

New Frontiers in Integrability

	Tue 13.06	Wed 14.06	Thu 15.06	Fri 16.06
9.30 - 10.00	Registration			
10.00 - 10.50	Vernier	Torrielli	Fioravanti	Matsui
11.00 - 11.50	Buca	Retore	Vicedo	Kasim
12.00 - 14.00	Lunch	Lunch	Lunch	Lunch
14.10 - 15.00	Goold	Nieto Garcia	Jones	
15.10 - 16.00	Frassek	Kimura	Rossi	
		Dinner (18.30)		

Talks

Speaker: Alessandro Torrielli (Surrey U.)
Title: *The strange world of AdS2 integrability*

Speaker: Ana Lucia Retore (Durham U.)
Title: *Is this an integrable model?*

Speaker: Eric Vernier (CNRS/LPSM Paris)
Title: *Integrability behind quantum groups*

Speaker: Berislav Buca (NBI Copenhagen)
Title: *Eigenoperator thermalization theory*

Speaker: John Goold (TCD)
Title: *Thermodynamics of non-equilibrium quantum systems in the mesoleads formalism*

Speaker: Rouven Frassek (Modena U.)
Title: *Non-compact spin chains and stochastic particle processes*

Speaker: Juan-Miguel Nieto Garcia (Hamburg U.)
Title: *Integrability in non-relativistic string theory*

Speaker: Davide Fioravanti (Bologna U.)
Title: *A new perspective on integrability, gauge theories, maybe black holes*

Speaker: Taro Kimura (IMB Dijon)
Title: *Bethe/gauge correspondence and supergroups*

Speaker: Benoit Vicedo (York U.)
Title: *2d Integrable Field Theories from 4d Chern-Simons*

Speaker: Nick Jones (Oxford U.)
Title: *Bulk/boundary correspondence in long-range quantum chains*

Speaker: Marco Rossi (Calabria U.)
Title: *On the origin of the correspondence between integrable models and differential equations*

Speaker: Chihiro Matsui (Tokyo U.)
Title: *Analysis of the steady state of the impurity-doped XXZ spin chain coupled to dissipators*

Speaker: Yusuf Kasim (Ljubljana U.)
Title: *Dual unitary circuits in random geometries*

Speaker: Alessandro Torrielli (Surrey U.)

Title: *The strange world of AdS2 integrability*

Abstract: We will review some of the features of integrable scattering in AdS2 backgrounds, paying particular attention to highlighting the differences with respect to AdS3 and higher dimensions. We will survey some of the progress obtained in the context of massless scattering in AdS2, and the non-standard techniques that enter the game in this case as opposed to the ordinary AdS/CFT methods.

Speaker: Ana Lucia Retore (Durham U.)

Title: *Is this an integrable model?*

Abstract: The presence of integrability is contributing to the solution of several interesting problems in modern theoretical physics. The question on whether a model is integrable or not, is therefore very relevant, but also difficult. In the first part of this talk, I will present a new method to systematically discover if a model is integrable or not and to construct new integrable models with nearest-neighbor interaction. I will focus on two interesting examples: a model that interpolates between AdS₃ and AdS₂ S-matrices, and a model with su(2)+su(2) symmetry where electrons only move in the chain when in pairs. In the second part of this talk, I will explain how to construct perturbative integrable models with longer and longer interaction. I will use this to construct the Lax operator and the R-matrices for up to three loops in the su(2) sector of planar N=4 Super Yang-Mills.

