Cost Action CaLISTA General Meeting 2025

Cartan, Generalised and Noncommutative Geometries, Lie Theory and Integrable Systems Meet Vision and Physical Models

SEPTEMBER 14 - SEPTEMBER 22, 2025

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Scientific Programme

1 Program Summary

Monday, September 15, 2025

9:00	9:30	Slovak, Jan	Effective normalization of sub-Riemannian connections
9:30	10:00	The, Dennis	Geometry of (3,6)-distributions: structure and models
10:00	10:30	**Coffee Break**	
10:30	11:00	Iseppi, Roberta Anna	Towards the Quantisation of the Spectral Action: A Geometric BV Approach
11:00	11:30	Krutov, Andrey	Quantised sl(2)-differential algebras
11:30	12:00	**Coffee Break**	
12:00	12:30	Boffo, Eugenia	Braidings in BV
12:30	13:00	Sagerschnig, Katja	On a class of parabolic geometries
13:00	17:00	**Lunch**	
17:00	17:30	Dimitrijevic Ćirić, Marjia	Phenomenological implications of D=4 braided NC gravity
17:30	18:00	Vysoky, Jan	Graded Lie groups with Examples
18:00	18:20	**Coffee Break**	
18:20	18:50	Valach, Fridrich	Geometry of supergravity and the Batalin-Vilkovisky formulation of the N=1 theory in 10 dimensions
18:50	19:10	Smolka, Rudolf	Frobenius Theorem for Graded Manifolds
19:10	19:30	Dalak, Frederik	Generalized Palatini formalism
20:00	23:00	**Welcome Reception**	

Tuesday, September 16, 2025

9:00	9:30	Penati, Silvia	Super-Higher-Form Symmetries
9:30	10:00	Brzezinski, Tomasz	Remarks On Differential Structures On Quantum Spheres
10:00	10:30	**Coffee Break**	
10:30	11:00	Martinetti, Pierre	Entropy on the Bloch sphere from the spectral action
11:00	11:30	Borowiec, Andrzej	Hopf Algebra Coderivations and Quantum Groups
11:30	12:00	**Coffee Break**	
12:00	12:30	Ramgoolam, Sanjaye	Simple harmonic oscillators from non-semisimple walled Brauer algebras.
12:30	13:00	Lescano, Eric	From Gauge Theory to Gravity: Classical Double Copy as a Path to Higher-Derivative Corrections
13:00	14:00	CaLISTA Round Table	P Aschieri, K Anagnostopoulos, I Moraiti, S Stefas, T Weber, G Zoupanos
14:00	17:00	**Lunch**	
17:00	17:30	Stoilova, Nedialka	Coloring of some simple Lie (super)algebras
17:30	18:00	Di Cosmo, Fabio	Field strengths in Poisson Electrodynamics
18:00	18:20	**Coffee Break**	
18:20	19:00	Poster Session	M. Hrmo, S. Kovacik, R. Moron-Sanz, P. Rusnak

Wednesday, September 17, 2025

9:00	9:30	Majid, Shahn	Variational calculus on quantum spacetime
9:30	10:00	O Buachalla, Reamonn	Borel-Weil-Bott theorems in quantum Riemannian geometry
10:00	10:30	**Coffee Break**	
10:30	11:00	Carotenuto, Alessandro	Convex Orderings and quantum tangent spaces
11:00	11:30	Benvenuti, Silvia	Dissemination: What, Who, Where, When, Why??
11:30	12:00	**Coffee Break**	
12:00	12:30	Minguzzi, Manuela	Horizon Europe and Marie Sklodowska Curie Actions: opportunities for research, networking and disseminating knowledge
12:30	13:00	Fornaini, Matteo	The Antikythera Mechanism: A Hellenistic Calculating Machine in the Archimedean Tradition and Its Modern Geometrical Simulations
13:00	17:00	**Lunch**	
17:00	17:30	Pistalo, Damjan	Homotopy theory for Lie algebroids
17:30	18:00	Chirco, Goffredo	Measuring quantum complexity in quantum spacetime
18:00	18:20	**Coffee Break**	
18:20	18:40	Burridge, Joseph	Fuzzy Geometries with an Internal Space
18:40	19:00	Stefas, Stelios	4D Fuzzy Gravity on a Covariant Noncommutative Space and Unification with Internal Interactions
19:30	0:30	**Greek Night**	

