XXXIII WORKSHOP ON GEOMETRIC METHODS IN PHYSICS

Białowieża, Poland, June 29 – July 5, 2014

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LIST OF ABSTRACTS

Plenary lectures

1. **Rui Loja FERNANDES** – *University of Illinois at Urbana-Champaign, USA*

   Normal Forms in Poisson Geometry and Lie Groupoid Theory

   In these lectures I will discuss several linearization theorems and other normals forms results in Poisson geometry and Lie Groupoid Theory. This includes the Conn's Linearization Theorem, the Weinstein-Zung Linearization Theorem, and the Crainic-Marcut Rigidity Theorem. The focus will be on the new techniques used to prove these results, which are reshaping our view of those fields.

2. **Alexander GAYFULLIN** – *Steklov Mathematical Institute, Russia*

   Flexible polyhedra in spaces of constant curvature

   In 1897 Bricard found three types of flexible self-intersected octahedra in the three-dimensional Euclidean space, and proved that there are no other flexible octahedra. Since this work the theory of flexible polyhedra started. Nevertheless, this theory lacked high-dimensional examples. Indeed, the first examples of flexible polyhedra in the four-dimensional Euclidean space were found by Walz and Stachel only in the very end of the 20^{th} century, and until recently no examples of flexible polyhedra of dimensions greater than four were known. In the talk, we shall describe the construction of flexible cross-polytopes in spaces of constant curvature, i.e., the Euclidean, the spherical, and the Lobachevsky spaces. In dimensions 5 and higher these are the first examples of flexible polyhedra. Moreover, we classify all flexible cross-polytopes. The key point of the construction is the interpretation of a certain relation between dihedral angles of a cross-polytope as an addition law for the Jacobi's elliptic functions.

3. **Andrey LAZAREV** – *Lancaster University, United Kingdom*

   Chern-Simons invariants of smooth manifolds via homological algebra

   Quantum Chern–Simons invariants of differentiable manifolds are analyzed from the point of view of homological algebra. Given a manifold M and a Lie (or, more generally, an L-infinity algebra, its tensor product with the cohomology of M has the structure of an L-infinity algebra whose homotopy type is a homotopy invariant of M. We formulate necessary and sufficient conditions for this L-infinity algebra to have a quantum lift. This is a joint work with C. Braun.

4. **Martin MARKL** – *Mathematical Institute of the Academy, Czech Republic*

   On the origin of higher braces

   The Koszul hierarchy (aka higher braces or Koszul braces) is an explicit construction that, for any commutative associative algebra A with a differential Delta (which is, very crucially, not necessary a derivation), produces a sequence of multilinear maps

   $$\Phi_n : A \times \ldots \times A \to A \quad (n \text{ copies of } A)$$

   such that

   (a) the operations Φ_n form a strongly homotopy Lie algebra, and

   (b) $\Phi_n = 0$ implies $\Phi_{n+1} = 0$ (heredity property)

Koszul braces are used for instance to define higher-order derivations: Δ is a degree n derivation if $\Phi_{n+1}(\Delta) = 0$. Higher order derivations play an important role e.g. in BRST approach to closed string field theory.

Recently, a similar construction appeared also for associative (non-commutative) algebras. I will show that both braces are given by the twisting by a specific unique automorphism and that they are essentially unique. Consequently, the notion of higher-order derivations is God given, not human invention.

5. **Alexander MIKHAILOV** — *University of Leeds, United Kingdom*

   Lax-Darboux scheme

6. **Nikolay MOSHCHEVITIN** — *Moscow Lomonosov State University, Russia*

   Dynamical systems in certain problems in number theory

   We discuss various applications of modern dynamics to certain problems in number theory as well as elementary number-theoretical approach to some dynamical settings. We discuss famous long-standing Littlewood conjecture and related topics.

