A B S T R A C T S

Abstracts (special dissemination session)

***Fioresi**, Rita*

Deep Learning and the Artificial Intelligence Revolution

The Deep Learning algorithm has accelerated the artificial intelligence revolution occurred at the turn of the millennium and transformed our world into science fiction territory. In this expository talk we will explain briefly the evolution of the algorithm, through the past few decades and its impact on the scientific research and on our everyday life.

***Tekel**, Juraj*

What do microwave and X-ray have in common? And what does quantum gravity have to do with it?

Microwave heats up your food, X-ray can see through your luggage at the airport or help doctors to see through your body. It is probably no secret that both these properties use different forms of electromagnetic radiation. We will describe what this radiation is but most importantly explain why its discovery in the late 19th century was one of the most fascinating moments of the history of physics. And how this experience and knowledge motivates us in the search of the ultimate theory of quantum gravity.

Abstracts (general)

Abenda, Simonetta

Spectral Data for Real Regular KP solutions on Rational Degenerations of M-curves and tropical M-curves

In recent papers D. Agostini et al. [1,2] and T. Ichikawa [3] have proven that real theta functions associated with periods of tropical curves have tropical limits as KP solutions. In a series of papers in collaboration with P.G. Grinevich [4-8] we have used the combinatorial structure of the totally non-negative real Grassmannians to explicitly construct the spectral data for the family of real regular KP multi-line solitons on reducible rational M-curves and we have proven that the desingularization of such data leads to real regular quasi-periodic solutions to the KP equation on smooth M-curves. More precisely, each real regular KP soliton family is represented by a positroid cell in the totally non-negative part of a real Grassmannian. Each planar bicolored graph representing this positroid cell in Postnikov's classification [9] is dual to the topological model of the reducible M-curve. The KP divisor for the soliton solution is then obtained solving a system of relations on such graph. Finally, Dubrovin-Natanzon theorem [10], which characterizes the reality and regularity of the desingularized KP solution, holds true if and only the soliton data are in the totally non-negative part of the Grassmannian. Thus, we have proven that each graph in Postnikov classification can be used to provide the model of the tropical limit of a smooth M-curve.

[1] D. Agostini, T.O. Çelik, J. Struwe, B. Sturmfels, Vietnam J. Math. 49 (2021), no. 2, 319-347. [2] D. Agostini, C. Fevola, Y. Mandelshtam, B. Sturmfels,, J. Symb. Comp 114 (2023), 282–301 [3] T. Ichikawa, Comm. Math. Phys.402 (2023), no.2, 1707-1723. [4] S. Abenda, Math. Phys. Anal. Geom. 24 (2021), Art. 35: 64 pp. [5] S. Abenda, P.G. Grinevich, Commun. Math. Phys. 361 Issue 3 (2018) 1029–1081. [6] S. Abenda, P.G. Grinevich, Proc. Steklov Inst. Math. 302 (2018), no. 1, 1-15. [7] S. Abenda, P.G. Grinevich, Sel. Math. New Ser. 25, no. 3 (2019) 25:43. [8] S. Abenda, P.G. Grinevich, Lett. Math. Phys. 112 (2022), no. 6, Paper No. 115, 64 pp. [9] A. Postnikov "Total positivity, Grassmannians, and networks.", arXiv:math/0609764 [math.CO]. [10] B. Dubrovin and S. Natanzon. Math. USSR-Izv. 32 (1989), no. 2, 269-288.

Anguelova, Lilia

Hidden Symmetries and the Dark Universe

With the help of hidden symmetries, one can find exact cosmological solutions that describe dark matter and dark energy. We explain how this method works for multifield cosmological models, which arise from the coupling of many scalar fields to gravity. Then we focus on a particular class of exact solutions in two-field models,

which behave as dark energy. We show that these solutions have an equation-of-state parameter very close to -1 (just like a cosmological constant), but nevertheless can have observationally distinct features due to the specific behavior of the perturbations around them.

