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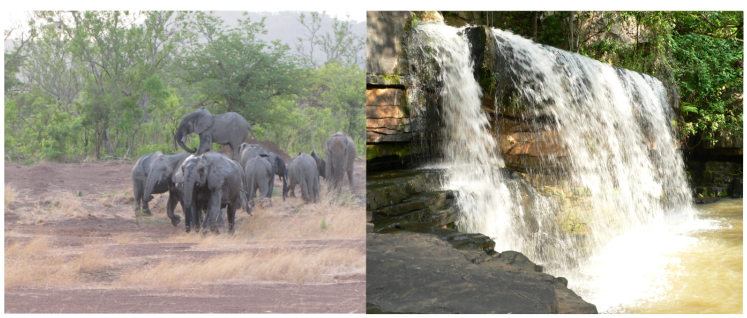
THE 33RD/35TH INTERNATIONAL COLLOQUIUM ON GROUP THEORETICAL METHODS IN PHYSICS (GROUP33/35)



The ICGTMP series is traditionally dedicated to the application of symmetry and group theoretical methods in physics, mathematics and other sciences, and to the development of mathematical tools and theories for progress in group theory and symmetries. Over the years, it has further broadened and diversified due to the successful application of group theoretical, geometric and algebraic methods in life sciences and other areas. The conference has an interdisciplinary character. It aims at bringing together experts and young researchers from different fields encouraging cross disciplinary interactions.

This is the meeting originally scheduled for 2020, postponed until now due to the Covid-19 pandemic.

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Contents

Dually weighted multi-matrix models as a path to causal gravity-matter systems

Juan Abranches
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Abstract:We introduce a dually-weighted multi-matrix model that for a suitable choice of weights reproduce two-dimensional Causal Dynamical Triangulations (CDT) coupled to the Ising model. When Ising degrees of freedom are removed, this model corresponds to the CDT-matrix model introduced by Benedetti and Henson [Phys. Lett. B 678, 222 (2009)]. We present exact as well as approximate results for the Gaussian averages of characters of the square of a Hermitian matrix for a given representation and establish the present limitations that prevent us to solve the model analytically. This sets the stage for the formulation of more sophisticated matter models coupled to two-dimensional CDT as dually weighted multi-matrix models providing a complementary view to the standard simplicial formulation of CDT-matter models.

Towards a conceptual approach to supersymmetry (CASSy)

Abel Afouda
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Abstract: By considering the universe as a dynamic system, this paper demonstrates that its primordial energy is a finite quantity occupying a non-zero primordial space. It is deduced that space-time emerges from this primordial space with an inherent symmetry. This symmetry in the emerging space-time structures the fluctuations of primordial matter. The duality relationship between space-time and matter forms a supersymmetry, whose spontaneous breaking allows us to recover all the particles of the standard model of physics and their superpartners. This phenomenological approach not only reproduces the results of the standard model of elementary particle physics but also those of the standard cosmological model. Furthermore, it provides natural answers to some of the current questions in physics, such as the nature and origin of dark matter, dark energy, and the matter-antimatter asymmetry.

Keywords: Supersymmetry, noncommutative geometry, string theory, quantum gravity, graph theory, and field theories

Integral Quantization of the Semi-Discrete Cylinder and its Related Quantum States

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Abstract:Following the work of Gazeau and Murenzi (Quantum Rep. 2022, 4) , we first further investigate the usefulness of the Weyl-Heisenberg or Gabor transformation on the semi-discrete cylinder (viewed as a phase space) in the context of quantum optics and signal processing. By taking key examples such as the Von Mises, Wrapped Gaussian, and Fejér distributions, we obtain the relevant reproducing kernels. Through the Gabor transformation, we obtain coherent states on the circle with promising applications in signal processing, quantum information, and other fields using circular datasets. Secondly, using covariant integral quantization of functions defined on the semidiscrete cylinder, novel quantum operators are derived. We give examples of density operators (i.e. quantum states) on the circle through the quantization of density distributions on the semi-discrete cylinder by using various coherent state weights ϖ_ϕ, that is, related to a fiducial vector ϕ. The related quantized operator of any density distribution on the semi-discrete cylinder is a density operator, whose degree of quantumness might be related to the number and distributions of zeros on that density distribution.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Entanglement and U(D)-spin squeezing in symmetric multi-quDit systems and applications to quantum phase transitions in Lipkin–Meshkov–Glick D-level atom models

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Abstract: Collective spin operators for symmetric multi-quDit (namely identical $D-$level atom) systems generate a $U(D)$ symmetry. We explore generalizations to arbitrary D of $SU(2)-$spin coherent states and their adaptation to parity (multi-component Schrödinger cats), together with multi-mode extensions of NOON states. We write level, one- and two-quDit reduced density matrices of symmetric $N-$quDit states, expressed in the last two cases in terms of collective $U(D)-$spin operator expectation values. Then, we evaluate level and particle entanglement for symmetric multi-quDit states with linear and von Neumann entropies of the corresponding reduced density matrices.

In particular, we analyze the numerical and variational ground state of Lipkin-Meshkov–Glick models of 3−level identical atoms. We also propose an extension of the concept of $SU(2) - s$pin squeezing to $SU(D)$ and relate it to pairwise $D-$level atom entanglement. Squeezing parameters and entanglement entropies are good markers that characterize the different quantum phases, and their corresponding critical points, that take place in these interacting $D-$level atom models.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Maximum likelihood estimation in ageneralized extreme value regression model forbinary response data

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Abstract: Binary responses $Y \in 0, 1$ are often present in medical studies. It may represent,for example, the occurrence of some outcome of interest (Y = 1 if the outcomeoccurred and Y = 0 otherwise). When the dependent variable Y represents arare event, the logistic regression model (obviously used for this category of datato study the relationship between potential predictors X and Y among the sus-ceptibles) shows relevant drawbacks. In order to overcome these drawbacks weuse the quantile function of the Generalized Extreme Value (GEV) distribution aslink function. We focus attention on the tail of the response curve for values closeto one. We develop a maximum likelihood estimation procedure for this problemusing the GEV link function, based on the modeling of the binary response ofinterest. We investigate the identifiability of the resulting model. We establishthe existency, consistency and asymptotic normality of the proposed maximumlikelihood estimator. Then, we conduct a simulation study to investigate its finite-sample behavior.

Keywords: Generalized extreme value; Regression model; Excess of zero; Maxi-mum likelihood estimation

Entanglement and U(D)-spin squeezing as quantum phase transitions indicators in symmetric multi-quDit systems

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Abstract: Squeezing parameters and entanglement entropies are good markers that characterize the different quantum phases of interacting D-level atom models. In particular, we analyze the lowest energy states of the 3-level Lipkin–Meshkov–Glick model. Nevertheless, we start from a general point of view with a symmetric multi-quDit or identical D-level atom problem, where U(D) symmetry is generated by collective spin operators. We explore generalizations to arbitrary D of SU(2)-spin coherent states and their adaptation to parity, together with multi-mode extensions of NOON states. We write level, one- and two-quDit reduced density matrices of symmetric N-quDit states, expressed in the last two cases in terms of collective U(D)-spin operator expectation values. Then, we evaluate level and particle entanglement for symmetric multi-quDit states with linear and von Neumann entropies of the corresponding reduced density matrices. At the end, we propose an extension of the concept of SU(2)-spin squeezing to SU(D) and relate it to pairwise D-level atom entanglement.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Generalized Noether theorem for conformable fractional field theory

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Abstract:Due to the absence of a single definition and uniform properties, the construction of fractional derivative useful in field theory appears to be a difficult task. The fractional derivative introduced by Thabet et al. in 2015 is well suited for field theory because it verifies Leibniz's rule and is conformable with respect to ordinary derivative for the differential functions in the ordinary sense. We generalize Noether's theorem to scalar field theory defined in this conformable spacetime with nonlocal Lagrangian including infinite order derivatives. The equivalent of the Ostrograsky's construction to field theories is also highlighting in our presentation.

From bi-Hamiltonian systems to Dirac-Nijenhuis structures

The number of 1-nearly independent vertex subsets

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Abstract: Let G be a graph with vertex set $V(G)$ and edge set $E(G)$. A subset I of $V(G)$ is an independent vertex subset if no two vertices in I are adjacent in G. We introduce the number, $\sigma_1(G)$, of all subsets of $V(G)$ that contain exactly one pair of adjacent vertices. We call those subsets 1-nearly independent vertex subsets. This talk will discuss lower (resp. upper) bound on σ_1 for graphs of order n. We deduce as a corollary that the star $K_{1,n-1}$ (the tree with degree sequence $(n-1, 1, \ldots, 1)$) is the n-vertex tree with smallest σ_1, while it is well known that $K_{1,n-1}$ is the n-vertex tree with largest number of independent subsets.

Keywords: 1-nearly independent vertex subset; Minimal connected graphs; Maximal graphs.

AMS subject classification: 05C69

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Abstract:A bi-Hamiltonian structure on a smooth manifold M is given by a pair (π_1, π_2) of two Poisson tensors that are compatible, in the sense that, $\lambda_1\pi_1 + \lambda_2\pi_2$ is again a Poisson tensor on M , for all λ_1, $\lambda_2 \in \mathbb{R}$. Bi-Hamiltonian systems play a crucial role in the study of integrable systems. They have been extensively studied in the mathematical physics since Magri and Morosi gave a geometric formulation of integrable Hamiltonian systems using the theory of Poisson- Nijenhuis structures in 1984. In this talk, we will discuss Dirac-Nijenhuis structures which include Poisson-Nijenhuis structures as a special case.

q-Difference equations for Cigler type polynomials and some applications

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Abstract: Motivated by Andrews' polynomials with double q-binomial coefficients [1], we further develop the Cigler type polynomials of [4] and [3] to construct q-difference equations with seven variables, which generalize recent works of Srivastava et al [5] and Jia et al [2]. Next, we obtain Rogers formulas, extended Rogers formulas and Srivastava–Agarwal type bilinear generating functions for generalized q-polynomials, which generalize generating functions for Cigler type polynomials. Finally, we also derive mixed generating functions using q-difference equations.

