Workshop on Mathematical Physics
ICTP-SAIFR, Sao Paulo, Brazil
August 10-13, 2018

List of Abstracts

PLENARY TALKS

Generalized CRF-structures and Spinors

Marco Aldi (Virginia Commonwealth University)

The interplay between generalized complex structures, pure spinors and superconformal algebras acting on the chiral de Rham complex is well understood. In this talk we discuss recent generalization to Vaismann's generalized CRF-structures.

Higgs branch conjecture for class S theory

Tomoyuki Arakawa (Research Institute for Mathematical Sciences, Kyoto University)

Rastelli et. al has constructed a map from 4d N=2 SCFTs to VOAs in such a way that the Schur index of a 4d N=S SCFT coincides with the character of the corresponding VOA. Later, Rastelli and Beem have further conjectured that the Higgs branch of a 4d N=2 SCFT should coincide with the associated variety of the corresponding VOA. In my talk we confirm the conjecture of Rastelli and Beem for the theory of class S.

Some new ideas of continuum graded Lie algebras

Wolfgang Bock (Technische UniversitÃ¤t Kaiserslautern)

In a series of papers end of 1980s and beginning of 1990s Saviliev and Vershik introduced Lie algebras which have a continuous root system. In the discrete case these algebras correspond to Kac-Moody algebras. In this talk I will give examples of dynamical systems related to the Lie algebra and give some new ideas how these algebras can be found as a continuum limit.

Rationality and Fusion Rules of Affine W-Algebras

Jethro van Ekeren (Universidade Federal Fluminense)

The affine W-algebras form a subtle class of vertex algebras (aka conformal field theories) which figure prominently in the geometric Langlands program, and in integrable systems. In general an affine W-algebra is constructed from the data of a simple Lie algebra and one of its nilpotent orbits, as well as a level. For special rational values of the level the theory is believed to be rational, i.e., modules are completely reducible, their characters are modular invariant, fusion products can be computed using the Verlinde formula, etc. Rationality and the fusion rules are known in the case of the principle nilpotent orbit.

In this talk I report on joint work with T. Arakawa in which we establish rationality for several other classes of affine W-algebras, including those associated with all nilpotent orbits in type A, and with subregular nilpotent orbits in all simply laced types. We compute modular transformations of characters and fusion rules for many cases. In the process we uncover a number of sporadic isomorphisms between these and other classes of affine W-algebras, as well as an apparently new unitary theory with 140 sectors obtained as a subregular reduction of E6.

Chiral symplectic leaves and arc spaces of Slodowy slices.

Anne Moreau (University of Lille)

Using the notion of chiral symplectic leaves, we show that the vertex Poisson center of the coordinate ring of the arc space of Slodowy slices coincides with the vertex Poisson center of

the coordinate ring of the arc space of the dual of the corresponding simple Lie algebra. As a consequence, the center of the affine W-algebra at the critical level coincides with the Feigin-Frenkel center. I will also present applications of the notion of chiral symplectic leaves to quasi-lisse vertex algebras.

Enumerative symplectic duality

Andrey Okounkov (Columbia University)

This will be a report on a joint work in progress with Mina Aganagic. Its goal is to prove the equality of curve counts in symplectically dual geometries, whenever both counts can be defined using present-day technology.

Categorification constructions involving superalgebras on the example of the periplectic case.

Vera Serganova (University of California, Berkeley)

In 2003 J. Brundan suggested categorification of sl(infinity) using translation functors in the category of representations of the Lie superalgebra gl(m|n). This approach provided a powerful method for solving many open problems in representation theory of classical superalgebras: gl, osp and q. The last case of periplectic superalgebra remained open and was done only recently. We will discuss this case in detail.

Factorization algebras from fibrations and toroidal vertex algebras

Mathew Szczesny (Boston University Dept. of Mathematics and Statistics)

The theory of factorization algebras developed by Kevin Costello and Owen Gwilliam describes the algebraic structure of observables in quantum field theories. When the space-time manifold has complex dimension 1, a certain class of factorization algebras corresponds to vertex algebras. I will give a sketch of this theory and describe a construction of factorization algebras on Riemann surfaces from holomorphic fibrations. When the fiber is a torus, the corresponding factorization algebra gives a vertex realization of a toroidal algebra.