Speaker: John Goold (TCD)

Title: *Thermodynamics of non-equilibrium quantum systems in the mesoleads formalism.*

Speaker: Berislav Buca (NBI Copenhagen)

Title: *Eigenoperator thermalization theory*

Abstract: I will provide a rigorous framework of dynamics in locally interacting systems in any dimension. It is based on pseudolocal dynamical symmetries generalising pseudolocal charges. This generalization proves sufficient to construct a theory of all sufficiently local quantum many-body dynamics in closed, open and time-dependent systems, in terms of time-dependent generalized Gibbs ensembles. These ensembles unify seemingly disparate manifestations of quantum non-ergodic dynamics including quantum many-body scars, continuous, discrete and dissipative time crystals, Hilbert space fragmentation, lattice gauge theories, and disorder-free localization. In the process novel pseudo-local classes of operators are introduced: "restricted local", which are local only for some states, and "crypto-local", whose locality is not manifest in terms of any finite number of local densities. This proven theory is intuitively the rigorous algebraic counterpart of the eigenstate thermalization hypothesis and has implications for thermodynamics: quantum many-body systems, rather than merely reaching a Gibbs ensemble in the long-time limit, are always in a time-dependent generalized Gibbs ensemble for any natural initial state.

Speaker: Eric Vernier (CNRS/LPSM Paris)

Title: *Integrability behind quantum groups*

Abstract: The understanding of integrable models as it emerged from the 80s is intimately related to algebraic structures called quantum groups, which offer a systematic construction of solutions of the Yang-Baxter equation. In this talk I will show how certain key integrable models (the six-vertex model and its higher spin generalization) allow for a description in some sense "more elementary" than in terms of quantum groups. Following recent work by Bazhanov and Sergeev, I will review a construction of those models in terms of an underlying Ising-like geometry, where the Yang-Baxter equation obeyed in the former can be seen as resulting from multiple applications of the Star-Triangle relation. Moving on, I will then focus on the "root-of-unity points", which are known from the quantum group point of view to have a particularly rich representation theory, with striking physical consequences. I will show how an underlying Ising-like construction illuminates these aspects, and present a striking connection with the Onsager algebra, involved in the solution of the two-dimensional Ising model.

Speaker: Rouven Frassek (Modena U.)

Title: *Non-compact spin chains and stochastic particle processes*

Abstract: I will discuss the relation between non-compact spin chains studied in high energy physics and the zero-range processes introduced by Sasamoto-Wadati, Povolotsky and Barraquand-Corwin. The main difference compared to the standard SSEP and ASEP is that in these models several particles can occupy one and the same site. For the models with symmetric hopping rates I will introduce integrable boundary conditions that are obtained from new solution to the boundary Yang-Baxter equation (K-matrix). An explicit mapping of the open SSEP (and the non-compact model cousin) to equilibrium is presented. It allows to obtain closed-form solutions of the probabilities in steady state and of k-point correlations function.

Speaker: Juan-Miguel Nieto Garcia (Hamburg U.)

Title: *Integrability in non-relativistic string theory*

Abstract: Integrability has played a huge role in understanding string theory in $AdS_5 \times S^5$. This has motivated people to explore if integrability techniques can be applied to more general backgrounds. One of these cases is the non-relativistic limit of $AdS_5 \times S^5$. In this talk, I will report on recent progress in understanding classical integrable structures present in non-relativistic string theory propagating in string Newton-Cartan $AdS_5 \times S^5$. In particular, I will discuss classical solutions, the coset construction of the action, the Lax connection and the classical spectral curve.

Speaker: Davide Fioravanti (Bologna U.)

Title: *A new perspective on integrability, gauge theories, maybe black holes*

Abstract: We show how functional relations, which can be considered as a definition of a quantum integrable theory, entail an integral equation that can be extended upon introducing dynamical variables to a Marchenko-like equation. Then, we naturally derive from the latter a classical Lax pair problem. We exemplify our method by focusing on the massive/massless version of the ODE/IM (Ordinary Differential Equations/Integrable Models) correspondence involving the sinh-Gordon/Liouville model, first emerged in the gauge theories and scattering amplitudes/Wilson loops AdS_3 context with many moduli/masses, but in a way which reveals its generality. In fact, we give some hints, in the end, to its application to spin chains.