Thursday, September 18, 2025

9:00	9:30	Landi, Giovanni	Monopoles and instantons on quantum spheres
9:30	10:00	Steinacker, Harold	Quantum Geometry of Data (and Spacetime)
10:00	10:30	**Coffee Break**	
10:30	11:00	Pagani, Chiara	Push-forward of Hopf-Galois extensions
11:00	11:30	Fioresi, Rita	Geometric Deep Learning meets Quantum Groups
11:30	12:00	**Coffee Break**	
12:00	12:30	Velasco-Forero, Santiago	A Tropical Geometry Perspective on Learning from Data: Challenges and Opportunities
13:00	14:00	**COST General Meeting**	
14:30	19:30	**Excursion**	
21:30	23:30	**Concert**	

Friday, September 19, 2025

9:00	9:30	Bieliavsky, Pierre	Kinematical Lie algebras and sub-Riemannian manifolds
9:30	10:00	Jonke, Larisa	From noncommutative Yang-Mills to noncommutative gravity (through a classical double copy map)
10:00	10:30	**Coffee Break**	
10:30	11:00	Chatzistavrakidis, Athanasios	Basic curvature tensors
11:00	11:30	Basile, Thomas	Supersymmetric Poisson sigma models, revisited
11:30	12:00	**Coffee Break**	
12:00	12:30	Freidel, Laurent	Asymptotic Higher spin symmetry in gravity
12:30	13:00	Ho, Pei-Ming	Quantum Geometry and Hawking Radiation
13:00	17:00	**Lunch**	
17:00	17:30	Tekel, Juraj	Matrix ensembles from fuzzy physics: the good, the bad, the ugly
17:30	18:00	Markov, Mikhail	Asymptotic structure of gravity in the BV-AKSZ formalism
18:00	18:20	**Coffee Break**	
18:20	18:40	Benner, Julius	Codifferential Calculi and quantum homogeneous spaces
18:40	19:00	Razzaq, Junaid	Complex Structures for the Full Quantum Flag Manifold of Quantum SU(3)

Saturday, September 20, 2025

9:00	9:30	Castellani, Leonardo	L - infinity structure of Free Differential Algebras and d=11 Supergravity
9:30	10:00	O'Connor, Denjoe	Gauged Matrix Models
10:00	10:30	**Coffee Break**	
10:30	11:00	Rivasseau, Vincent	Tensor Track IX: Cumulants
11:00	11:30	Martin, Carmelo Perez	Entanglement, scattering and NCQED
11:30	12:00	**Coffee Break**	
12:00	12:30	Tsuchiya, Asato	Emergence of (3+1)-dimensional expanding spacetime in the Lorentzian type IIB matrix model
12:30	13:00	Asano, Yuhma	Path integral for the closed superstring and the matrix model
13:00	17:00	**Lunch**	
17:00	17:30	Sasakura, Naoki	Universality of eigenvalue distributions of random tensors
17:30	17:50	Seko, Tatsuya	Regularization of matrices in the covariant derivative interpretation of the type IIB matrix model
17:50	18:10	**Coffee Break**	
18:10	18:30	Maris, Valentine	Star-products for Lie-algebraic noncommutative Minkowski space-times
18:30	18:50	Massar, Arthur	Quantization of the Poincaré group as locally compact quantum group

Sunday, September 21, 2025

9:00	9:30	Lizzi, Fedele	Mixed in Translations
9:30	10:00	Fiore, Gaetano	Generalized group structures for changes of quantum reference frames: the θ-Poincaré case
10:00	10:30	**Coffee Break**	
10:30	11:00	Driezen, Sibylle	Jordanian-twisted strings and spins: integrability and spectrum
11:00	11:30	Osten, David	Generalised Cartan Geometry

2 Detailed Program with Abstracts

2.1 Monday, September 15, 2025

Time: 9:00 – 9:30
Speaker: Slovak, Jan (Masaryk University)
Title: Effective normalization of sub-Riemannian connections
Abstract: I shall report on a recent paper by Erlend Grong and myself, see arXiv:2508.00108, giving a new normalization condition for connections on sub-Riemannian manifolds with constant symbols. The condition is formulated in terms of Cartan connections and depends only on the first degree of homogeneity of the resulting curvature. The essential part of our result is to show how a Cartan connection can be uniquely determined by a partial connection on the horizontal bundle. Viewed from the manifold, this observation is equivalent to the following claim: a compatible partial affine connection can be uniquely extended to both a full affine connection and a grading of the tangent bundle, and our normalization ensures that the holonomy of this connection will coincide with the horizontal holonomy, i.e., related to horizontal paths only.

