Classical and Quantum Integrability

Report of Contributions

https://indico.math.cnrs.fr/e/cqi2019

Contribution ID: **21** Type: **not specified**

Bloch spectrum for water waves

Monday, September 2, 2019 9:00 AM (45 minutes)

We examine the motion of the free surface of a body of fluid with a periodically varying bottom. We consider the water wave system linearized near a stationary state and develop a Bloch theory. The analysis takes the form of a spectral problem for the Dirichlet– Neumann operator in a fluid domain with a periodic bottom and a flat surface elevation. We find that, generically, the presence of the bottom results in the splitting of double eigenvalues creating a spectral gap. The analysis is uniform in the spectral parameter and provides the gap asymptotics.

Primary author: SULEM, Catherine (University of Toronto)

Presenter: SULEM, Catherine (University of Toronto)

Session Classification: Morning Session

Contribution ID: **22** Type: **not specified**

On Birkhoff coordinates for the Benjamin-Ono equation on the torus and applications to solutions with negative Sobolev regularity. Part 1

Monday, September 2, 2019 9:45 AM (45 minutes)

This talk is a survey of a recent joint work with Thomas Kappeler about the construction of Birkhoff coordinates for real valued, spatially periodic and square integrable solutions of the Benjamin-Ono equation.

Primary author: GÉRARD, Patrick (Université Paris-Sud)

Presenter: GÉRARD, Patrick (Université Paris-Sud)

Session Classification: Morning Session

Contribution ID: **23** Type: **not specified**

On Birkhoff coordinates of the Benjamin-Ono equation on the torus and applications to solutions with negative Sobolev regularity. Part 2

Monday, September 2, 2019 11:00 AM (45 minutes)

In this talk I report on joint work with Patrick Gérard and Peter Topalov concerning properties of the flow map of the Benjamin-Ono equation on the torus. The main result says that the flow map, introduced in our previous work on the space $L^2_{r,0}$ of real valued, $2\pi-$periodic L^2-functions with mean 0,
can be extended to the Sobolev spaces $H^{-s}_{r,0}$ for $0 < s < 1/2$. The key ingredient is a corresponding extension of the Birkhoff coordinates to these Sobolev spaces.

Primary author: KAPPELER, Thomas (University of Zurich)

Presenter: KAPPELER, Thomas (University of Zurich)

Session Classification: Morning Session

Contribution ID: **24** Type: **not specified**

Hydrodynamics for integrable systems

Monday, September 2, 2019 11:45 AM (45 minutes)

Hydrodynamics is a powerful framework for large-wavelength phenomena in many-body systems. It was extended recently to include integrable models, giving "generalised hydrodynamics". In this talk, I will review fundamental aspects of the hydrodynamic of integrable systems, with the simple examples of the quantum Lieb-Liniger and the classical Toda models. I will then show some of the exact results that can be obtained with this formalism, such as exact nonequilibrium steady states and exact asymptotic of correlation functions at large space-time separations in Gibbs and generalised Gibbs states

Primary author: DOYON, Benjamin (King's college London)

Presenter: DOYON, Benjamin (King's college London)

Session Classification: Morning Session

Contribution ID: **25** Type: **not specified**

Monodromy dependence of Painlevé tau functions

Monday, September 2, 2019 2:30 PM (30 minutes)

In many interesting cases, distribution functions of random matrix theory and correlation functions of integrable models of statistical mechanics and quantum C-field theory are given by tau functions of Painlevé equations. I will discuss an extension of the Jimbo-Miwa-Ueno differential to the space of monodromy data and explain how this construction can be used to compute constant terms in the tau function asymptotics.

Primary author: LISOVYI, Oleg (Université de Tours)

Presenter: LISOVYI, Oleg (Université de Tours)

Session Classification: Afternoon Session

Contribution ID: **26** Type: **not specified**

Short review of results on Isomonodromy Deformations and Applications

Monday, September 2, 2019 3:00 PM (30 minutes)

Some results on non-generic isomonodormy deformations, already presented in other conferences and seminars is some detail, will be here reviewed in 25 minutes, stressing their relevance for computations involving Painleve' equations and Dubrovin-Frobenius Manifolds. From joint works with G. Cotti and B. Dubrovin

Primary author: GUZZETTI, Davide (SISSA)

Presenter: GUZZETTI, Davide (SISSA)

Session Classification: Afternoon Session

Contribution ID: **27** Type: **not specified**

The non-commutative KdV equation and enumerative geometry

Monday, September 2, 2019 3:30 PM (30 minutes)

In the past years, in a joint project with A. Buryak, we have developed a general framework to construct classical and quantum field systems (in one space and one time dimensions) from intersection theory of the moduli space of stable curves. Recently a particularly interesting example came under our attention, which actually produces a integrable system of Hamiltonian PDEs in two space and one time dimensions. Computations of quadratic double ramification integrals, an entirely natural problem in algebraic geometry, turn out to produce a interesting generalization of the KdV hierarchy to 2 non-commutative space dimensions (KdV on a noncommutative Moyal torus).