Keywords: Operator theory, differential/difference equations, orthogonal polynomials, and special functions

Barut-Girardello coherent states for isotonic harmonic oscillator

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Abstract: In this work, we study the physical and mathematical characteristics of Barut-Giradello coherent states for the isotonic harmonic oscillator. Some relevant optical and statistical properties are analyzed and discussed. Furthermore, the thermodynamic and temporal stability are obtained respectively from P representation of the density operator, and probability density approaches. In addition, a comparative analysis of non-classical behaviors is made between these states and those of the Gazeau-Klauder type constructed for this quantum system

Keywords: Isotonic oscillator; coherent states; density operator P-representation; probability density formalism.

On brauer configurations and brauerhypergraphs algebras

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Application(ICMPA-UNESCO CHAIR),

Abstract: This study delves into the Brauer graph algebra via a ribbon quivertied to a specific ribbon graph. It also scrutinizes the Brauer hypermapalgebra, which stems from a hypermap quiver linked to a hypermap.Furthermore, the research inspects the Brauer configuration algebra, whicharises from a Brauer configuration quiver.Subsequently, the research draws analogies between graphs and hypergraphs,ribbon graphs and hypermaps, as well as ribbon quivers and hypermapquivers, to broaden the scope of findings from graph theory. Moreover, thestudy seeks to forge links between the Brauer hypermap quiver, the Brauerconfiguration quiver, and their respective algebras.

Partial duality for hypermaps and polynomial invariant

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Abstract:Chmutov and Vignes-Tourneret initially introduced the concept of partial duality in hyper-maps, which can be combinatorially characterized in one of three distinct manners: throughthree involutions on the flag set, three permutations on the half-edge set, or via edge 3-colouredgraphs. In our study, we specifically define partial duality in terms of the hyperedge set, utiliz-ing three permutations on a finite set that delineates the ribbon graphs, employing Schmutov'sarrow representation method, and leveraging the bipartite graph associated to a hypergraph.We then present the partial duality polynomial for hypermaps and explore some ofitsproperties.

The number of 1-nearly independent vertex subsets

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Abstract: Let G be a graph with vertex set $V(G)$ and edge set $E(G)$. A subset I of $V(G)$ is an independent vertex subset if no two vertices in I are adjacent in G. We introduce the number, $\sigma_1(G)$, of all subsets of $V(G)$ that contain exactly one pair of adjacent vertices. We call those subsets 1-nearly independent vertex subsets. This talk will discuss lower (resp. upper) bound on σ_1 for graphs of order n. We deduce as a corollary that the star $K1, n1$ (the tree with degree sequence $(n1, 1, ..., 1)$) is the n-vertex tree with smallest σ_1, while it is well known that $K_{1,n1}$ is the n-vertex tree with largest number of independent subsets.

Keywords: Independent Subsets ; Trees

Affine extensions of Z_2^2 $osp(1|2)$ and Virasoro algebra

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Abstract: We present affine extensions of Z_2^2-graded Lie superalgebra $osp(1|2)$, where $Z_2^2 = Z_2 x Z_2$. There are two inequivalent Z_2^2-graded $osp(1|2)$, one of them is eight-dimensional and the other is ten-dimensional algebras. Their affine extensions are presented explicitly. For the eight-dimensional case, it is shown that there is the unique central extension of the loop Z_2^2-$osp(1|2)$. While, the ten-dimensional one admits a central extension of nontrivial Z_2^2-grading. With these affine Z_2^2-graded extensions, we consider the Sugawara construction of the Virasoro algebra. It is shown that the ten-dimensional one gives a kind of Z_2^2-graded extension of the Virasoro algebra.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

Modular Quantization and Non-commutative Space-time

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Abstract: A deep link between quantization and (non-commutative) geometry is uncovered via a careful usage of modular theory. It is premature to assume that space-time geometry in quantum gravity becomes relevant only at the emergent macroscopic level. At the covariant quantum level, there is still some viable option for a-posteriori derived space-time (non-commutative) geometries, induced by states (see arXiv:1007.4094v1). The ideas involved are strongly motivated by algebraic quantum field theory, suitably freed from its old reliance on background manifolds. The mathematical techniques rely on an interplay between Tomita-Takesaki modular theory and derived categorical non-commutative geometry that seems to hint at further deep modifications of the notions of space and geometry, waiting to be further explored.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states, Supersymmetry, noncommutative geometry, string theory, quantum gravity, graph theory, and field theories

New familly of symmetry constraints for tensorial group field theory

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Abstract:Tensorial group field theories (TGFTs) are quantum field theories with tensor fields defined on a group manifold. They are particularly characterized by a specific form of their interactions, which, in the case of a complex field, are generally invariant under unitary transformations. This invariance implies the constancy of the partition function and leads to the so-called Ward identities. In this presentation, we provide all the Ward identity constraints involved in such models. These constraints will become crucial when considering a nonperturbative renormalization of TGFTs, particularly the functional renormalization group approach.

Some problems in combinatorial physics and representation theory of the symmetric group

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Abstract: The representation theory of the symmetric group S_n (permutations of n objects) has numerous applications in theoretical physics, combinatorics, and computational complexity theory. Recently, we have shown that some problems in theoretical physics can provide insights into well-known problems in the representation theory of S_n. The first problem is the famous and longstanding question posed by Murnaghan [Amer. J. Math., 1938], which asks for a combinatorial interpretation of the Kronecker coefficient — an integer that counts the multiplicity of an irreducible representation (irrep) of S_n in the decomposition of a tensor product of two irreps. We show that counting $U(N)^3$ tensor model observables leads to an answer to this question. The second problem is a variant of a problem posed by Stanley, which seeks an interpretation of the row sum of the character table of S_n. We focus on the column sum of this table of normalized characters evaluated at a given conjugacy class and for all irreps. Interestingly, there is a Topological Quantum Field Theory with a permutation group as the gauge group, whose partition function computes this column sum. Inspired by this, we provide a construction of the column sum in terms of ribbon graphs with a given face structure. Finally, using permutation factorizations, we are able to prove that deciding the positivity of the column sum of the normalized central character of S_n in a given conjugacy class can be performed in polynomial time in the size of the entry.

Sherical gabor transformation of type delta

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Abstract: The classical Gabor transformation is well known on abelian topological group. In this work, we study the general case of any topological group according to an unitary dual of some compact subgroup.

Polynomial invariants of the quantum queer superalgebra

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Abstract: The queer Lie superalgebra $\mathfrak{q}_n$ naturally acts on $V = \mathbb{C}^{n|n}$, and thus acts on the symmetric superalgebra

$$\mathcal{U}_{s,l}^{r,k} = \mathrm{Sym}\left(V^{\oplus r} \oplus \Pi(V)^{\oplus k} \oplus V^{*\oplus s} \oplus \Pi(V)^{*\oplus l}\right)$$

as endomorphisms of superalgebras, where Π is the parity reversing functor and V^* is the dual of V. A set of generators of the $U(\mathfrak{q}_n)$-invariant subalgebra of $\mathcal{U}_{s,l}^{r,k}$ was given by A. Sergeev, which is the so-called the first fundamental theorem of the invariant theory for $\mathfrak{q}_n$. In this talk, we will present a quantum version of this result. Namely, we created a quantum analogue $\mathcal{B}_{s,l}^{r,k}$ of $\mathcal{U}_{s,l}^{r,k}$. The quantum queer superalgebra $\mathrm{U}(\mathfrak{q}_n)$ acts on $\mathcal{B}_{s,l}^{r,k}$ as endmorphisms of superalgebras. We will show a set of generators of the $\mathrm{U}_q(\mathfrak{q}_n)$-invariant subalgebra of $\mathcal{B}_{s,l}^{r,k}$. The superalgebra $\mathcal{B}_{s,l}^{r,k}$ is created by a braided tensor product. Since the quantum queer superalgebra $\mathrm{U}_q(\mathfrak{q}_n)$ is not quasi-triangular, our braided tensor product is created via an explicit intertwining operator instead of the universal $\mathcal{R}$-matrix. This talk is based on the joint work with Yongjie Wang (Hefei University of Technology).

Deformation families of Novikov bialgebras via differential antisymmetric infinitesimal bialgebras

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Abstract: We generalize S. Gelfand's classical construction of a Novikov algebra from a commutative differential algebra to get a deformation family $(A, \circ_q)$ of Novikov algebras by an admissible commutative differential algebra, which ensures a bialgebra theory of commutative differential algebras, enriching the antisymmetric infinitesimal bialgebra. Moreover, a deformation family of Novikov bialgebras is obtained, under certain further condition. In particular, we obtain a bialgebra variation of S. Gelfand's construction with an interesting twist: every commutative and cocommutative differential antisymmetric infinitesimal bialgebra gives rise to a Novikov bialgebra whose underlying Novikov algebra is $(A, \circ_{-\frac{1}{2}})$ instead of $(A, \circ_0)$ which recovers the construction of S. Gelfand. This is the joint work with Yanyong Hong and Li Guo.