7. **Ali MOSTAFAZADEH** — *Koç University, Turkey*

   Spectral Singularities, Unidirectional Invisibility, and Dynamical Formulation of One-Dimensional Scattering Theory

   Complex scattering potentials have surprising properties that real scattering potentials lack. Among these are spectral singularities and unidirectional invisibility. In the first part of this talk, I will survey the recent development in the study of physical meaning and applications of spectral singularities. In particular, I show that they provide the basic mathematical framework for all lasing and antilasing systems. In the second part of the talk, I outline a dynamical theory of potential scattering in one-dimension and offer an inverse scattering scheme for the construction of scattering potentials with desirable properties at a prescribed wavelength. This is based on the curious observation that given a possibly complex scattering potential $v(x)$ we can construct a two-level non-stationary and non-Hermitian Hamiltonian $H(t)$ whose S-matrix coincides with the transfer matrix of $v(x)$. We use this approach to develop a complete perturbative description of the phenomenon of unidirectionally invisibility, construct multi-mode unidirectionally invisible potentials with wavelength-dependent direction of invisibility, and show that the application of the adiabatic approximation for $H(t)$ coincides with the semiclassical (WKB) treatment of the scattering problem. A remarkable outcome of the latter result is the identification of the geometric part of the phase of the adiabatically evolving states with the pre-exponential factor of the WKB wave functions.

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8. **Karl-Hermann NEEB** — *Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

A representation theoretic perspective on reflection positivity

Reflection positivity (sometimes called Osterwalder-Schrader positivity) was introduced by Osterwalder and Schrader in the context of axiomatic euclidean field theories. On the level of unitary representations, it provides a passage from representations of the euclidean isometry group to representations of the Poincaré group. In our talk we shall explain how these ideas can be used to obtain a natural context for the passage from representations of symmetric Lie groups to representations of their dual Lie group. In particular, we shall discuss the role of distribution vectors and reproducing kernels in this picture and how distributions on a Lie group can lead to "reflection positive" representations.

9. **Stefan NEMIROVSKI** — *Steklov Mathematical Institute, Russia*

Contact topology on spaces of light rays

The talk will survey our joint work with Vladimir Chernov (Dartmouth College) on the applications of contact topology to questions in Lorentz geometry raised by Roger Penrose and Robert Low.

10. **Sylvie PAYCHA** — *Universität Potsdam, Germany*

Traces on the noncommutative torus

The global symbol calculus for pseudodifferential operators on tori can be generalised to noncommutative tori. In this global approach, the quantisation map is invertible and traces are discrete sums. On the noncommutative torus, Fathizadeh and Wong had characterised the Wodzicki residue as the unique trace which vanishes on trace-class operators. In contrast, we build and characterise the canonical trace on classical pseudodifferential operators on a noncommutative torus, which extends the ordinary trace on trace-class operators. It can be written as a canonical discrete sum on the underlying toroidal symbols. On the grounds of this uniqueness result, we prove that in the commutative setup, this canonical trace on the noncommutative torus reduces to Kontsevich and Vishik's canonical trace which is thereby identified with a discrete sum. By means of the canonical trace, we derive defect formulae for regularised traces on noncommutative toris. The conformal invariance of the zeta-function at zero of the Laplacian on the noncommutative torus is then a straightforward consequence.

This is based on joint work with Cyril Lévy and Carolina Neira Jiménez.

11. **Fernand PELLETIER** — *Université de Savoie, France*

Integrability of weak distributions on Banach manifolds and applications

In differential geometry, a distribution on a smooth manifold M is an assignment

$$\mathcal{D} : x \to \mathcal{D}_x \subset T_x M$$

on M, where $\mathcal{D}_x$ is a subspace of $T_x M$. The distribution is *integrable* if, for any $x \in M$ there exists an immersed submanifold $f : L \to M$ such that x belongs to $f(L)$ and for any $z \in L$ we have $Tf(T_z L) = \mathcal{D}_{f(z)}$. On the other hand, D is called *involutive* if, for any vector fields X and Y on M which are tangent to $\mathcal{D}$, the Lie bracket $[X, Y]$ is also tangent to $\mathcal{D}$. The distribution is *invariant* if for any vector field X tangent to $\mathcal{D}$, the flow ϕ_t^X leaves $\mathcal{D}$ invariant. On finite dimensional manifold, when $\mathcal{D}$ is a subbundle of TM, the classical Frobenius Theorem gives an equivalence between integrability and involutivity. In the other case, the distribution is "singular" and even under assumptions of smoothness on $\mathcal{D}$, in general, the involutivity is not a sufficient condition for integrability (we need some more additional local conditions). These problems were clarified and resolved essentially in [Su], [St].

