AAMP XXIII meeting

Prague, August 25 - 28, 2026

→ (Tentative) Book of Abstracts ←

preliminary version dated August 31, 2026

Group functions in filtered randomised benchmarking for passive bosonic devices

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We reduce the cost of the current bosonic randomised benchmarking proposal. First, we introduce a filter function based on immanants and characters of the unitary group. Using entries of the irreps of the unitary group, this filter avoids computing Clebsch-Gordan coefficients. Our filter uses the same data as the original scheme, but we propose a different data-collection process that requires only a single measurement type. Additionally, we argue that weak coherent states and intensity measurements are sufficient to advance the characterisation. Our work could then enable simpler platforms to be characterised and streamline data analysis.

Standard subspaces of Hilbert spaces via analytic extensions of one-parameter operator groups

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The importance of standard subspaces of the one-particle Hilbert space is due to the fact that, as shown by H. Araki, these subspaces give rise to von Neumann algebras for which the vacuum vector is both cyclic and separating, in the framework of the Fock representation of canonical commutation relations. We use antiunitary representations of Lie groups and analytic extensions of orbit maps in order to construct nets of standard subspaces that are isotone, covariant and satisfy the Reeh–Schlieder and Bisognano–Wichmann conditions from Algebraic Quantum Field Theory. We also characterize the existence of nets with the above properties by a regularity condition in terms of Euler elements in Lie algebras and we show that all antiunitary representations of the split oscillator group have this property. The talk is based on joint work with Karl-Hermann Neeb.

Strong-coupling approximation for PT-symmetric quantum field theory

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Strong-coupling approximation techniques that were originally developed for Hermitian quantum field theory can also be used for non-Hermitian PT-symmetric quantum field theories in D-dimensional spacetime. In this talk we explain the diagrammatic methods needed for calculating the coefficients in a strong-coupling expansion. Strong-coupling series have two advantages over weak-coupling series: (1) Strong-coupling graphs can always be calculated exactly in any spacetime dimension; weak-coupling graphs usually involve the evaluation of difficult transcendental integrals that require numerical analysis; (2) Strong-coupling series converge; weak-coupling series diverge so asymptotic summation techniques (e.g. Pade summation) must be used to obtain information from the series. The techniques discussed here are general and work in any space-time dimension but for simplicity of presentation, we focus on low-dimensional PT-symmetric $ig\phi^3$ quantum field theory.

Magnetic Monopoles with Internal Degree of Freedom

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We present a general family of effective $SU(2)$ models with an adjoint scalar. We construct the Bogomol'nyi–Prasad–Sommerfield (BPS) limit and derive monopole solutions in analytic form. In contrast to the 't Hooft–Polyakov monopole, included here as a special case, these solutions tend to exhibit more complex energy density profiles. Typically, we obtain monopoles with a hollow cavity at their core where virtually no energy is concentrated; instead, most of the

monopole's energy is stored in a spherical shell (in some cases with several "sub-shells") around its core. Most interestingly, however, we show that some of the analytic monopole solutions contain an unconstrained constant of integration that controls the monopole's energy density profile, while keeping its total energy (i.e., the mass) constant. Thus, it can be interpreted as an internal degree of freedom or as a new moduli space parameter.

Oscillons as Q-balls through renormalization

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Based on a renormalization-group-inspired perturbation expansion, we establish a novel connection between oscillons in generic real scalar-field theories and Q-balls in specific complex field theories. We show that the dynamics of small oscillons can be well approximated by integrable systems, in particular, the complex sine-Gordon model. The oscillon/Q-ball correspondence naturally explains the amplitude modulation of oscillons as being a composite state of two Q-balls with different frequencies. Although we work mostly in $(1 + 1)$-dimensional models for simplicity, the method is applicable in any number of spatial dimensions.

Dynamical systems based on nonlinear Lie–Hamilton systems

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The Lie–Hamilton formalism is extended to cover the so-called nonlinear LieHamilton systems, which are no longer related to a linear t-dependent combination of a basis of a finite-dimensional Lie algebra of functions W, but arbitrary t-dependent functions on W. This approach is based on the use of momentum maps and generalized distributions, as well as an extended t-dependent Poisson coalgebra method. The approach is illustrated with the study of harmonic oscillators, Hénon–Heiles systems and oscillators with a t-dependent frequency and Kepler–Coulomb systems with a t-dependent coupling constant on some spaces of non-constant curvature.