Time: 9:30 – 10:00
Speaker: The, Dennis (UiT The Arctic University of Norway)
Title: Geometry of (3,6)-distributions: structure and models
Abstract: I'll report on some recent joint work with Omid Makhmali and Travis Willse in which we use parabolic geometry theory to explore the geometry of (3,6)-distributions. I'll discuss some interesting examples, give a partial analogue of the Cartan-Petrov classification, and discuss holonomy and BGG equations for such structures.

Time: 10:30 – 11:00
Speaker: Iseppi, Roberta Anna (University of Göttingen)
Title: Towards the Quantisation of the Spectral Action: A Geometric BV Approach
Abstract: The quantisation of the spectral action remains one of the central open problems in the development of noncommutative geometry towards fundamental physics. A key obstacle is the proper treatment of gauge symmetries in the noncommutative setting. In this talk, I will present recent progress in this direction, based on an adaptation of the geometric Batalin–Vilkovisky (BV) formalism to the context of Chern–Simons and Yang–Mills-type theories formulated in terms of differential forms on noncommutative manifolds. This framework provides a natural setting for handling gauge symmetry at a homological level and offers a promising route for defining a perturbative expansion of the spectral action. After outlining the general construction, I will focus on the explicit case of matrix geometries, where computations become more concrete and illustrative. This is joint work with T. Krajewski and C. Pérez

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Time: 11:00 – 11:30
Speaker: Krutov, Andrey (Charles University)
Title: Quantised sl(2)-differential algebras
Abstract: We propose a definition of a quantised sl(2)-differential algebra and show that the quantised exterior algebra (defined by Berenstein and Zwicknagl) and the quantised Clifford algebra (defined by the authors) of sl(2) are natural examples of such algebras. We discuss the corresponding Poisson geometry of the classical limit q->1. Bases on joint works with P. Pandžić (arXiv:2209.09591 and arXiv:2403.08521)

Time: 12:00 – 12:30
Speaker: Boffo, Eugenia (Charles University Prague)
Title: Braidings in BV
Abstract: A modern area of interest and applications for quantum groups is the Batalin-Vilkovisky formalism for gauge theories. This framework for the perturbative quantization of field theories is nowadays expressed also in terms of deformation retracts and the homological perturbation lemma. Thus far, the perturbative BV framework could be extended to the braided setting with triangular R-matrices. In this talk, I will present some work in progress with Krutov and Weber, aimed at providing the extension to the quasi-triangular case. A preliminary, toy model example for the classical case, constructed with Ravas and Pulmann, will be discussed along the way.

Time: 12:30 – 13:00
Speaker: Sagerschnig, Katja (Center for Theoretical Physics, Polish Academy of Sciences)
Title: On a class of parabolic geometries
Abstract: I will introduce parabolic geometries with a focus on two examples, namely, conformal structures and (2,3,5)

distributions. Then I will discuss results about these geometries and explain how they are related.

Time: 17:00 – 17:30
Speaker: Dimitrijevic Ćirić, Marjia (University of Belgrade, Faculty of Physics)
Title: Phenomenological implications of D=4 braided NC gravity
Abstract: In this talk, we discuss some phenomenological implications of the recently constructed braided NC gravity in D=4. The model is based on the braided NC diffeomorphism and braided local Lorentz symmetries and the corresponding action is uniquely determined by the underlying braided L-infinity algebra. Somehow unexpectedly, we find that this model shares the identical three-graviton vertex with the twisted gravity model constructed in hep-th/0504183. This work can be seen a step towards understanding the diverse landscape of NC gravity models constructed within the star-product framework.

Time: 17:30 – 18:00
Speaker: Vysoky, Jan (Czech Technical University)
Title: Graded Lie groups with Examples
Abstract: Lie groups and their algebras are fundamental mathematical objects of differential geometry. We show how their analogue is brought into the realm of graded manifolds. Standard aspects of graded Lie theory are discussed. We focus on examples, namely of graded versions of general, orthogonal and symplectic Lie groups.