Angulo, Jesus Gustavo

Lattice theory and algebraic models for deep learning based on mathematical morphology

The Matheron-Maragos-Banon-Barrera (MMBB) [Matheron75, Maragos89, Banon91] representation theorems provide an astonishing general formulation for any nonlinear operator between complete lattices, based on combinations of infimum of dilations and supremum of erosions. The theory is relevant when the basis (minimal kernel) of the operators can be learnt. In the case of non-increasing or non-translation-invariant operators the constructive decomposition of operators becomes more complex but would still be based on basic morphological dilation, erosion, anti-dilation and anti-erosion. In this talk, I will first discuss the theoretical interest of the MMBB representation theory to model nonlinear layers and operators in deep learning networks and to highlight their interest to propose more general nonlinearity activations and layers [Velasco-Forero22a].

Any network architecture combining convolution, down/up-sampling, ReLUs, etc. could be seen at first sight as incompatible with a lattice theory formulation. In fact, as it was shown by Keshet [Keshet02, Keshet03], low-pass filters, decimation/interpolation, Gaussian-

-Laplacian pyramids and other typical image processing operators, admit an interpretation as erosions and adjunctions in the framework of (semi)-lattices. In addition, max-pooling and ReLUs are just dilation operators. The notion of deepness or recurrence in a network can be seen as the iteration of basic operators. In the second part of the talk, I will therefore discuss a complete theoretical formulation of deep learning networks in terms of morphological operators and point out some open questions on the fixed points [Velasco-Forero22b] and the study of order stability in the corresponding (semi-)lattices [Hejmans92].

[Banon91] G.J.F. Banon, J. Barrera. Minimal representations for translation-invariant set mappings by mathematical morphology. SIAM Journal Applied Mathematics, 51(6): 1782-1798, 1991. [Hejmans92] H.J.A.M. Hejmans, J. Serra. Convergence, continuity, and iteration in mathematical morphology. Journal of Visual Communication and Image Representation, 3(1): 84-102, 1992. [Keshet02] R. Keshet. A Morphological View on Traditional Signal Processing. In Mathematical Morphology and its Applications to Image and Signal Processing. Computational Imaging and Vision, Vol 18. Springer, 2002. [Keshet03] R. Keshet, H.J.A.M. Heijmans. Adjunctions in Pyramids, Curve Evolution and Scale-Spaces. International Journal of Computer Vision, 52: 139-151, 2003. [Matheron75] G. Matheron. Random sets and integral geometry. NewYork, Wiley, 1975. [Maragos89] P. Maragos. A repre-

sentation theory for morphological image and signal processing. IEEE Transactions on Pattern Analysis and Machine Intelligence, 2(6): 1989. [Velasco-Forero22a] S. Velasco-Forero, J. Angulo. MorphoActivation: Generalizing ReLU Activation Function by Mathematical Morphology. In: Discrete Geometry and Mathematical Morphology. DGMM 2022. Lecture Notes in Computer Science, vol 13493. Springer, 2022 [Velasco-Forero22b] S. Velasco-Forero, A. Rhim, J. Angulo. Fixed point layers for geodesic morphological operations. In: BMVC. London, United Kingdom, 2022.

***Aschieri**, Paolo*

Noncommutative geometry and physics, old and new

Quantum physics sparkled the study of noncommutative geometry more than a century ago. Since then the interplay between this area of mathematics and physics has been growing. In this overview we present a nontechnical introduction and review motivations and applications of the study of noncommutative geometry, ranging from the quest for a quantum theory of gravitational interactions to models of artificial intelligence based on deep learning neural networks.

***Barhoumi**, Yacine*

Max-independance structures in integrable probability

We consider classical models of random partitions and random matrices. We show that the extremal functionals (eigenvalue and part of the partition) can be written as maxima of independent random variables. The random variables use Painlevé functions (continuous and discrete in the case of random partitions) and can be used to find the Tracy-Widom distribution.

***Carotenuto**, Alessandro*

The complex geometry of the full flag manifold of quantum SU_3

I will report on a work in collaboration with Réamonn Ó Buachalla and Junaid Razzaq on a quantum deformation of the complex geometry of the full flag manifold of SU_3, probably the simplest non-irreducible case of flag manifold. This is given by a quantum De Rham complex that includes the calculus already discovered by Ó Buachalla and Somberg as its holomorphic part. I shall review this construction that makes use of Lusztig quantum root vectors, while at the same time giving a general overview of the theory of noncommutative differential calculi for quantum homogeneous spaces.