Symmetry-guided quantum couplers for Dirac materials

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We develop a theoretical framework for designing quantum couplers based on Dirac materials that can modulate the polarization of transmitted quasiparticles without significantly perturbing their propagation. We analyze in detail the conditions required for perfect transmission (Klein tunneling) together with controlled polarization transformation of the incoming states. We then discuss an explicit model of a quantum coupler composed of AA-stacked bilayer graphene nanoribbons with armchair edges and a localized interlayer interaction. Perfect transmission

through the desired polarization channels is examined for both narrow and wide couplers. We show that the transmission of polarized states can be finely tuned by external fields.

Estimating the Accuracy of Variational Calculations in Quantum Mechanics

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The variational method provides an upper bound to the ground-state energy but does not, by itself, quantify how close this bound or the corresponding trial wavefunction is to the exact solution. Logarithmic perturbation theory, formulated through the Nonlinearization Procedure, offers a systematic way to estimate this accuracy. Although established long ago, its numerical realization for multidimensional few-body atomic systems has remained largely unexplored. We present a numerical approach based on a simple collocation method for solving the resulting hierarchy of partial differential equations at low computational cost. As an example of application, the method is applied to the ground state of helium and helium-like ions using perimetric coordinates and an explicitly correlated trial function.

The one-dimensional Coulomb Hamiltonian perturbed by a point interaction

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This paper is the continuation of a previous one devoted to the study of the self-adjoint realisation of the one-dimensional Coulomb Hamiltonian determined by a Dirichlet boundary condition at the origin. In particular, we investigate how the spectrum of the latter Hamiltonian is modified by the addition of a point perturbation. Such a one-dimensional Hamiltonian may be relevant in the study of the so-called exotic atoms, that is to say atoms inside which an electron is substituted by a negatively charged hadron, so that the hadron is subjected to both the Coulomb interaction and the strong one of the nucleus. Furthermore, our one-dimensional Hamiltonian, regarded as the radial part of the corresponding three-dimensional one, may as well be of some relevance to the so-called δ-shell interaction perturbing the Coulomb potential, a model for the interaction between charged particles undergoing short-range (strong, nuclear) interparticle forces.

Deforming the Dyson gas by a configuration of fixed point charges in the plane: a problem inspired by the real Ginibre ensemble

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We determine analytically (in the large-N limit) the equilibrium density distribution of a Dyson gas perturbed by a finite fixed array of pairs of complex-conjugate point charges in the complex plane.

This well defined electrostatic problem is inspired by the problem of determining the density of real eigenvalues in the extremely rare sector of the real Ginibre ensemble (GinO) of real asymmetric matrices, in which almost all eigenvalues (save for a finite number of pairs of complex-conjugate eigenvalues) are real. More precisely, the problem I will discuss today is obtained by quenching the pairs of complex eigenvalues in the GinO sector, and by simplifying the confining potential of real eigenvalues into Gaussian form.

Non-Hermitian Jacobi-Natanzon systems and so(4,C) potential algebra

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We construct a PT-symmetric complex extension of a Jacobi-Natanzon potential and study a real-energy bound-state sector through a Liouville reduction to the Jacobi equation. By considering a general complexified Jacobi-Natanzon family, of which the PT-symmetric system is a special case, and using a complex-parameter continuation of the algebraic-Jacobi-function ladder construction within the Jacobi-polynomial sector, we develop a potential-algebra description in terms of two commuting complex ladder structures realizing the semisimple Lie algebra so(4,C). The ladder action admits an integer-shift interpretation on the space of potential labels, where closed-loop products of Jacobi-ladder maps can acquire nontrivial complex multipliers, with corresponding real finite-dimensional loops being phase-trivial.

Based on joint work with Kevin Zelaya, Chitrak Chatterjee, and Bhabani Prasad Mandal

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Non-Hermiticity and non-Markovianity of open quantum systems

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The open quantum system is a part of a bigger closed system; it is typically a small but complex system (often called the system) surrounded by a large but simple system (often called the environment). I report here our new findings on the non-Hermiticity and non-Markovianity of open quantum systems. Since the system exchanges energy and probability with the environment, the effective Hamiltonian of the system is generally non-Hermitian. Complex eigenvalues of all resonant states are given by the non-Hermitian Hamiltonian. For the one-body scattering problem, I report our new resolution of unity that comprises all point spectra, including all complex eigenvalues. Another interesting feature of open quantum systems is their dynamics. Since the environment serves as a memory, the dynamics of the system are generally non-Markovian, with the memory kernel arising from the Green's function of the environment. Again, for the one-body problem, I report our new findings on the power-law decay in the short- and long-term regimes of the system's dynamics.

