Abstracts and Programme

7th International Workshop on New Challenges in Quantum Mechanics: Integrability and Supersymmetry

A conference in honor of

Prof. Mikhail Plyushchay

CENTRO DE CIENCIAS
DE BENASQUE
PEDRO PASCUAL

September 1–7, 2019

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Financial support:

Foreword

The *"7th International Workshop on New Challenges in Quantum Mechanics: Integrability and Supersymmetry"* will take place in Benasque (Spain) on September 1-7, 2019 in honor of Prof. Mikhail Plyushchay on the occasion of his 60th birthday.

Prof. Plyushchay is an internationally recognized expert in many branches of mathematical physics. Indeed, he has made remarkable contributions in theory of anyons, classical and quantum mechanics, with exotic hidden and nonlinear (super)symmetries, among other topics that show his wide range of interests. During his fruitful scientific carrier, he has inspired numerous collaborators with his expertise and strong dedication to the scientific research. His commitment to lecturing and teaching as well as demanding, yet enriching leadership was highly appreciated by his doctoral students and postdoctorates. It helped them with opening the gates to their scientific lives. It is a pleasure for all of us to dedicate this special scientific event to him.

The Organizing Committee

Benasque, September 1st, 2019

Contents

Abstracts

Lagrangian Quantum Mechanics for indistinguishable fermions: a self-consistent universe

Adrián ARANCIBIA
Universidad de Talca (Chile)

This work corresponds to a paradigmatic classical mechanic approach to quantum mechanics and, as a consequence, the paradigm of expanding universe is replaced for a universe of contracting particles which allows explaining the cosmological redshift because as the time progresses the hydrogen atoms absorb smaller wavelengths.

Quantum particles are defined as linearly independent indistinguishable normalized classical bi-spinor fields with fourth interactions, this matter allows defining positive energy spectra and to evade the problems with infinities associated with quantization procedure, to have a consistent particle interpretation in each inertial system, a large N approach for fermions must be imposed.

Bulk-Edge dualities in Topological Matter

Manuel ASOREY
Universidad de Zaragoza (Spain)

Novel bulk-edge dualities have recently emerged in topological materials from the observation of some phenomenological correspondences. The similarity of these dualities with string theory dualities is very appealing and has boosted a quite significant number of cross field studies. We analyze the bulk-edge dualities in some simple planar systems, where the duality can be scrutinized by powerful analytic techniques. In particular we will discuss the connections with Atiyah-Patodi-Singer index theorems.

Position-dependent mass, finite-gap systems, and supersymmetry

Rafael BRAVO
Universidad de Chile (Chile)

In this talk, I will discuss how to address the ordering problem in quantum systems with position-dependent mass (PDM) considering a classically fictitious similarity transformation into the kinetic term. This transformation provides a generation of supersymmetry with the first-order supercharges from the kinetic term alone. The inclusion of the potential term allows generating nonlinear supersymmetry with higher-order supercharges as well. A broad class of finite-gap systems with PDM is obtained by different reduction procedures. Among these models, there are reflectionless-like Lagrangians which their field theory extension is used in the context of cosmological inflation. I would also briefly comment on how these models are useful to overcome recently proposed Swampland conjectures in the context of string theory.

Lie and quasi-Lie systems in Quantum Mechanics

José F. CARIÑENA
Universidad de Zaragoza (Spain)

After a quick presentation of the theory of Lie and quasi Lie systems from a geometric perspective, recent progresses on their applications when compatible geometric structures exist will be described with an special emphasis in the particular case of admissible Kähler structures, and therefore with applications in Quantum Mechanics. Finally we point out the relationship of time-independent Schrödinger equation with a special case of Lie system and its relation with the theory of Darboux transformations.

Freezable quantum states or bound states in the continuum for time dependent potentials

Alonso CONTRERAS-ASTORGA
CINVESTAV (Mexico)

In this work, we constructed time dependent potentials via supersymmetric quantum mechanics. The generated potentials have a quantum state with the property that after a certain time t_0, when the potential does not longer change, the evolving state becomes a bound state in the continuum, its probability distribution freezes. Closed expressions for the potential, the bound states in the continuum and different wave packets are given for specific examples.