***Dimitrov**, Ivan*

Inversion sets of roots

I will provide a recursive description of all decompositions of the positive roots

of a root system into disjoint unions of inversion sets. This description is type-independent and generalizes the analogous result for the symmetric groups, i.e., for type A root systems. The main tool is the notion of an inflation of a subset of a quotient root system. This new notion allows us to treat all root systems uniformly. I will also mention some numerical results about the number of special decompositions. The sequences obtained in this way may be considered as extensions of Catalan numbers.

***Fioresi**, Rita*

Mathematical models for the visual pathway and Deep Learning

We present a simple mathematical model for the mammalian low visual pathway, taking into account its key elements: retina, lateral geniculate nucleus (LGN), primary visual cortex (V1). With this model and the help of sub-Riemannian geometry, we show solutions to the contour completion problem and we related it to bike rear wheel paths. The analogies between the cortical level of the visual system and the structure of popular CNNs, used in image classification tasks, suggests the introduction of an additional preliminary convolutional module inspired to precortical neuronal circuits to improve robustness with respect to global light intensity and contrast variations in the input images. We validate our hypothesis on the popular databases.

***Gateva-Ivanova**, Tatiana*

Algebras defined by Lyndon words and Artin-Schelter regularity

Let $X = \{x_1 \cdots x_n\}$ be a finite alphabet, and let K be a field. We study classes $C(X, W)$ of graded K-algebras , generated by X and with a fixed set of obstructions W. Initially we do not impose restrictions on W and investigate the case when the algebras in $C(X, W)$ have polynomial growth and finite global dimension . Next we consider classes of algebras whose sets of obstructions are antichains of Lyndon words. The central question is "when a class C(X, W) contains Artin-Schelter regular algebras?" Each class defines a Lyndon pair (N, W), which, if N is finite, determines uniquely the global dimension, gldim A, and the Gelfand-Kirillov dimension, GKdim A , for every algebra A in $C(X, W)$. We find a combinatorial condition in terms of (N, W), so that the class contains the enveloping algebra , of a Lie algebra g. We introduce monomial Lie algebras defined by Lyndon words, and prove results on Gröbner-Shirshov bases of Lie ideals generated by Lyndon-Lie monomials. Finally we classify all two-generated and all three-generated, Artin-Schelter regular algebras of global dimension at most 10 and occurring as enveloping U = Ug of standard monomial Lie algebras g. The classification is made in terms of their Lyndon pairs (N, W), each of which determines also the explicit relations of g and Ug. The classification is found in a joint work with Violeta Ivanova-Rohling.

Hristova, Elitza

Some relatively free algebras and their structure as GL(n)-modules

Let V be an n-dimensional vector space over a field K of characteristic 0 and let $T(V)$ denote the tensor algebra of V. We define a sequence of ideals in $T(V)$ $I_2 \supset I_3 \supset \cdots \supset I_p \supset \cdots$ in the following way: For any integer $p \geq 2$, I_p is the two-sided associative ideal generated by all commutators $[u_1, \ldots, u_p]$ of length p, where we define recursively $[u_1, \ldots, u_p] = [[u_1, \ldots, u_{p-1}], u_p]$ for all $u_1, \ldots, u_p \in T(V)$ and $[u_1, u_2]$ is the usual double commutator in $T(V)$. The quotient algebra $T(V)/I_{p+1}$ is an example of a relatively free algebra of rank n. The group $\mathrm{GL}(n) := \mathrm{GL}(n, K)$ acts in a natural way on $T(V)/I_{p+1}$ and the $GL(n)$-module structure of $T(V)/I_{p+1}$ is known for $p = 1, 2, 3, 4$. In this talk, we discuss some results on the $\mathrm{GL}(n)$-module structure of $T(V)/I_{p+1}$ for any p. We give a bound on the values of partitions λ such that the irreducible $\mathrm{GL}(n)$-module corresponding to the partition λ appears with nonzero multiplicity in the $\mathrm{GL}(n)$-decomposition of $T(V)/I_{p+1}$. We discuss also applications of these results related to the subalgebras of G-invariants in $T(V)/I_{p+1}$, where we take G to be one of the classical groups $\mathrm{SL}(n)$, $\mathrm{O}(n)$, $\mathrm{SO}(n)$, $\mathrm{Sp}(2s)$ (for $n = 2s$), and $\mathrm{UT}(n)$.