Classical motion in a complex crystal

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The study of classical PT-symmetric systems consists of examining particle motion in the complex plane, and more precisely, on complex multisheeted Riemann surfaces. In prior studies, the complex position of the particle $x(t)$ is represented in Cartesian form as $x(t) = Rex(t)+iImx(t)$, where time t is real. This talk introduces a new way to portray complex classical motion in which the Riemann surface is viewed as a complex crystal: Instead of using Cartesian coordinates, the path of the particle is represented in polar coordinates as $x(t) = r(t)e^{i\theta(t)}$ where $0 \leq r < \infty$ and $-\infty < \theta < \infty$. The n-th cell of this complex crystal is defined by $-3\pi/2+2n\pi \leq \theta \leq \pi/2+2n\pi$, where $n = 0, \pm1, \pm2, \ldots$. Adjacent cells are delineated graphically by a vertical line from $r = 0$ to $r = \infty$ at $\theta = \pi/2+2n\pi$. In this representation a PT reflection leaves r invariant and replaces θ by $-\pi - \theta$, so it replaces n by $-n$. The complex path of a classical particle is determined by solving Hamilton's equations. A given Hamiltonian in the complex domain may define multiple distinct physical theories (or phases) having differing physical properties. The advantage of this representation is that the properties of these phases can be clearly identified and examined in detail.

Wigner-Yang Quantum Mechanics, its Generalisation and Supersymmetry

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We revisit Wigner's question "Do the Equations of Motion Determine the Quantum Mechanical Commutation Relations?" [Phys. Rev. 77 (1950) 711-712] and its corresponding x-representation found by Yang [Phys. Rev. 84 (1951) 788-790]. Initially, we consider only one of the two equations of motion leading us to what we call generalised Wigner-Yang quantum mechanics (gWYQM). Its close relation to Witten's model of supersymmetric quantum mechanics (SUSYQM) is explicated. Both cases, unbroken and broken SUSY, are studied in some detail using the harmonic oscillator as example for both cases. Implementing the second equation of motion leads us to Yang's original realisation of Wigner's deformed Heisenberg algebra, and what is called Wigner-Yang quantum mechanics (WYQM). Here we first look into Wigner's original problem of the harmonic oscillator on the real line, which does not allow for a SUSY structure. However, by considering the attractive Coulomb-like potential $V(x) = -\gamma/|x|$ we are able to establish SUSY. Both systems are then mapped into each other via a modified Hooke-Newton duality.

Periodic discrete graphs with prescribed spectrum

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We present a construction of a periodic weighted graph whose discrete Laplacian exhibits a prescribed band-gap structure. More precisely, for any $n \in \mathbb{N}$, we construct a graph whose spectrum contains exactly n gaps, furthermore, by a suitable choice of the graph weights, the endpoints of these gaps, as well as the upper edge of the spectrum, can be prescribed arbitrarily. The underlying graph has a brush-like geometry, consisting of an infinite chain of vertices with

n pendant vertices attached to each vertex of the chain. We also derive semi-explicit formulae for the edge weights: part of the coefficients are given explicitly, while the remaining ones are characterized as roots of an explicitly determined polynomial. This is a joint work with Anna Muranova (University of Warmia and Mazury in Olsztyn, Poland); preprint: arXiv:2606.06398 [math.SP].

The relativistic rotated harmonic oscillator

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We introduce a relativistic version of the non-self-adjoint operator obtained by a dilation analytic transformation of the quantum harmonic oscillator. While the spectrum is real and discrete, we show that the eigenfunctions do not form a basis and that the pseudospectra are highly non-trivial.

This is joint work with Aitor Balmaseda and Juan Manuel Pérez-Pardo published in Proceedings A.

Closely Watched Potentials*

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Solvable quantum mechanical potentials have attracted the attention of physicist since the introduction of quantum mechanics hundred years ago. Various models have been applied to solve the one-dimensional Schrödinger equation, and this resulted in the description and classification of a large number solvable potentials. The solutions are usually given in terms of some special function of mathematical physics, which reduce to polynomial form for bound-state solutions. The most well- known potential class, the Natanzon potentials are obtained from the transformation of the Schrödinger equation into the hypergeometric or confluent hypergeometric differential equation. These potentials have also been associated with various symmetries (Lie, SUSYQM, PT symmetry). As the result of more recent efforts, examples of potentials outside the Natanzon class have been identified, and also, more general concepts of solvability (e.g. conditional and quasi-exact) have been introduced. Here we discuss these developments by investigating potentals derived from Heun-type differential equations. We demonstrate that this scheme offers a unified framework into which some non-Natanzon-class potentials can be accommodated, and also allows the reinterpretation of the novel concepts of solvability.