In the context of Banach manifolds, the Frobenius Theorem is again true, for distributions which are complemented subbundles in the tangent bundle. For singular distributions, some papers ([ChSt] for instance) show that, when the distribution is closed and complemented (i.e. $\mathcal{D}_x$ is a complemented Banach subspace of T_xM), we have equivalence between integrability and invariance. First of all we will introduce the notion of "weak submanifolds" in a Banach manifold and we will consider "weak Banach distributions": $\mathcal{D}_x$ can be not closed in T_xM but $\mathcal{D}_x$ is endowed with its own Banach structure, so that the inclusion $\mathcal{D}_x to T_xM$ is continuous. Secondly we will expose the notion of local triviality for weak distribution and give our results of integrability for weak Banach distributions. We will end by application of these results in the framework of Banach Poisson manifolds and Banach Lie algebroids.

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12. **Anton SAVIN** — *Peoples Friendship University of Russia, Russia*

Differential equations on complex manifolds

In this talk we deal with the theory of differential equations on complex manifolds. Namely, we study linear differential equations in $\mathbb{C}^N$ and, more generally, on complex manifolds. This theory is remarkable and interesting. It turns out that to study equations on complex manifolds, one has to use essentially new methods, than in the classical (real) theory. These methods will be described in the talk, in particular, we shall describe Sternin-Shatalov transform, which enables one to solve equations with constant coefficients.

Complex theory has important applications in mathematics and physics. In particular, we shall show how the methods described in the talk enable one to solve balayage inwards problem (Poincaré).

(joint talk by A.Yu. Savin and B.Yu. Sternin)

13. **Andrzej SITARZ** — *Uniwersytet Jagielloński, Poland*

Measuring noncommutative spaces: the metric

In the realm of noncommutative geometry there are several notions of metric. I'll briefly review some of them then concentrating on a proposition to encode the metric in the Dirac operator and present a family of geometrically motivated Dirac operators for noncommutative spaces.

14. **Alexander VORONOV** — *University of Minnesota / Kavli IPMU / IHES, USA*

The BV formalism for L_∞-algebras and quantum ∞-groups

We interpret the theory of L_∞-algebras using the BV formalism. We introduce r_∞ matrices, which are solutions to the Maurer-Cartan equation in the exterior algebra of a dg Lie algebra or, more generally, an L_∞ algebra. This equation generalizes the classical Yang-Baxter equation $[r, r] = 0$ in the exterior algebra of a Lie algebra. We show have such r_∞ matrices give rise to triangular L_∞ bialgebras and quantum ∞-groups. This is a joint work with my graduate student Denis Bashkirov.

Contributed lectures

15. **Syed Twareque ALI** – *Concordia University, Canada*

 Title to be announced

16. **Anatolij ANTONEVICH** – *Uniwersytet w Białymstoku, Poland*

 On bounded solutions of differential equation on the line

 The problem under consideration is to construct a bounded solution of linear differential equation in Hilbert space for any bounded function f from right-side part of equation. A linear operator R such that the function Rf is a bounded solution, will be given.

17. **Marco BERTOLA** – *Concordia University, Canada*

 Gap probabilities and Riemann-Hilbert problems in determinantal random point processes with or without outliers

 It is well known that the gap probabilities for determinantal random point processes are computed by suitable Fredholm determinants of integral operators. For special type of kernels known as "integrable" (Its-Izergin-Korepin-Slavnov) the connection with a Riemann–Hilbert problem is also well known. On the other hand, in the case of processes, the kernels do not have this property but we will show how to still connect an appropriate RHP. The approach also yields a more straightforward proof of the well-known Tracy Widom distribution expressed in terms of Painleve' II solutions (a matrix version of the result produces solutions of the non-commutative PII equation). We will also show how gap probabilities of processes with outliers (Airy and other examples) relate to the notion of Schlesinger discrete transformations, a notion that originates in the theory of ODEs but can be extended to RHPs as well.