Primary author: ROSSI, Paolo (Università degli Studi di Padova)

Presenter: ROSSI, Paolo (Università degli Studi di Padova)

Session Classification: Afternoon Session

Contribution ID: **28** Type: **not specified**

Extended Lagrangian approach for the defocusing Non-Linear Schrödinger equation

Monday, September 2, 2019 4:30 PM (30 minutes)

We study the defocusing Non-Linear Schrödinger (NLS) equation written in hydrodynamic form through the Madelung transform. From the mathematical point of view, the hydrodynamic form can be seen as the Euler-Lagrange equations for a Lagrangian submitted to a differential constraint corresponding to the mass conservation law. The dispersive nature of the NLS equation poses some major numerical challenges. The idea is to introduce a two-parameter family of extended Lagrangians, depending on a greater number of variables, whose Euler-Lagrange equations are hyperbolic and accurately approximate NLS equation in a certain limit. The corresponding hyperbolic equations are studied and solved numerically using Godunov type methods. Comparison of exact and asymptotic solutions to the one-dimensional cubic NLS equation ('grey' solitons and dispersive shocks) and the corresponding numerical solutions to the extended system was performed. A very good accuracy of such a hyperbolic approximation was observed. This is a joint talk with Firas Dhaouadi and Nicolas Favrie.

Primary author: GAVRILYUK, Sergey (Aix-Marseille Université)

Presenter: GAVRILYUK, Sergey (Aix-Marseille Université)

Session Classification: Afternoon Session

Contribution ID: **29** Type: **not specified**

Integrable and near-integrable long-wave models in stratified shear flows

Monday, September 2, 2019 5:00 PM (30 minutes)

In this talk I will overview recent developments concerning a version of the Kadomtsev-Petviashvili (KP) equation for surface gravity waves related to elliptic-cylindrical geometry, a system of coupled Ostrovsky equations derived for strongly interacting internal waves in the presence of background rotation and a shear flow, and 2+1-dimensional cylindrical Korteweg-de Vries (cKdV)-type model describing ring waves in a stratified fluid in the presence of a depth-dependent parallel shear flow.

Primary author: KHUSNUTDINOVA, Karima (Loughborough University)

Presenter: KHUSNUTDINOVA, Karima (Loughborough University)

Session Classification: Afternoon Session

Contribution ID: **30** Type: **not specified**

Integrability of new class of hyperbolic two-dimensional linear equations of second order

Monday, September 2, 2019 5:30 PM (30 minutes)

We consider a linear two-dimensional hyperbolic equation of second order, whose coefficients are polynomials with respect to one of independent variables.

We show that this equation possesses infinitely many particular solutions, determined by solutions of ordinary differential equations.

Primary author: PAVLOV, Maxim (Lebedev Physical Institute of Russian Academy of Sciences)

Presenter: PAVLOV, Maxim (Lebedev Physical Institute of Russian Academy of Sciences)

Session Classification: Afternoon Session

Contribution ID: **31** Type: **not specified**

Conformal Fishnet Theory

Tuesday, September 3, 2019 9:00 AM (45 minutes)

I will review the propreties and recent results for conformal fishnet theory (FCFT) which was proposed by O.Gurdogan and myself as a special double scaling limit of gamma-twisted N=4 SYM theory. FCFT, in its simplest, bi-scalar version, is a UV finite strongly coupled 4-dimensionl logarithmic CFT dominated by planar fishnet Feynman graphs (of the shape of regular square lattice). FCFT inherits the planar integrability of N=4 SYM which becomes manifest in this case: the fishnet graphs can be mapped on the SO(2,4) integrable spin chain (A.Zamolodchikov 1980). The D-dimensional generalization of FCFT, with SO(2,D) conformal symmetry can be also provided. A remarkable property of FCFT is the possibility of spontaneous symmetry breaking, which is not lifted by quantum corrections. I will also discuss the exact computation of certain anomalous dimensions and 4-point correlators, and of related fishnet Feynman graphs (of "wheel" or "spiral" type), using the quantum integrability tools: asymptotic and thermodynamic Bethe ansatz and quantum spectral curve.