Time: 18:20 – 18:50
Speaker: Valach, Fridrich (Charles University, Prague)
Title: Geometry of supergravity and the Batalin-Vilkovisky formulation of the N=1 theory in 10 dimensions
Abstract: We clarify the geometric structure of N=1 D=10 supergravity and present its full Batalin-Vilkovisky formulation in the background independent component field formalism coming from generalised geometry. This is a joint work with Julian Kupka and Charles Strickland-Constable.

Time: 18:50 – 19:10
Speaker: Smolka, Rudolf (Czech Technical University in Prague)
Title: Frobenius Theorem for Graded Manifolds
Abstract: One of the fundamental theorems in differential geometry, the Frobenius theorem is often stated in two parts. The so-called local Frobenius theorem states that a smooth distribution is involutive if and only if it is integrable. The so-called global Frobenius theorem then states that every integrable distribution is given by a unique regular foliation. In this talk we revisit the theorem in the category of Z-graded manifolds, though the discussion applies to other gradings as well. We will see that one needs to be careful with the definition of integrable distribution and integral sumbanifold. These can be given in several ways that are equivalent in non-graded geometry, but not so in graded geometry.

Time: 19:10 – 19:30
Speaker: Dalak, Frederik (Charles University Prague)
Title: Generalized Palatini formalism
Abstract: Palatini formalism in classical geometry is a well-known approach to obtain the equations of general relativity by considering both the metric and the connection as independent variables in the action. Recently this formalism has been shown to transcend remarkably well into the setting of generalized geometry. Our aim here is to highlight the advantages this formalism has in the generalized setting compared to the classical one and outline the interesting possible directions of research where it may find applications.

2.2 Tuesday, September 16, 2025

Time: 9:00 – 9:30
Speaker: Penati, Silvia (University of Milano-Bicocca)
Title: Super-Higher-Form Symmetries
Abstract: Higher-form symmetries have revealed to be a crucial piece of information in any QFT. I will generalize their construction to theories with supersymmetry. Using a supergeometry formulation, I will discuss how topological higher-form symmetries nicely combine with supersymmetry to give rise to a brand-new set of super-higher-form symmetries, including new geometric-Chern-Weil symmetries, whose generators are constructed using invariant differential forms in

supermanifolds. The case of super-Maxwell theory in various dimensions will be used as an explanatory example.

Time: 9:30 – 10:00
Speaker: Brzezinski, Tomasz (University of Bialystok and Swansea University)
Title: Remarks On Differential Structures On Quantum Spheres
Abstract: Bimodule of one-forms of a two-dimensial differential calculus on the coordinate algebra of the standard Podle ́s or quantum sphere O(S_q^2) has a natural intepretation as the direct sum E2 ⊕ E−2 of modules of sections on non-commutative line bundles over S_q^2 with topological charges ±2. In this talk we address the following question: is such an interpretation possible for nonstandard Podles two-spheres? The results presented have been obtained in collaboration with Reamonn O Buachalla (Charles University, Prague) as a part of joint project Quantum geometric representation theory and noncommutative fibrations, funded by the NCN grant WEAVE-UNISONO 2023/05/Y/ST1/00046.

Time: 10:30 – 11:00
Speaker: Martinetti, Pierre (Università di Genova and INFN)
Title: Entropy on the Bloch sphere from the spectral action
Abstract: I will present some preliminary results, obtained in collaboration with Axel Priou, regarding the entropy defined by Connes, Chamseddine and v. Suijlekom in 2018, using the spectral action. In particular we will see how the entropy on the Bloch sphere (seen as the pure state space of the algebra of complex 2x2 matrices) does not only depend on the distance between pure states, unlike Suijlekom example of the two points space.

Time: 11:00 – 11:30
Speaker: Borowiec, Andrzej (Wrocław University, Institute of Theoretical Physics)
Title: Hopf Algebra Coderivations and Quantum Groups
Abstract: TBA

Time: 12:00 – 12:30
Speaker: Ramgoolam, Sanjaye (Queen Mary University of London)
Title: Simple harmonic oscillators from non-semisimple walled Brauer algebras.
Abstract: based on : arxiv.org/abs/2509.04234

Time: 12:30 – 13:00
Speaker: Lescano, Eric (Wroclaw University)
Title: From Gauge Theory to Gravity: Classical Double Copy as a Path to Higher-Derivative Corrections
Abstract: I will show how to apply the classical double copy map to the Yang-Mills Lagrangian to construct the NSNS supergravity Lagrangian at cubic order in fields. I will then generalize this result in two distinct ways to derive higher-derivative gravitational theories, also at cubic order in fields: First, I will construct a higher-derivative gauge theory that reproduces the four-derivative corrections of bosonic supergravity in a specific limit (based on 2409.05628). Second, I will apply the double copy map to the non-commutative version of Yang-Mills, leading to a new gravitational theory that remains ghost-free for a particular choice of the non-commutative parameter (based on 2502.03521).