18. **Andrey BYTSENKO** – *Universidade Estadual de Londrina, Brazil*

 Topological vertex, strings and the Hilbert scheme revisited

19. **Goce CHADZITASKOS** – *České Vysoké Učení Technické v Praze, Czech Republic*

 Coherent States on Discrete Spaces

 We present an overview of the possibilities to construct families of coherent states over some giscrete systems: a periodic chain with periodic symmetry, a periodic chain with dihedral symmetry, and an infinite chain with periodic symmetry. The theory of generalized coherent states is used, and the results are discussed.

20. **Smail CHEMIKH** – *Preparatory School in Science and Technic, Algiers*

 Statistical manifolds geometry

21. **Alina DOBROGOWSKA** – *Uniwersytet w Białymstoku, Poland*

 Integrable systems of Neumann type

 We construct families of integrable systems that interpolate between N-dimensional harmonic oscillators and Neumann systems. This is achieved by studying a family of integrable systems generated by the Casimir functions of the Lie algebra of real skew-symmetric matrices and a certain deformation thereof.

22. **Gerald GOLDIN** – *Rutgers University, USA*

Nonlinear gauge transformations and the "hydrodynamical" formulation of quantum mechanics

The group of nonlinear gauge transformations introduced by H.-D. Doebner and the author acts on the Hilbert manifold of quantum-mechanical wave functions. A nonlinear gauge transformation alters the wave functions, changes the time-evolution equation, and modifies the expressions for observables, in such a way as to leave all of the outcomes of physical measurements invariant. The nonlinearities thus introduced into the Schrödinger equation involve functionals suggestive of Madelung's "hydrodynamical" formulation, and the resulting family of nonlinear equations may be wholly re-expressed in terms of such hydrodynamical variables. After reviewing these earlier results briefly, I shall discuss how this leads to a renewed interest in the role of nodal sets (zeroes of wave functions) in both linear and nonlinear quantum mechanics, and report on some preliminary explorations.

23. **Tomasz GOLIŃSKI** – *Uniwersytet w Białymstoku, Poland*

Lie bundle of deformed skew-symmetric matrices

We study deformed spaces of symmetric and skew-symmetric $n \times n$ matrices with deformations parametrized by a sequence of $n-1$ real numbers. We introduce a Lie algebra structure on the space of deformed skew-symmetric matrices using a Lie bracket given by a choice of deformed symmetric matrix. Using that we introduce a Lie-Poisson structure on the space of upper-triangular matrices. In this way we generate hierarchies of Hamilton systems with bihamiltonian structure.

24. **Mahouton Norbert HOUNKONNOU** – *University of Abomey-Calavi, Benin*

Supersymmetric vector coherent states for systems with Zeeman coupling and spin-orbit interactions

This work addresses a method for constructing supersymmetric vector coherent states (VCS) for a 2-dimensional electron gas in a perpendicular magnetic field in the presence of both Rashba and Dresselhaus spin-orbit (SO) interactions, with an effective Zeeman coupling. The model Hamiltonian, decomposed into two conveniently defined operators, acts on a tensor product of two Hilbert spaces associated with corresponding chiral sectors. Supersymmetric (SUSY) VCS, related to a SUSY pair of Hamiltonians, are built. A generalized oscillator algebra is provided using quadrature operators. Mean-values of position and momentum operators and uncertainty relation in the SUSY VCS are obtained and discussed.

25. **Dmitry KAPARULIN** – *Tomsk State University, Russia*

Stability of higher derivative dynamics

We observe that a wide class of higher derivative systems admits a bounded conserved quantity that ensures classical stability of the dynamics while the canonical energy is unbounded. We use the tool of Lagrange anchor to demonstrate that bounded integral of motion is connected with the translation invariance. A procedure is suggested for switching on interactions in free higher derivative systems without breaking their stability. We also demonstrate the quantization technique that keeps the higher derivative dynamics stable at quantum level. The general construction is illustrated by examples of Pais-Uhlenbeck oscillator, higher derivative scalar field model, and higher-derivative Podolsky electrodynamics. For all these models, the positive conserved quantity is explicitly constructed and the interactions are identified such that do not break stability.