Integrable systems and non-associative algebraic structures

Vladimir Sokolov (Landau Institute for Theoretical Physics)

Relations between multi-component integrable evolution systems with polynomial right hand sides and non-associative algebraic structures are established. Special classes of integrable systems are in one-to-one correspondence with left-symmetric, Jordan algebras, Jordan triple systems and some algebraic structures, which are not investigated by algebraists yet.

Characters in the modular representation theory of algebraic groups

Geordie Williamson (University of Sydney)

I will discuss what is known and not known about characters of important modules (simple, tilting, ...) in the representation theory of reductive algebraic groups in positive characteristic.

Representation theory using Coxeter groupoids

HIROYUKI YAMANE (Graduate School of of Science and Engineering for Research Science, University of Toyama)

As applications of Coxeter groupoids whose axiomatic definition was introduced in 2008, my collaborators and I have studied representation theory of generalized quantum groups, e.g., Shapovalov determinants, Classification of finite dimensional irreducible representations, Universal R-matrices, Harish-Chandra type theorem, and Bruhat order.

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TALKS

Tilting Sheaves, Tilting Complexes and Piecewise Hereditary Algebras

Edson Ribeiro Alves (UFPR)

Some classification problems of modules over certain algebras can be done in a similar way to the problems of coherent sheaves on certain projective algebraic varieties.

In this talk we consider the class of finite dimensional algebras whose bounded derived category is equivalent as a triangulated category to the bounded derived category of the category of coherent sheaves over a weighted projective line.

We are mainly interested in presenting some aspects of the representation theory of these algebras.

The structure of bounded weight modules

Lucas Henrique Calixto (UFMG)

In this talk we describe the structure of all simple bounded weight modules of the Lie algebras sl(âˆž)-, o(âˆž)-, sp(âˆž).

Linearization of the Schroedinger Equation

Maria Lewtchuk Espindola (UFPB)

A new foundation to Hamiltonian Analytical Mechanics, named two fold or alternative Hamiltonization, furnishes two Hamiltonian functions, a linear in the momenta and the usual one. As a inference in quantum mechanics it will always be possible to linearize the SchrÃ¶dinger equation. In the procedure of two fold or alternative Hamiltonization the Hamiltonian function must be a solution to the PDE obtained by the substitution of the first set of Hamiltonian canonical equations of motion in the definition of the Hamiltonian function. The main change proposed in this procedure is that the conjugate momenta should not be postulated a priori, but instead are determined as a consequence of a canonical description of the mechanical system. It is also proved that Hamiltonâ€™s definition of the conjugate momenta is obtained by the imposition of the envelope condition in the generalized solution of the PDE that defines the Hamiltonian function. Therefore in the singular mechanics the usual definition cannot be used as the PDE is linear in the momenta. It must be noted that the Hamiltonian yielded is identical to that obtained by Dirac, but with an additional advantage as there is no constraints, no need of new definitions as "weak equalities" or "super phase space" nor a new variational procedure. Then this procedure can be applied to Singular (Dirac), Nambu, or Non Holonomic Mechanics, and can be used to the linearize the Hamilton-Jacobi equation or to determinate constants of motion. The linearization of the SchrÃ¶dinger equation can also be obtained from the Hamilton-Jacobi one. The same idea was extended for field theories singular or not. As there will be always a Hamiltonian density linear in the momentum density there is always the possibility of a linearization of the corresponding SchrÃ¶dinger field equation.

The role of $\mathfrak{sl}_{-1}(\mathbb{R})$ symmetries on Dirac-like representations

Nelson José Rodrigues Faustino (UFABC)

The orthosymplectic Lie algebra $\mathfrak{osp}(1|2)$ allows us to duly characterize the classical harmonic oscillator $\frac{1}{2}(-\Delta+|x|^2)$ in terms of Wigner quantal systems in case where its factorization is recasted in terms of the pair (D_+,D_-) of Clifford-valued operators of the form $D_\pm=\frac{1}{\sqrt{2}}(X\mp D)$, where D stands the Dirac operator and X the multivector counterpart of the multiplication operator (cf. [D Constales, N Faustino, RS KrauÃŸhar - Journal of Physics A: Mathematical and Theoretical, 2011]). In this presentation we show that when we consider the Dirac-like operator $D-m\gamma$ carrying a unitary pseudo-scalar γ, instead of its massless limit $D=\lim\limits_{m\rightarrow 0} (D-m\gamma)$ provide a non-trivial realization of the quantum Lie algebra $\mathfrak{sl}_q(\mathbb{R})$, in the limit $q\rightarrow -1$.