Covariant Quantization of the Discrete Torus Phase Space: Applications to Quantum Information and Computation

Romain Murenzi, Aidan Zlotak

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Abstract: Covariant quantization is implemented for systems whose phase space is Z_N x Z_N. The symmetry group of this phase space is the discrete the Weyl-Heisenberg group, namely the central extension of the abelian group Z_N x Z_N. In this regard, the phase space is viewed as the left coset of the group with its center. The non-trivial unitary irreducible representation of this group, acting on $L^2(Z_N)$, is square integrable on the phase space. We derive corresponding covariant quantizations, for functions and distribution densities defined the phase space, from various weights. We explore the applicability of this quantization to quantum information and computation

Keywords: Covariant quantization; discrete torus; coherent states; quantum information and computation.

The T-X Arctan Log-Logistic Odd Family of Distributions: properties and applications to materials and composite engineering data

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Abstract: This paper proposes anewfamily of distributions obtained by composing a distribution derived fromthe arctangent, the Log-logistic distribution, and the Odd family of distributions using the T-X transformation method. Mathematical properties are developed for this composite family, including moments, quantile function and density function series expansion. Two applications are shown on composite materials data, particularly using the Gumbel distribution, to illustrate the benefits of this new family for modeling in the field of reliability and strength of composite materials. The results indicate a better fit to the data compared to common distributions. This study thus proposes a new statistical model and demonstrates its concrete contribution for the analysis of real life data.

Keywords: T-X transformation; Mathematical properties; Odd family ; Maximum likelihood estimation; Gumbel distribution

Cohomologies des opérateurs relatifs de Rota-Baxter sur les algèbres de Jacobi-Jordan

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Abstract: Certains résultats sur les réprésentations des algèbres de Jacobi-Jordan sont prouvés. De plus la notion d'opérateurs relatifs de Rota-Baxter sur les algèbres de Jacobi-Jordan est introduite et certaines constructions sont faites. En se basant sur la théorie de cohomologies des algèbres de Jacobi-Jordan, la théorie de cohomologies des opérateurs relatifs de Rota-Baxter sur ces algèbres est étudiée et des exemples sont donnés.

Keywords: Hom-algebras, Lie groupoids, Lie algebroids and nonassociative algebras

New Paradigm for Signal Analysis

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Abstract: Quantum formalism and signal analysis have a number of properties in common. One of them is identity resolution. By means of so-called covariant integral quantization, this resolution of the identity enables us to construct operators, satisfying certain properties, that allow us to extract the information contained in the wave function describing the state of a quantum physical system. We show that the operators obtained by this quantisation can be used for signal processing (analysis and reconstruction). We show that, in addition to the very standard signal analysis methods (Fourier transform, Gabor transform, wavelet transform), there are other methods that are just as robust (see the results obtained by digitally processing a few elementary signals using Matlab software) and efficient.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

A direct approach to the coherent states of billiards using a quantum algebra structure

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Abstract: Quantum billiards are a key focus in quantum mechanics, offering a simple but powerful model for studying complex quantum features. The development of algebras for quantum systems is traced from the harmonic oscillator algebra to one-dimensional integral models for quantum groups and to other algebras, such as the Generalized Heisenberg Algebra (GHA). The main focus of this work is to extend the GHA to quantum billiards, showing its application to separable and non-separable billiards. We apply the GHA formalism to a square billiard, first generating one-dimensional coherent states with specific quantum numbers and exploring their time evolution. We also demonstrate its applicability to a non-separable equilateral triangle billiard, describing its algebra generators and the associated one-dimensional coherent states.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Multivariate Principal Component Analysis and BinaryFunctional Linear Models under non-random sampling

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Abstract:Multivariate principal component analysis and a multivariate functional binarychoice model is explored in a case-control or choice-based sample design context. In other wordsa model is considered in which the response is binary, the explanatory variables are functional,and the sample is stratified with respect to the values of the response variable. A dimension re-duction of the space of the explanatory random functions based on a Karhunen–Loève expansionis used to define a conditional maximum likelihood estimate of the model. Based on this formu-lation, several asymptotic properties are given. A simulation study and an application to realdata are used to compare the proposed method with the ordinary maximum likelihood method,which ignores the nature of the sampling. The proposed model yields encouraging results. Thepotential of the functional choice-based sampling model for integrating special non-random fea-tures of the sample, which would have been difficult to see otherwise, is also outlined.

Keywords: Case-Control - Functional linear model - Binary Choice Model - MultivariatePrincipal Component Analysis

”Massive Elementary Systems in a (3+1) Anti-deSitter Space-Time”

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Abstract:We present ‘’massive” elementary systems in the (1+3)-dimensional Anti-de Sitter (AdS4) spacetime, on both classical and quantum levels. The symmetry group isomorphic to Sp(4,R), that is, the two-fold covering of SO0(2,3) recognized as the relativity/kinematical group of motions in AdS4 spacetime is studied. In particular, the group coset Sp(4,R)/ S(U(1) x SU(2)) can be interpreted as a phase space for the set of free motions of a test massive particle on AdS4 spacetime. The (projective) unitary irreducible representations (UIRs) of the Sp(4,R) group, describing the quantum version of such motions, are found in the discrete series of the Sp(4,R) UIRs. We also present the null-curvature (Poincaré) and non-relativistic (Newton-Hooke) contraction limits of such systems, on both classical and quantum levels. In this way we display the dual nature of ‘’massive” elementary systems living in AdS4 spacetime, as each being a combination of a Minkowskian-like elementary system (with positive proper mass), with an isotropic harmonic oscillator arising from the AdS4 curvature and viewed as a Newton-Hooke elementary system. The possible cosmological implication of the oscillating term is conjectured.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

2D magnetic stability

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Abstract:The stability of matter is an old and mathematically difficult problem, relying both on the uncertainty principle of quantum mechanics and on the exclusion principle of quantum statistics. We consider the stability of the self-interacting almost-bosonic anyon gas, generalizing the Gross-Pitaevskii / nonlinear Schrodinger energy functionals to include magnetic self interactions. We prove that there is a type of supersymmetry in the model which holds only for higher values of the magnetic coupling but is broken for lower values, and that in the former case supersymmetric ground states exist precisely at even-integer quantized values of the coupling. These states constitute a manifold of explicit solitonic vortex solutions whose densities solve a generalized Liouville equation,

and can be regarded as nonlinear generalizations of Landau levels. This joint work with Alireza Ataei and Dinh-Thi Nguyen makes an earlier analysis of self-dual abelian Chern-Simons-Higgs theory by Jackiw and Pi, Hagen, and others, mathematically rigorous.

On Level Energy and Level Characteristic Polynomial of Rooted Trees

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Abstract:Building from the level index, a Wiener-like topological index proposed by Balaji and Mahmoud, we define the level matrix and study the level energy and the level characteristic polynomial of rooted trees. We establish relations between the level matrix and the usual distance matrix. Moreover, we determine various lower and upper bounds on the level energy and calculate the level energy in specific tree families. We also provide an explicit expression of the level characteristic polynomial of the so-called rooted double stars and rooted binary caterpillars. Finally, we provide a positive answer to a conjecture that the rooted path maximises the level energy among all trees with a given number of vertices.

Keywords: Level index ; Level characteristic polynomial ; Level energy ; Distance energy ; Distance matrix ; Rooted trees

Odzijewicz, Berezin and Fedosov-type quantizations on smooth compact manifolds

Dey Rukmini
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Abstract:In this work we define Odzijewicz-type, Berezin-type and Fedosov-type quantization on compact smooth manifolds. For the first two quantisations, we embed the smooth manifold of real dimension n into complex projective space of dimension n. In the Fedosov quantization case we can embed the smooth manifolds into any real 2n dimensional symplectic manifold. The pullback coherent states are defined in the usual way. In the Odzijewicz-type, Berezin-type quantization the Hilbert space of geometric quantization is the pullback by the embedding of the Hilbert space of geometric quantization of the ambient complex projective space. The coherent states are pullback coherent states. In the Berezin case, the operators that are quantized

are those induced from the ambient space. The Berezin-type quantization exhibited here is a generalization of an earlier work of the author and Ghosh (where we had needed totally real embedding). The Fedosov-type quantization is carried out by restriction to the submanifold given by the embedding.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Why deal with self-normalized sums in high dimension ? Which covariance estimator can be used?

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Abstract: We start by to present the relation to ϕ-divergence (entropy) with self-normalized sums. We present too the (well known) Hotelling statistic in high-dimensionnal framework and its relation with self-normalized sums. Then, we propose new estimators of the sample covariance in high-dimension that preserves the good properties of self-normalised sums. On the one hand, self-normalised sums use the inverse of the covariance matrix, which does not exist in the context of high-dimensional data. On the other hand, the field of high-dimensional covariance estimators offers a wide variety of invertible estimators - in particular shrinkage covariance estimators - but these do not allow us to retain the self-normalisation structure that results in the absence of the moments hypothesis. We propose a regularized estimators of the covariance, of the type presented by Bodnar et al (2014) [1], but with a regularization that can be random and explicit, allowing to keep the good property of no moment hypothesis in the case of symmetric laws. The finite distance control of the tail distribution of the self-normalized sum constructed with this estimator will also be exposed. [1] Bodnar, A. K. Gupta, N. Parolya, On the strong convergence of the optimal linear shrinkage estimator for large dimensional covariance matrix, Journal of Multivariate Analysis 132 (2014) 215–228.
Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Estimation of extreme risks for -mixing timeseries and applications in Environment andPublic Health

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Abstract: In this framework, we discuss the application of extreme value theory in the contextof stationary -mixing sequences that belong to the Fr ´echet domain of attraction.In particular, we propose a methodology to construct bias-corrected tail estimators.Our approach is based on the Box-Cox Tranformation of the estimation of extremevalue index to cancel the bias. The resulting estimator is used to estimate extremequantiles. In a simulation study, we outline the performance of our proposals thatwe compare to alternative estimators recently introduced in the literature. Also,we compute the asymptotic variance in specific examples when possible. Ourmethodology is applied on environmental data

Keywords: Asymptotic normality; β-mixing; Extreme value index; GARCH-models; High quantile; Return level; Wind speed data

Semi-Classical quantisation of 3-particles Toda lattice improved and its application to the Mixmaster anisotropy Hamiltonian

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Abstract: Usual approaches to quantisation of a 3-Toda system lead to numerical calculations requiring many steps that can be time consuming to insure their reliability. In order to reduce as much as possible the numerical part of the EKB quantisation procedure, and then to ease numerical calculations, we propose a reformulation of the mathematical framework with more adapted variables. This more explicit framework will be useful for studying quantum Toda-Bianchi IX models in quantum cosmology where the true Bianchi IX anisotropy Hamiltonian can be approximated by a 3-particle Toda system.