*Inspired by the Oscar winning movie (1966) by Jiří Menzl, dedicated to Miloslav Znojil on the occasion of his 80'th birthday

The One-Dimensional Symmetric Woods–Saxon Potential in Dunkl Quantum Mechanics

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The one-dimensional symmetric Woods–Saxon potential is investigated within the framework of Dunkl quantum mechanics. The Dunkl deformation introduces a reflection-dependent inverse-square interaction, leading to distinct effective potentials for the two reflection sectors. By employing a Pekeris-type approximation, the resulting Dunkl–Schrödinger equation is reduced to a hypergeometric differential equation, allowing an analytical treatment of bound, scattering, and metastable states within a unified framework. The deformation is shown to lift the degeneracy between the reflection sectors in the bound-state spectrum and to modify the reflection and transmission properties of the system. In the scattering regime, narrow transmission peaks are identified and interpreted in terms of Gamow resonance states obtained through analytic continuation into the complex-energy plane. The results illustrate how reflection symmetry and the Dunkl deformation modify the spectral and resonance properties of the symmetric Woods–Saxon system.

Bound states in the continuum in cuprous oxide quantum wells

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We propose a realistic semiconductor system containing bound states in the continuum (BICs) which allows for a practical realization. By varying the confinement strength of excitons in cuprous oxide quantum wells, we show that long-lived Rydberg states of the confined electron-hole pairs appear in the continuum background. The accuracy of calculations of the linewidths based on the coupled-channel Schrödinger equation with three channels and only few basis states is confirmed by numerically exact solutions employing a B-spline basis.

Reference:
A. Aslanidis, J.Main, P. Rommel, S. Scheel, and P. Belov, Phys. Rev. B 111, L121103 (2025)

Emergence of Hermitian topology from non-Hermitian knots

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The non-Hermiticity of the system gives rise to a distinct knot topology in the complex eigenvalue spectrum, which has no counterpart in Hermitian systems. In contrast, the singular values of a non-Hermitian (NH) Hamiltonian are always real by definition, meaning that they can also be interpreted as the eigenvalues of some underlying Hermitian Hamiltonian. We demonstrate

that if the singular values of an NH Hamiltonian are treated as eigenvalues of prototype translational invariant Hermitian models that undergo a topological phase transition between two distinct topological phases, the complex eigenvalues of the NH Hamiltonian will also undergo a first-order knot transition between different knot structures. Unlike the usual knot transition, this transition is not accompanied by an exceptional point (EP); in contrast, the real and complex parts of the eigenvalues of the NH Hamiltonian show a discrete jump at the transition point. We emphasize that the choice of an NH Hamiltonian whose singular values match the eigenvalues of a Hermitian model is not unique. However, our study suggests that this connection between the NH and Hermitian models remains robust as long as the periodicity in lattice momentum is the same for both. Furthermore, we provide an example showing that a change in the topology of the Hermitian model implies a transition in the underlying NH knot topology, but a change in knot topology does not necessarily signal a topological transition in the Hermitian system.

Dynamical formulation of stationary scattering and new exactly solvable diffraction-grating scattering problems

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Dynamical formulation of stationary scattering is a basic alternative to the standard approach to scattering theory that has recently led to the discovery of large classes of exactly solvable scattering problems. It relies on the idea of mapping scattering problems to the determination of the dynamics of an effective quantum system that is determined by a non-Hermitian Hamiltonian operator [1,2]. In this talk, I will present a brief review of this approach and report on its applications in the scattering of TE and TM waves by two-dimensional scattering media. These include an analytic construction of low-frequency series expansion of the scattering amplitude [3] as well as the discovery of a large class of exactly solvable diffraction-grating scattering problems for both TE and TM waves [4]. The latter includes Berry's lop-sided grating [5] as a specific example.
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Oscillators on constant curvature spaces: Demkov-Fradkin type symmetries

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We deal with the symmetries of quantum oscillator systems defined on constant curvature surfaces. Here, we want to build these symmetries from more elementary operators in the same way as creation-annihilation operators do for the usual flat quantum oscillators (this is what

we call Demkov-Fradkin type symmetries). In fact, we chose a unifying formalism depending on the curvature κ, such that in the limit $\kappa \to 0$ we recover the well known expressions for the flat quantum oscillator. We will explicitly work out the spectrum and eigenfunctions of these systems in low dimensions. This problem can also be addressed within the classical context by the same methods. Here, we will plot some of the trajectories.