Some applications of indefinite Kac- Moody Lie algebras

Malika Ait Ben Haddou (Faculty of sciences- Moulay Ismail University. Meknes .)

We will give some physic applications of Indefinite Kac- Moody algebras.

Symmetry Group Analysis of Conformable Fractional Differential Equations

EL KINANI EL HASSAN (Université Moulay Ismail Meknes)

In this talk, we give a proper extension of the classical prolongation formula of point transformations to conformable fractional derivative. This technique is illustrated and employed to construct symmetry group admitted by a conformable fractional ordinary and partial differential equations. Using Lie symmetry analysis, we obtain an exact solution of the conformable fractional heat equation.

Solitons in a chain of charge-parity-symmetric dimers

Natanael Karjanto (Sungkyunkwan University)

We consider an array of dual-core waveguides (which represent an optical realization of a chain of dimers) with an active (gain-loss) coupling between the cores, opposite signs of the discrete diffraction in the parallel arrays, and a sufficiently large phase-velocity mismatch between them, which is necessary for the overall stability of the system. The corresponding linear array provides an optical emulation of the charge-parity ($\mathcal{CP}$) symmetry. The addition of the intra-core cubic nonlinearity, despite breaking the $\mathcal{CP}$ symmetry, gives rise to several families of fundamental bright discrete solitons, whose existence and stability are explored here by means of analytical and numerical methods. An asymptotic analysis is presented for the case of weak intersite coupling between the dimers, as well as between the parallel cores. In particular, we find stable discrete solitons that have no counterparts in the continuum limit (CL), as well as a branch which carries over into a family of stable gap solitons in the CL. A soliton family which develops an oscillatory instability above a critical strength of the intersite coupling is found too.

Topological theories and quantum computing

Dmitry Melnikov (International Institute of Physics - UFRN)

I will review recent developments on the application of methods of topological quantum field theories to quantum information theory, quantum computing and knot theory.

On Tanabe algebra and complex reflection group G(r, p, n)

Ashish Mishra (Universidade Federal do Para)

The complex reflection group G(r, p, n) acts diagonally on the tensor space (C n) ⊗k where C n is the reflection representation of G(r, p, n). We define subalgebras, denoted by CAk(r, p, n) and CAk+ 1 2 (r, p, n), of partition algebras CAk(n) and CAk+ 1 2 (n) respectively and show that CAk(r, p, n) and CAk+ 1 2 (r, p, n) are the centralizer algebras of the action of G(r, p, n) and L(r, p, n) (a subgroup of G(r, p, n)) on (C n) ⊗k respectively. We call the algebras CAk(r, p, n) and CAk+ 1 2 (r, p, n) Tanabe algebra. In this talk, we exhibit Schur-Weyl dualities between Tanabe algebras and complex reflection group (and its subgroup L(r, p, n)). Also, we study the representation theory of Tanabe algebra and describe the Jucys-Murphy elements. This is a joint work with Shraddha Srivastava.

Hasimoto transform for stochastic Landau-Lifshitz-Gilbert equation

Mikhail Neklyudov (Universidade Federal do Amazonas)

Berezin transforms attached to Landau levels

Zouhair Mouayn (Sultan Moulay Slimane University, Faculty of Sceinces and Technics (M'Ghila))

We review the definition and properties of coherent states with examples. We construct coherent states attached to Landau levels on the Poincar Ì e disk D, Euclidean plane C and the Riemann sphere CP1 . Generalization to the complex unit ball Bn , to Cn and CPn are also discussed. In these cases, we apply a coherent states quantization method to recover the corresponding Berezin transforms and we give formulae representing these transforms as functions of Laplace-Beltrami operators.