Keywords: Quantum systems, quantum mechanics, quantification techniques, and coherent states

A direct approach to the coherent states of billiards using a quantum algebra structure

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Abstract: Quantum billiards are a key focus in quantum mechanics, offering a simple but powerful model for studying complex quantum features. The development of algebras for quantum systems is traced from the harmonic oscillator algebra to one-dimensional integral models for quantum groups and to other algebras, such as the Generalized Heisenberg Algebra (GHA). The main focus of this work is to extend the GHA to quantum billiards, showing its application to separable and non-separable billiards. We apply the GHA formalism to a square billiard, first generating one-dimensional coherent states with specific quantum numbers and exploring their time evolution. We also demonstrate its applicability to a non-separable equilateral triangle billiard, describing its algebra generators and the associated one-dimensional coherent states.

Keywords: Quantum systems, quantum mechanics, quantification techniques, and coherent states

The number of 1-nearly independent vertex subsets

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Abstract: Let G be a graph with vertex set $V(G)$ and edge set $E(G)$. A subset I of $V(G)$ is an independent vertex subset if no two vertices in I are adjacent in G. We introduce the number, $\sigma_1(G)$, of all subsets of $V(G)$ that contain exactly one pair of adjacent vertices. We call those subsets 1-nearly independent vertex subsets. This talk will discuss lower (resp. upper) bound on σ_1 for graphs of order n. We deduce as a corollary that the star $K_{1,n-1}$ (the tree with degree sequence $(n-1, 1, \ldots, 1)$) is the n-vertex tree with smallest σ_1, while it is well known that $K_{1,n-1}$ is the n-vertex tree with largest number of independent subsets

Keywords: 1-nearly independent vertex subset; Minimal connected graphs; Maximal graphs.

Approximate controllability for some integrodifferential evolution equations with nonlocal conditions

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Abstract:The main objective of this work is to investigate the existence of mild solutions and approximate controllability for some integrodifferential evolution equations with nonlocal conditions. Assuming that the linear part is exactly null and approximately controllable, using resolvent operator theory, we provide our main results. An example is given to illustrate the basic results of this work.

Keywords: Combinatorics, Probability, statistical models, infinite dimensional analysis and related topics

Volatility estimation of Gaussian mean-reverting Ornstein-Uhlenbeck process of the second kind

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Abstract:"We study the asymptotic behavior of the realised power variation of the stochastic integral $Z_t = \int_0^t u_s dY^{(1)}_{s,G}$, where u is a process with finite q-variation, q"

Keywords: Combinatorics, Probability, statistical models, infinite dimensional analysis and related topics

Basic representation of loop algebras in perspective: From Weyl's constructions to Wigner's philosophy

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Abstract:Weyl's character formula and its loop algebra generalization were instrumental in the construction of the basic representation. We review the latter as well as its q-deformation and consider its applications to physics. We'll also obtain a categorification of the basic representation using the representation theory of wreath product groups. Schur-Weyl duality and Weyl's gauge group are directly related to this categorification. We'll explain how the structure of basic representation led to the theory of vertex operator algebras and how it is related to 2d conformal field theory. Then it will be shown how a particular example of the basic representation helped to construct a vertex operator algebra with the monster group symmetry, which also has a remarkable relation

to 3d quantum gravity. We'll conclude with Wigner's "unreasonable effectiveness" of mathematics in physics in our example of the basic representation.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis, Integrable models, geometric mechanics, differential geometry methods and symmetry, Quantum systems, quantum mechanics, quantification techniques and coherent states, Supersymmetry, noncommutative geometry, string theory, quantum gravity, graph theory, and field theories, Superintegrable and exact solvable systems, and Lie symmetries, Clifford algebras, Clifford analysis and applications, Hopf algebras, quantum groups, and K-theory, Hom-algebras, Lie groupoids, Lie algebroids and nonassociative algebras

Universality of the Weyl-Heisenberg symmetry and its covariant quantizations

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Abstract:The Weyl-Heisenberg symmetries originate from translation invariances of various phase spaces, e.g. Euclidean plane, semi-discrete cylinder, torus, in the two-dimensional case, and higher-dimensional generalisations. In this review talk I will describe, on an elementary level, how this symmetry emerges through displacement operators and standard Fourier analysis, and how their unitary representations are used both in Signal Analysis (time-frequency techniques, Gabor transform) and in quantum formalism (covariant integral quantizations and semi-classical portraits).

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states, Signal theory, wavelets, and related topics

Banach Lie groupoids, von Neumann algebras and restricted Grassmannian

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Abstract:The talk is devoted to the notion of Lie groupoids in the context of Banach manifolds. As it is well known, in infinite dimensions, many geometric constructions get significantly more complicated or even fail altogether. One of the examples is existence of Poisson brackets for which there is no Poisson tensor. The notion of Banach Lie groupoid will be illustrated by many examples, including the groupoids of partial isometries and partially invertible elements in von Neumann algebras and their counterpart over the restricted Grassmannian. Some possible applications in integrable systems will be mentioned.

Keywords: Integrable models, geometric mechanics, differential geometry methods and symmetry, Operator theory, differential/difference equations, orthogonal polynomials, and special functions

Cauchy coherent states for the Euclidean group and their realization in a waveguide array

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Abstract:"A new resolution of the identity is obtained for Perelomov coherent states of the Euclidean group E(2). The key point to construct this novel resolution of the identity is the fact that coherent states satisfy Helmholtz equation (in coherent states labels), and thus every coherent state belong to a one-parameter family uniquely determined by the Cauchy initial data of the coherent state in a one-dimensional Cauchy set.

A novel, non-local resolution of the identity in terms of Cauchy coherent states is provided using frame theory. It is also shown that Perelomov coherent states for the Eucliean E(2) group have a simple and natural physical realization in infinite homogeneous waveguide arrays."

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Supersymmetry, Adinkras, and Codes

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Abstract:Since 2004, physicists have been using diagrams called Adinkras to describe supermultiplets in 1 dimension of space-time. In this talk I will explain what these diagrams are and how to use them, and explain how the classification of Adinkras is related to the classification of doubly even error correcting codes. The relationship to supersymmetry in 2, 4, and higher dimensional spacetimes will also be discussed.

Keywords: Adinkra Symbols in mathematical physics

$N = 2Z_2^2$ -Supersymmetry and Quantum Mechanics

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Abstract: The supersymmetric quantum mechanics(SQM) is a Z_2 -graded extension of the quantum mechanics. It is known that the SQM can be extended by replacing Z^2 with $Z_2^n := Z_2 Z_2 (n - times)$. The $Z_2^n - SQM$ is highly nontrivial because its symmetry is Z_2^n -super Poincaré algebra and there are detectable defferences from the ordinary SQM in a multi-partcle sector. Many studies of $Z_2^n - SQM$ are focused on n = 2, N = 1, and one-dimensional(one-particle) systems. In this talk, we present a novel N = 2 $Z_2^2 - SQM$ [1] which has different features from those introduced so far. It is a two-dimensional (two-particle) system and is the first example of the quantum mechanical realization of an eight-dimensional irrep of the N = 2 Z_2^2 -super Poincaré algebra.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

Decomposition of module over the spherical subalgebra of the Cherednik algebra

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Abstract:Given a finite subgroup $W \subset GL(h)$ of a linear group of finite-dimensional complex vector field h, it is a well-studied problem to describe the structure of the symmetric algebra of $B = sym(h\star)$ as a representation of G, and also as a module over the ring of invariant differential operators under W in the ring D(h) of differential on h. Since the Cherednik algebra Hc(W, h) and the spherical algebra eHce are universal deformations of the ring D(h) and the ring D(h)W of W -invariant differential operators , we would like to build an analogy between the decomposition of module over the invariant differential operators in [3] and the decomposition over the sperical algebra. The ring $Dc = eHce$ inherits the natural grading of B, and we let $Dc0 \subset Dc$ and $Dc \subset Dc$ be the elements of degree 0 end strictly negative degree, respectively. Our main result is that there is for such all finite reflection groups a lowest weight description of category Dc-module of B where the ring $Rc = Dc0/Dc0 \cap DcDc$ plays a very important role of "Cartan algebra". Theorem 0.1. The decomposition of C[h] as a Dc-module is the same as the decomposition of Hom(Dc , C[h]) as a Rc-module. $DcDc$

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

A New Quantization and Its Vast Classical Realm

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Abstract: This new quantization procedure can deal with quantum field theory as well as quantum gravity, because canonical quiz is not the best way to study those topics. The new quantization feature, reaches features, which are not in canonical quantization, that must be in any equalization of the objects. For example, gravity is only positive in its field because it works that way to attract and not repel, and quantum field theory has to deal with field values equal to zero which are mathematically correct but physically. The fact that zero is just another mathematical term is correct, but it is difficult to include into physics because a situation where $F(x) = 0 = 3F(x) = 0 = F(x)^3 = 0$ can become poor physics