Primary author: KAZAKOV, Vladimir (Ecole Normale Superieure, Univ. Sorbonne)

Presenter: KAZAKOV, Vladimir (Ecole Normale Superieure, Univ. Sorbonne)

Session Classification: Morning Session

Contribution ID: **32** Type: **not specified**

Field-theoretical formulation of the Thermodynamic Bethe Ansatz

Tuesday, September 3, 2019 9:45 AM (45 minutes)

We construct a quantum system which generates the finite size effects in massive integrable models of QFT. The quantum system is built on a pair of operators creating particles wrapping the space and the time directions. The two wrapping operators are given a representation as vertex operators for a pair of free bosonic fields. The partition function at finite volume is represented as the expectation value of an operator creating the ensemble of virtual particles wrapping the space direction. This operator simplifies after approximating the sum over mode numbers by an integral over the rapidities. The non-trivial measure in the rapidity space requires adding a pair of fermionic partners of the two bosonic fields. The expectation value is formulated as a path integral which localises to the critical point described by the TBA equations. We restrict ourselves to a field theory with a single particle with factorised scattering and no bound states, such as the sinh-Gordon model. Both periodic and open boundary conditions are considered. In case of periodic boundary conditions the loop effects due to bosons and fermions compensate completely while for open boundary conditions the one-loop contribution gives the universal part of the boundary free energy.

Primary author: KOSTOV, Ivan (IPhT Saclay)

Presenter: KOSTOV, Ivan (IPhT Saclay)

Session Classification: Morning Session

Contribution ID: **33** Type: **not specified**

The quantum beating and its numerical simulation

Tuesday, September 3, 2019 11:00 AM (45 minutes)

Quantum beating may nowadays refer to many, often quite different phenomena studied in various domains of quantum physics. A paradigmatic example is the inversion in the ammonia molecule, observed experimentally in 1935.
A theoretical explanation of the quantum beating was obtained by modelling the nitrogen atom as a quantum particle in a double well potential. The quantum environment of this particle can be modelled as a non-linear perturbation term added to the double well potential.

In this talk, I shall examine numerically the suppression of the quantum beating in a one dimensional non-linear double well potential, made up of two focusing nonlinear point interactions. The study of the Schroedinger dynamics is reduced to the study of a system of coupled nonlinear Volterra integral equations. I will show that already for a nonlinearity exponent well below the critical value, there is complete suppression of the typical beating behaviour characterizing the linear quantum case.

Primary author: NEGULESCU, Claudia (Univ. Paul Sabatier)

Presenter: NEGULESCU, Claudia (Univ. Paul Sabatier)

Session Classification: Morning Session

Contribution ID: **34** Type: **not specified**

A hybrid WKB-based method for Schrödinger scattering problems in the semi-classical limit

Tuesday, September 3, 2019 11:45 AM (45 minutes)

We consider 1D scattering problems related to quantum transport in diodes. We discuss the efficient numerical integration of ODEs like $\epsilon^2 * u" + a(x) * u = 0$ for $0 < \epsilon << 1$ on coarse grids, but still yielding accurate solutions; including oscillatory (for given $a(x) > 0$) and evanescent regimes (for $a(x) < 0$), partly including turning points. In the oscillatory case we use a marching method that is based on an analytic WKB-preprocessing of the equation. And in the evanescent case we use a FEM with WKB-ansatz functions.

(co-authors: Claudia Negulescu; Kirian Döpfner; Christian Klein, Bernhard Ujvari)

Primary author: ARNOLD, Anton (Vienna University of Technology)

Presenter: ARNOLD, Anton (Vienna University of Technology)

Session Classification: Morning Session

Contribution ID: **35** Type: **not specified**

The stability of periodic solutions of the focusing NLS equation

Tuesday, September 3, 2019 2:30 PM (30 minutes)

A surprisingly large number of physically relevant dispersive partial differential equations are integrable. Using the connection between the spectrum and the eigenfunctions of the associated Lax pair and the linear stability problem, we investigate the stability of the spatially periodic traveling wave solutions of such equations, extending the results to orbital stability in those case where solutions are linearly stable. The talk will emphasize recent results for the focusing NLS equation, as this situation is more complicated than that of other equations previously studied, for which the Lax pair is self adjoint.