High-density hard-core model on a triangular lattice

Izabella Stuhl (The Pennsylvania State University)

The hard-core model has attracted attention for quite some time and generated a notable literature. The first rigorous results about the phase transition on a lattice were obtained by Dobrushin in late 1960s. Since then, various aspects of the model gained importance in a number of applications. We propose a solution for the high-density hard-core model on a triangular lattice. The high-density phase diagram (i.e., the collection of pure phases) depends on arithmetic properties of the exclusion distance D; a convenient classification of possible cases can be given in terms of Eisenstein primes. For two classes of values of D the phase diagram is completely described: (I) when either D or $D/{\sqrt 3}$ is a positive integer whose prime decomposition does not contain factors of the form $6k+1$, (II) when $\D^2$ is an integer whose prime decomposition contains (i) a single prime of the form $6k+1$, and (ii) other primes, if any, in even powers, except for the prime 3. For the remaining values of D we offer some partial results. The main method of proof is the Pirogov-Sinai theory with an addition of Zahradnik's argument. The theory of dominant ground states is also extensively used, complemented by a computer-assisted argument. This is a joint work with A. Mazel and Y. Suhov.

Quasi-nonassociativity from an exceptional spectrum-generating superalgebra.

Francesco Toppan (CBPF)

Exceptional Lie (super)algebras are derived from octonions. I present the Calogero-deformed quantum oscillator derived from the spectrum generating superalgebra F(4). Its spectrum is a direct sum of

F(4) lowest weight representations. This system is a unique example of "quasi-nonassociativity". This means, in particular, that the Calogero coupling constants are determined in terms of the octonionic structure constants. The Hilbert space is a 16-ple of square integrable functions. This talk is based on the paper arXiv:1711.02923[math-ph], published in J. Math. Phys. 59, 022101 (2018) in collaboration with N. Aizawa and Z. Kuznetsova.

Relation modules of yangian and it is tensor products

Jian Zhang (IME-USP)

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POSTERS

The Restricted Inomata-McKinley spinor-plane, homotopic deformations and the Lounesto classification

Dino Beghetto Junior (DFQ-UNESP)

We define a two-dimensional space called the spinor-plane, where all spinors that can be decomposed in terms of Restricted Inomata-McKinley (RIM) spinors reside, and describe some of its properties. Some interesting results concerning the construction of RIM-decomposable spinors emerge when we look at them by means of their spinor-plane representations. We show that, in particular, this space accomodates a bijective linear map between mass-dimension-one and Dirac spinor fields. As a highlight result, the spinor-plane enables us to construct homotopic equivalence relations, revealing an algebraic-topological link between these spinors. In the end, we develop a simple method that provides the categorization of RIM-decomposable spinors in the Lounesto classification, working by means of spinor-plane coordinates, which avoids the often hard work of analising the bilinear covariant structures one by one.

A model for the effects of unsteady free convection radiation near an infinite vertical porous plate with hall current

Sanjeev Kumar (Dr. Bhimrao Ambedkar University, Agra)

A study of radiation effect on unsteady free convection flow of an electrically conducting gray gas near equilibrium in the optically thin limit along an infinite vertical porous plate in the presence of strong transverse 'magnetic field imposed perpendicularly to the plate, taking hall current in to account, is considered in this work. A similarly parameter length scale (h), as a function of time and the suction velocity are considered to be inversely proportional to this derived and solved numerically using the shooting method. The numerical values of skin-friction and rate of heat transfer are represented in the table. The effects of radiation parameter, hall parameter, and magnetic field parameter are discussed and shown through appropriate tables/ graphs.

Gelfand-Tsetlin representations of vertex algebra.

Oscar Armando Hernández Morales (Institute of Mathematics and Statistics)

In the recent paper Arakawa, Futorny and Ramirez (2017) described a new family of relaxed highest weight representations of an admissible affine vertex algebra $V_{k}(\mathfrak{g})$ of type A. These representations are simple quotients of representations of the affine Kac-Moody algebra $\widehat{\mathfrak{g}}$ induced from $\mathfrak{g}$-modules. In particular, they described a class of $V_{k}(\mathfrak{\mathfrak{sl}_n})$-modules induced from $\mathfrak{sl}_2$-modules in the principal nilpotent orbit. Our work is to extend these results to all $\mathfrak{sl}_2$-induced modules.

Entanglement Entropy in sigma-model on de Sitter space

Ion Vasile Vancea (Universidade Federal Rural do Rio de Janeiro)

In this work I will briefly review the results obtained in the study of the inner (Left-Right) entanglement entropy in the two-dimensional sigma-model with the de Sitter target space from Nucl.Phys. B924 (2017) 453-476 and Adv.High Energy Phys. 2017 (2017) 3706870.