Helium molecule inside a prolate spheroidal box

Elso DRIGO FILHO
São Paulo State University (Brazil)

Confined quantum systems has received considerable attention by the scientific community. The spatial confinement affects the physical and chemical properties of atoms and molecules. Confined systems has been used to simulate effects of high pressure and also to study of zeolites and carbon nanotube [1]. The potential for the ground state of confined helium molecule are studied in this work. The ground state energy for confined helium molecule are computed using the variational method with a trial function obtained by Slater determinant. The trial molecular orbitals are inspired by functions obtained through Supersymmetric Quantum Mechanics formalism for confined coulomb potential [2,3]. The confined cavity are given by a revolution ellipsoid with the molecule nuclei clamped in the foci. The confining potential is considered zero inside ellipsoid and infinity outside. The potential curve is calculated for each value of the major axis. The results for a minimal of ground state energy curve, as a function of the internuclear distance for each major axis, indicates that the confinement induces the formation of helium molecule.

[1] Sabin, J. R., and Erkki J. B. *Advances in quantum chemistry: theory of confined quantum systems-part one. Vol. 57*, Academic Press, 2009.
[2] Drigo Filho, E. and Ricotta, R. M., Phys. Lett. A **299** (2002) 137-143.
[3] de Oliveira Batael, H. and Drigo Filho, E., Theor. Chem. Acc. **137** (2018) 65.

Dirac electron in graphene with magnetic fields generated by first-order intertwining operators

David J. FERNÁNDEZ CABRERA
CINVESTAV (Mexico)

It is studied the behavior of a Dirac electron in graphene with magnetic fields which are orthogonal to the layer. The initial problem is reduced to two one-dimensional Schrödinger Hamiltonians which are intertwined by first order differential operators. Special magnetic field are initially chosen, in order that the associated potential will be shape invariant. When more general first order intertwining operators are used, such partner potentials are no longer shape invariant, and the new associated magnetic fields lead to analytic solutions of the initial problem. The iteration of this procedure is also discussed.

Quantum localisation on the circle

Rodrigo FRESNEDA
Universidade Federal do ABC (Brazil)

Covariant integral quantisation using coherent states for semidirect product groups is studied and applied to the motion of a particle on the circle. In the present case the group is the Euclidean group $\mathrm{E}(2)$. We implement the quantisation of the basic classical observables, particularly the 2π-periodic discontinuous angle function and the angular momentum, and compute their corresponding lower symbols. An important part of our study is devoted to the angle operator given by our procedure, its spectrum and lower symbol, its commutator with the quantum angular momentum, and the resulting Heisenberg inequality. Comparison with other approaches to the long-standing question of the quantum angle is discussed.

Nonlocal gauge equivalent integrable systems

Andreas FRING
City University of London (UK)

We demonstrate how new integrable nonlocal systems in space and/or time can be constructed by exploiting certain parity transformations and/or time reversal transformations possibly combined with a complex conjugations. By employing Hirota's direct method as well as Darboux-Crum transformations we construct explicit multi-soliton solutions for nonlocal versions of Hirota's equation that exhibit new types of qualitative behaviour. We exploit the gauge equivalence between these equations and an extended version of the continuous limit of the Heisenberg equation to show how the nonlocality is implemented in those latter systems and an extended version of the Landau-Lifschitz equation.

Based on joint work with Julia Cen and Francisco Correa, arXiv:1710.11560 to appear in Journal of Mathematical Physics and work in preparation.

Eternal life of entropy in non Hermitian quantum systems

Thomas FRITH
City University of London (UK)

We find a new effect for the behaviour of Von Neumann entropy. For this we derive the framework for describing Von Neumann entropy in non-Hermitian quantum systems and then apply it to a simple interacting PT-symmetric bosonic system. We show that our model is well defined even in the PT broken regime with the introduction of a time-dependent metric and that it displays three distinct behaviours relating to the PT symmetry of the original time-independent Hamiltonian. When the symmetry is unbroken, the entropy undergoes rapid decay to zero (so-called "sudden death") with a subsequent revival. At the exceptional point it decays asymptotically to zero and when the symmetry is spontaneously broken it decays asymptotically to a finite constant value ("eternal life").

