YRMIS

Young Researchers Meeting on Integrable Sysytems

13, 14 June 2019 Université de Cergy Pontoise

Room E1: 1st floor, building E, St. Martin 2 avenue A. Chauvin, Pontoise 95302 Cergy-Pontoise

Program

Thursday, June 13th

9:15	Opening
9:30-10:30	**B. Basso**: *Continuum limit of fisnet graphs and AdS sigma model*
10:30-11:00	Coffee Break
11:00-11:50	**M. Stoppato**: *A connection between the classical r-matrix formalism and covariant Hamiltonian field theory*
11:50-12:40	**S. Grijalva**: *Open XXZ chain and boundary modes at zero temperature*
12:40-14:00	Lunch Break
14:00-14:50	**B. Bertini**: *Exact Spectral Form Factor and Entanglement Spreading in a Minimal Model of Many-Body Quantum Chaos*
14:50-15:20	Coffee Break
15:20-16:10	**M. Fairon**: *From double brackets to integrable systems*
16:10-17:00	**M. Ljubotina**: *Non equilibrium spin dynamics in an integrable Trotterization of the Heisenberg spin chain*

Friday, June 14th

9:30-10:30	**T. Prosen**: *Exact Correlation Functions for Dual Unitary Lattice Models in 1+1 Dimensions*
10:30-11:00	Coffee Break
11:00-12.00	**I. Findlay**: *An Equal-Space Construction of Integrable Models*
12:00-13:00	**I. Kukuljan**: *TCSA: from new topological effects in QFT to experiments in ultracold atoms*
13:00-14:00	Buffet
Afternoon	Free Discussions

Abstracts

Benjamin Basso (ENS-Paris): *Continuum limit of fisnet graphs and AdS sigma model*

Bruno Bertini (University of Ljubljana): *Exact Spectral Form Factor and Entanglement Spreading in a Minimal Model of Many-Body Quantum Chaos*

I will show that the periodically driven Ising chain in transverse field, for some particular values of the couplings, can be regarded as a minimal model for many body quantum chaos. Specifically, I will present an exact proof of the fact that the spectral form factor (a measure of spectral correlations) is described by random matrix theory. This result implies ergodicity for any finite amount of disorder in the longitudinal field, excluding the possibility of many-body localisation. The method used provides a novel route for obtaining exact non-perturbative results in non-integrable systems. As an example of this, I provide exact results on the entanglement spreading from a class of initial states and use that to characterise the entanglement spreading in the system.

References:

B. Bertini, P. Kos, and T. Prosen, arXiv:1812.05090
B. Bertini, P. Kos, and T. Prosen, Phys. Rev. Lett. 121, 264101(2018)

Maxime Fairon (University of Leeds): *From double brackets to integrable systems*

Double brackets were introduced by M. Van den Bergh in his successful attempt to understand the Poisson geometry of (multiplicative) quiver varieties directly at the level of the path algebra of quivers. I will begin with a review of the basics of this theory and its relation to usual geometric structures. As a first application, I will explain how the double Poisson bracket on the path algebra of an extended Jordan (or one-loop) quiver has been used to easily derive integrable systems of Calogero-Moser type. As a second application, I will explain the corresponding relation between double quasi-Poisson brackets and Ruijsenaars-Schneider systems based on recent works with O. Chalykh (Leeds).

Iain Findlay (Heriot-Watt University): *An Equal-Space Construction of Integrable Models*

This talk aims to explain how we can describe (1+1)-dimensional models in terms of their "space evolution", using spatially conserved "Hamiltonians" and a suitable compatible Poisson structure. This is developed in the Lax/zero-curvature description, where the core objects we make use of are the Lax pair and the classical r-matrix. The model we use as an example of the results is the anisotropic Landau-Lifshitz model (the continuous classical analogue of the Heisenberg quantum XYZ spin chain). This equal-space construction will be used to discuss non-trivial time-like boundary conditions, as well as used to derive novel integrable models.

Sebastian Grijalva (Université Paris-Sud): *Open XXZ chain and boundary modes at zero temperature*

Ivan Kukuljan (University of Ljubljana): *TCSA: from new topological effects in QFT to experiments in ultra-cold atoms*

Truncated conformal space approach (TCSA) is a not so widely known but powerful numerical method for strongly interacting quantum field theories. It is a nonperturbative technique based on RG and CFT, it is a genuinely field theoretical method in the sense that it requires no discretization of space and it is conceptually not limited neither to 1+1 D nor integrability. Recently we have applied the TCSA to study a variety of topics, ranging from elementary theoretical questions to producing theory for experiments with ultra-cold atoms.

In my talk I will first explain how the TCSA conceptually works. I will proceed with an interesting topological phenomenon in QFT which we found using the TCSA and were also able to establish analytically. Finally, I will discuss our work related to ultra-cold experiments and the broad variety of things that such an approach enables to do.

Marko Ljubotina (University of Ljubljana): *Nonequilibrium spin dynamics in an integrable Trotterization of the Heisenberg spin chain*

I will discuss the nonequilibrium spin dynamics of an integrable Trotterisation of the Heisenberg spin chain [1]. From a numerical point of view, these Trotterisations are easier to simulate up to long times than their continuous-time counterparts. In our Trotterised Heisenberg chain one may still observe all three types of transport (diffusive, superdiffusive and ballistic). I will then focus on the ballistic case, for which we will bound the Drude weight from below, much like this was done in the continuous-time model in the past. If time permits, I will also discuss the isotropic point, where one can observe Kardar-Parisi-Zhang physics in a quantum system [2].

References:
[1] M. Ljubotina, L. Zadnik and T. Prosen, Phys. Rev. Lett. 122, 150605 (2019).
[2] M. Ljubotina, M. Žnidarič and T. Prosen, arXiv:1903.01329 (2019).

Tomaz Prosen (University of Ljubljana): *Exact Correlation Functions for Dual Unitary Lattice Models in 1+1 Dimensions*

We consider a class of quantum lattice models in 1+1 dimensions, specifically local quantum circuits, which enjoy a particular "dual unitarity" property. In essence, this symmetry ensures that both the evolution "in time" and that "in space" are given in terms of unitary transfer matrices. We show that for this class of circuits one can compute explicitly all dynamical correlations of local observables. Our result is exact, non-pertubative, and holds for any dimension d of the local Hilbert space. In the minimal case of qubits ($d = 2$) we also present a complete classification of all dual unitary circuits which allows us to single out a number of universality classes for the behaviour of the dynamical correlations. We stress that these systems are generically non-integrable and include ergodic and non-ergodic behavior.

Matteo Stoppato (University of Leeds): *A connection between the classical r-matrix formalism and covariant Hamiltonian field theory*

We bring together aspects of covariant Hamiltonian field theory and of classical integrable field theories in 1+1 dimensions. Specifically, our main result is to obtain the classical r-matrix structure within a covariant Poisson bracket for the Lax connection, or Lax one form. This exhibits a certain covariant nature of the classical r-matrix with respect to the underlying spacetime variables. The main result is established by means of several prototypical examples of integrable field theories, all equipped with a Zakharov-Shabat type Lax pair. Full details are presented for: a) the sine-Gordon model which provides a relativistic example associated to a classical r-matrix of trigonometric type; b) the Nonlinear Schrodinger equation and the (complex) modified Korteweg-de Vries equation which provide two non-relativistic examples associated to the same classical r-matrix of rational type, characteristic of the AKNS hierarchy. The appearance of the r-matrix in the covariant Poisson bracket is a signature of the integrability of the field theory rather than a manifestation of (non)relativistic invariance.