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Cauchy coherent states for the Euclidean group and their realization in a waveguide array

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Abstract:A new resolution of the identity is obtained for Perelomov coherent states of the Euclidean group E(2). The key point to construct this novel resolution of the identity is the fact that coherent states satisfy Helmholtz equation (in coherent states labels), and thus every coherent state belong to a one-parameter family uniquely determined by the Cauchy initial data of the coherent state in a one-dimensional Cauchy set. A novel, non-local resolution of the identity in terms of Cauchy coherent states is provided using frame theory. It is also shown that Perelomov coherent states for the Euclean E(2) group have a simple and natural physical realization in infinite homogeneous waveguide arrays.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Coherent States for infinite homogeneous waveguide arrays: Cauchy coherent states for E(2)

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Abstract:A new resolution of the identity is obtained for Perelomov coherent states of the Euclidean group E(2). The key point to construct this novel resolution of the identity is the fact that coherent states satisfy Helmholtz equation (in coherent states labels), and thus every coherent state belong to a one-parameter family uniquely determined by the Cauchy initial data of the coherent state in a one-dimensional Cauchy set. A novel, non-local resolution of the identity in terms of Cauchy coherent states is provided using frame theory. It is also shown that Perelomov coherent states for the Euclean E(2) group have a simple and natural physical realization in infinite homogeneous waveguide arrays.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Z2 × Z2-graded Lie (super)algebras and generalized quantum statistics

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Abstract:A Z2 × Z2-graded Lie algebra or Lie superalgebra is a Z2 × Z2-graded algebra g with a bracket that satisfies certain graded versions of the symmetry and Jacobi identity. In particular, despite the common terminology, g is not a Lie algebra nor a Lie superalgebra, but a color algebra. We first construct classes of Z2 × Z2-graded Lie algebras corresponding to the classical Lie algebras, in terms of their defining matrices. For the Z2 × Z2-graded Lie algebra of type A, the construction coincides with the previously known class. For the Z2 × Z2-graded Lie algebra of type B, C and D our construction is new and gives rise to interesting defining matrices closely related to the classical ones but undoubtedly different. Next, we construct the most general orthosymplectic Z2 × Z2-graded Lie superalgebra in terms of defining matrices. A special case of this algebra appeared already in work of Tolstoy in 2014. Our construction is based on the notion of graded supertranspose for a Z2 × Z2-graded matrix. Since the orthosymplectic Lie superalgebra osp(2m + 1—2n) is closely related to the definition of parabosons, parafermions and mixed parastatistics, we investigate here the new parastatistics relations following from our Z2 x Z2-graded construction. Some special cases are of particular interest, even when one is dealing with parabosons only.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Resolutions of the Identity and their Relatives

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Abstract: The main scope of this paper is to investigate the behavior of the Hilbert space valued functions that are obtained by applying some linear operator W to a resolution of the identity (i.e, a continuous Parseval frame) ϕ. Both the cases when either W is bounded or unbounded are considered. Riesz maps, i.e, the image of a resolution of the identity by a bounded operator W with bounded inverse, are studied in more detail.

Keywords: Quantum systems, quantum mechanics, quantification techniques, and coherent states

Transition de phase et brisure spontanée de symétrie: Cas du modèle quasi-Gaussien ou renormalisé de la théorie de Ginzburg-Landau.

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Abstract: In this study we address the properties of continuous or second order phase transitions in classical systems from the point of view of symmetries. We assume that a small number of macroscopic degrees of freedom can replace the infinity of microscopic degrees of freedom, the residual effects being able to be treated perturbatively or following a renormalization process which brings out the essential concept of dimensionality in the manifestation and the analysis of transitions since the approach suggests the dependence of certain critical parameters and exponents on dimensionality as well as quantum character. It is shown that at low temperature, the thermodynamic parameters of one-dimensional systems become either zero or infinite at T = 0 K according to the Mermin-Wagner theorem. We show how second-order Ginzburg-Landau theory combined with symmetry group considerations allows us to highlight a certain number of universal properties of continuous phase transitions in the vicinity of the transition temperature.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

On the uncertainty principles for hypergroups

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Abstract: It is known that for a locally compact abelian group G, if f 2 $L1(G)$ and the product of the measure of the support of f and its Foourier transform b f is less than one, then $f = 0$ a.e; it is the so called uncertainty principle. The uncertainty principle is an obstacle to the simultaneous study of the properties of a funtion and its Fourier trnasform. Several authors have expressed it in various manners. This of Donoho Starch qualified as quantitative relates a function and its Fourier transform throught an inequality. That of Benedicks qualified as qualitative is expressed as a sufficient condition on the simultatneous localization of a function and its Fourier transform so that the function is zero almost everywhere. In the case of hypergroups, authors like Kumar in [6] and Michael Voit in [12],are interested in the subject when the hypergroup is commutative. Let us note that hypergroups generalize locally compact groups. They appear when the Banach space of all bounded Radon measures on a locally compact space carries a convolution having all properties of a group convolution apart from the fact that the convolution of two point measures is a probability measure with com- pact support and not necessarily a point measure. The intention was to unify harmonic analysis on duals of compact groups, double coset spaces $K == H$ (H a compact subgroup of a locally compact group K), and commutative convolution algebras associated with product linearization formulas of special functions. The notion of hypergroup has been su¢ ciently studied (see for example [2, 5, 8, 9]). Harmonic analysis and probability theory on commutative hypergroups are well developed meanwhile where many results from group theory remain valid (see [1]). When K is a commutative hypergroup, the convolution algebra $Mc(K)$ consisting of measures with compact support on K is commutative. A typical example of commutative hypergroup is the double coset$K == H$ when K is a locally compact group, H is a compact subgroup of K such that $(K; H)$ is a Gelfand pair. When the hypergroup K is not commutative, it is possible to involve a compact subhy- pergroup H of K leading to a commutative subalgebra of $Mc(K)$. In fact, if H is a compact subhypergroup of a hypergroup K, the pair $(K; H)$ is said to be a Gelfand pair if $Mc(K == H)$ the convolution algebra of measures with compact support on $K == H$ is commutative. The notion of Gelfand pairs for hypergroups is well-known (see [3, 10, 11]). The goal of this work is to extend the uncertainty princilple to Gelfand pair associ- ated with noncommutative hypergroup. In the next section, we give notations and setup useful for the remainder of this paper. In section 3, we give some properties of the Fourier transform and it reverse. Finally, thanks to these properties, we

prove a quantitative and a qualitative uncertainty principles for the pair $(K; H)$.

Spin-dependent conformally invariant integral transform

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Abstract:As an extension of the Hilbert transform, which is characterized by the spacetime conformally invariant integral transform, we deal with a spin-dependent conformally invariant integral transform, which can be written as a product of the spacetime integral transform (Riesz potential) and the Casimir operator of the spin-dependent conformal group. Contrary to ordinary context, where a physical state transforms as a scalar under spacetime translation, we introduce an intrinsic momentum operator, associated with the spin operator as an intrinsic angular momentum. Even for an irreducible representation, the Casimir operator of the corresponding conformal group is not given by an identity map multiplied by a scalar, but is composed of spin-orbit coupling, Pauli-Lubanski (pseudo) vector, and the like. To accommodate the spacetime translational invariance of a physical state, we show that the physical state is annihilated by the intrinsic momentum operator.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

Wigner function for a quantum particle on a sphere

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Abstract: The Wigner function for the quantum mechanics on a sphere is introduced and its basic properties are studied. This function is labeled by points of the classical phase space i.e. the cotangent bundle T^*S^2. As far as we are aware, the constructed function is the first example in the literature of the Wigner function defined on the phase space that is the nontrivial vector bundle.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

A quantum deformation of the conformally compactified (super) Minkowski spacetime

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Abstract:We develop a quadratic deformation of (super) Minkowski, D=4 spacetime, conformally compactified as to be an homogeneous space of the conformal (super) group. We depart from a complexified spacetime, which can be then be seen as a flag (super) manifold, in the twistor formalism, and proceed to its quantum deformation via the group of symmetry, the conformal group, that becomes a quantum group.

Keywords: quantum group, Quantum systems, quantum mechanics

On R-matrix presentation of Yangians

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Abstract: R-matrices are the solutions of the Yang-Baxter equation. R-matrix realization is an important realization of quantum algebra, which originated from the study of quantum inverse scattering theory.

In this talk, we will introduce our recent work on R-matrix realization of quantum algebra, including: (1) The isomorphism between R-matrix presentation and Drinfeld's new realization of BCD type Yangians .

This is a joint work with Naihuan Jing and Alexander Molev. (2) The parabolic presentation of BCD type Yangian which is a joint work with Zhihua Chang, Naihuan Jing and Haitao Ma.

