resolutions. I will present explicit examples and show that the new partition functions turn out to be homogeneous on MacMahon factors.

Alexander Getmanenko
Kavli IPMU, The University of Tokyo

Microlocal properties of sheaves and complex WKB method

Abstract: In a joint work with Dmitry Tamarkin, we apply Kashiwara-Schapira theory of sheaves to the Laplace-transformed Schrödinger equation. We prove analytic continuation of solutions of this equation needed for mathematical justification of connection formulas in resurgent analysis.

Talk 1: Motivations and statement of the results.

Talk 2: Construction of analytic continuation and structure of the proof.

Gregory Ginot
Université de Paris 6

Centralizers of maps and deformations

Abstract: We will describe (derived) centralizers of maps in terms of higher Hochschild homology, of commutative algebras and their applications to deformation of algebras, bialgebras and other higher algebraic structures. This is a work in progress.

Pinhas Grossman
IMPA

Representation theory of exotic fusion categories

Abstract: The category of representations of a given group has a ring-like structure, with tensor product playing the role of multiplication and direct sum that of addition. A fusion category is a "categorification" of a ring modeled on the category of representations of a finite group. In addition to finite groups, interesting examples come from quantum groups and from von Neumann algebras. Just as rings have a representation theory given by modules, fusion categories have a representation theory given by module categories, or "quantum subgroups".

In this talk we will introduce fusion categories and describe their representation theory. We will then discuss examples of exotic fusion categories, which were discovered by Asaeda and Haagerup in the 1990's. An analysis of the representations of these exotic fusion categories has led to a greater understanding of their structure as well as many new examples of fusion and module categories - this is joint work with Noah Snyder.

Stéphane Guillermou
CNRS, Université de Grenoble I

Microsupport of sheaves and symplectic geometry

Abstract: The microsupport of a sheaf on a manifold is a co-isotropic subset of the cotangent bundle of the manifold introduced by M. Kashiwara and P. Schapira in order to analyze the "singularities" of the sheaf.

Following ideas of Tamarkin, it is possible in some cases to associate a sheaf with a given Lagrangian submanifold of a cotangent bundle. In a joint work with M. Kashiwara and P. Schapira we have done this when the Lagrangian is the graph of a symplectic diffeomorphism, and, using this result, we do this now for a general Lagrangian satisfying some topological assumptions.

Then we can use this sheaf to deduce geometric properties of the Lagrangian submanifold. For example we can recover a result of Fukaya-Seidel-Smith, related to a conjecture of Arnold, on the cohomology of the Lagrangian.

Reimundo Heluani
IMPA

Moonshine and string theory on $K3$

Abstract: Recently some numerical evidence has been found of a possible appearance of Mathieu's $M24$ group as a hidden symmetry of the sigma model with target a $K3$ surface. In this talk we will set up the problem in a rigorous mathematical framework and review recent progress.

Eduardo Hoefel
Universidade Federal do Paraná

Open-closed homotopy algebras through Koszul operad theory

Abstract: Open-closed homotopy algebras (OCHA) were introduced by Kajiura and Stasheff in 2004. In an appendix to their paper, Markl observed that an OCHA should be equivalent to an algebra over the minimal model of a certain operad, without showing that the operad is Koszul. In this talk we show that OCHAs are algebras over the minimal model of the zeroth homology of the Swiss-cheese operad and prove that such operad is Koszul. This is joint work with Muriel Livernet.

Marcos Jardim
Universidade Estadual de Campinas

Nested Hilbert schemes

Abstract: The nested Hilbert scheme of points in $\mathbb{C}^2$ parametrizes nested ideals of zero-dimensional subschemes of $\mathbb{C}^2$. Similarly to what is done by Nakajima for the Hilbert scheme of points, we provide in this talk a description of the nested Hilbert scheme in terms of quadratic, ADHM-like equations and stable representations of a certain quiver.

Giovanni Landi
Università degli studi de Trieste

Gauge fields and q-vortices over the quantum sphere

Abstract: We extend equivariant dimensional reduction techniques to spaces which are the product of a Kähler manifold M with a noncommutative space. In particular, we work out the reduction of bundles which are equivariant under the natural action of the quantum $SU(2)$ group, and also of invariant gauge connections on these bundles. The reduction of Yang–Mills gauge theory from the product space leads to deformed quiver gauge theories on M. Corresponding vacuum moduli spaces are generally better behaved than their undeformed counterparts, but much more constrained by the q-deformation. This is joint work with R. Szabo.