Time: 13:00 – 14:00
Session: CaLISTA Round Table
Panelists: P Aschieri, K Anagnostopoulos, I Moraiti, S Stefas, T Weber, G Zoupanos
Title: Fostering science in Corfu meetings: present and future

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Time: 17:00 – 17:30
Speaker: Stoilova, Nedialka (INRNE, BAS)
Title: Coloring of some simple Lie (super)algebras
Abstract: We construct classes of Z_2xZ_2-graded (color) Lie algebras and Lie superalgebras corresponding to classical Lie algebras and basic classical Lie superalgebras of type A,B,C and D. For some of these color algebras structure theory in terms of roots and root vectors is developed. We also construct Z_2xZ_2xZ_2-graded color algebras and a Z_2xZ_2-graded color algebra of type G_2.

Time: 17:30 – 18:00
Speaker: Di Cosmo, Fabio (Universidad de Alcalá)
Title: Field strengths in Poisson Electrodynamics
Abstract: In recent years a novel approach to understand the behavior of gauge symmetries in the presence of non-commutativity has been introduced under the name of Poisson Gauge Theories. Within this framework several results have been obtained in the case of U(1) gauge symmetry, i.e., Poisson Electrodynamics. Interestingly, the geometric framework emerging from the above mentioned results appears to be that of symplectic groupoids and symplectic realizations. In this talk I will present this geometric framework and show the relation existing among the different notions of field strengths that have been considered so far. Joint work with P. Vitale and V. Kupriyanov.

Time: 18:20 – 19:00
Session: Poster Session
Presenters: M. Hrmo, S. Kovacik, R. Moron-Sanz, P. Rusnak
Presentations: Matej Hrmo (Comenius U, Bratislava): Scalar Field Theory on the Fuzzy Onion model, Samuel Kovacik (Comenius U, Bratislava): The Fuzzy Onion, Rodrigo Moron-Sanz (U Leon): Cartan geometries with model the future lightlike cone of Lorentz-Minkowski spacetime, Patrik Rusnak (Comenius U, Bratislava): Quantum mechanical problems on the Fuzzy Onion

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2.3 Wednesday, September 17, 2025

Time: 9:00 – 9:30
Speaker: Majid, Shahn (Queen Mary University of London)
Title: Variational calculus on quantum spacetime
Abstract: We apply methods of non commutative geometry to formulate for the the first time the ideas of variational calculus to quantum spacetimes including discrete lattice models. This is joint work with F. Simao.

Time: 9:30 – 10:00
Speaker: O Buachalla, Reamonn (Charles University in Prague)
Title: Borel-Weil-Bott theorems in quantum Riemannian geometry
Abstract: We survey developments over the past two decades on quantum group extensions of the classical Borel–Weil theorem, beginning with Majid's work on the Podleś sphere. This line of research employs differential calculi equipped with noncommutative complex structures to provide a framework for "noncommutative geometric representation theory", yielding noncommutative geometric realisations of finite-dimensional representations of the Drinfeld–Jimbo quantum groups. In this setting, the representations arise naturally as holomorphic sections of noncommutative line bundles over quantum flag manifolds. We then present new results that extend these constructions to higher-rank noncommutative vector bundles. (Joint work with Arnab Bhattacharjee)

Time: 10:30 – 11:00
Speaker: Carotenuto, Alessandro (Università di Parma)
Title: Convex Orderings and quantum tangent spaces

Time: 11:00 – 11:30
Speaker: Benvenuti, Silvia (U. Pisa)
Title: Dissemination: What, Who, Where, When, Why??

Time: 12:00 – 12:30
Speaker: Minguzzi, Manuela (University of Bologna)
Title: Horizon Europe and Marie Sklodowska Curie Actions: opportunities for research, networking and disseminating knowledge

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Time: 12:30 – 13:00
Speaker: Fornaini, Matteo (University of Bologna)
Title: The Antikythera Mechanism: A Hellenistic Calculating Machine in the Archimedean Tradition and Its Modern

Geometrical Simulations
Abstract: The Antikythera Mechanism, discovered in a Roman shipwreck and dated to the 2nd century BCE, is often regarded as the first known calculating machine for astronomical phenomena. In this talk, I will present a few simulations of the mechanism, with both historical reconstructions and modernized interpretations. Focus will be given to its ability to show celestial periodicities such as lunar phases, eclipses, and celestial cycles.