On Sobolev spaces on groups and beyond

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Abstract:In this talk, we define Sobolev spaces on a locally compact unimodular group in link with the spherical Fourier transform of type delta. Properties of these spaces are obtained. Analogues of some Sobolev embedding theorems are proved. Similar studies can be conducted for locally compact hypergroups or homogenous spaces related to Gelfand pairs.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

SU$(1,1)$-displaced coherent states, photon counting and squeezing

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Abstract:In this communication we present families of SU$(1,1)$ coherent states that might be interested in quantum optics. They are.: marianoantonio.olmo@uva.es Perelomov SU$(1,1)$ displaced coherent states states. We show interesting statistical aspects of these states in relation with photon counting and squeezing. Some of these properties are related to the parameter labeling the discrete series of unitary irreducible representations of SU$(1,1)$. The quantization of a classical radiation field is is carried out using the framework on these families of coherent states. In this way we obtain displacement operators which might allow to prepare such states as proposed by Glauber for the standard coherent states.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

Kepler dynamics on a α–deformed Poisson manifold:recursion operators and master symmetries

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Abstract:The problem of Kepler dynamics on a α-deformed Poisson manifold is addressed. The Hamiltonian function is defined and the related Hamiltonian vector field governing the dynamics is derived, which leads to a modified Newton second law. α-deformed momentum and Laplace-Runge-Lenz vectors are considered, generating $SO(3), SO(4)$, and $SO(1,3)$ dynamical symmetry groups. The corresponding first Casimir operators of $SO(4)$ and $SO(1,3)$ are, respectively, obtained. The recursion operators are constructed and used to compute the integrals of motion in action-angle coordinates. Main relevant properties such as quasi-bi-Hamiltonian systems, bi-Hamiltonian systems, and master symmetries are deducted. Then, a plethora of conserved quantities is highlighted.

Keywords: Kepler dynamics, α-deformed Poisson manifold, recursion operator, quasi-bi-Hamiltonian system, bi-Hamiltonian system, master symmetry.

Some aspects of quantum correlations in multipartite coherent states systems

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Abstract: In this talk, I discuss the relation between Dicke states in $d-$dimensional space and vectors in the representation space of a generalized Weyl-Heisenberg algebra of finite dimension d. This relation provides us with a nice scheme to distinguish between the separable and entangled states of a system of $N = d - 1$ symmetric qubit states. A connection between multiqubit separable states and the Perelomov coherent states associated with the generalized Weyl-Heisenberg algebra is considered. A geometrical picture of this connection will be presented. I will discuss also the quantum discord in multipartite coherent states.

Keywords: Quantum systems, quantum mechanics, quantification techniques, and coherent states

Convex Hulls of Higher-Dimensional Random Walks

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Abstract:First we focus on the convex hull of a single multidimensional random walk, with iid steps taken from any symmetric, continuous distribution. We investigate the persistence of vertices and faces on the hull. In particular we show that the corresponding distributions are universal, and follow three regimes closely linked to the Sparre Andersen theorem for one dimensional random walks.

Second, we turn to the convex hull of several multidimensional Gaussian random walks. Explicit formulas for the expected volume and expected number of faces are derived in terms of the Gaussian persistence probabilities. Special cases include the already known results about the convex hull of a single Gaussian random walk and the d-dimensional Gaussian polytope.

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Abstract:Exact solvability of one-dimansional quantum-mechanical potentials has extensively been studied and constructed, yet there still exist other

interaction models whose wave functions are given by special functions. In this talk, we discuss an exactly solvable Schrödinger equation where the eigenfunctions are expressed in terms of the Bessel functions of purely imaginary order. Our potential is defined by piecewise analytic functions, and the solutions are derived through the so-called matching of wavefunctions. We compute the whole bound-state spectra as well as scattering solutions. The explanation regarding the Bessel functions of purely imaginary order is also provided.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states, Superintegrable and exact solvable systems, and Lie symmetries, Operator theory, differential/difference equations, orthogonal polynomials, and special functions

Towards Knot Matrix Models via the Harer-Zagier transform

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Abstract:Torus Knot Matrix Models are defined by the superintegrability condition that the average of characters should be equal to the HOMFLY polynomial of torus knots. Such superintegrability, can alternatively manifest as the complete factorisability of the Harier-Zagier (HZ) transform -a discrete version of the Laplace transform- of the HOMFLY polynomial. In an attempt to investigate Knot Matrix Models beyond torus knots, we studied the HZ transform and its factorisability properties in more detail and the outcome of this study shall be the topic of the present talk. In particular, I will show some interesting relations between various knot invariants, such as the Kauffman polynomial and Khovanov homology, that are revealed via the HZ transform. Moreover, I will explain how, after a "magic" substitution, it can be related to Modular forms and that its zero structure can be used to tie Knot Theory to other areas of mathematics and physics, such as Singularity Theory and Statistical Physics.

Keywords: Knot invariants ; HOMFLY polynomial ; Harer ; Zagier transform ; factorisability ; superintegrability ; Knot Matrix Models

Landau levels versus Hydrogen atom

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Abstract:The Landau problem and harmonic oscillator in the plane share a Hilbert space that carries the structure of Dirac's remarkable so (2, 3) representation. We show that the ortho-symplectic algebra osp(1—4) is the spectrum-generating algebra for the Landau problem and, hence, for the 2D isotropic harmonic oscillator.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Fidelity in quantum physics

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Abstract:The concept of fidelity in quantum physics is rooted in what was coined Loschmidt echo. In this talk, we discuss fidelity from the classical level to the quantum level and how fidelity is nowadays used in quantum teleportation.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states, Superintegrable and exact solvable systems, and Lie symmetries, Operator theory, differential/difference equations, orthogonal polynomials, and special functions

A mathematical model of the interrelated dynamics of TB transmission in people and animals amidst seasonal flux, saturation incidence rates, and intervention efficacy

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Abstract:Tuberculosis (TB) is an infectious granulomatous illness that affects both animals and humans. It is caused by acid-fast bacilli of the genus Mycobacterium, specifically the Mycobacterium tuberculosis complex (human and mammalian TB) and the Mycobacterium avium complex. Bovine TB is a chronic bacterial illness caused by members of the Mycobacterium tuberculosis complex, namely as M. Bovis TB and is mostly transmitted by cattle, making it a significant zoonotic threat to humans. TB affects domesticated animals including sheep, goats, equines, pigs, dogs, and cats, as well as wildlife like wild boars, deer, and antelopes. A dynamics model for TB in humans and animals with a saturated incidence rate and effectiveness level is proposed. The model's fundamental reproduction number, , is calculated. An epidemiological research of TB in people and animals is conducted. The model parameters are examined. The model's reproduction number is predicted to be 2.7624, implying that the TB infection persist in the host. When , there is a singular endemic equilibrium that is globally asymptotically stable, and an epidemic develops. The fundamental reproduction ratio ( ) determines the global stability of both the disease-free and endemic equilibria. We further show that , when beta =0.001 and and when and beta= 0.001, , the DFE is globally asymptotically stable; epidemiologically, the infectious illness will vanish. When and delta greater than zero infectious tuberculosis exists. It is observed that if the carrier rate ( ) is very low, diseased animals should be confined and treated properly to prevent the transmission of contagious tuberculosis in humans. It is also observed that as the magnitude of seasonal fluctuation increases, so does the rate of infection. It is shown that cases of tuberculosis will be averted at the conclusion of adequate treatment efficacy, and that if the government promotes public awareness, the infection rate will fall.

Keywords: Analysis, Control theory, mathematical biology/epidemiology

Landau levels for the Haldane's spheres

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Abstract:"We employ the background field of a dyon in a MICZ-Kepler model to constrain the electron's motion on a sphere. The quantum MICZ-Kepler model is the magnetized hydrogen atom. We show that the 4D Dirac oscillator representation of the charge-dyon systems is a natural frame for the Haldane's spherical geometry for the Landau problem. The Majorana reduction of the 4D Dirac spinor to 2D Weyl spinor projects the Landau levels on the spheres onto the Landau levels in the tangent plane."

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Modular Quantization and Non-commutative Space-time

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Abstract: A deep link between quantization and (non-commutative) geometry is uncovered via a careful usage of modular theory.
It is premature to assume that space-time geometry in quantum gravity becomes relevant only at the emergent macroscopic level. At the covariant quantum level,

there is still some viable option for a-posteriori derived spacetime (non- commutative) geometries, induced by states (see arXiv:1007.4094v1). The ideas involved are strongly motivated by algebraic quantum field theory, suitably freed from its old reliance on background mani- folds. The mathematical techniques rely on an interplay between Tomita-Takesaki modular theory and derived categorical non-commutative geometry that seems to hint at further deep modifications of the notions of space and geometry, waiting to be further explored.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

RKHS, Odzijewicz, Berezin and Fedosov-type quantizations on smooth compact manifolds

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Abstract: In this article we define Odzijewicz, Berezin and Fedosov-type quantization on compact smooth manifolds. The method is as follows. We embed the smooth manifold of real dimension n into CP n (and in the Fedosov quantization case embed into any real 2n dimensional symplectic manifold). The pullback coherent states are defined in the usual way. In the Odzijewicz-type, Berezin-type quantization the Hilbert space of geometric quantization is the pullback by the embedding of the Hilbert space of geometric quantization of CPn. In the Berezin case, the operators that are quantized are those induced from the ambient space. The Berezin-type quantization exhibited here is a generalization of an earlier work of the author and Kohinoor Ghosh (where we had needed totally real embedding). The Fedosov-type quantization is carried out by restriction to the submanifold given by the embedding.

Keywords: Berezin quantization, coherent states, reproducing kernel

A Kac-Moody algebra associated to the non-compact manifold $SL(2, R)$

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Abstract:In this talk I will construct explicitly a Kac-Moody algebra associated to $SL(2, R)$ in two different but equivalent ways: either by identifying a Hilbert basis of $L^2(SL(2, R))$ or by the Plancherel Theorem. Central extensions and hermitian differential operators are identified.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

On the universality polynomial invariants and handle slide operation

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Abstract:In this talk, I will focus on the handle slide operation and its application to delta-matroids. This operation, which draws inspiration from the classification of surfaces, is crucial for proving the universality property of the ribbon graph polynomial. I will begin with the handle slide operation and show its importance in the proof of the universality of the ribbon graph polynomial. The session will progress to demonstrate how the handle slide operation applies to delta-matroids. To conclude, I will present a simple example that illustrates the transformation of a binary delta-matroid into a canonical delta-matroid through a sequence of handle slides.