26. **Ryszard KOSTECKI** – *Perimeter Institute for Theoretical Physics, Canada*

Towards nonlinear quantum information geometric foundations of quantum theory

I will present a new approach to information-theoretic foundations of quantum theory, that does not rely on probability theory, spectral theory, or Hilbert spaces. The direct nonlinear generalisations of quantum kinematics and dynamics are constructed using quantum information geometric structures over algebraic states of W^*-algebras (quantum relative entropies and Banach Lie-Poisson structure). In particular, unitary evolution is generalised to nonlinear hamiltonian flows, while Lueders' rules are generalised to constrained relative entropy maximisations. Orthodox probability theory and quantum mechanics are special cases of this framework. I will also discuss the conceptual changes associated with this approach (a shift from quantum deductive logic to quantum inductive logic/bayesianity), as well as the possibility of deriving emergent space-times directly from quantum models.

27. **Simon LYAKHOVICH** – *Tomsk State University, Russia*

Consistent interactions and involution

Starting from the concept of involution of field equations, a universal method is proposed for constructing consistent interactions between the fields. The method equally well applies to the Lagrangian and non-Lagrangian equations and it is explicitly covariant. No auxiliary fields are introduced. The equations may have (or have no) gauge symmetry and/or second class constraints in Hamiltonian formalism, providing the theory admits a Hamiltonian description. In every case the method identifies all the consistent interactions.

28. **Vladimir MOLCHANOV** – *Derzhavin Tambov State University, Russia*

Poisson and Fourier transforms for tensor products

We write explicitly operators intertwining finite-dimensional representations of the group $G = \mathrm{SL}(2,\mathbb{R})$ with their tensor products. We call these operators *Poisson* and *Fourier transforms* respectively, they are conjugate to each other. We also write explicitly an interaction of these transforms with Lie operators of the overgroup $G \times G$. All these operators (transforms etc.) turn out to be *differential* operators.

29. **Yurii NERETIN** – *Institute for Theoretical and Experimental Physics, Russia*

Matrix beta-integrals

We discuss matrix analogs of beta-functions. They are multiparametric matrix integrals admitting explicit evaluations as long products of Gamma-functions (first examples were discovered by Hua Loo Keng and Siegel in 50s, last known families were obtained in this year). They also can be regarded as integrals over Riemannian symmetric spaces and flag spaces. We also will shortly discuss some variations of "matrix integrals" in this context, namely summation over space of all lattices in $\mathbb{Q}^n$ (in this case, Gamma-functions are replaced by zeta-functions) and integration in "Jacobi elliptic coordinates".

30. **Petr NOVOTNY** – *České Vysoké Učení Technické v Praze, Czech Republic*

On (a, b, c)–derivations of Jordan algebras

Using three complex parameters, we generalize the concept of derivations of Jordan algebras. Obtained operator spaces are investigated and used for definition of invariant functions of Jordan algebras. These invariant functions form a complete set of invariants for Jordan algebras up to dimension three. We also show how these invariants work with classification of four-dimensional Jordan algebras.

31. **Mikołaj ROTKIEWICZ** — *Instytut Matematyczny Polskiej Akademii Nauk, Poland*

Bundle-theoretic methods for higher-order variational calculus

I will present a geometric interpretation of the integration-by-parts formula on an arbitrary vector bundle (E, σ, M). A bundle $\tilde{T}^{r,r}E \to T^{2r}M$ of higher semi-holonomic velocities of σ will be constructed and an interesting canonical vector bundle morphism $\Upsilon_{k,\sigma} : \tilde{T}^{r,r}E \to E$ will be derived. Based on a joint paper with Michał Jóźwikowski.

32. **Andreas RUFFING** — *Technische Universität München, Germany*

Quantum Difference-Differential Equations

Differential equations which contain the parameter of a scaling process are referred to by the name Quantum Difference–Differential Equations. Some of their applications to discrete models of the Schrödinger equation are presented and some of their rich, filigrane und sometimes unexpected analytic structures are revealed.

A Lie-algebraic concept for obtaining basic adaptive discretizations is explored, generalizing the concept of deformed Heisenberg algebras by Julius Wess.

Some of the moment problems of the underlying basic difference equations are investigated. Applications to discrete Schrödinger theory are worked out and some spectral properties of the arising operators are presented, also in the case of Schrödinger operators with basic shift–potentials and in the case of ground state difference–differential operators.

For the arising orthogonal function systems, the concept of inherited orthogonality is explained. The results in this talk are mainly related to a recent joint work with Sophia Roßkopf and Lucia Birk.

