RAQIS 24

Rapport sur les contributions

https://indico.in2p3.fr/e/32579

ID de Contribution: **1** Type: **Non spécifié**

Variational approach in quantum field theory.

We develop a variational approach to study a two-dimensional non-integrable quantum field theories through the lenses of integrable ones. We focus on the φ4 Landau- Ginzburg theory and compare it with the integrable Sinh-Gordon. We employ exact Vacuum Expectation Values and Form Factors of local operators of the Sinh-Gordon model for getting the best variational estimates of several quantities of the φ4 theory, such as the ground state energy on a finite volume or the physical mass as function of the coupling constant.

Orateur: HUTSALYUK, Arthur

ID de Contribution: **2** Type: **Non spécifié**

Exact dynamics with free fermions in disguise.

A large class of free fermionic spin chain models 2305.15625, 2310.19897, 2402.02984 have been found recently, that are not soluble by a Jordan-Wigner transformation, but by some more complex construction introduced in the original work 1901.08078 of Fendley, that rather resembles the methods to solve integrable systems. In 2405.20832 we relied on these techniques to calculate the correlation functions of local operators in Fendley's model and also established a scheme to measure them on a quantum computer. Thus, it is another example of a classically simulable quantum system, that may also be used for benchmarking these hardware. In my talk, I will introduce the audience to the free fermions in disguise models and explain how to solve their dynamics.

Orateur: VONA, Istvan

ID de Contribution: **3** Type: **Non spécifié**

Boundary energy of the quantum spin chain with various boundary terms.

Applying the recent developed method-the off-diagonal Bethe ansatz method, we construct the exact solutions of the Heisenberg spin chain with various boundary conditions. The results allow us to calculate the boundary energy of the system in the thermodynamic limit. The method used here can be generalized to study the thermodynamic properties and boundary energy of other high rank models with non-diagonal boundary fields.

Orateur: YANG, Wen-Li

ID de Contribution: **4** Type: **Non spécifié**

Quantum many-body spin ratchets.

I will describe a novel class of exactly solvable quantum unitary circuits on qudits. Their key feature is architecture that breaks parity and time reversal symmetries, while retaining the combined PT symmetry. A consequence of this chirality is a spin transport with a finite drift: the circuit acts as a quantum spin pump. The drift velocity is universal in that it depends only on the Casimir invariant of the local quantum spaces and survives non-integrable perturbations of the circuit. I will comment on connection to integrable Troterizations and, if time permits, discuss spin transport coefficients and hydrodynamics.

Orateur: ZADNIK, Lenart

ID de Contribution: **5** Type: **Non spécifié**

Bethe Ansatz for the Propagator of the Multi-Species Totally Exclusion Process.

We explore the dynamics of the N-species totally asymmetric simple exclusion process (N-TASEP) on a one-dimensional lattice, where different species of particles exhibit hierarchical dynamics depending on arbitrary parameters. We employ the Algebraic Bethe Ansatz method to establish a framework that enables the calculation of finite-time conditional probabilities for the positions of a finite number of particles across multiple species. This formalism is analogous to a propagator operator for quantum spin chains and can be viewed as a stochastic vertex model, leading to explicit formulas which simplifies to a determinantal form in particular situations, generalising thus the work of Schütz et al. for the single-species case. The formalism relies on a new method of Baxterization for R-matrices that depends on two separate spectral parameters with a braid-like algebra that was proposed by Ragoucy et al. This is a joint work with Luigi Cantini.

Orateur: ZHARA, Ali

ID de Contribution: **6** Type: **Non spécifié**

Lagrangian multiforms: paths from classical to quantum.

Lagrangian multiform theory has appeared in the last 15 years as a variational approach to classical integrable systems. It describes both continuous and discrete systems, and initial steps have been made towards a quantum version. In this talk I will introduce Lagrangian multiform theory as it appears in classical integrable systems and its extensions to the semi-classical regime. I will highlight opportunities and potential obstacles for a quantum version of the theory.

Orateur: VERMEEREN, Mats

ID de Contribution: **7** Type: **Non spécifié**

Exact loop densities in the O(1) dense loop model on an infinite cylinder of odd circumference.

Loop models are a class of two-dimensional statistical lattice models, and many classical models are equivalent to them. In this talk, we discuss the O(1) dense loop model on a square lattice wrapped on an infinite cylinder of odd circumference. Our main goal is to measure the average density of loops. We show that this problem is equivalent to finding the average density of percolation clusters in a percolation model with the critical probability $p = 1/2$ on an infinite cylinder. To find the average density of loops, we explore the relationship between the O(1) dense loop model and the six-vertex model at specific values of parameters. We apply the algebraic Bethe ansatz to diagonalize the six-vertex transfer matrix and, as a result, to calculate the average density of loops in O(1) DLM. These results reproduce the infinite-plane density limit and provide finite-size corrections predicted to be universal by the Coulomb gas theory. The talk is based on ongoing research with Alexander Povolotsky.