Estimates for Dirichlet Eigenvalues of the Schrödinger operator with the Kronig-Penney Model

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We first improve some asymptotic formulas previously obtained and provide sharp asymptotic formulas explicitly expressed by the potential. For the potentials of bounded variation, we obtain asymptotic formulas in which the first and second terms are explicitly determined and separated from the error terms. In addition, we illustrate these formulas for the Kronig-Penney potential. We then provide estimates for the small Dirichlet eigenvalues of the one-dimensional Schrödinger operator in the Kronig-Penney model. We derive several useful equations from certain iteration formulas for computing these Dirichlet eigenvalues, and prove that all the eigenvalues can be found by the fixed point iteration. Then, using the Banach fixed point theorem, we estimate the eigenvalues numerically. Moreover, we present error estimates and include a numerical example.

Reference:
Cemile Nur and Oktay Veliev, Estimates for Dirichlet Eigenvalues of the Schr¨odinger operator with the Kronig-Penney Model, arXiv:2512.07470v2

Supersymmetric Quantum Mechanics in Dirac and Weyl Semimetals: Spectral and Transport Properties

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Dirac materials provide a versatile platform for studying novel electronic transport phenomena arising from the interplay between topology, chirality, and external fields. In this work, we use Supersymmetric Quantum Mechanics (SUSY-QM) to investigate two semimetallic systems exhibiting an underlying supersymmetric structure. The first system consists of a Dirac semimetal subjected to static, non-uniform, and parallel electric and magnetic fields. By choosing suitable electromagnetic profiles, the $(3 + 1)$-dimensional Dirac equation is reduced, for each chirality, to SUSY partner Schrödinger equations, allowing for analytical solutions and the study of transverse current densities associated with the Planar Hall Effect. The second system consists of a Weyl semimetal slab subjected to an external magnetic field and exhibiting an axionic electrodynamic response. In this case, the Hamiltonian can be decomposed into SUSY and PT-SUSY partner Hamiltonians, from which exact spinor solutions, chiral currents, and the energy spectrum are obtained under mixed boundary conditions. We demonstrate that both systems exhibit a nontrivial SUSY structure that provides a unified framework for understanding their

spectral and transport properties, highlighting the role of chirality, external fields, and axionic effects in Dirac and Weyl semimetals.

Closed Periodic Trajectories in Molecular Physics: The H_3^+ Molecule

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A molecule is a many-body quantum system composed of electrons and nuclei. The well-known Born–Oppenheimer approximation allows us to separate the electronic and nuclear motions. The eigenvalues of the electronic Hamiltonian define the potential energy surfaces. In the quantum-mechanical description, the rotational-vibrational spectrum of a molecule is obtained by solving the nuclear Schrödinger equation using one of these electronic potential energy surfaces as the potential. In the classical picture, instead, we can study trajectories. In this talk, we present a study of closed periodic trajectories of the H_3^+ molecule. We will explore a rich zoo of such trajectories and show how their properties lead to a phenomenon of energy quantization.

Topological characterization of the electronic band structure of Haldane chains with complex hoppings

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We propose an artificial molecular chain inspired by polyphenol that realizes a 1D version of the Haldane model through complex hopping parameters. While the original 2D Haldane model is renowned for predicting the anomalous quantum Hall effect without external magnetic fields, we demonstrate how its topological properties translate to a 1D architecture. By expressing the Bloch Hamiltonian through the tensor product of Pauli and Gell-Mann matrices, we identify the specific terms responsible for breaking chiral and time-reversal symmetries. Our results reveal a direct correspondence between the 1D Berry phase diagram and the 2D Chern number as a function of these symmetry-breaking parameters. Furthermore, we characterize the emergent boundary states within the topological phases of the finite chain. This work provides a roadmap for engineering complex hoppings in artificial crystals to unlock novel topological phases.