Primary author: DECONINCK, Bernard (University of Washington)

Presenter: DECONINCK, Bernard (University of Washington)

Session Classification: Afternoon Session

Contribution ID: **36** Type: **not specified**

Edge vectors on planar networks and tropical limit of real finite gap solutions of KP hierarchy

Tuesday, September 3, 2019 3:00 PM (30 minutes)

In this talk, I shall report on some recent results obtained in collaboration with P.G. Grinevich (LITP,RAS). We construct edge vectors on planar networks obtained by gluing the positive part of copies of Gr(1,3) and Gr(2,3) and apply such construction to associate real regular KP divisors on rational degenerations of M-curves.

Primary author: ABENDA, Simonetta (University of Bologna)

Presenter: ABENDA, Simonetta (University of Bologna)

Session Classification: Afternoon Session

Contribution ID: **37** Type: **not specified**

On the derivative nonlinear Schrödinger equation related to symmetric spaces

Tuesday, September 3, 2019 3:30 PM (30 minutes)

We will present multi-component generalizations of derivative nonlinear Schrödinger (DNLS) type of equations having quadratic bundle Lax pairs related to $\mathbb{Z}_2$-graded Lie algebras and A.III symmetric spaces. The Jost solutions and the minimal set of scattering data for the case of local and nonlocal reductions are constructed.

Furthermore, the fundamental analytic solutions (FAS) are constructed and the spectral properties of the associated Lax operators are briefly discussed. The Riemann-Hilbert problem (RHP) for the multi-component generalizations of DNLS equation of Kaup-Newell (KN) and Gerdjikov-Ivanov (GI) types is derived. A modification of the dressing method is presented allowing the explicit derivation of the soliton solutions for the multi-component GI equation with both local and nonlocal reductions.

The infinite set of integrals of motion for these models is briefly described at the end.

Based on a joint work with Vladimir Gerdjikov and Rossen Ivanov.

[1] Gerdjikov V.S, Grahovski G.G. and Ivanov R.I., On integrable wave interactions and Lax pairs on symmetric spaces, Wave Motion 71 (2017), 53–70, E-print: arXiv:1607.06940.

Primary author: GRAHOVSKI, Georgi (University of Essex)

Presenter: GRAHOVSKI, Georgi (University of Essex)

Session Classification: Afternoon Session

Contribution ID: **38** Type: **not specified**

Non-ultralocality, affine Gaudin models and Chern-Simons theory

Wednesday, September 4, 2019 11:00 AM (30 minutes)

Non-ultralocality is a long-standing open problem in classical integrable field theory which has precluded the first-principle quantisation of many important models. I will review a recent proposal for dealing with this issue, which relates it to the study of Gaudin models associated with affine Kac-Moody algebras. I will then go on to discuss its relation to another very recent proposal of Costello and Yamazaki who's starting point is a four-dimensional variant of Chern-Simons theory.

Primary author: VICEDO, Benoit (University of York)

Presenter: VICEDO, Benoit (University of York)

Session Classification: Morning Session

Contribution ID: **39** Type: **not specified**

Integrable coupled sigma-models from affine Gaudin models

Wednesday, September 4, 2019 11:30 AM (30 minutes)

In this talk, we will discuss realisations of affine Gaudin models and their application to integrable sigma-models. After reviewing the properties of affine Gaudin models and their relation with integrable sigma-models (see also B. Vicedo's talk), we will explain a systematic procedure allowing to assemble two affine Gaudin models into a unique one. As an application of this formalism, we will present an integrable coupled sigma-model obtained by assembling together N copies of the Principal Chiral Model with Wess-Zumino term.

Primary author: LACROIX, Sylvain (Universtät Hamburg)

Presenter: LACROIX, Sylvain (Universtät Hamburg)

Session Classification: Morning Session

Contribution ID: **40** Type: **not specified**

Rational spin chains at higher rank: new tools to solve, completeness, and separation of variables

Thursday, September 5, 2019 4:30 PM (30 minutes)

We present recent advances in solution of rational spin chains that build on results from representation theory of Yangian and analytic Bethe Ansatz. First we show how to find spectrum of supersymmetric GL(N|M) chains using Q-system on Young diagrams. This approach can be more efficient than conventional nested Bethe equations, and also it provides one with means for explicitly counting solutions and hence for proving completeness. Second, we discuss the separation of variables program for GL(N) chains with generic twist and inhomogeneities and, notably, in arbitrary finite-dimensional representation. For them, we present an SoV basis in which eigenstates are products of Slater determinants of Baxter Q-functions and discuss its connection to Gelfand-Tsetlin patterns and to generalisations of Sklyanin B-operator.