Ivanova-Rohling, Violeta

On monomial Lie algebras defined by Lyndon words

It is known that the standard bracketings of Lyndon words in a finite alphabet A form a basis for the free Lie algebra $Lie(A)$ generated by A . All finitely presented Lie algebras have the form $g = Lie(A)/J$, where J is a Lie ideal generated by a finite number of relations. We study monomial Lie algebras, where J is generated by Lie monomials on Lyndon words and investigate when does a set of Lyndon monomials on 2 or 3 generators define a Lie algebra with a prescribed dimension. We classify all such Lie algebras with dimension at most 10. This is a joint work with Tatiana Gateva-Ivanova.

Kaad, Jens

Spectral metrics on quantum projective spaces

A spectral metric space is a unital spectral triple satisfying that the coordinate algebra becomes a compact quantum metric space via the seminorm which measures the size of first order derivatives. In this talk we investigate the spectral metric properties of quantum projective spaces. The geometric framework for this investigation is provided by the unital spectral triples introduced by D'Andrea and Dabrowski in their CMP paper from 2010. We shall see that these unital spectral triples are in fact spectral metric spaces and, if time permits, indicate how this can be proved. This result makes it possible to investigate the spectral metric continuity properties of quantum projective spaces under variations of the deformation parameter q. It can moreover be viewed as a first step for understanding the higher Vaksman-Soibelman

spheres from the point of view of spectral metric spaces. The talk is based on joint work with Max Holst Mikkelsen.

***Krutov**, Andrey*

Clifford algebra analogue of the Cartan theorem

Let $\mathfrak{g}$ be a complex simple Lie algebra. The Hopf-Koszul-Samelson theorem asserts that the algebra of $\mathfrak{g}$-invariants in the exterior algebra of $\mathfrak{g}$ is the exterior algebra over the space of primitive invariants P. Kostant proved the analogous result for the Clifford algebra of $\mathfrak{g}$. Namely, the algebra of $\mathfrak{g}$-invariants in $Cl(\mathfrak{g})$ is the Clifford algebra over the space of primitive invariants. Let $\mathfrak{k}$ be a symmetric subalgebra of $\mathfrak{g}$ and $\mathfrak{p}$ be the corresponding isotropy representation. The Cartan theorem states that the algebra of $\mathfrak{k}$-invariants in the exterior algebra of $\mathfrak{p}$ is isomorphic to the tensor product of the exterior algebra of the Sameson subspace of P, corresponding to the pair $(\mathfrak{g}, \mathfrak{k})$, and a certain commutative algebra A. We prove a Clifford algebra analogue of the Cartan theorem. Namely, we show that the algebra of $\mathfrak{k}$-invariants in $Cl(\mathfrak{p})$ is the tensor product of the Clifford algebra over the space of primitive invariant of $\mathfrak{p}$ with a certain filtered deformation of A. This is joint work with K. Calvert, K. Grizelj, and P. Pandžić.

***Lledó**, Maria A.*

Science communication

I will expose the motives and the ways to do science communications in our society.

***McKay**, Benjamin*

Chern-Simons invariants of Cartan geometries

I will explain how to find equations constraining the Chern–Simons invariants of complex manifolds bearing holomorphic Cartan geometries.

***Mikhailov**, Alexander*

Commutative Poisson algebra from deformations of noncommutative algebras and non-Abelian Hamiltonian systems.

