

LABORATORY OF TOPOLOGY AND DYNAMICS,  
NOVOSIBIRSK STATE UNIVERSITY



**RUSSIAN-CHINESE CONFERENCE ON INTEGRABLE  
SYSTEMS AND GEOMETRY,  
ST. PETERSBURG, RUSSIA, AUGUST 18 – 26, 2018**

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## CERTAIN ABSTRACTS

**On integrability of magnetic geodesic flows on 2-torus on all energy levels.**  
*S. Agapov (Novosibirsk State University, Sobolev Institute of Mathematics, Novosibirsk)*

The questions related to integrability of geodesic flows and magnetic geodesic flows on a 2-torus are considered. It is proved for magnetic geodesic flow there is no irreducible polynomial in momenta first integrals of degree 3, 4 or 5 on all energy levels.

**Extended r-spin theory and the mirror symmetry for the A-singularity**  
*A. Buryak (School of Mathematics, University of Leeds, UK)*

The Landau-Ginzburg mirror symmetry for the A-singularity says that the associated Saito Frobenius manifold is isomorphic, after a certain change of coordinates, called the mirror map, to the Frobenius manifold structure controlling the intersection theory on the moduli space of r-spin curves. In the talk, I will show that the mirror map, described traditionally in terms of the singularity theory, also has an elegant description in terms of the geometry of the moduli space of r-spin curves.

**Classification of five-point differential-difference equations**  
*R. Garifullin (Institute of Mathematics, Ufa)*

Using the generalized symmetry method, we carry out the classification of integrable equations of a subclass of the autonomous five-point differential-difference equations. This subclass includes such well-known examples as the Itoh-Narita-Bogoyavlensky and the discrete Sawada-Kotera equations. The resulting list contains 31 equations some of which seem to be new. We have found non-point transformations relating most of the resulting equations among themselves, properties of some equations are investigated.

**On the recursion operators for integrable equations.**  
*I. Habibullin (Institute of Mathematics, Ufa)*

It is widely known that the recursion operator is a very important component of integrability. It allows one to describe in a compact form both hierarchies of the generalized symmetries and infinite series of the local conservation laws. In the literature, we can find several methods for constructing recursion operators, some of them use the Hamiltonian approach and the others are based on the Lax representation of the equation. In the present article we discuss on an alternative method, suggested in I. T. Habibullin, A. R. Khakimova, "A direct algorithm for constructing recursion operators and Lax pairs for integrable models", *Theoret. and Math. Phys.*, 196:2 (2018), 1200–1216, which is connected only with the first several generalized symmetries of the given equation. Efficiency of the method is illustrated with the examples of KdV, Krichever-Novikov and Kaup-Kupershmidt equations and discrete models.

**NLS hierarchy, MRW solutions and  $P_n$  breathers:  
from  $\alpha, \beta$  to  $t_k$  parametrization.**

*V.B. Matveev (St.Peterburg Department of Steklov Mathematical Institute)*

We describe a unified structure of rogue waves and multiple rogue waves (MRW) solutions for all equations of the NLS hierarchy and their mixed and deformed versions. It is possible to extend the basic wronskian formulas and their reductions, which we used for NLS equation in order to obtain the quasi-rational or rational, multiple rogue waves solutions of any rank for the NLS hierarchy, parametrising the solutions by the times  $t_k$ , associated with its different members. The general scheme is illustrated by examples of small rank  $n, n \leq 7$  rational or quasi-rational solutions. We emphasise a kind of universality for Peregrine breathers solutions and their higher versions, maintaining, with minimal variations, the same properties for all odd number members of the NLS hierarchy. This talk is based on the recent joint works V.B. Matveev, A.O. Smirnov: Solutions of the AKNS hierarchy equations of the "rogue wave" type. *Theor. Math. Phys.* **186**(2), 156–182 (2016) and "AKNS and NLS hierarchies, MRW solutions,  $P_n$  breathers, and beyond - Submitted to the JMP special issue dedicated to the memory of L.D. Faddeev.

**Lax pairs, recursion operators and new multiparameter  
bi-Hamiltonian systems in (3+1) dimensions.**

*M. B. Sheftel (Bogazici University) and*

*D. Yazici (Department of Physics, Yildiz Technical University, Turkey)*

We define the entropy and study typical shapes of elements of an arithmetic semigroup with power-law or exponential asymptotics of the counting function of abstract primes and show how these problems naturally give rise to Lagrangian manifolds and quasi-thermodynamic models. Relations to other fields and possible applications are discussed. The talk is based on results obtained jointly with V.P. Maslov.

## Program

## Conference "Russian-Chinese Conference on Integrable Systems and Geometry"

Monday, August 20	
09:00-10:00	Registration.
10:00-10:10	Opening.
10:10-11:05	<i>J. Zhou</i> . Emergent Geometry of KP Hierarchy.
Coffee break (20 minutes)	
11:25-12:20	<i>V. Matveev</i> . NLS hierarchy, MRW solutions, $P_n$ breathers and beyond.
12:25-13:20	<i>L. Chekhov</i> . Fenchel-Nielsen coordinates for surfaces with nontrivial boundaries.
Lunch (100 minutes)	
15:00-15:55	<i>S. Slavyanov</i> . Antiquantization of double confluent Heun equation and Teukholsky equation.
16:00-16:55	<i>M. Shiflet</i> . Lax pairs, recursion operators and new multiparameter bi-Hamiltonian systems in $(3+1)$ dimensions.
Welcome Party (17:00)	

Tuesday, August 21	
10:00-10:55	<i>D. Zuo</i> . Frobenius manifolds and Frobenius algebra-valued integrable system.
Coffee break (20 minutes)	
11:15-12:10	<i>A. Buriak</i> . Extended $r$ -spin theory in all genera and the discrete KdV hierarchy.
Lunch (110 minutes)	
14:00-14:55	<i>M. Pavlov</i> . Widest class of solutions for the Gibbons-Tsarev system.
Coffee break (20 minutes)	
15:15-16:10	<i>A. Smirnov</i> . On a class of solutions of KP-I equation.

Wednesday, August 22	
10:00-10:55	<i>R. Lin</i> . Soliton hierarchy with self-consistent sources: inverse scattering method and Darboux transformation.
Coffee break (20 minutes)	
11:15-12:10	<i>D. Korotkin</i> . Hodge and Prym tau functions, Jenkins-Strebel differentials and combinatorial model of $M_{g,n}$ .
12:15-13:10	<i>V. Korepin</i> . Six-vertex model: history and open problems.
Lunch (140 minutes)	
Cultural program (15:30)	
Conference Dinner (19:00)	

Thursday, August 23	
10:00-10:55	<i>S. Lando</i> . Integrability properties of graph invariants.
Coffee break (20 minutes)	
11:15-12:10	<i>E. Korotyaev</i> . Inverse problem for rotationally symmetric manifolds.
Lunch (110 minutes)	
14:00-14:55	<i>I. Habibullin</i> . On the recursion operators for integrable equations.
Coffee break (20 minutes)	
15:15-16:10	<i>R. Garifullin</i> . Classification of five-point differential-difference equations.

Friday, August 24	
10:00-10:55	<i>A. Bobenko</i> . Discrete confocal quadrics and IC-nets.
Coffee break (20 minutes)	
11:15-12:10	<i>A. Zhiglov</i> . Normal forms of spectral surfaces of commuting partial differential operators.
12:15-13:10	<i>S. Agapov</i> . On integrability of magnetic geodesic flows on 2-torus on all energy levels.