Primary author: VOLIN, Dmytro (Uppsala University and Nordita)

Presenter: VOLIN, Dmytro (Uppsala University and Nordita)

Session Classification: Afternoon Session

Contribution ID: **41** Type: **not specified**

On a gas of soliton for the modified KdV equation

Wednesday, September 4, 2019 9:30 AM (30 minutes)

We study a gas of solitons in the limit when the number of solitons goes to infinity.
We characterize the asymptotic behaviour and the long time behaviour of the soliton gas.

Primary author: GRAVA, Tamara (SISSA)

Presenter: GRAVA, Tamara (SISSA)

Session Classification: Morning Session

Contribution ID: **42** Type: **not specified**

A Riemann-Hilbert approach to the lower tail of the KPZ equation

Wednesday, September 4, 2019 10:00 AM (30 minutes)

Fredholm determinants associated to deformations of the Airy kernel are known to be closely connected to the solution to the Khardar-Parisi-Zhang (KPZ) equation with narrow wedge initial data, and they also appear as largest particle distribution in models of positive-temperature free fermions. It is of particular importance in these models to understand the lower tail of the Fredholm determinants.
We show that logarithmic derivatives of the Fredholm determinants can be expressed in terms of a 2×2 Riemann-Hilbert problem, and we use this to derive asymptotics for the Fredholm determinants. As an application of our result, we derive precise lower tail asymptotics for the solution of the KPZ equation with narrow wedge initial date, thus refining recent results by Corwin and Ghosal.

Primary author: CAFASSO, Mattia (Université d'Angers)

Presenter: CAFASSO, Mattia (Université d'Angers)

Session Classification: Morning Session

Contribution ID: **44** Type: **not specified**

Stratified 2D Euler Flows: Hamiltonian aspects, conserved quantities and classes of solutions.

Wednesday, September 4, 2019 9:00 AM (30 minutes)

Primary author: FALQUI, Gregorio (University of Milano-Bicocca)

Presenter: FALQUI, Gregorio (University of Milano-Bicocca)

Session Classification: Morning Session

Contribution ID: **46** Type: **not specified**

Numerical study of the Davey-Stweartson equation

Tuesday, September 3, 2019 4:30 PM (30 minutes)

In this work we will look at the focusing Davey-Stewartson equation from two different angles, using advanced numerical tools.
As a nonlinear dispersive PDE and a generalisation of the non-linear Schrödinger equation, DS possesses solutions that develop a singularity in finite time. We numerically study the long time behaviour and potential blow-up of solutions to the focusing Davey-Stewartson II equation for various initial data and propose a conjecture describing the blow up rate and solution profiles near the singularity.
Secondly, DS is an integrable system and can be studied as an inverse scat- tering problem. Both the forward and inverse scattering transformation in this case are reduced to a d-bar system which plays the role that Riemann-Hilbert problems play in one dimensional problems. We will present numerical solutions for Schwartzian and compactly supported potentials. In all studied cases we use spectral methods and achieve machine precision.

Based on joint works with Christian Klein and Ken McLaughlin

Primary author: STOILOV, Nikola (Université de Bourgogne)

Presenter: STOILOV, Nikola (Université de Bourgogne)

Session Classification: Afternoon Session

Contribution ID: **47** Type: **not specified**

Inverse Scattering for the Intermediate Long Wave Equation

Thursday, September 5, 2019 9:00 AM (45 minutes)

This talk reports on joint work with Joel Klipfel (University of Kentucky) and Yilun Wu (University of Oklahoma). The intermediate long wave equation (ILW) is a model of weakly nonlinear wave propagation in a fluid of finite depth. It interpolates between the Benjamin-Ono equation (infinite depth) and the Korteweg-de Vries equation (shallow water). Ablowitz and Kodama showed that ILW is completely integrable and, subsequently, an inverse scattering approach to solving ILW was developed by Ablowitz-Kodama-Satsuma and Santini-Ablowitz-Fokas. Our work is, to our knowledge, the first rigorous analysis of direct and inverse scattering maps for ILW. Both the direct and inverse problems are Riemann-Hilbert problems (respectively local and non-local); their proper formulation involves several interesting technical challenges.