Time: 17:00 – 17:30
Speaker: Pistalo, Damjan (University of Luxembourg)
Title: Homotopy theory for Lie algebroids
Abstract: Lie algebroids and their strong homotopy counterparts appear naturally in the presence of symmetries. In particular, their homotopy theory provides a useful tool in the study of foliations, gauge symmetries, (higher) groupoids, etc. In the present talk, I present certain advances in this direction, focusing the notion of cofibrant strong homotopy Lie algebroids, which resolve singular Lie algebroids, and are well behaved from the point of view of abstract homotopy theory.

Time: 17:30 – 18:00
Speaker: Chirco, Goffredo (Università di Napoli Federico II and INFN Napoli)
Title: Measuring quantum complexity in quantum spacetime
Abstract: We investigate the notion of quantum complexity in quantum geometry by calculating the Stabilizer Rényi Entropy of SU(2) gauge-invariant states associated with quantum intertwiners dual to quantum tetrahedra, the building blocks of discrete approaches to quantum gravity. We show how harnessing quantum complexity in this context has a concrete application in current efforts of simulating quantum geometry states, toward experimental demonstrations of quantum gravity effects.

Time: 18:20 – 18:40
Speaker: Burridge, Joseph (University of Nottingham)
Title: Fuzzy Geometries with an Internal Space
Abstract: In this work we investigate taking the product of a non-commutative matrix spectral triple with an internal space. This simple formalism gives fermion, gauge and Higgs fields in the context of field theory on finite spectral triples. It provides a framework for analysing UV/IR-mixing in finite spectral triple models.

Time: 18:40 – 19:00
Speaker: Stefas, Stelios (National Technical University of Athens)
Title: 4D Fuzzy Gravity on a Covariant Noncommutative Space and Unification with Internal Interactions

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2.4 Thursday, September 18, 2025

Time: 9:00 – 9:30
Speaker: Landi, Giovanni (Università di Trieste)
Title: Monopoles and instantons on quantum spheres
Abstract: We report on some recent work on the geometry of monopole and instanton bundles on quantum spheres.

Time: 9:30 – 10:00
Speaker: Steinacker, Harold (University of Vienna)
Title: Quantum Geometry of Data (and Spacetime)
Abstract: Quantum geometry provides a suitable framework for a quantum theory of spacetime and gravity defined by matrix models. More recently, the same concept of quantum geometry has been applied in the context of machine learning and data science. I will describe how Quantum Cognition Machine Learning (QCML) encodes data as quantum geometry, by machine learning Hermitian matrices and mapping data points to states in Hilbert space. The quantum geometry description endows the dataset with rich geometric and topological structure, including intrinsic dimension, quantum metric, Berry curvature and Chern numbers. QCML captures global properties of data, while avoiding the curse of dimensionality inherent in local methods. This is illustrated with a number of synthetic and real-world examples. Quantum geometric representation of QCML is envisaged to advance our understanding of cognitive phenomena. (based on arXiv:2507.21135)

Time: 10:30 – 11:00
Speaker: Pagani, Chiara (University of Naples Federico II)
Title: Push-forward of Hopf-Galois extensions
Abstract: Smash biproduct, or twisted tensor product, of algebras were introduced in the late 1990s, generalizing earlier constructions by Majid and Radford. In this talk we show how the theory can be applied to the construction of push-forward of Hopf-Galois algebra extensions, algebraic counterparts of geometric pull-back of principal bundles. The talk is based on joint work with Giovanni Landi (University of Trieste).

Time: 11:00 – 11:30
Speaker: Fioresi, Rita (University of Bologna)
Title: Geometric Deep Learning meets Quantum Groups
Abstract: We show how the noncommutative language of quantum differential calculi can help with a natural description of differential operators in graph neural networks (message passing mechanism).