Coherent Gamow states for the hyperbolic Pöschl-Teller potential

Manuel GADELLA
University of Valladolid (Spain)

The one dimensional high barrier Pöschl-Teller potential shows an infinite number of resonances, characterized as pairs of poles of the S matrix in the momentum representation $S(k)$. There are two series of resonance poles symmetric with respect to the imaginary axis. For each resonance pole, there exists a Gamow function, which is an eigenfunction of the Hamiltonian with eigenvalue the resonance pole in the representation of energies. Gamow functions corresponding to each series of resonance poles are related via creation and annihilation operators. For each series of Gamow functions, we may construct respective coherent generalized states, here called coherent Gamow states, which satisfy basic properties of coherent states.

The Algebraic Construction of Integrable Hierarchies, solitons and Infinite Dimensional Algebras

José Francisco GOMES
São Paulo State University (Brazil)

The structure of infinite dimensional algebras is employed to construct integrable hierarchies in two dimensional field theories.

In particular, it is shown to provide a universal framework in order to describe its integrable properties, symmetries and also, the construction in a systematic manner, of soliton (multi soliton) solutions and Bäcklund transformation for the entire hierarchy.

Type I Liouville Dynamical Systems on the Lobachevski plane

Miguel Ángel GONZÁLEZ-LEÓN
Universidad de Salamanca (Spain)

A trajectory isomorphism between separable Hamiltonian systems in pseudo-spheroconical coordinates on L^2 and type I Liouville systems on the Euclidean $\mathbb{R}^2$ plane is constructed. As an application, the orbits of the two fixed center problem in L^2 are classified using this equivalence with the corresponding orbits in the Euclidean planar problem.

Quantum observers from Poisson-Lie geometry

Iván GUTIÉRREZ-SAGREDO
University of Burgos (Spain)

In this talk I will discuss a general framework, recently introduced to describe quantum observers in Minkowski spacetime. This framework involves two main ingredients: on the one hand we need to give a geometrical interpretation of the space of inertial observers, which we identify with the space of time-like oriented geodesics in Minkowski spacetime. We use the fact that Minkowski spacetime is a simply connected Lorentzian space of constant curvature. On the other hand a quantum deformation, in the sense of quantum groups, is used to describe quantum gravitational effects on this space of observers.

The general procedure above will be illustrated with a concrete example, the so-called κ-deformation. For this well-known quantum group deformation, the associated Poisson G-space will be explicitly constructed. Its quantization gives the first explicit instance of the above-mentioned construction. Time-permitting we will comment on ongoing research concerning the description of the fuzzy nature of these quantum observers, that should be related to quantum gravity effects.

Klein four-group and Darboux duality

Luis INZUNZA
Universidad de Santiago (Chile)

The one-dimensional conformal quantum mechanics model with confining harmonic potential and coupling constant $g(\nu) = \nu(\nu + 1) \geq -1/4$ is characterized by the Klein four-group symmetry which undergoes a complete or partial symmetry breaking when parameter ν takes non-half-integer or half-integer values. Exploiting this symmetry together with the associated Darboux duality, we generate infinite families of the new rationally deformed conformal models, and construct the complete sets of the spectrum generating ladder operators for them. Nonlinearly deformed $sl(2, \mathbb{R})$ algebra encodes a specific discrete finite-gap structure of the obtained systems which undergoes structural changes at half-integer values of ν. The same discrete symmetry is shown also to play a nontrivial role in supersymmetric extensions of conformal mechanics.

Lindblad master equation in Lie group representation

Pedro Raúl JIMÉNEZ-MACÍAS
CINVESTAV (Mexico)

The density matrix that represents the state of a Markovian quantum system is in general a semigroup member. In turn, the Liouvillian that defines the related Lindblad master equation (LME) is the generator of a contraction semigroup. If the algebra of super-operators associated to the LME is closed, it is possible to construct a representation space where the action of the Liouvillian is easy to handle. This turns out in the analytical solution of the problem. In this work we show that even if the algebra of super-operators is not closed it is still possible to construct such a representation. Then, we analyze the general physical properties of the dynamical evolution of open systems.

Path integral and spectral representations for supersymmetric Dirac-Hamiltonians

Georg JUNKER
European Southern Observatory (Germany)

The resolvent of supersymmetric Dirac Hamiltonian is studied in detail. Due to supersymmetry the squared Dirac Hamiltonian becomes block-diagonal whose elements are in essence non-relativistic Schrödinger-type Hamiltonians. This enables us to find a Feynman-type path-integral representation of the resulting Green's functions. In addition, we are also able to express the spectral properties of the supersymmetric Dirac Hamiltonian in terms of those of the non-relativistic Schrödinger Hamiltonians. The methods are explicitly applied to the free Dirac Hamiltonian, the so-called Dirac oscillator and a generalization of it. The general approach is applicable to systems with good and broken supersymmetry.