An analogous situation on an equidistant lattice has been worked out.

33. **Akifumi SAKO** — *Tokyo University of Science, Japan*

Deformation Quantization of Gauge theories with Separation of Variables

A noncommutative gauge theory in a homogeneous Kähler space is constructed. Its noncommutative deformation is done by using deformation quantization with separation of variables which is formulated by Karabegov. This is achieved to make vector fields as inner derivations. We construct the gauge theory in homogeneous manifolds whose covariant derivatives are given by vector fields. As examples, we construct the noncommutative gauge theory in $\mathbb{C}P^N$ and $\mathbb{C}H^N$ with explicit expression.

34. **Martin SCHLICHENMAIER** — *University of Luxembourg, Luxembourg*

Lie superalgebras of Krichever-Novikov type

Lie superalgebras of Krichever-Novikov type are certain algebras consisting of meromorphic half-forms on compact Riemann surfaces, which are holomorphic outside a given finite set of points. We introduce them, their almost-grading and their central extensions. We will show that there is up to equivalence and rescaling of the central element only one almost-graded central extension for a given such algebra with fixed almost-grading.

35. **Ewa SCHMEIDEL** – *Uniwersytet w Białymstoku, Poland*

Some properties of solution of Volterra difference equations

In many real-life situations, the present state and the manner in which it changes are both dependent on the past. An appropriate model for such situation are discrete Volterra equations, in which the present state depends on the whole previous history. So, Volterra difference equations are widely used for modeling processes in many fields. In our investigation we consider a Volterra difference equation of nonconvolution type in both: scalar and vector cases. We take into consideration this equation under different assumptions on its kernel. The sufficient conditions for existence of solution with required asymptotic properties are obtained. Particularly, we present sufficient conditions under which the considered equation has asymptotically constant solution, asymptotically periodic solution, weighed asymptotically periodic solution and bounded solutions.

36. **Armen SERGEEV** – *Steklov Mathematical Institute, Russia*

On moduli space of Yang-Mills gauge fields on $\mathbb{R}^4$

There is a well-known description of the moduli space of instantons on $\mathbb{R}^4$ given by Atiyah–Drinfeld–Hitchin–Manin. In contrast to that the structure of Yang–Mills gauge fields on $\mathbb{R}^4$ remains to a large extent unknown. In particular, there is no good twistor decription of this space. In our talk we shall discuss the known facts and conjectures concerning the structure of the Yang–Mills moduli space.

37. **Alexey SHARAPOV** – *Tomsk State University, Russia*

Peierls' brackets in non-Lagrangian field theory

The concept of Lagrange anchor introduced in [P.O. Kazinski, S.L. Lyakhovich, A.A. Sharapov, JHEP0507(2005)076] allows one to consistently quantize the non-Lagrangian dynamics within the path-integral approach. I will show that any Lagrange anchor gives rise to a covariant Poisson bracket on the space of true histories of the theory. The bracket generalizes the well-known Peierl's bracket construction and makes a bridge between the path-integral and the deformation quantization of non-Lagrangian dynamics.

38. **Oleg SHEINMAN** – *Steklov Mathematical Institute, Russia*

Lax operator algebras and gradings on semi-simple Lie algebras

Lax operator algebras appeared as a unifying tool for construction, investigation of the Hamiltonian structure, and quantization of finite-dimensional integrable systems, like Hitchin systems, gyroscopes, and integrable cases of hydrodynamics of a solid body in a 2-dimensional flow. So far Lax operator algebras were known for classical simple and reductive Lie algebras, and for the exceptional Lie algebra G_2. The talk is devoted to a new general approach to Lax operator algebras, and their central extensions, given in terms of gradings of the corresponding semi-simple algebras, i.e. mainly in terms of their root systems. After joint work with E.B. Vinberg.

39. **Ekaterina SHEMYAKOVA** – *State University of New York at New Paltz, USA*

Structure of invertible Darboux transformations

40. **Aneta SLIŻEWSKA** – *Uniwersytet w Białymstoku, Poland*

Algebroids associated to the groupoid of partially invertible elements of W^*-algebra

41. **Elizaveta VISHNYAKOVA** – *University of Luxembourg, Luxembourg*

On n-ary analogue of Lie (super)algebras

A different reading of the standard Jacobi identity leads to various generalizations of the notion of Lie superalgebra for n-ary case. The most popular n-ary analogues were suggested by V.T. Filippov, P. Michor, A. Vinogradov, M. Vinogradov and other. For instance, A. Vinogradov and M. Vinogradov introduced a two parameter series of n-ary Lie superalgebras. The interesting fact here is that this series contains also commutative associative algebras.