Primary author: PERRY , Peter (University of Kentucky)

Presenter: PERRY , Peter (University of Kentucky)

Session Classification: Morning Session

Contribution ID: **48** Type: **not specified**

On a $\partial, \overline{\partial}$ system with a large parameter.

Thursday, September 5, 2019 9:45 AM (45 minutes)

This is part of a joint work with
Christian Klein and Nikola Stoilov. We consider a 2×2 system of $\partial, \overline{\partial}$ type in the large parameter limit, appearing in the study of the Davey-Stuartson II equation.

When a certain potential is smooth, we show that the solution is given by a convergent perturbation series.

When it is the characteristic function of a strictly convex domain, we analyze the leading term in the series. Numerical simulations show a fairly good coincidence with the full solution despite the lack of smoothness of the potential in this case.

Primary author: SJÖSTRAND, Johannes (Université de Bourgogne)

Presenter: SJÖSTRAND, Johannes (Université de Bourgogne)

Session Classification: Morning Session

Contribution ID: **49** Type: **not specified**

Electrical Impedance Tomography and the Novikov-Veselov equation

Thursday, September 5, 2019 11:00 AM (45 minutes)

The D-bar method, introduced by Beals and Coifman in the 1980's, provides a solution method for Calderón's inverse conductivity problem in dimension two, as was shown by Nachman in 1996. This presentation shows how Nachman's proof can be developed further to yield the D-bar method, a practical imaging algorithm for Electrical Impedance Tomography (EIT). Furthermore, demonstrated is how machine learning can be combined with the D-bar method for the diagnosis of stroke. Finally, the nonlinear Novikov-Veselov equation can be solved using the inverse scattering method and the same nonlinear Fourier transform than the one used in EIT.

Primary author: SILTANEN, Samuli (University of Helsinki)

Presenter: SILTANEN, Samuli (University of Helsinki)

Session Classification: Morning Session

Contribution ID: **52** Type: **not specified**

The direct problem of perturbed KPII multi-line solitons

Wednesday, September 4, 2019 12:00 PM (30 minutes)

Boiti-Pempinelli-Pogrebkov's inverse scattering theories on the KPII equation provide an integrable approach to solve the Cauchy problem of the perturbed KPII multi-line soliton solutions and the stability problem of KPII multi-line solitons.

In this talk, we will present rigorous analysis for the direct scattering theory of perturbed KPII multi line solitons, illustrated by perturbations of low dimensional Grassmannian cases.

Primary author: WU, Derchyi (Academica Sinica, Taipei)

Presenter: WU, Derchyi (Academica Sinica, Taipei)

Session Classification: Morning Session

Contribution ID: **54** Type: **not specified**

Tropical limit of matrix solitons

Tuesday, September 3, 2019 5:00 PM (30 minutes)

The "tropical limit" of a matrix (KdV, Boussinesq, or the like) soliton solution in two-dimensional space-time consists of a piecewise linear graph in space-time, together with values of the dependent variable along its segments. In two space-time dimensions, it associates with such waves a point particle picture, in which free "particles" with internal degrees of freedom interact at definite points in space-time. Whereas for KdV the values of the dependent variable attached to incoming and outgoing solitons at a vertex are related by a (highly nonlinear) Yang-Baxter map, such a map appears to be insufficient in the Boussinesq case to describe all possible soliton interactions in the tropical limit. The interaction in case of solitons in more than two dimensions is definitely richer. We will report about some insights for soliton solutions of the KP equation.
This talk is based on joint work with A. Dimakis [1,2,3] and X.-M. Chen [3].
[1] A. Dimakis and F. Müller-Hoissen: Matrix KP: tropical limit and Yang-Baxter maps, Lett. Math. Phys. 109 (2019) 799-827.
[2] A. Dimakis and F. Müller-Hoissen: Matrix KP: tropical limit, Yang-Baxter and pentagon maps, Theor. Math. Phys. 196 (2018) 1164-1173.
[3] A. Dimakis, F. Müller-Hoissen and X.-M. Chen: Matrix Boussinesq solitons and their tropical limit, Physica Scripta 94 (2019) 035206.