From Yang-Mills in de Sitter space to electromagnetic knots

Olaf LECHTENFELD
Leibniz Universität Hannover (Germany)

I will review analytic $SU(2)$ Yang-Mills solutions with finite action on de Sitter space from a new perspective. As a byproduct, all abelian solutions are classified and related with rational electromagnetic knots in Minkowski space. In the Yang-Mills case, the gravitational backreaction is easily taken into account as well.

Supergrassmanians, superflags and the conformal superspace

María A. LLEDÓ
Universitat de Valencia (Spain)

We study the conformal superspace in terms of projective supergrassmanians and superflags. The Segre embedding allows a formal quantization of such superspaces.

Superintegrability, special functions and representations

Ian MARQUETTE
University of Queensland (Australia)

I will review results on classification of quantum superintegrable systems on two-dimensional Euclidean space with higher order integrals. I will discuss the connection with exceptional orthogonal polynomials, Painlevé transcendents and the Chazy class of equations. I will discuss how their symmetry algebras are associated with polynomial algebras and how these algebraic structures and their Casimir operators can be used to obtain the energy spectrum algebraically.

On some applications of contact potentials

Luis M. NIETO
Universidad de Valladolid (Spain)

The Schrödinger equation with singular potentials containing terms of the type $\delta(x - x_0)$ and $\delta'(x - x_0)$, with $x, x_0 \in \mathbb{R}^n$, are considered, and some interesting examples are analyzed in detail.

Groups, special functions and rigged Hilbert spaces

Mariano A. del OLMO
University of Valladolid (Spain)

The aim of this talk is to present a unified picture of the connections between representations of Lie algebras, special functions, discrete and continuous bases and rigged Hilbert spaces.

Each class of orthogonal polynomials is a particular representation of a Lie algebra. This is the case of the Hermite polynomials and the Heisenberg-Weyl algebra or the associated Laguerre polynomials and the Spherical harmonics with $so(3, 2)$, Zernike polynomials, etc. Spaces supporting the representation of these associated algebras include discrete as well as continuous bases of which the matrix transformation is described by the orthogonal polynomials.

Hilbert spaces are not apt to describe these spaces as they do not have continuous bases. These spaces are quite often used by physicists, so that it would be necessary to introduce spaces allowing both discrete and continuous bases. They are the rigged Hilbert spaces.

Perfectly invisible $\mathcal{PT}$-symmetric zero-gap systems and exotic nonlinear superconformal symmetry

Mikhail S. PLYUSHCHAY
University of Santiago de Chile (Chile)

A special class of $\mathcal{PT}$-symmetric quantum models is discussed, which are perfectly invisible zero-gap systems with a unique bound state at the very edge of the continuous spectrum of scattering states. We show that their potentials can be promoted up to solutions of the complexified Korteweg-de Vries equation with a behavior typical for extreme waves. The peculiar properties of quantum systems are reflected in the associated exotic nonlinear $\mathcal{N} = 4$ super-Poincaré and super-conformal symmetries affected by Lax-Novikov integrals.

Towards a dynamical model of protein folding through Supersymmetric Quantum Mechanics

Regina Maria RICOTTA
Faculdade de Tecnologia de São Paulo (Brazil)

The biological process of protein folding, as a diffusion process, is modeled by a one-dimensional Fokker-Planck equation (FPE) with a triple well potential. Through the mapping into a Schrödinger-type equation (SE), an approximate spectrum of stationary states is calculated through the use of the variational method associated with supersymmetric quantum mechanics (SQM) formalism aiming the construction of the temporal evolution of the probability density distribution. Thus, the diffusion problem is characterized by the calculation of the characteristic times of the intermediate states of the system described by a triple well potential.

An integrable model for magnetic skyrmions

Bernd SCHROERS
Heriot-Watt University (UK)

Magnetic skyrmions are topological solitons which occur in a large class of ferromagnetic materials and which are currently attracting much attention in the condensed matter community because of their possible use in future magnetic information storage technology. The talk is about an integrable model for magnetic skyrmions, introduced in a recent paper (arxiv 1812.07268) and generalised in (arxiv 1905.06285). The model can be solved by interpreting it as a gauged nonlinear sigma model. In the talk will explain the model and the geometry behind its integrability, and discuss some of the solutions. I will also discuss supersymmetric extensions, and the possibility of anyonic statistics of the skyrmions.