By a well–known procedure, usually referred to as "taking the classical limit", quantum systems become classical systems, equipped with a Hamiltonian stucture (symplectic or Poisson). From the deformation quantisation theory we know that a formal deformation of a commutative algebra $\mathcal{A}$ leads to a Poisson bracket on $\mathcal{A}$ and that the classical limit of a derivation on the deformation leads to a Hamiltonian derivation on $\mathcal{A}$ defined by the Poisson bracket. In this talk I present a generalisation of it for formal deformations of an arbitrary noncommutative algebra $\mathcal{A}$. A deformation leads in this case to a commutative Poisson algebra structure on $\Pi(\mathcal{A}) := Z(\mathcal{A}) \times (\mathcal{A}/Z(\mathcal{A}))$ and to the structure of a $\Pi(\mathcal{A})$-Poisson module on $\mathcal{A}$, where $Z(\mathcal{A})$ denotes the centre

of $\mathcal{A}$. The limiting derivations are then still derivations of $\mathcal{A}$, but with the Hamiltonians belong to $\Pi(\mathcal{A})$, rather than to $\mathcal{A}$. We illustrate our construction with several cases of formal deformations, coming from known quantum algebras, such as the ones associated with the Kontsevich integrable map, the quantum plane the quantised Grassmann algebra and quantisations of the Volterra hierarchy.
This talk is based on a joint work with Pol Vanhaecke.

***Niemi**, Antti*

Timecrystalline Vortices, Saddle Points and the Poincare Index Formula

Vortices in a Bose-Einstein condensate are modelled as spontaneously symmetry breaking minimum energy solutions of the time dependent Gross-Pitaevskii equation. In a non-rotating axially symmetric trap, the core of a single vortex precesses around the trap center and, at the same time, the phase of its wave function shifts at a constant rate. The precession velocity, the speed of phase shift, and the distance between the vortex core and the trap center, depend continuously on the value of the conserved angular momentum that is carried by the entire condensate. The number of vortices increases with increasing angular momentum, and the vortices repel each other to form timecrystalline Abrikosov lattices. Poincaré index formula states that besides vortices there are also saddle points, and the difference in the number of vortices and saddle points can never change. But unlike vortices the saddle points can also attract each other, they can join and become combined into timecrystalline degenerate critical point configurations. But when the number of saddle points becomes sufficiently large there is a transition, and instead of attracting each other, the saddle points start repelling each other, and pair up with vortices. The ensuing structures rotate around the trap center, in regular arrangements akin Abrikosov lattices.

***Pistalo**, Damjan*

The category of strong homotopy Lie Rinehart pairs

The first example of a strong homotopy Lie algebroid was the BV-BRST complex. In modern language, it appears when homotopy transfer is applied to a resolution of a Lie Rinehart pair by a semi-free dgc algebra and a graded projective dg module. However, a homotopy theory in which this phenomenon embeds does not yet exist: in the current homotopical algebra for Lie Rinehart pairs developed by J. Nuiten, the base is fixed, hence the formalism does not address its semi-free resolution. We show that, with the appropriate notion of weak equivalences, the full subcategory of pairs (A,M) with A a semi-free dgc algebra and M a cofibrant A-module is a category of fibrant objects. Apart from the above historical application, the formalism is expected to provide the correct notion of a cotangent complex of a general Lie Rinehart pair, enabling the study of shifted symplectic structures (introduced by Pym and Safranov for Lie algebroids over a smooth base), derived Lagrangian intersections etc.

***Popov**, Todor*

Landau problem and Dirac's remarkable SO(2,3)-representation

The Landau problem and harmonic oscillator in the plane share a Hilbert space that carries the structure of Dirac's remarkable so(2,3) representation. We show that the orthosymplectic algebra osp(1|4) is the spectrum generating algebra for the Landau problem. The 2D harmonic oscillator is in duality with the 2D quantum Coulomb-Kepler systems, with the osp(1|4) symmetry broken down to the conformal symmetry so(2,3). The Hilbert space of the Landau problem is a direct sum of two massless unitary so(2,3) representations, namely, the Di and Rac singletons introduced by Flato and Fronsdal.

***Razzaq**, Junaid*

Fundamental theorems of super invariant theory

The fundamental theorems of classical invariant theory characterizes the ring of invariants of special linear group via Plucker relations. In this talk, I will try to describe a 'super version' of these fundamental theorems for special linear supergroup characterizing the superalgebra of invariants via super Plucker relations.