Keywords: Combinatorics, Probability, statistical models, infinite dimensional analysis and related topics

Symmetries analysis in tensorial group field theories without closure constraint

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Abstract:Symmetry in tensorial group field theory as with all field theories in general leads to the so called Ward-Takahashi identities. These identities are considered as the generalization of the Noether currents available to quantum field theory and include quantum fluctuation effects. Usually, they take the form of relations between correlation functions, which ultimately correspond to the relation between coupling constants of the theory. Since last years, they have been intensively considered in the construction of approximate solutions for nonperturbative renormalization group of tensorial group field theories. The construction of these identities is based on the formal invariance of the partition function under a unitary transformation, and Ward's identities result from a first-order expansion around the identity. Due to the group structure of the transformation under consideration, it is expected that a first-order expansion is indeed

sufficient. We show in this presentation that this does not seem to be the case for a complex tensor theory model, with a kinetic term involving a Laplacian.

On calculation of spin group elements

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Abstract:A method for calculating elements of spin groups in the case of arbitrary dimension is presented. This method generalizes the Hestenes method, which works in the case of dimension 4. We use the method of averaging in Clifford algebras previously proposed by the author. This method is related to the method of averaging from the representation theory of finite groups. We present explicit formulas for elements of spin groups that correspond to elements of orthogonal groups as two-sheeted coverings. These formulas allow us to compute rotors, which connect two different frames related by a rotation in Clifford algebra of arbitrary dimension.

Keywords: Clifford algebras, Clifford analysis and applications

Cyclotron frequency and electron-phonon effects on thermodynamic properties of GaAs quadratic quantum dot under laser field and impurity

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Abstract: We investigate the cyclotron frequency and the electron-phonon coupling effects on on thermodynamic properties of GaAs quadratic quantum dot potential in the presence of laser field and coulomb potential. We used the Schrodinger equation to determine the energy and the canonical ensemble approach to find the different thermodynamic properties such as: Heat capacity, entropy and free energy. We found out that the temperature affect the stability of the particles. We also found out that the heat capacity is a decreasing function of magnitude confinement strength of potential. Moreover, the system reduces its capacity to store energy until it reaches a constant value characterizing the fact that the system is no more sensitive to the confinement strength for each temperature. Furthermore cyclotron frequency is very important parameter during the confinement of the particles, as participating to the acceleration of particles and therefore the system tends to be stable. So, The cyclotron frequency and confinement strength are the parameters not to be neglected

in the investigation of thermodynamic properties. Also, we discover that the exchange of energy between the system and its environment increases with the strength coulombic impurity. So, the coulomb impurity potential make the electron interact with more phonon . From the result obtained, we found out that the laser frequency reduces the exchange of energy between the system and its environment when the temperature increases. Keywords: cyclotron frequency, electron-phonon, quantum dot, coulomb potential , laser field and thermodynamic properties.

General Theory for Diophantine Equations in Fibonacci Sums: An Open Problem Presented at the $2O^{th}$ international Conference of Fibonacci

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Abstract:In this study, we address the open problem of determining the general term of the sequence 4, 9, 15, 60, 106, ..., which counts the number of solutions to the Diophantine equation $\sum_{k=1}^{N} F_{n_k} = 2^a$ for $N = 1, 2, 3, 4, \ldots$, where F_n represents the Fibonacci sequence. This sequence, not previously listed in the Sloan OEIS, has been newly added as OEIS A356928 by the author in 2022. The problem was presented at the $2O^{th}$ international Conference of Fibonacci held at the University of Sarajevo in Bosnia from July 25 to 29, 2022. This work aims to contribute to the formulation of a general theory for such Diophantine equations for any N, and underscores the importance of computational tools in solving complex sequence problems.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis

Landau Levels for the Haldane's Spheres

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Abstract:We employ the background field of a dyon in a MICZ-Kepler model to constrain the electron's motion on a sphere. The quantum MICZ-Kepler model is the magnetized hydrogen atom. We show that the 4D Dirac oscillator representation of the chargedyon systems is a natural frame for the Haldane's spherical geometry for the Landau problem. The Majorana reduction of the 4D Dirac spinor to 2D Weyl spinor projects the Landau levels on the spheres

onto the Landau levels in the tangent plane.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Metasymmetry of braided Majorana qubits

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Abstract:"This talk introduces several new mathematical structures connected with the parastatistics of multiparticle braided Majorana qubits presented (in the framework of a graded Hopf algebra endowed with a braided tensor product) in Nucl. Phys. B 980 (2022) 11583. At first it is presented a quantum group interpretation for the roots-of-unity truncation of the energy spectra observed in the NPB paper. Furthermore, borrowing from Leites-Serganova the notion of "metasymmetry" as "symmetry wider than supersymmetry which do not respect a grading", it is shown that the creation/annihilation operators of the braided Majorana qubits close generalized Heisenberg-Lie algebras defined in terms of mixed-brackets which interpolate ordinary commutators and anticommutators. The talk is based on preprint CBPF-NF-002/24 (soon in arXiv). "

Keywords: Hopf algebras, quantum groups, and K-theory

Copula-based estimation of health concentration curves

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Abstract:This paper aims to utilize copulas for deriving estimators of the health concentration curve and Gini coefficient for health distribution. We highlight the importance of expressing health inequality measures in terms of copulas, which we in turn use to build copula-based semi and nonparametric estimators of the above measures. Subsequently, we investigate the asymptotic properties of these estimators, establishing their consistency and asymptotic normality. We provide formulas for their variances, facilitating the construction of confidence intervals and tests for the health concentration curve and Gini health coefficient **with respect to a given socioeconomic variable**. Through a Monte-Carlo simulation exercise, we demonstrate the superior performance of the semiparametric estimator over the smoothed nonparametric estimator, with the lat-

ter outperforming the empirical estimator in terms of Mean Squared Error. Additionally, an extensive empirical study applies our estimators, revealing that inequalities in U.S. states' socioeconomic variables, such as income/poverty and race/ethnicity, contribute to observed disparities in COVID-19 infections and deaths in the U.S.

On the detectability of paraparticles

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Abstract: Unlike anyons (which live in 2 space dimensions and transform under the braid group), paraparticles beyond bosons and fermions (living in any space dimension and transforming under the permutation group) have been dismissed for a long time as unobservable; this common wisdom was based on the so-called "conventionality of parastatistics" argument. In recent years this conventional wisdom has been challenged and put to a test. Mechanisms which allow to overcome the conventionality argument have been elucidated; theoretical toy-models whose paraparticles are detectable have been presented. On the experimental side, recent advances in engineering paraparticles in the laboratory suggest the possibility of an experimental detection of this type of parastatistics.

Z2 × Z2-graded Lie (super)algebras and generalized quantum statistics

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Abstract:A Z2 × Z2-graded Lie algebra or Lie superalgebra is a Z2 × Z2-graded algebra g with a bracket that satisfies certain graded versions of the symmetry and Jacobi identity. In particular, despite the common terminology, g is not a Lie algebra nor a Lie superalgebra, but a color algebra. We first construct classes of Z2 × Z2-graded Lie algebras corresponding to the classical Lie algebras, in terms of their defining matrices. For the Z2 × Z2-graded Lie algebra of type A, the construction coincides with the previously known class. For the Z2 × Z2-graded Lie algebra of type B, C and D our construction is new and gives rise to interesting defining matrices closely related to the classical ones but undoubtedly different. Next, we construct the most general orthosymplectic Z2 × Z2-graded Lie superalgebra in terms of defining matrices. A special case of this algebra appeared already in work of Tolstoy in 2014. Our construction is based on the notion of graded supertranspose for a Z2 × Z2-graded matrix. Since the orthosymplectic Lie superalgebra osp(2m + 1—2n) is closely related to the definition of parabosons, parafermions and mixed parastatistics, we investigate here the new parastatistics relations following from our Z2 x Z2-graded construction. Some special cases are of particular interest, even when one is dealing with parabosons only.

Keywords: Group theory, Lie groups, Semigroups, Lie superalgebras, representation theory, and harmonic analysis, Quantum systems, quantum mechanics, quantification techniques and coherent states

A quantum deformation of the conformally compactified (super) Minkowski spacetime

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Abstract: We develop a quadratic deformation of (super) Minkowski, D=4 spacetime, conformally compactified as to be an homogeneous space of the conformal (super) group. We depart from a complexified spacetime, which can be then be seen as a flag (super) manifold, in the twistor formalism, and proceed to its quantum deformation via the group of symmetry, the conformal group, that becomes a quantum group.

Combinatorial problems on lattice walks related to the Hofstadter model

Vinet Luc

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Abstract:This talk is concerned with combinatorial enumeration problems related to the Hofstadter model. Specifically, it will focus on the q-enumeration of lattice walks with respect to the algebraic area and the evaluation of the generating function at roots of unity. Both exact and asymptotic formulas, the latter obtained by means of methods from analytic combinatorics, will be discussed

Keywords: Discrete mathematics

Dimers, spanning trees and loops on fractal-like graphs

Vinet Luc

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Abstract:TWe discuss the combinatorial analysis of models from statistical physics (such as the dimer model) in the context of fractal-like graphs. A typical illustrative example are the Sierpiński gasket and its finite approximations. The focus will lie on two different kinds of models where graphs are partitioned into cycles (loops). In one model, a 2-factor (spanning subgraph whose components are cycles) is chosen uniformly at random. In the other, the edge set is partitioned into cycles, again uniformly at random. The presence of "holes" in the graph turns out to have interesting consequences. While the latter model mostly yields rather short cycles, long cycles surrounding the holes appear with high probability in random 2-factors, and those long loops feature interesting geometric properties reminiscent of random walks and their loop-erased variant. Moreover, an interesting phase transition can be observed.