Orateur: TROFIMOVA, Anastasiia

ID de Contribution: **8** Type: **Non spécifié**

On multipoint correlation functions in the Sinh-Gordon 1+1 dimensional quantum field theory.

The S-matrix bootstrap program offers a unique possibility to compute explicitly the form factors of local operators in integrable quantum field theories. We shall build on those results so as to compute, in terms of explicit series of multiple integrals, the multipoint correlation functions in the Sinh-Gordon 1+1-dimensional quantum field theory, which is a simple case where the S-matrix is scalar and there is only one kind of particle. In particular, our expressions allow us to explicitly check the causalty principle on the level of the correlation functions. This is a joint work with K. Kozlowski, Y. Potaux.

Orateur: SIMON, Alex

ID de Contribution: **9** Type: **Non spécifié**

From Set-Theoretical Solutions of the Braid Equation to Left Shelves.

In this talk, I will introduce the set-theoretic braid equation and the algebraic structure of a left shelf. I will demonstrate how to associate a solution with every left shelf and show that every left non-degenerate solution can be derived from a left shelf solution. Additionally, I will explore the equivalence of solutions under bijective maps, termed Drinfel'd isomorphisms. The presentation will also include a definition of set-theoretic Yang-Baxter algebras and a discussion of their properties. Notably, some set-theoretic Yang-Baxter algebras possess an additional structure known as a pre-Lie skew brace. When the additional operation of this pre-Lie skew brace is abelian, a pre-Lie ring can be obtained. All concepts will be illustrated with examples.

Orateur: RYBOŁOWICZ, Bernard

ID de Contribution: **10** Type: **Non spécifié**

F-bases, Bethe Ansatz, and Quantum Circuits.

We obtained a quantum circuit to prepare Bethe states. The quantum circuit is deterministic and has multi-qubit unitaries. The quantum circuit is limited to quantum-integrable spin-1/2 chains with periodic boundary conditions that are homogeneous nonetheless, such as the Heisenberg XXZ model. In this talk, we report our progress in the systematisation of quantum circuits for Bethe states. We show that the F-basis permits a rephrasing of Bethe states in terms of a preferred matrix-product state, which turns into a quantum circuit under unitarisation. We connect the matrix-product state with the coordinate Bethe Ansatz. We illustrate our approach in the construction of the quantum circuit for the inhomogeneous Heisenberg XXZ model. This work has been developed in collaboration with Esperanza López, Balázs Pozsgay, Germán Sierra, and Alejandro Sopena.

Orateur: RUIZ, Roberto

ID de Contribution: **11** Type: **Non spécifié**

Navier-Stokes equations for nearly integrable quantum gases.

The Navier-Stokes equations are paradigmatic equations describing hydrodynamics of an interacting system with microscopic interactions encoded in transport coefficients. In this talk I will present recent results showing how the Navier-Stokes equations arise from the microscopic dynamics of nearly integrable 1d quantum many-body systems. The method builds upon the recently developed hydrodynamics of integrable models to study the effective Boltzmann equation with collision integral taking into account the non-integrable interactions. I will illustrate the approach by computing the transport coefficients for an experimentally relevant case of coupled 1d cold-atomic gases.

Orateur: PANFIL, Miłosz

ID de Contribution: **12** Type: **Non spécifié**

Coordinate Bethe Ansatz for N=2 SCFTs.

In this talk I present a novel approach to the coordinate Bethe Ansatz which allowed the computation of the three-magnon wave function for the spin chains that capture the spectral problem of the marginally deformed Z2 orbifold of N=4 SYM in planar limit. The novel idea is to introduce contact terms that incorporate the dynamical structure of the spin chain.

Orateur: NIETO GARCÍA, Juan Miguel

ID de Contribution: **13** Type: **Non spécifié**

Supersymmetric generalization of q-deformed long-range spin chains of Haldane-Shastry type.

We discuss a matrix spin generalization of Ruijsenaars-Macdonald operators. We construct a commuting set of matrix-valued difference operators in terms of trigonometric GL(N|M)-valued R-matrices. Next, we present construction of long-range spin chains using the Polychronakos freezing trick. As a result, we obtain a new family of spin chains, which extends the gl(N|M)-invariant Haldane-Shastry spin chain to q-deformed case with possible presence of anisotropy. Joint work with Andrei Zotov, arXiv:2312.04525.