Goldstone bosons in different PT-regimes of non-Hermitian scalar quantum field theories

Takanobu TAIRA
City University of London (UK)

We study the interplay between spontaneously breaking global continuous and discrete antilinear symmetries in a newly proposed general class of non-Hermitian quantum field theories containing a mixture of complex and real scalar fields. We analyse the model for different types of global symmetry preserving and breaking vacua. In addition, the models are symmetric under various types of discrete antilinear symmetries composed out of nonstandard simultaneous charge conjugations, time-reversals and parity transformations; CPT. While the global symmetry governs the existence of massless Goldstone bosons, the discrete one controls the precise expression of the Goldstone bosons in terms of the original fields in the model and its physical regimes. We show that even when the CPT-symmetries are broken on the level of the action expanded around different types of vacua, the mass spectra might still be real when the symmetry is preserved at the tree approximation and the breaking only occurs at higher order. We discuss the parameter space of some of the models in the proposed class and identify physical regimes in which massless Goldstone bosons emerge when the vacuum spontaneously breaks the global symmetry or equivalently when the corresponding Noether currents are conserved. The physical regions are bounded by exceptional points in different ways. There exist special points in parameter space for which massless bosons may occur already before breaking the global symmetry. However, when the global symmetry is broken at these points they can no longer be distinguished from genuine Goldstone bosons.

A three-dimensional superconformal quantum mechanics with $sl(2|1)$ dynamical symmetry

Francesco TOPPAN
Centro Brasileiro de Pesquisas Fisicas (Brazil)

A three-dimensional superconformal quantum mechanics and its associated de Alfaro-Fubini-Furlan deformed oscillator possessing an $sl(2|1)$ dynamical symmetry is constructed. At a coupling parameter b different from zero the Hamiltonian contains a $1/r^2$ potential and a spin-orbit (hence, a first-order differential operator) interacting term. At $b = 0$ four copies of undeformed three-dimensional oscillators are recovered. The Hamiltonian gets diagonalized in each sector of total j and orbital l angular momentum (the spin of the system is 1/2). The Hilbert space of the deformed oscillator is given by a direct sum of $sl(2|1)$ lowest weight representations. The selection of the admissible Hilbert spaces at given values of the coupling constant b is discussed. The spectrum of the model is computed. The vacuum energy (as a function of b) consists of a recursive zigzag pattern. The degeneracy of the energy eigenvalues grows linearly up to E equal to b (in proper units) and quadratically for $E > b$. The orthonormal energy eigenstates are expressed in terms of the associated Laguerre polynomials and the spin spherical harmonics. The dimensional reduction of the model to $d = 2$ produces two copies (for b and $-b$, respectively) of the two-dimensional $sl(2|1)$ deformed oscillator. The dimensional reduction to $d = 1$ produces the one-dimensional $D(2, 1; a)$ deformed oscillator, with a determined by b. Based on the arXiv:1906.11705 paper in collaboration with I. E. Cunha.

Is Nature Supersymmetric?

Jorge ZANELLI
Centro de Estudios Científicos (Chile)

The most successful accurate description of microscopic phenomena, the Standard Model of particles physics (SM), does not seem to require the existence of supersymmetry (SUSY). All experiments have systematically failed to provide the slightest evidence of SUSY in Nature. Nevertheless, most high-energy theorists stubbornly believe SUSY plays an important role in the description of the world.

The smoking gun for the presence of SUSY scenarios is the existence of a super partner for every known existing particle: *s-quarks* and *s-leptons*, bosonic partners of quarks and leptons; *gauginos* and *higgsinos*, the fermionic partners of gauge interaction carriers and Higgs bosons. After nearly half a century of fruitless search for such super partners, some theorists believe it is time to put a tombstone on the idea and move on; others insist that SUSY, albeit broken at the current energy level, must be restored perhaps at the energy level of the next generation of supercolliders.