IMAGINARY CUBIC OSCILLATOR: OLD & NEW

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Based on the prominent PT-symmetric example, we summarize spectral and pseudospectral results for complex oscillators. In particular, we include:

- asymptotics of eigenvalues,
- stability of spectra w.r.t. domain truncations and perturbations,
- asymptotics and decay of eigenfunctions,

- basis properties of eigenfunctions,
- resolvent estimates (pseudospectra),
- time evolution.

Recurrence of unitary and stochastic quantum walks

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Recurrence means a return of the dynamical system to its initial state. Classical result of Polya [1] from 1920's shows that a random walk on a line and a 2D grid returns to the origin with certainty, while it is transient on higher-dimensional lattices. For quantum walks, detection of recurrence requires partial measurement after each step, yielding a conditional quantum dynamics. We review the method to study quantum recurrence based on generating functions [2], focusing on the quantum walk on a line. Combination of measurement induced effects and faster spreading implies that a quantum walk on a line can escape to infinity without ever returning to the origin. Finally, we present a recent extension of the study of recurrence to quantum stochastic walks [3], which interpolates between quantum and classical walk dynamics [4]. Surprisingly, we find that introducing classical randomness can reduce the recurrence probability — despite the fact that the classical random walk returns with certainty — and we identify the conditions under which this intriguing phenomenon occurs.

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Quantum particle confined to a triangular fragment of the honeycomb lattice

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One way of constructing the honeycomb lattice is by subtracting the root lattice from the weight lattice, both belonging to the root system A_2. A tight-binding Hamiltonian is introduced for a particle located on the honeycomb lattice containing two alternating types of atoms with nearest and next-to-nearest neighbour interactions. Weyl orbit functions can subsequently be used to express the corresponding eigenenergies. By introducing boundary interactions into the Hamiltonian, the particle is confined to a quantum dot situated in the fundamental domain of the associated affine Weyl group. In this case, the configuration space of the particle is finite, therefore discrete energy levels appear. Existence of a closed form solution of the quantum dot eigenenergy problem will be discussed depending on the various parameters of the Hamiltonian.

Exact-solvability of superintegrable systems

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All, so far known explicitly two-dimensional quantum superintegrable systems in flat space are exactly solvable with spectra linear in quantum numbers (in agreement with the Montreal Conjecture by Tempesta-Turbiner-Winternirz (2001)). Their eigenfunctions are bivariate orthogonal polynomials in invariants of the (discrete) symmetry group. It includes the Smorodinsky-Winternitz potentials I-IV (or the Holt potential), the Fokas-Lagerstrom model, the 3-body Calogero (equivalently, A_2 rational) and the Wolfes (equivalently, G_2 rational, or I_6) models, and the Tremblay-Turbiner-Winternitz system with integer index k=1,2,3,4. They have hidden (Lie) algebraic structure $g^{(k)}$ with various k, and they possess a (finite order) polynomial algebras of integrals generated by the Hamiltonian, two algebraically-independent integrals and their commutator.

Perturbing the singular realm

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Singular problems like delta function interactions, from a physical point of view, require renormalization. Ordinary perturbations of these problems can be analyzed by the usual methods of perturbation theory, however, when the parameters of the singular interaction itself are changing this is not such a simple issue. We analyze various time dependent perturbations in a novel approach and show that one can get a sensible approximation scheme much like the usual version. This approach is illustrated in a few examples that we have some analytical control over the 1st and 2nd order terms. (Joint work with F. Erman, K. G. Akbas)

Imaginary cubic oscillator – regularization by discretization

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Since Stone (1932) we know that the quantum Hamiltonians H must be self-adjoint in a physical Hilbert space $\mathcal{H}$. Since Dyson (1956) we also know that for the calculation-efficiency purposes it may make good sense to introduce our H as non-Hermitian, defined simply in another, user-friendlier, non-equivalent Hilbert space (say, $\mathcal{L}$). The essence of the acceptability of the trick is that H is required bounded (cf., e.g., the 1992 review by Scholtz et al). In 2012, Siegl with Krejcirik reconsidered the popular benchmark imaginary-cubic oscillator and proved that such a model (with unbounded H) fails to be mathematically consistent and acceptable (cf. also a different, 2019 proof by Guenther and Stefani). We propose (and, via an explicit constructive example, illustrate) that for all of the similar ordinary differential Hs (characterized, roughly speaking, by a certain subtle form of their exceptional-point-like degeneracy) one of the possible regularizations yielding their acceptable physical interpretation can be achieved via their appropriate discretization.

References:
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