Orateur: MATUSHKO, Maria

ID de Contribution: **14** Type: **Non spécifié**

Hybrid integrable systems.

We develop the framework for quantum integrable systems on an integrable classical background. We call them hybrid quantum integrable systems (hybrid integrable systems), and we show that they occur naturally in the semiclassical limit of quantum integrable systems. We start with an outline of the concept of hybrid dynamical systems. Then we give several examples of hybrid integrable systems. The first series of examples is a class of hybrid integrable systems that appear in the semiclassical limit of quantum spin chains. Then we look at the semiclassical limit of the quantum spin Calogero–Moser system. The result is a hybrid integrable system driven by usual classical Calogero–Moser (CM) dynamics. This system at the fixed point of the multi-time classical dynamics CM system gives commuting spin Hamiltonians of Haldane–Shastry model.

Orateur: LIASHYK, Andrii

ID de Contribution: **15** Type: **Non spécifié**

Landscapes of integrable spin chains.

Based on 2405.09718 with Jules Lamers: I discuss the general construction of integrable long-range spin chains from R-matrices, in particular the two known elliptic solutions to the sl2 Yang-Baxter equation. I'll show how each generates its own landscape of models, which connect only incidentally, and identify the various models that appear in each. In particular, I'll show how the Sechin-Zotov spin chain, which belongs to the landscape generated by the eight-vertex R-matrix, can be thought of as an antiperiodic version of the Inozemtsev spin chain (which sits in the landscape of Felder's dynamical R matrix). As a byproduct, this shows that the (hyperbolic) Sechin-Zotov chain is a long-range deformation of the antiperiodic XX model.

Orateur: KLABBERS, Rob

ID de Contribution: **16** Type: **Non spécifié**

Exact overlaps for integrable boundary states of gl(N) symmetric spin chains.

In recent years, there has been growing interest (both in statistical physics and in the AdS/CFT duality) in exact overlaps between boundary and Bethe states. Combining the algebraic Bethe Ansatz with the KT-relation (which is the defining equation of the integrable boundary states), a sum rule of off-shell overlaps can be derived. This sum rule is sufficient to express the on-shell overlaps in a determinant form. The results can be extended to the so-called integrable matrix product states.

Orateur: GOMBOR, Tamas

ID de Contribution: **17** Type: **Non spécifié**

On the nested Bethe ansatz for a spin chain with simple Lie group symmetry.

We present a new framework for the nested algebraic Bethe ansatz for a closed, rational spin chain with g-symmetry for any simple Lie algebra g. Starting the nesting process by removing a single simple root from g, we use the residual U(1) charge and the block Gauss decomposition of the R-matrix to derive many standard results in the Bethe ansatz, such as the nesting of Yangian algebras, and the AB commutation relation. Based on arXiv:2405.20177.

Orateur: GERRARD, Allan

ID de Contribution: **18** Type: **Non spécifié**

Generalizations of spin Sutherland models from Hamiltonian reductions of Heisenberg doubles.

We explain how Ruijsenaars–Schneider type deformations of two types of trigonometric spin Sutherland models arise from Hamiltonian reductions of Heisenberg doubles of compact semisimple Lie groups in general and from an extended Heisenberg double of the unitary group U(n) in particular. As of writing, the quantization of the resulting classical integrable systems is still an open problem.

Orateur: FEHER, Laszlo

ID de Contribution: **19** Type: **Non spécifié**

Integrability of the Inozemtsev spin chain and its generalization.

I will discuss a recent answer to an old open question regarding the integrability of the Inozemtsev spin chain. I will also explain how this quantum spin chain can be further generalised. Based on arXiv:2407.03276.

Orateur: CHALYKH, Oleg

ID de Contribution: **20** Type: **Non spécifié**

Entanglement Hamiltonian for inhomogeneous free fermions.

The last two decades have witnessed an increasingly growing interest in the study and characterization of the entanglement structure of many-body quantum systems, also due to the development of related experiments. In this framework, a central object is the so-called entanglement Hamiltonian (EH), defined as the logarithm of the reduced density matrix, that provides a full description of the entanglement of a quantum state. In this seminar, I will present results on the EH of inhomogeneous free fermionic systems, in the presence of a linear or quadratic potential. For both cases we find that the EH is given by a deformed version of the physical Hamiltonian, with local inverse temperatures increasing linearly from the entanglement cut. The results are in perfect agreement with CFT predictions.

Orateur: BONSIGNORI, Riccarda

ID de Contribution: **21** Type: **Non spécifié**

Reflections on integrability.