We point out that the existence of superpartners is not a necessary consequence of SUSY, but a feature of a particular representation of it. If SUSY is represented through a gauge field with values on a superalgebra, it can describe systems of fermionic matter minimally coupled to gauge fields. Theories constructed in this manner are locally supersymmetric and require no "SUSY partners": $s = 1/2$ fields in a vector representation of the internal gauge group and massless $s = 1$ bosons as carriers of gauge interactions, just like in the SM. As a bonus, Einstein gravity coupled with the other fields in the normal way is naturally ad necessarily included.

Time-dependent exactly solvable potentials generated by Darboux and point transformations

Kevin ZELAYA
University of Montreal (Canada)

The appropriate form-preserving point transformation is introduced in order to deform a given stationary Schrödinger equation into one with time-dependent potential. This construction allows to obtain a set of orthogonal solutions inherited from the stationary system, where the orthogonality of the set is guaranteed from the preservation of the inner product. The respective constants of motion (invariant operators) are extracted in a straightforward form by simply performing the appropriate mapping and exploiting the preservation of the first integrals available in the initial system. In particular, it is shown that the parametric oscillator is obtained as a deformation of the harmonic oscillator. Lastly, a new family of time-dependent potentials is generated after combining the Darboux and point transformations, leading to a generalization of the Abraham-Moses-Mielnik potential.

CENTRO DE CIENCIAS DE BENASQUE PEDRO PASCUAL

7th International Workshop on New challenges in Quantum Mechanics: Integrability and Supersymmetry
Workshop programme

	Monday	Tuesday	Wednesday	Thursday	Friday
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10:05 - 10:40	Mariano A. del Olmo Groups, special functions and rigged Hilbert spaces	Manuel Asorey Bulk-Edge dualities in Topological Matter	María A. Lledó Supergrassmanians, superflags and the conformal superspace	Free day	Luis M. Nieto On some applications of contact potentials
10:40 - 11:15	Adrián Arancibia Lagrangian Quantum Mechanics for indistinguishable fermions: a self-consistent universe	Regina M. Ricotta Towards a dynamical model of protein folding through Supersymmetric Quantum Mechanics	Andreas Fring Nonlocal gauge equivalent integrable systems		Elso Drigo Filho Helium molecule inside a prolate spheroidal box
11:15 - 11:45	Coffee Break	Coffee Break	Coffee Break		Coffee Break
11:45 - 12:20	Alonso Contreras-Astorga Freezable quantum states or bound states in the continuum for time dependent potentials	Jorge Zanelli Is Nature Supersymmetric?	Olaf Lechtenfeld From Yang-Mills in de Sitter space to electromagnetic knots	Free day	José F. Gomes `The Algebraic Construction of Integrable Hierarchies, solitons and Infinite Dimensional Algebras
12:20 - 12:55	Georg Junker Path integral and spectral representations for supersymmetric Dirac-Hamiltonians	Rodrigo Fresneda Quantum localisation on the circle	Francesco Toppan A three-dimensional superconformal quantum mechanics with sl(2|1) dynamical symmetry		Mikhail S. Plyushchay Perfectly invisible PT-symmetric zero-gap systems and exotic nonlinear super-conformal symmetry
12:55 - 13:30	Ian Marquette Superintegrability, special functions and representations	Manuel Gadella Coherent Gamow states for the hyperbolic Pöschl-Teller potential	Luis Inzunza Klein four-group and Darboux duality		José F. Cariñena Lie and quasi-Lie systems in Quantum Mechanics
13:30 - 16:00	Lunch	Lunch	Free afternoon		Free afternoon
16:00 - 16:35	Thomas Frith Eternal life of entropy in non Hermitian quantum systems	Rafael Bravo Position-dependent mass, finite-gap systems, and supersymmetry		Free day	
16:35 - 17:10	Iván Gutiérrez-Sagredo Quantum observers from Poisson-Lie geometry	Takanobu Taira Goldstone bosons in different PT-regimes of non-Hermitian scalar quantum field theories			
17:10 - 17:45	Pedro R. Jiménez-Macías Lindblad master equation in Lie group representation	Kevin Zelaya Time-dependent exactly solvable potentials generated by Darboux and point transformations			
		20:00 Dinner at La Llardana Restaurant			19:00 Farewell Cocktail

Programme:

Monday September 2, 2019

Morning Session

9:00 - 9:30	**Registration**	
9:35 - 9:45	**Welcome**	
9:50 - 10:05	**Laudatio**	
Chairman: L.M. Nieto		
10:05 - 10:40	M.A. del Olmo	*Groups, special functions and rigged Hilbert spaces*
10:40 - 11:15	A. Arancibia	*Lagrangian Quantum Mechanics for indistinguishable fermions: a self-consistent universe*
11:15 - 11:45	**Coffee Break**	
Chairman: A. Fring		
11:45 - 12:20	A. Contreras-Astorga	*Freezable quantum states or bound states in the continuum for time dependent potentials*
12:20 - 12:55	G. Junker	*Path integral and spectral representations for supersymmetric Dirac-Hamiltonians*
12:55 - 13:30	I. Marquette	*Superintegrability, special functions and representations*
13:30- 16:00	**Lunch**	

Afternoon Session

Chairman: M. A. Lledó		
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6:35 - 17:10	I. Gutiérrez-Sagredo	*Quantum observers from Poisson-Lie geometry*
17:10 - 17:45	P.R. Jiménez-Macías	*Lindblad master equation in Lie group representation*
17:45- 18:15	**Coffee Break**	

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Morning Session

Chairman: J. F. Cariñena		
9:30 - 10:05	D.J. Fernández C.	*Dirac electron in graphene with magnetic fields generated by first-order intertwining operators*
10:05 - 10:40	M. Asorey	*Bulk-Edge dualities in Topological Matter*
10:40 - 11:15	R.M. Ricotta	*Towards a dynamical model of protein folding through Supersymmetric Quantum Mechanics*
11:15 - 11:45	**Coffee Break**	
Chairman: O. Lechtenfeld		
11:45 - 12:20	J. Zanelli	*Is Nature Supersymmetric?*
12:20 - 12:55	R. Fresneda	*Quantum localisation on the circle*
12:55 - 13:30	M. Gadella	*Coherent Gamow states for the hyperbolic Pöschl-Teller potential*
13:30- 16:00	**Lunch**	

Afternoon Session

Chairman: M. de la Torre		
16:00 - 16:35	R. Bravo	*Position-dependent mass, finite-gap systems, and supersymmetry*
6:35 - 17:10	T. Taira	*Goldstone bosons in different PT-regimes of non-Hermitian scalar quantum field theories*
17:10 - 17:45	K. Zelaya	*Time-dependent exactly solvable potentials generated by Darboux and point transformations*
17:45- 18:15	**Coffee Break**	

20:00	**CONFERENCE DINNER at** *"La Llardana"*

Wednesday September 4, 2019

Morning Session

Chairman: J. M. Mateos-Guilarte		
9:30 - 10:05	M.A. González-León	*Type I Liouville Dynamical Systems on the Lobachevski plane*
10:05 - 10:40	M.A. Lledó	*Supergrassmanians, superflags and the conformal superspace*
10:40 - 11:15	A. Fring	*Nonlocal gauge equivalent integrable systems*
11:15 - 11:45	**Coffee Break**	
Chairman: J. Zanelli		
11:45 - 12:20	O. Lechtenfeld	*From Yang-Mills in de Sitter space to electromagnetic knots*
12:20 - 12:55	F. Toppan	*A three-dimensional superconformal quantum mechanics with $sl(2\|1)$ dynamical symmetry*
12:55 - 13:30	L. Inzunza	*Klein four-group and Darboux duality*
13:30- 16:00	**Lunch**	

FREE AFTERNOON

Friday September 6, 2019

Morning Session

Chairman: R. M. Ricotta		
9:30 - 10:05	B. Schroers	*An integrable model for magnetic skyrmions*
10:05 - 10:40	L.M. Nieto	*On some applications of contact potentials*
10:40 - 11:15	E. Drigo Filho	*Helium molecule inside a prolate spheroidal box*
11:15 - 11:45	**Coffee Break**	
Chairman: M.A. del Olmo		
11:45 - 12:20	J. Gomes	*The Algebraic Construction of Integrable Hierarchies, solitons and Infinite Dimensional Algebras*
12:20 - 12:55	M.S. Plyushchay	*Perfectly invisible $\mathcal{PT}$-symmetric zero-gap systems and exotic nonlinear super-conformal symmetry*
12:55 - 13:30	J.F. Cariñena	*Lie and quasi-Lie systems in Quantum Mechanics*
13:30- 16:00	**Lunch**	

FREE AFTERNOON

19:00	**FAREWELL PARTY**

Participants

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