Keywords: Dimer model , loop model , fractal , Sierpiński gasket , phase transition

An algebraic approach for extending the Askey scheme to rational functions

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Abstract:"Meta algebras with three generators are introduced. They subsume algebras of Askey-Wilson type and provide a unified algebraic description of hypergeometric orthogonal polynomials and companion biorthogonal rational functions that will be fully characterized. The latter special functions will be seen to arise as overlaps between eigenbases of generalized and ordinary eigenvalue problems on meta algebra modules. They will be shown to be bispectral. The framework extends the notion of Leonard pair. Certain examples will be discussed in details."

Keywords: Operator theory, differential/difference equations, orthogonal polynomials, and special functions

Quantum groups, Yang-Baxter equation and Stokes phenomenon

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Abstract:This talk gives an introduction to the Stokes phenomenon of meromorphic linear ODEs. It then constructs univeral solutions of Yang-Baxter equations via the Stokes phenomenon. Many other aspects of the Drinfeld-Jimbo quantum groups can then be recasted from the Stokes phenomenon.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Optimal Stopping under Model Uncertainty in a General Setting

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Abstract: We consider the optimal stopping time problem under model uncertainty $R(v) =_{\in\ \tau\in_v} E^[Y(\tau)|_v]$, for every stopping time v, set in the framework of families of random variables indexed by stopping times. This setting is more general than the classical setup of stochastic processes, and particularly allows for general payoff processes that are not necessarily right-continuous. Under weaker integrability, and regularity assumptions on the reward family $Y = (Y(v), v \in S)$, we show the existence of an optimal stopping time. We then proceed to find sufficient conditions for the existence of an optimal model. For this purpose, we present a universal Doob-Meyer-Merten's decomposition for the generalized Snell envelope family associated with Y. This decomposition is then employed to prove the existence of an optimal probability model and study its properties.

Bessel Functions of Purely Imaginary Order and an Exactly Solvable Quantum-mechanical Potential

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Abstract:Exact solvability of one-dimensional quantum-mechanical potentials has extensively been studied and constructed, yet there still exist other interaction models whose wave functions are given by special functions. In this talk, we discuss an exactly solvable Schrödinger equation where the eigenfunctions are expressed in terms of the Bessel functions of purely imaginary order. Our potential is defined by piecewise analytic functions, and the solutions are derived through the so-called matching of wavefunctions. We compute the whole bound-state spectra as well as scattering solutions. The explanation regarding the Bessel functions of purely imaginary order is also provided.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Vibration de l'interaction pont-charge roulante par approche sémi-analytique

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Abstract:Dans cet article nous présentons une méthode semi-analytique basée sur le couplage intermodal négligé par plusieurs études afin de déterminer directement la déflexion du tablier de pont sous charge roulante. Le pont étudié est une plaque mince orthotrope à deux travées dont les propriétés de rigidités sont différentes dans deux directions orthogonales, avec une ligne support rigide perpendiculaire au tablier. La charge roulante sur le tablier de pont est modélisée par une masse mobile qui prend en compte les effets d'inerties négligés par plusieurs auteurs. Le système d'équation différentielle non linéaire résultant de l'interaction pont charge roulante est intégré dans le domaine temporel via un schéma d'intégration numérique à un pas. Cette approche proposée évite de discrétiser la structure, qui entraîne de ce fait des erreurs difficiles à contrôler. Cette approche peut être étendue à une plaque multi-travée avec différentes conditions aux limites et aussi avec la prise en compte d'un modèle véhicule à plusieurs degrés de liberté.

Keywords: Pont, Plaque orthotrope, Multi-travées, Fréquences propres, Modes propres, Déflexion.

Theoretical research on tensor-network based machine learning models

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Abstract: Tensor networks are efficient representations of high-dimensional tensors with widespread applications in quantum many-body physics. Recently, they have been adapted to the field of machine learning, giving rise to an emergent research frontier that has attracted considerable attention. In this talk, we mainly focus on the theoretical foundations of tensor-network-based machine

learning models. Specifically, we first report the presence and absence of barren plateaus in tensor-network-based machine learning models by exploring the landscapes of different loss functions, including the cases of both the matrix product states and projective entangled pair states. Furthermore, we report the no-free-lunch theorem of the tensor-network-based machine learning models. Our findings unveil some fundamental concepts of tensor network-based machine learning models and open up an avenue for further research on exploring the advantages and limitations of quantum-inspired machine learning models.

Post-groups, post-groupoids and the Yang-Baxter equation

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Abstract:We introduce the notion of post-groups, which are the underlying structures of Rota-Baxter operators on groups. The differentiation of post-Lie groups gives post-Lie algebras. Post-groups are also related to braces and Lie-Butcher groups, and give rise to set-theoretical solutions of Yang-Baxter equations. We further introduce the notion of post-groupoids, whose differentiations are post-Lie algebroids. We show that post-groupoids give quiver-theoretical solutions of the Yang-Baxter equation on the underlying quiver of the subadjacent groupoids. The talk is based on the joint work with Chengming Bai, Li Guo, Rong Tang and Chenchang Zhu.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Generalizations of Schrodinger equation for open systems: Modern approach

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Abstract:Within the framework of quantum-statistical approach, one can derive various generalizations of the von Neumann equation, usually referred to as master equations for reduced density operators. If one considers an evolution of pure states only, disregards coherence and spontaneous transitions from pure to mixed states, then one can resort to studying the dynamics of state vectors described by quantum-mechanical equations of a Schrodinger type. It turns out that the proposed equations have a larger range of applicability for open systems, in comparison to other generalized Schrodinger equations proposed hitherto. Among other features, they can describe not only systems which remain in the stationary eigenstates of the Hamiltonian as time passes, but also those which evolve from. We demonstrate that effects of dissipative environments of a different type can cancel each other, thus resulting in an effectively dissipation-free classical system. Another discussed phenomenon is whether a nontrivial quantum system can reduce to a classical system in free motion, i.e., without experiencing any classical Newtonian forces or potentials. This uncovers a large class of quantum-mechanical non-Hamiltonian systems whose dynamics is not determined by conventional potentials and forces but comes about through quantum statistical effects of a system's environment.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Algebras in a pseudotensor category

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Abstract:A pseudotensor category is also called a multilinear category, which is introduced by Beilinson and Drinfld. A typical pseudotensor category is defined on a category of all left modules over a Hopf algebra H. The algebras defined on this pseudotensor category are called H-pseudoalgebras, which is a kind of multi-parameter conformal algebras. These algebras were introduced in 2001 by V. Kac etc. The simple finite-generated Lie H-pseudoalgebras are classified. In this talk, I will recall the main result obtained by V. Kac etc. Then we give my new results about associative H-pseudoalgebras, these results generalize classic results about traditional algebras over a field.

Keywords: Quantum systems, quantum mechanics, quantification techniques and coherent states

Generalizations of Schrödinger equation for open systems: Modern Approach

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Abstract:Within the framework of the quantum-statistical approach, one can derive various generalizations of the von Neumann equation, usually referred to as master equations for reduced density operators. If one considers an evolution of pure states only and disregards coherence and spontaneous transitions from pure to mixed states, then one can resort to studying the dynamics of state vectors described by quantum-mechanical equations of a Schrödinger type. It turns out that the proposed equations have a larger range of applicability for open systems, in comparison to other generalized Schrödinger equations proposed hitherto. Among other features, they can describe not only systems that remain in the stationary eigenstates of the Hamiltonian as time passes but also those that evolve from. We demonstrate that the effects of dissipative environments of a different type can cancel each other, thus resulting in an effectively dissipation-free classical system. Another discussed phenomenon is whether a nontrivial quantum system can reduce to a classical system in free motion, i.e., without experiencing any classical Newtonian forces or potentials. This uncovers a large class of quantum-mechanical non-Hamiltonian systems whose dynamics is not determined by conventional potentials and forces but come about through quantum statistical effects of a system's environment.

Keywords: open quantum systems; dissipative systems; density matrix; generalization of Schrödinger equation.

Rota-Baxter Lie Bialgebras and Rota-Baxter Poisson Lie Groups

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Abstract: First we introduce the notion of quadratic Rota-Baxter Lie algebras of arbitrary weight, and show that there is a one-to-one correspondence between factorizable Lie bialgebras and quadratic Rota-Baxter Lie algebras of nonzero weight. Then we introduce the notions of matched pairs, bialgebras and Manin triples of Rota-Baxter Lie algebras, and show that Rota-Baxter Lie bialgebras, Manin triples of Rota-Baxter Lie algebras and certain matched pairs of Rota-Baxter Lie algebras are equivalent. Finally, we present some results on Rota-Baxter Poisson Lie groups. This is joint work in progress with Yunhe Sheng.

On R-matrix presentation of Yangian

Ming Liu
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Abstract: R-matrices are the solutions of the Yang-Baxter equation. R-matrix realization is an important realization of quantum algebra, which originated from the study of quantum inverse scattering theory.

In this talk, we will introduce our recent work on R-matrix realization of quantum algebra, including: (1) The isomorphism between R-matrix presentation and Drinfeld's new realization of BCD type Yangians .

This is a joint work with Naihuan Jing and Alexander Molev. (2) The parabolic presentation of BCD type Yangian which is a joint work with Zhihua Chang, Naihuan Jing and Haitao Ma.