We will discuss recent developments and open problems in the algebraic theory of universal reflection equations and its application to quantum integrable systems with boundary conditions, which is one of its main motivations. The main class of examples is described by quantum symmetric pairs of affine type (a quantum affine algebra together with a so-called quantized fixed-point subalgebra). They provide a limitless supply of trigonometric K-matrices.

Orateur: VLAAR, Bart

ID de Contribution: **22** Type: **Non spécifié**

On correlation functions of the XXZ/XYZ open spin chain.

We review recent results concerning the computation of correlation functions in open XXZ and XYZ spin 1/2 chains with boundary fields. In the XXZ case with longitudinal boundary fields, correlation functions at zero temperature can be computed within the algebraic Bethe Ansatz framework in the form of multiple integrals in the half-infinite chain limit. We discuss the extension of this result to two different cases : (1) the temperature case ; (2) the case of more general boundary fields at zero-temperature and the open XYZ case. In the temperature case (1), form factor series for correlation functions can be written within the quantum transfer matrix framework. The case of non-longitudinal boundary fields in open XXZ/XYZ (2) can be considered within the Separation of Variables approach. If the two boundary fields are related by one constraint, we can compute the matrix elements of a set of local operators as multiple integrals, similarly as in the longitudinal case.

Orateur: TERRAS, Véronique

ID de Contribution: **23** Type: **Non spécifié**

New integrable models: from short to long-range deformations.

The integrability toolkit provides a powerful way to solve certain quantum models. It plays a role in several different areas of physics, being in particular responsible for remarkable progress in the context of AdS/CFT and statistical physics, and more recently in quantum circuits. Therefore, asking whether a model is integrable is a very relevant question, but not always an easy one. In this talk, I will discuss two methods to construct integrable models. The first allows to classify integrable models whose Hamiltonians have nearest-neighbour interaction, while the second can also be applied to long-range spin chains. Examples will include new integrable deformations of AdS2 and AdS3 S-matrices; and the Lax operator and R-matrix of the two-loop SU(2) sector in N=4 SYM. I will also show that all known range 3 integrable deformations of the 6-vertex model are generated by an R-matrix.

Orateur: RETORE, Ana

ID de Contribution: **24** Type: **Non spécifié**

On the recurrence relations for the Bethe vectors.

Different type recurrence relations for the off-shell Bethe vectors in the rational quantum integrable models are discussed. The off-shell Bethe vectors in the gl(N)- and o(2n+1)-invariant integrable models are considered. It is demonstrated that the recurrence relations for these Bethe vectors are based on the different hierarchical embedding of the smaller monodromy matrices into the bigger one.

Orateur: PAKULIAK, Stanislav

ID de Contribution: **25** Type: **Non spécifié**

Solutions of tetrahedron and 3D reflection equations from quantum cluster algebras.

Tetrahedron and 3D equations are three-dimensional generalizations of the Yang-Baxter and the reflection equations. I will explain how quantum cluster algebras lead to solutions that generalize and unify many known solutions.
Joint work with Rei Inoue, Xiaoyue Sun, Yuji Terashima and Junya Yagi.

Orateur: KUNIBA, Atsuo

ID de Contribution: **26** Type: **Non spécifié**

Set-theoretic YBE: quantum algebras & universal R matrices.

The theory of the parametric set-theoretic Yang-Baxter equation is established from a purely algebraic point of view. We first introduce certain generalizations of the familiar shelves and racks called parametric (p)-shelves and racks. These objects satisfy a parametric self-distributivity condition and lead to solutions of the Yang-Baxter equation. Novel, non-reversible solutions are obtained from p-shelf/rack solutions by a suitable parametric twist, whereas all reversible set-theoretic solutions are reduced to the identity map via a parametric twist. The universal algebras associated to both p-rack and generic parametric, set-theoretic solutions are also presented and the corresponding universal R-matrices are derived. The admissible universal Drinfel'd twist is constructed allowing the derivation of the general set-theoretic universal R-matrix.

Orateur: DOIKOU, Anastasia

ID de Contribution: **27** Type: **Non spécifié**

Integrable Quantum Field Theories, Irrelevant Perturbations and Minimal Form Factors.

In this talk I will review some of my recent work on the form factor program for integrable quantum field theory in the presence of irrelevant perturbations. In particular, I will highlight how the solution to this problem can be employed to shed light on the structure of the form factors of more standard integrable quantum field theory, particularly their minimal form factors. I will consider the sinh-Gordon model as a particularly clear example.

Orateur: CASTRO-ALVAREDO, Olalla