Primary author: MÜLLER-HOISSEN, Folkert (University of Goettingen)

Presenter: MÜLLER-HOISSEN, Folkert (University of Goettingen)

Session Classification: Afternoon Session

Contribution ID: **57** Type: **not specified**

On some (non-integrable) KP type equations

Friday, September 6, 2019 11:45 AM (45 minutes)

We present recent results and open issues on KP-type equations arising in the modeling of internal waves

Primary author: SAUT, Jean-Claude (Universite Paris-Sud)

Presenter: SAUT, Jean-Claude (Universite Paris-Sud)

Session Classification: Morning Session

Contribution ID: **58** Type: **not specified**

Asymptotic stability in 3d Zakharov-Kuznetsov equation

Friday, September 6, 2019 11:00 AM (45 minutes)

We consider Zakharov-Kuznetsov (ZK) equation, a higher-dimensional generalization of the well-known KdV equation. We discuss the behavior of solutions close to the solitary wave given by Q(x-t,y,z) with Q being the standard ground state.
We discuss the stability of solitary waves in the 3d quadratic (subcritical) ZK equation, proving that solutions in the energy space that are orbitally stable (which is due to de Bouard) are also asymptotically stable, that is, as time goes to infinity, they converge to a rescaling and shift of Q(x-t,y,z) in some rightward moving window. While the local and global well-posedness is currently available only in higher regularity spaces (than finite energy) and due to Ribaud-Vento and Molinet-Pilod, we nevertheless obtain asymptotic stability in the energy space. This is a joint work with Luiz Gustavo Farah, Justin Holmer, and Kai Yang.

Primary author: ROUDENKO, Svetlana (Florida International University)

Presenter: ROUDENKO, Svetlana (Florida International University)

Session Classification: Morning Session

Contribution ID: **59** Type: **not specified**

Sine-Gordon field theory vs. relativistic Calogero-Moser N-particle sytems

Thursday, September 5, 2019 11:45 AM (45 minutes)

We survey the relation between the relativistic sine-Gordon model and (a special case of) the hyperbolic relativistic integrable N-particle systems of Calogero-Moser type. More specifically, we review the intimate link between the classical version of the latter and the particle-like sine-Gordon solutions, and present compelling evidence that this soliton-particle correspondence turns into a physical equivalence on the quantum level, in the sense that the same scattering amplitudes and bound state energies arise in the quantum field-theoretic and N-particle models.

Primary author: RUIJSENAARS, Simon (University of Leeds)

Presenter: RUIJSENAARS, Simon (University of Leeds)

Session Classification: Morning Session

Contribution ID: **60** Type: **not specified**

Universality in Random Tiling Models

Friday, September 6, 2019 9:00 AM (45 minutes)

Tilings of polygonal regions with non-convexities (cuts) lead to a new kernel and a new statistics for the asymptotic fluctuations of the tiles, when the size of the region and the cuts gets large under an appropriate scaling. The limiting statistics has been observed in very different circumstances.

Primary author: VAN MOERBEKE, Pierre (University of Louvain and Brandeis University)

Presenter: VAN MOERBEKE, Pierre (University of Louvain and Brandeis University)

Session Classification: Morning Session

Contribution ID: **61** Type: **not specified**

Multiple rogue waves and integrable models: perspectives and retrospectives

Friday, September 6, 2019 9:45 AM (45 minutes)

This talk is dedicated to the description of the modulation instabilities, leading to the appearance of phenomena of multiple rogue waves generation in a frame of integrable hierarchies. It is mainly concentrated on the AKNS hierarchy and some related systems.
An essential part of the results is exposed in our recent article: V.B. Matveev, A.O. Smirnov "AKNS and NLS hierarchies, MRW solutions, P_n breathers, and beyond", J.Math. Phys. 59, 091419(2018); doi: 10.1063/1.5049949

Primary author: MATVEEV, Vladimir (Université de Bourgogne)

Co-author: SMIRNOV, Alexander (St.-Petersburg State University)

Presenter: MATVEEV, Vladimir (Université de Bourgogne)

Session Classification: Morning Session

Contribution ID: **62** Type: **not specified**

Novikov algebras and Darboux coordinate: the construction of flat coordinates

Thursday, September 5, 2019 2:30 PM (45 minutes)

The classical Muira maps transforms the second Hamiltonian structure of the KdV hierarchy into constant, or Darboux, form. In this talk multi-component versions of this map are constructed, for Hamiltonian structures defined by Novikov algebras.