***Santi**, Andrea*

On intransitive 3-nondegenerate CR manifolds in dimension 7

I will report on joint works with B. Kruglikov on CR hypersurfaces in C^4 with a degenerate Levi form. I will focus on 3-nondegenerate 7-dimensional CR real-analytic structures whose symmetry algebra g acts locally intransitively (i.e., there is no open orbit), discuss a variety of methods to obtain the bound 6 on the dimension of g and demonstrate the existence of infinitely many pairwise non-equivalent such CR-hypersurfaces with dim g = 6.

***Sciandra**, Andrea*

Noncommutative differential geometry on crossed product algebras

Principal bundles play a decisive role in differential geometry, topology and gauge theory. A generalization to quantum principal bundles on noncommutative algebras was proposed by H-J. Schneider in 1990 and T. Brzezinski, S. Majid in 1993, employing Hopf-Galois extensions. A class of Hopf-Galois extensions of particular interest is given by cleft extensions (crossed product algebras) with its subclass of trivial extensions (smash product algebras). We generalize the construction of the covariant calculus on smash product algebras given by M. Pflaum and P. Schauenburg to the case of crossed product algebras, requiring a compatibility condition between the differential on the base algebra and the 2-cocycle involved. We further give a classification of the smash product calculus in terms of the differentials of the cleaving and inclusion maps. Moreover, higher order forms are constructed and we

prove that the crossed product calculus forms a quantum principal bundle which is regular and strong. We also describe the induced bimodule covariant derivatives on all associated bundles. As an application of our construction we provide a calculus on some examples of pointed Hopf algebras. Joint work with Thomas Weber.

Staicova, Denitsa

Probing for Lorentz Invariance Violation in Pantheon Plus Dominated Cosmology

The Hubble tension in cosmology is not showing signs of alleviation and thus, it is important to look for alternative approaches to it. One such example would be the eventual detection of a time delay between simultaneously emitted high-energy and low-energy photons in gamma-ray bursts (GRB). This would signal a possible Lorentz Invariance Violation (LIV) and in the case of non-zero quantum gravity time delay, it can be used to study cosmology as well. In this work, we use various astrophysical datasets (BAO, Pantheon Plus and the CMB distance priors), combined with two GRB time delay datasets with their respective models for the *intrinsic time delay*. Since the intrinsic time delay is considered the largest source of uncertainty in such studies, finding a better model is important. Our results yield as quantum gravity energy bound EQG=1017 GeV and EQG=1018 GeV respectively. The difference between standard approximation (constant intrinsic lag) and the extended (non-constant) approximations is minimal in most cases we coincide. However, the biggest effect on the results comes from the prior on the parameter cH0rd, emphasizing once again that at current precision, cosmological datasets are the dominant factor in determining the cosmology. We estimate the energies at which cosmology gets significantly affected by the time delay datase

Stoilova, Neli

$Z_2 \times Z_2$-graded Lie (super)algebras and generalized quantum statistics

We construct classes of $Z_2 \times Z_2$-graded Lie algebras and superalgebras corresponding to the classical Lie algebras and some basic classical Lie superalgebras in terms of defining matrices. We also give examples and possible applications to quantum statistics.

Strung, Karen

Realising quantum flag manifolds as graph C*-algebras

In this talk I will show how the C*-completions of the so-called quantum flag manifolds—noncommutative spaces arising as homogeneous spaces of quantum groups—can be realised as graph C*-algebras. After recalling the definition of a quantum flag manifold and its C*-algebra, I will describe how to compute the primitive ideal space using Dijkhuizen and Stokmann's description of a complete set of irreducible *-representations. This allows one to to construct a graph directly from the Weyl group

of the associated Lie algebra, and appeal to classification results of Eilers, Ruiz and Sorensen to show that this graph C*-algebra is isomorphic to the C*-algebra of the relevant quantum flag manifold. This recovers some known isomorphisms between the C*-algebras of quantum flag manifolds, as well as determining surprising new ones.
Joint work with Tomasz Brzeziński, Ulrich Krähmer, and Réamonn Ó Buachalla.

***Tekel**, Juraj*

Connection unexpected – a case study in science outreach

For several years I have been hosting a YouTube series of videos presenting various physical concepts to the general public. The hallmark of the series is in describing two different scenarios, where the same principle applies and bringing it closer to people in this way. In this talk I will describe my approach, motivations, ideas, the production of such material and also explain what I have learned over the years.