We will discuss the following: this theory in the context of quadratic n-ary Lie superalgebras using a "derived bracket" approach from Poisson Geometry; classification of simple n-ary Lie algebras, a decomposition of such algebras into elementary pieces.

42. **Luca VITAGLIANO** – *Università degli Studi di Salerno, Italy*

L_∞ algebras from multicontact geometry

I define higher versions of contact structures on manifolds as maximally non-integrable distributions. I call them multicontact structures. Cartan distributions on jet spaces provide canonical examples. More generally, I define higher versions of pre-contact structures simply as distributions. After showing that the standard symplectization of contact manifolds generalizes naturally to a (pre-)multisymplectization of (pre-)multicontact manifolds, I make use of results by C. Rogers and M. Zambon to associate a canonical sh Lie algebra to any (pre-)multicontact structure. Such sh Lie algebra is a higher version of the Jacobi brackets on contact manifolds. Since every partial differential equation (PDE) can be geometrically understood as a manifold with a distribution, then there is a (contact invariant) sh Lie algebra attached to any PDE.

43. **Theodore VORONOV** – *University of Manchester, United Kingdom*

On volumes of classical supermanifolds

44. **Akira YOSHIOKA** – *Tokyo Univeristy of Science, Japan*

Star function, example and application

We consider a star product whose deformation parameter is a number, not a formal parameter. The star product also depends on complex matrices. We consider exponential elements of the star product algebra. Using star exponential elements, star functions are introduced.

We discuss star functions and consider examples and applications.

Poster session

45. **Mariusz BODZIOCH** – *Uniwersytet Warmińsko-Mazurski w Olsztynie, Poland*

The metric on SOL group and its geodesic flow

46. **Satish DIXIT** – *ICFAI University Raipur, India*

Differential equations on complex manifolds

47. **Lenka HÁKOVÁ** – *České Vysoké Učení Technické v Praze, Czech Republic*

Weyl group orbit functions in image processing

We deal with the Fourier-like analysis of functions on discrete grids in two-dimensional simplexes using $C-$, and $E-$ Weyl group orbit functions. We present the convolution theorem and provide an example of application of image processing using orbit convolutions for spatial filtering of a treated image.

48. **Robert JANKOWSKI** – *Uniwersytet w Białymstoku, Poland*

On the stability Nash equilibrium in the model of replicator dynamics with assumption of asymmetric games

In this poster, the model of replicator dynamics in asymmetric games is investigated. The Nash equilibrium is stable strategy in such contest only with special boundary conditions of differential equations describing the dynamics of all players.

49. **Hassan JOLANY** – *University of Lille 1, France*

Metaplectic quantization

We give a short review on recent results of metaplectic quantization.

50. **Joanna ZONENBERG** – *Uniwersytet w Białymstoku, Poland*

Properties of solutions of difference equations system

Special economics session

51. **Łukasz HARDT** – *Uniwersytet Warszawski, Poland*

Is economics in crisis? Some remarks on the state of economic theory in the face of the post 2008 crisis

Many argues that economic theory is in crisis. As Krugman (2009) put it: "the economics profession went astray because economists, as a group, mistook beauty, clad in impressive-looking mathematics, for truth". Such comments are quite surprising since just before the global financial crisis the majority of economists were quite satisfied with the state of their profession. Take, for instance, the following comment made by Nobel laureate R. Lucas (2004): "the central problem of depression-prevention has been solved [by economic theory]". So, how one can assess the state of economics? What I am to claim is that the majority of contributions criticizing modern economics are not based on clear methodological principles and thus many of them are not correct. In other words, I am to criticize the critique of economics. Also, my presentation is to serve as a starting point for discussing the role of economists in public debates.

52. **Bogdan MIELNIK** – *CINVESTAV, Mexico*

From Nicolas Copernicus economical law up to the modern disasters