Dmitry Alekseevsky

Para-Kähler geometry and its applications (to neurogeometry)

Hilja Huru

A Summary of Quantizations of Group Actions

Abstract: I will give an overview of quantizations of group actions for a collection of groups G and finite G-modules, and discuss applications in Galois and Lie theory.

Hovhannes Khudaverdian

Operator pencil passing through a given operator (joint with A.Biggs; math-arXiv:1301.6625)

Abstract: Let Δ be a linear differential operator acting on the space of densities of a given weight λ on a manifold M. One can consider a pencil of operators $\mathbb{R}\{\Delta_\lambda\}$ passing through the operator Δ such that any Δ_λ is a linear differential operator acting on densities of weight λ. This pencil can be identified with a linear differential operator acting on the algebra of densities of all weights. The existence of an invariant scalar product in the algebra of densities implies a natural decomposition of operators, i.e. pencils of self-adjoint and anti-self-adjoint operators.

We study lifting maps equivariant with respect to volume preserving diffeomorphisms and with values in self-adjoint or anti-self-adjoint operators. In particular we analyze the relation between these two concepts, and apply it to the study of Diff(M)-equivariant liftings.
Finally we consider the case of liftings equivariant with respect to the algebra of projective transformations. This can be considered as a next step to equivariant quantisation suggested and developed by Duval, Ovsienko and Lecompte; they have considered the lifting of symbols of operators to operators on densities of given weight.

Alexei Kotov

The space of maps between supermanifolds (joint with G. Bonavolonta, University of Luxembourg)

Abstract: Using auxiliary connections and jet spaces, we construct the space of super maps between smooth supermanifolds as an infinite dimensional bundle with the reversed parity of fibres over the space of base smooth maps.

Joseph Krasilshchik

Natural super-commutative structures in the geometry of integrable systems

Abstract: Integrability properties of PDEs are closely related to existence of Hamiltonian and recursion operators on the equation at hand. These operators may be understood as symmetry-like objects (so-called shadows) on special extensions of the equation, its tangent and cotangent coverings. Hamiltonian and hereditary properties are expressed in terms of Schouten and Nijenhuis brackets, respectively, while these brackets are interpreted as super-commutators of the corresponding shadows. I'll try to expose general theory in an elementary way and illustrate it by clear examples.

Boris Kruglikov

Symmetry and Integrability

Abstract: It is often in geometry and differential equations that maximally symmetric structures are distinguished (in particular, they allow complete description). The smaller the size of the symmetry is, the bigger the moduli space grows. I will illustrate this with many examples, and draw a bridge to integrability issue, mainly speculative for now.

Valentin Lychagin

Projective differential invariants and Poisson structure on space of shapes

Abstract: We'll discuss a description of the space of shapes in terms of projective differential invariants.
This description allows us to find different geometrical structures on the space.
As one of the main issue, we show that the space of shapes possesses Poisson structure are correspondent Hamiltonian flows closely related to integrable differential equations.

Gianni Manno

2-dimensional metrics admitting projective vector fields

Abstract: A vector field is called projective if sends geodesics into geodesics without necessarily preserving the affine parameter. The problem of classifying 2-dimensional metrics admitting a non-trivial projective vector field dates back to Sophus Lie, who showed that the set of projective vector fields is an algebra. We show how to obtain such metrics, also when the orbits of the projective algebra are of non-constant rank.

Irina Markina

Algebras of Heisenberg type and possible generalizations

Abstract: We introduce a special class of nilpotent Lie groups of step 2, that generalizes the so-called H(eisenberg)-type groups, defined by A. Kaplan in 1980. We change the presence of the inner product to an arbitrary non-degenerate scalar product and relate the construction to the composition of quadratic forms and to the Clifford modules. We discuss a possibility to construct a basis of the Lie algebras having rational structure constants that leads to the existence of lattices on the corresponding Lie groups according to the Maltcev criterion.

Oleg Morozov

Recursion Operators via Cartan's method of Equivalence

Abstract: The talk will describe recent results of applying Cartan's method of equivalence to the problem of construction of recursion operators for symmetries and cosymmetries of PDEs.

Irina Pankratova jointly with **Klas Pettersson**

About localization effects arising in spectral problems stated in perforated domain

Abstract: We consider two closely related spectral problems stated in a domain with perforation. The first one deals with a homogenization of elliptic spectral problem stated in a perforated domain, Fourier boundary conditions being imposed on the boundary of perforation. The presence of a locally periodic coefficient in the boundary operator gives rise to the effect of a localization of the eigenfunctions.