***Terzic**, Svjetlana*

Toric topology of Grassmann manifolds and weighted stable curves

We discuss how the category of the moduli spaces of weighed stable curves of genus zero can be modelled by the orbit spaces of the Grassmann manifolds regarded to the canonical action of the maximal compact torus. Special attention will be devoted to the Losev-Manin spaces which parametrize the stable genus zero curves endowed with smooth painted by black and white points. The talk is based on the joint work with Victor M. Buchstaber.

***The**, Dennis*

On 4D split-conformal structures with G2-symmetric twistor distribution

In their 2014 article, An & Nurowski considered two surfaces rolling on each other without twisting or slipping, and defined a twistor distribution (on the space of all real totally null self-dual 2-planes) for the associated 4D split-signature conformal structure. If this split-conformal structure is not anti-self dual, then the twistor distribution is a (2,3,5)-distribution, and An-Nurowski identified interesting rolling examples where it achieves maximal, i.e. G2, symmetry. Relaxing the rolling assumption, a similar construction can be made for any 4D split-conformal structure, and my talk will discuss a broader classification of examples where such exceptional symmetry for the twistor distribution is achieved. (Joint work with Pawel Nurowski & Katja Sagerschnig.)

***Trenchevski**, Kostadin*

Geometrical description and structure of the photon and electron

In this paper it is given a geometrical model of the photon. It is based on the properties of the space-time and the properties of the spinning bodies. The basic properties

of the photons (angular momentum, speed, electromagnetic field and speed of time) are derived. This description leads to a description of the electron as a large number of photons. It is also given the interaction between the electron and the photons.

***Tsanov**, Valdemar*

Linear embeddings between flag varieties

Equivariant embeddings of complex flag varieties are associated to monomorphisms of complex reductive Lie groups and suitable choices of parabolic subgroups. I will discuss the notion of linearity for such embeddings from several aspects related to Picard groups, Gaussian fundamental forms, Root systems, momentum maps.

***Wang**, Jing Ping*

Symmetries of Differential-Difference Equations

In this talk, we'll discuss symmetries of differential-difference equations (DDEs) and their applications. A DDE is a functional relation among functions and their derivatives calculated at several points of a lattice. Typical examples are Volterra chain and Toda lattice equations. A DDE may possess discrete symmetries, continuous point symmetries and Lie algebras of infinitesimal symmetries. Symmetry reductions enable one to study symmetry-invariant solutions of DDEs and link them with finite dimensional dynamical systems and Painleve equations. For integrable equations, the existence of infinite hierarchies of symmetries can be regarded as the definition of their integrability. We'll present the recent classification result for scalar integrable differential-difference equations.

***Weber**, Thomas*

On the Durdevic approach to quantum principal bundles

In this talk we revisit the noncommutative differential geometry framework developed by M. Durdevic in the 90's. Starting from a Hopf-Galois extension, a bicovariant differential calculus on the structure Hopf algebra and a complete calculus on the total space algebra, we introduce vertical, horizontal and basic forms. These are related via the noncommutative Atiyah sequence and we obtain a graded Hopf-Galois extension, amplifying the initial data. The total space algebra and complete calculus further admit a natural braiding operation induced from the (graded) translation map. We spell out the above structures explicitly for the noncommutative 2-torus and the quantum Hopf fibration and further discuss examples on crossed product calculi. This is based on collaborations with A. Del Donno, E. Latini and A. Sciandra.

***Yuncken**, Robert*

Crystallised function algebras on compact semisimple Lie groups

When Woronowicz introduced the C^*-algebra of continuous functions on the compact quantum group $SU_q(2)$, he observed that it is isomorphic to a graph C^*-algebra

by considering its limit as q goes to 0. Hong-Szymanksi and Giselsson generalized this result to quantum projective spaces and $SU_q(3)$ respectively. We will show how these $q = 0$ limits can be obtained from Kashiwara and Lusztig's crystal basis theory, and hence obtain the crystal limit of any function algebra of a compact semisimple Lie group as a higher-rank graph algebra. (Joint work with M. Matassa)

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