Speaker: Taro Kimura (IMB Dijon)

Title: *Bethe/gauge correspondence and supergroups*

Abstract: Bethe/Gauge correspondence provides us with a new perspective of quantum integrable systems from supersymmetric gauge theory. Under this correspondence, for example, one can obtain the Bethe equation of quantum integrable systems from the supersymmetric vacuum condition. In this talk, I'll discuss the Bethe/Gauge correspondence for supergroup gauge theory and show its peculiar behavior. I'll in particular show how to obtain Toda/Calogero-type systems associated with the root system of superalgebra from this perspective. I'll also mention that there exists a negative magnon carrying negative energy in a quantum spin chain system.

Speaker: Benoit Vicedo (York U.)

Title: *2d Integrable Field Theories from 4d Chern-Simons*

Abstract: In recent years various unifying frameworks for understanding 2d integrable field theories have emerged. In this talk I will review the approach based on 4d Chern-Simons theory, due to Costello and Yamazaki, and describe recent progress towards extracting general 2d integrable fields theories from 4d Chern-Simons theory.

Speaker: Nick Jones (Oxford U.)

Title: *Bulk/boundary correspondence in long-range quantum chains*

Abstract: I will introduce and analyse a family of free-fermion chains with algebraically decaying coupling strengths. This family is topological, and I will show that the bulk winding number counts Majorana zero modes on the boundary. Using the Wiener-Hopf method and properties of Toeplitz determinants, I will argue that the localisation properties and finite-size splittings correspond to 'filling singularities' of a complex function. This is based on arxiv:2211.15690 with Ryan Thorngren and Ruben Verresen.

Speaker: Marco Rossi (Calabria U.)

Title: *On the origin of the correspondence between integrable models and differential equations*

Abstract: We start from some functional relations as definition of a quantum integrable theory and derive from them a linear integral equation. This is extended, by introducing dynamical variables, to become an equation with the form of the Marchenko one. Then, we naturally derive from the latter a classical Lax pair problem. We exemplify our method by focusing on the massive version of the ODE/IM (Ordinary Differential Equations/Integrable Models) correspondence involving the classical sinh-Gordon (ShG) equation with many moduli/masses, as describing super-symmetric gauge theories and the AdS_3 strong coupling of scattering amplitudes/Wilson loops. However, we present it in a way which reveals its generality of application.

Speaker: Chihiro Matsui (Tokyo U.)

Title: *Analysis of the steady state of the impurity-doped XXZ spin chain coupled to dissipators*

Abstract: We give an exact matrix product steady state and matrix product forms of local observables for the bulk impurity-doped XXZ spin model coupled to dissipators at both ends, whose dynamics is

described by the Lindblad quantum master equation. We find that local magnetization is induced at the impurity site when the spin current flows, which is contrary to the usual situation where current suppresses magnetization due to heating. It is proved that this current-induced magnetization survives in the thermodynamic limit, and the spin current does not depend on the impurity strength. We discuss the role of bulk integrability by comparing the results with those of non-integrable models solved numerically by the quantum trajectory method.

Speaker: Yusuf Kasim (Ljubljana U.)

Title: *Dual unitary circuits in random geometries*

Abstract: Recently introduced dual unitary brickwork circuits have been recognised as paradigmatic exactly solvable quantum chaotic many-body systems with tunable degree of ergodicity and mixing. In this talk we show that regularity of the circuit lattice is not crucial for exact solvability. We consider a circuit where random 2-qubit dual unitary gates sit at intersections of random arrangements of straight lines in two dimensions (mikado) and analytically compute the variance of the spatio-temporal correlation function of local operators. Note that the average correlator vanishes due to local Haar randomness of the gates. The result can be physically motivated for two random mikado settings. The first corresponds to the thermal state of free particles carrying internal qubit degrees of freedom which experience interaction at kinematic crossings, while the second represents rotationally symmetric (random Euclidean) space-time.