The second one studies elliptic spectral problem with a large potential stated in a thin rod with a locally periodic perforation, so that the size of the perforation gradually varies from point to point. We impose homogeneous Neumann boundary conditions on the boundary of perforation and on the lateral boundary of the rod. The presence of a large parameter 1/epsilon in front of the potential and the dependence of the perforation on the slow variable gives rise to the effect of localization of the eigenfunctions.
In both cases it is shown that the leading term of the asymptotics for the k-th eigenfunction is a scaled exponentially decaying function being the k-th eigenfunction of a corresponding harmonic oscillator operator. The localization takes place in the scale epsilon^{1/4}.

Andrei Piatnitski

Khasminskii-Whitham averaging for randomly perturbed KdV equation

Abstract. The talk will focus on the large time behaviour of solutions to a KdV equation with a small viscosity and small random stationary forces. Our goal is to show that for a properly rescaled time the solutions converge to a solution of the averaged stochastic partial differential equation. The first part of the talk will be devoted to the finite-dimensional version of this result.

Volodymyr Rybalko

Ginzburg-Landau equation with semi-stiff boundary conditions

Abstract: This talk is devoted to a variational problem for Ginzburg-Landau functional when the unknown complex-valued function u (order parameter) is constrained to be S^1-valued on the boundary. The corresponding PDE problem involves the so-called semi-stiff boundary conditions: the Dirichlet condition |u|=1 and the Neumann condition for phase. To find nontrivial solutions one can prescribe the degree (winding number) on the boundary. However this typically leads to a lack of compactness in the variational problem. In this talk some recent existence/nonexistence results will be discussed.

Artur Sergyeyev

Coupling constant metamorphosis for non-Hamiltonian dynamical systems and integrability

Abstract: We extend the multiparameter coupling constant metamorphosis, also known as the generalized Stäckel transform, from Hamiltonian dynamical systems to general finite-dimensional dynamical systems and ODEs. This transform interchanges the values of integrals of motion with the parameters these integrals depend on, but leaves the phase space coordinates intact. Sufficient conditions under which the transformation in question preserves integrability are given. Further details can be found in the paper A. Sergyeyev, Phys. Lett. A 376 (2012), no.28-29, 2015-2022.

Vadim Shurygin

On one approach to the problem of contact equivalence for ODEs F(x,y,y',y'')=0

Absract: We discuss the application of the path lifting method to the contact equivalence problem of second order ODEs F(x,y,y',y'')=0. For the case when functions F are polynomial in y'' we find out when the contact diffeomorphism is the prolongation of a point diffeomorphism.

Alexander Vasiliev

Contour dynamics and integrable systems

Abstract: We consider two models of planar contour evolution. Laplacian growth is a typical example of a field problem. Given an initial contour the evolution is defined to be only normal and the velocity field inside has a harmonic potential. The other evolution is an example of an infinite-dimensional control problem. We tune the evolution from the unit circle to an arbitrary contour in the complex plane. The governing law is provided by the Loewner-Kufarev equation. We show that both evolutions admit Hamiltonian formulation, there are infinite number of conserved quantities, which indicates possible relation to exactly solvable models of mathematical physics. Indeed we show that the Laplacian growth is embedded into the dispersionless Toda hierarchy and we construct solutions to the KP hierarchy which preserve their form along Loewner trajectories.

Luca Vitagliano

Strong Homotopy Algebras and PDEs

Abstract: A PDE is geometrically described by a diffiety, i.e., an infinite dimensional manifold E + an involutive distribution C. The horizontal cohomologies of (E,C) encode important properties of the PDE. Typically, horizontal cohomologies are supplied with algebraic structures. I conjecture that all these algebraic structures come from suitable strong homotopy (sh) algebras at the level of cochains. An sh algebraic structure is, roughly, an algebraic structure up to homotopy. After an introduction to sh algebras, I will present one example supporting the conjecture: the canonical sh Lie-Rinehart algebra of horizontal forms with values in vertical vector fields.

Henrik Winther

Homogeneous Almost Complex- and Related Structures in dimension 6 (joint work with Boris Kruglikov and Dmitry Alekseevsky)

Abstract: We classify homogeneous spaces M=G/H of real dimension 6 with semi-simple H and G-invariant almost complex structure J by representation theory. These turn out to consist of a short discrete list of known spaces and proper homogeneous spaces, as well as several families of (solvable) Lie groups equipped with left invariant J. We investigate existence of almost-symplectic forms and Hermitian triplets on these spaces, and their integrable versions such as symplectic and Kähler structures. We also remark on the significance of this work to the question of sub-maximally symmetric non-degenerate almost complex structures.

Valery Yumaguzhin

The Einstein-Maxwell complex (joint work with Valentin Lychagin)

Abstract: We obtained recently the complete description of formal solutions of the Cauchy problem for the vacuum Einstein equation in the terms of spectral sequences of the corresponding complex. In this talk, we represent a similar complex for the Einstein-Maxwell equation and calculate cohomologies of its symbolic complex.