IAT 2014

Integrable Systems and All That 2014

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18–19 September 2014

Program

Last updated: September 17, 2014

Thursday 18

15.00 – 15.45	Bogdanov	*Doubrov-Ferapontov general heavenly equation and the hyper-Käler hierarchy*
15.45 – 16.30	De Sole	*W-algebras and Hamiltonian equations*
16.30 – 17.00	*Coffee Break*	
17.00 – 17.45	Lorenzoni	*Darboux-Egorov system, bi-flat F-manifolds and Painlevé VI*
17.45 – 18.30	Konopelchenko	*Whitham type equations revisited: critical points and Lauricella functions*

Friday 19

09.00 – 09.45	Zullo	*Baxter's operator and quantum Backlund transformations for the Ablowitz-Ladik chain*
09.45 – 10.30	Vitale	*Inverse Scattering Transform for the focusing NLS equation with fully asymmetric boundary conditions*
10.30 – 11.15	Savoldi	*Hamiltonian operators of Dubrovin-Novikov type in 2D*
11.15 – 11.45	*Coffee Break*	
11.45 – 12.15	Vitolo	*On the projective geometry of Hamiltonian operators of differential-geometric type*
12.15 – 13.00	Pavlov	*On the bi-Hamiltonian geometry of WDVV equations*

Abstracts [1]

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Doubrov-Ferapontov general heavenly equation and the hyper-Käler hierarchy

L.V. Bogdanov
Landau Institute for Theoretical Physics of the Russian Academy of Sciences, Moscow, Russia

Talk Summary: We introduce differential-geometric description of the Doubrov-Ferapontov general heavenly equation and discuss its connections with the hyper-Kähler hierarchy.

W-algebras and Hamiltonian equations

A. De Sole
Università di Roma – La Sapienza

Talk Summary:

We will give a brief overview on the structure of finite and affine W-algebras. We will then discuss how classical affine W-algebras are applied in the theory of generalized Drinfeld-Sokolov integrable biHamiltonian hierarchies.

Whitham type equations revisited: critical points and Lauricella functions

B.G. Konopelchenko
Dipartimento di Matematica e Fisica "E. De Giorgi", Università del Salento

Talk Summary: Whitham type equations revisited: critical points and Lauricella functions.

Darboux-Egorov system, bi-flat F-manifolds and Painlevé VI.

P. Lorenzoni
Dipartimento di Matematica, Università di Milano Bicocca

Talk Summary: Motivated by the theory of integrable PDEs of hydrodynamic type, we consider a special class of F-manifolds, called bi-flat F-manifolds.

Similarly to the way in which semisimple Frobenius manifolds are constructed starting from Darboux-Egorov systems, also bi-flat F-manifolds can be built from solutions of suitably modified Darboux-Egorov system. Using this construction we show that three dimensional semisimple bi-flat F-manifolds are parametrized by solutions of the full family of Painlevé VI.

We discuss also integrable hierarchies related to this class of manifolds, in particular focusing on recursive schemes available on any bi-flat F-manifold.

[1] TBA = to be announced

On the bi-Hamiltonian geometry of WDVV equations

M. Pavlov
Lebedev Institute of Physics, RAS, Moscow, Russia

Talk Summary: We consider the WDVV equations (associativity equations) in the four dimensional case. These nonlinear equations of the third order can be written as a pair of six component commuting two-dimensional non-diagonalizable hydrodynamic type systems. We prove that these systems possess a compatible pair of local homogeneous Hamiltonian structures of Dubrovin–Novikov type (of first and third order, respectively).

Hamiltonian operators of Dubrovin-Novikov type in 2D

A. Savoldi
Loughborough University, UK

Talk Summary: First order Hamiltonian operators of differential-geometric type were introduced by Dubrovin and Novikov in 1983, and thoroughly investigated by Mokhov. In 2D, they are generated by a pair of compatible flat metrics which satisfy a set of additional constraints coming from the skew-symmetry condition and the Jacobi identity. We demonstrate that these constraints are equivalent to the requirement that the second metric is a linear Killing tensor of the first metric with zero Nijenhuis torsion. This allowed us to obtain a complete classification of 3- and 4-component operators. For 2D operators the Darboux theorem does not hold: the operator may not be reducible to constant coefficient form. All interesting (non-constant) examples correspond to the case when the flat pencil of the two metrics is not semisimple. In the case of a direct sum of Jordan blocks with distinct eigenvalues we obtain a complete classification of Hamiltonian operators for any number of components n, revealing a remarkable correspondence with the class of trivial Frobenius manifolds. (joint work with E.V. Ferapontov and P. Lorenzoni).

Inverse Scattering Transform for the focusing NLS equation with fully asymmetric boundary conditions

F. Vitale
Università del Salento

Talk Summary: We present the inverse scattering transform (IST) for the focusing nonlinear Schrödinger equation with non-zero boundary conditions $q(x,t) \sim q_{l/r}(t) = A_{l/r} e^{i\theta_{l/r}(t)}$ as $x \to \mp\infty$ in the fully asymmetric case.

The direct problem is shown to be well-posed for NLS solutions $q(x,t)$ such that $q(x,t) - q_{l/r}(t) \in L^{1,1}(\mathbb{R}^{\mp})$ with respect to x for all $t \geq 0$, for which analyticity properties of eigenfunctions and scattering data are established. The inverse scattering problem is formulated both via (left and right) Marchenko integral equations, and as a Riemann-Hilbert problem on a single sheet of the scattering variables $\lambda_{l/r} = \sqrt{k^2 + A_{l/r}^2}$, where k is the usual complex scattering parameter in the IST. The time evolution of the scattering coefficients is then derived, showing that, unlike the case of solutions with the same amplitude as $x \to \pm\infty$, here both reflection and transmission coefficients have a nontrivial time dependence. Joint work with F. Demontis, B. Prinari, and C. van der Mee.

Hamiltonian operators of differential-geometric type

R. Vitolo
Dipartimento di Matematica e Fisica "E. De Giorgi", Università del Salento

Talk Summary: Homogeneous differential-geometric Poisson brackets were introduced by Dubrovin and Novikov in 1984. Such operators appear in many integrable systems. First order operators have been extensively studied so far. In this talk we will devote ourselves to the classification of third order operators. Starting from a normal form due to G. Potemin we show that the invariance group of the normal form is the group of reciprocal transformations of projective type. We prove that there is a bijective correspondence between third-order operators and quadratic line complexes. Using the Weiler–Segre classification of quadratic line complexes we give a complete classification of third-order operators under the action of the above invariance group for a number of components not greater than 3. Joint work with E.V. Ferapontov and M. Pavlov.

Baxter's operator and quantum Backlund transformations for the Ablowitz-Ladik chain

F. Zullo
Università di Roma Tre

Talk Summary: We shall give the Baxter's operator and the corresponding Baxter's equation for a quantum version of the Ablowitz Ladik model. The result is achieved in two different ways: by using the well-known Bethe ansatz technique and looking at the quantum analogue of the classical Backlund transformations. General results about integrable models governed by the same r-matrix algebra will be given. The Baxter's equation comes out to be a q-difference equation involving both the trace and the quantum determinant of the monodromy matrix. Further, we will show how the spectrality property of the classical Backlund transformations gives a trace formula representing the classical analogue of the Baxter's equation. Finally we will discuss a q-integral representation of the Baxter's operator.