Primary author: STRACHAN, Ian (University of Glasgow)

Presenter: STRACHAN, Ian (University of Glasgow)

Session Classification: Afternoon Session

Contribution ID: **63** Type: **not specified**

Integrable Lagrangians and Picard modular forms

Thursday, September 5, 2019 3:15 PM (45 minutes)

We consider first-order Lagrangians whose Euler-Lagrange equations belong to the class of 3D dispersionless integrable systems. Our main results can be summarised as follows:
(1) A link between integrable Lagrangians and Picard curves/Picard modular forms studied by E. Picard as far back as in 1883 is established.
(2) A parametrisation of integrable Lagrangian densities by generalised hypergeometric functions (solutions of the Picard-Fuchs system governing periods of Picard curves) is obtained.
(3) Conjectured theta representations and power series expansions of the integrable Lagrangian densities are proved.
(based on joint work with F. Cl\'ery A. Odesskii and D. Zagier)

Primary author: FERAPONTOV, Evgeny (Loughborough University)

Presenter: FERAPONTOV, Evgeny (Loughborough University)

Session Classification: Afternoon Session

Contribution ID: **64** Type: **not specified**

On dressing factors of 2-dimensional Toda field theories and multicomponent MKdV equations

Tuesday, September 3, 2019 5:30 PM (30 minutes)

Presenter: GERDJIKOV, Vladimir (Bulgarian Academy of Sciences)

Session Classification: Afternoon Session

Contribution ID: **65** Type: **not specified**

Strongly interacting soliton gas and the noise-induced modulation instability

Thursday, September 5, 2019 5:00 PM (30 minutes)

We investigate the statistically stationary state of spontaneous noise-driven modulation instability of a plane wave (condensate) background. As a model we use the integrable focusing one-dimensional nonlinear Schrodinger equation (NLSE). The fundamental statistical characteristics of the stationary state of the modulation instability obtained numerically by Agafontsev and Zakharov in 2015 [1] have not been explained so far. When the condensate is spatially wide the inverse scattering transform (IST) theory predicts that interacting solitons play the dominating role in the system evolution. Here we explain statistical characteristics of the modulation instability by using N-soliton solutions (N-SS, here N means the number of solitons) of the NLSE. We determine parameters of the N-SS corresponding to the statistically stationary state of the integrable turbulence produced by the instability development. These N-SS are strongly interacting bound states of solitons having specific distribution of the IST eigenvalues and random phases. The condensate is a coherent state of the N-SS and initial stage of the modulation instability development represents the loss of coherence of the soliton phases. We use a special approach to construct ensembles of the multi-soliton solutions with statistically large number of solitons N ~100 [2]. Our investigation demonstrates complete agreement in spectral and statistical properties of the long-term evolution of the condensate perturbed by noise and the constructed multisoliton bound states [3]. Our results can be generalised to the broad class of integrable turbulence problems in the cases when the wave filed dynamics is strongly nonlinear and driven by solitons.

[1] D. Agafontsev and V. E. Zakharov, Nonlinearity 28, 2791 (2015)

[2] A. A. Gelash and D. S. Agafontsev, Phys. Rev. E 98, 042210 (2018).

[3] A. Gelash, D. Agafontsev, V. Zakharov, G. El, S. Randoux and P. Suret, Bound state soliton gas dynamics underlying the noise-induced modulational instability, In preparation.

Presenter: GELASH, Andrey (Skolkovo Institute of Science and Technology)

Session Classification: Afternoon Session

Contribution ID: **66** Type: **not specified**

A complex-analysis friendly form of Schroedinger equation with a non-vanishing potential

Thursday, September 5, 2019 5:30 PM (30 minutes)

The aim of the talk is to introduce a transformation which reduces initial-value problem for one-dimensional Schroedinger equation with a non-vanishing potential to an elementary homogeneous first-order nonlinear ODE. The latter exhibits nonlinearity merely as complex conjugation and hence is very amenable to application of transform methods and further complex-analytic treatment. The obtained reformulation is beneficial for both analytical and practical purposes such as simplification of construction of efficient hybrid asymptotical-numerical schemes for oscillatory quasi-classical regime, a new form of Prufer equations and new classes of solvable potentials due to reduction to an integral equation of convolution type on a half-line.

Presenter: PONOMAREV, Dmitry (TU Wien)

Session Classification: Afternoon Session