Ryszard Nest
Københavns Universitet

On quantization of Hamiltonian actions of Poisson Lie groups

Abstract: We will give a general scheme for formal quantization of Hamiltonian actions of Poisson Lie groups on Poisson manifolds related to the formality theorems and construct some explicit examples.

Eric Ragoucy
CNRS, Université de Savoie

Bethe ansaetzen for open spin chains with non diagonal boundaries

Abstract: We introduce two generalizations of the Bethe ansatz that allows to treat the case of open spin chains with non diagonal boundary matrices. The first one is a generalization of the original coordinate Bethe ansatz, and the second one a generalization of the Matrix anstaz, used in statistical physics. The two ansaetzen are complementary in the sense that they provide different eigenvalues of the same Hamiltonian. Altogether they are conjectured to give the full spectrum. We illustrate it on two cases: the XXX and XXZ chains. Relations with algebraic Bethe ansatz will be also discussed.

Pierre Schapira
Université de Paris 6

Hochschild homology and microlocal Euler classes

Abstract: We define the notion of a Hochschild kernel on a manifold M. Roughly speaking, it is a sheaf on $M \times M$ for which the formalism of Hochschild homology applies. We associate a microlocal Euler class to such a kernel, a cohomology class with values in the relative dualizing complex of the cotangent bundle T^*M over M and we prove that this class is functorial with respect to the composition of kernels. This is joint work with Masaki Kashiwara.

Wilfried Schmid
Harvard University

Colloquium *In collaboration with the Graduate School of Mathematics*

Harmonic analysis on reductive Lie groups

Abstract: After recalling the Peter-Weyl theorem and Weyl's description of the unitary dual of compact Lie groups, I shall describe what is known about harmonic analysis on noncompact reductive Lie groups. I shall end with a discussion of the problem of describing the unitary dual of such groups.

Wilfried Schmid
Harvard University

Hodge theory and the unitary dual of reductive Lie groups

Abstract: Understanding the unitary dual of reductive Lie groups is the major open problem in the representation theory of such groups. I shall describe a conjectural application of Saito's theory of mixed Hodge modules, and outline an approach towards the proof of the conjecture. This is joint work with Kari Vilonen.

Francesco Toppan
CBPF

Critical scaling dimensions for N=4,7,8 superconformal algebras

Abstract: Representations of global supersymmetry induce D-module representations of N=4,7,8 finite superconformal algebras for critical values of the scaling dimension of the supermultiplets. Constraints are derived for the admissible Lagrangians of single-particle and multi-particle superconformal mechanics.

Dmitri Vassilevich
Universidade Federal do ABC

Spectral action and quantum field theory

Abstract: In the Connes approach to noncommutative geometry the dynamics of classical fields is governed by the so-called spectral action principle. We shall discuss possibilities to quantize the spectral action.

Alexander Voronov
University of Minnesota

Quantum master equation and deformation theory

Abstract: Classical deformation theory is based on the Classical Master Equation (CME), a.k.a. the Maurer-Cartan Equation: $dS + 1/2\{S, S\} = 0$. Physicists have been using a quantized CME, called the Quantum Master Equation (QME), a.k.a. the Batalin-Vilkovisky (BV) Master Equation: $dS + h\Delta S + 1/2\{S, S\} = 0$. The CME is defined in a dg Lie algebra g, whereas the QME is defined in a space $V[[h]]$ of formal power series with values in a differential graded (dg) BV algebra V. One can view a generalization of classical deformation theory arising from the QME as quantum deformation theory.

There are a few papers which may be viewed as making first steps in abstract quantum deformation theory: Quantum Backgrounds and QFT by Jae-Suk Park, Terilla, and Tradler; Modular Operads and Batalin-Vilkovisky Geometry by Barannikov; Smoothness Theorem for Differential BV Algebras by Terilla; and Quantizing Deformation Theory by Terilla.

Further steps in quantum deformation theory will be discussed in the talk.