Time: 12:00 – 12:30
Speaker: Velasco-Forero, Santiago (MINES ParisTech)
Title: A Tropical Geometry Perspective on Learning from Data: Challenges and Opportunities
Abstract: Tropical geometry offers a novel mathematical framework for analyzing learning processes, bridging combinatorial structures with geometric representations of data. This perspective provides a powerful lens to reduce model complexity, and the interplay between algebraic structures and statistical learning. In this work, we outline the fundamental challenges of adopting tropical methods in machine and deep learning, including computational scalability, interpretability, and integration with existing frameworks. A particularly promising direction arises from the use of categorical closure operators, which generalize classical closure concepts and establish a unifying bridge with mathematical morphology. Concrete examples of this approach will be presented in the context of learning to count from data. References: S. Gaubert & M. Plus, Methods and applications of (max,+) linear algebra, Annual symposium on theoretical aspects of computer science, 261-282, (1997) P Misiakos, G Smyrnis, G Retsinas, & P Maragos, Neural network approximation based on hausdorff distance of tropical zonotopes, ICLR, (2022) Blusseau, S., Liu, X. & Velasco-Forero, S. Cell Counting with Trainable h-Maxima and Connected Component Layers. J Math Imaging Vis 67, 27 (2025). Penauld-Polge, Velasco-Forero S. & J. Angulo. Group Equivariant Morphological Networks. Accepted to SIAM Journal on Imaging Sciences, (2025). Velasco-Forero S., A. Rhim & J. Angulo, Fixed point layers for geodesic morphological operations, British Machine Vision Conference, (2022).

2.5 Friday, September 19, 2025

Time: 9:00 – 9:30
Speaker: Bieliavsky, Pierre (Universite Catholique de Louvain)
Title: Kinematical Lie algebras and sub-Riemannian manifolds
Abstract: The notion of kinematical Lie algebra was introduced in physics for the classification of the various possible relativity Lie algebras an isotropic spacetime can accommodate. I will explain how such a (generalized) kinematical Lie algebra canonically underlies a contact sub-Riemannian symmetric space which completely governs its structure. This is a joint work with Nicolas Boulanger.

Time: 9:30 – 10:00
Speaker: Jonke, Larisa (Rudjer Boskovic Institute)
Title: From noncommutative Yang-Mills to noncommutative gravity (through a classical double copy map)

Time: 10:30 – 11:00
Speaker: Chatzistavrakidis, Athanasios (Ruđer Bošković Institute)
Title: Basic curvature tensors

Time: 11:00 – 11:30
Speaker: Basile, Thomas (Mons University)
Title: Supersymmetric Poisson sigma models, revisited

Time: 12:00 – 12:30
Speaker: Freidel, Laurent (Perimeter Institute)
Title: Asymptotic Higher spin symmetry in gravity
Abstract: In this talk I'll review the construction from phase space of a tower of asymptotic charges that inculdes the mass aspect, the angular momentum aspect and a tower of similar higher spin charges. I will show that they generates a canonical algebra which provides a non linear generalization of LW_\infty when the shear doesnt not vanish. I will also present how this construction provides a new perspective on the connection between asymptotic iinfinity and twistor theory.

Time: 12:30 – 13:00
Speaker: Ho, Pei-Ming (National Taiwan University)
Title: Quantum Geometry and Hawking Radiation
Abstract: TBA

Time: 17:00 – 17:30
Speaker: Tekel, Juraj (Comenius University, Bratislava)
Title: Matrix ensembles from fuzzy physics: the good, the bad, the ugly
Abstract: Fuzzy spaces are matrix geometries and as such, they give rise to a multitude of random matrix models describing physics they host. We will look into various matrix ensembles which appear when one describes physics on and physics of the fuzzy spaces. We will collect different known results and present the plethora of challenges and questions that remain to be answered.

Time: 17:30 – 18:00
Speaker: Markov, Mikhail (University of Mons)
Title: Asymptotic structure of gravity in the BV-AKSZ formalism
Abstract: The talk will be based on a joint work with Maxim Grigoriev, in particular on arXiv:2310.09637. We propose a framework to study local gauge theories on manifolds with boundaries and asymptotic symmetries, which is based on representing them as so-called gauge PDEs. These objects extend the conventional BV-AKSZ sigma-models to the case of not necessarily topological and diffeomorphism invariant systems and are known to behave well with respect to restrictions to submanifolds and boundaries. We introduce the notion of gauge PDE with boundaries, which takes into account generic boundary conditions, and apply the framework to asymptotically simple gravity. In so doing, we start with a suitable representation of gravity (possibly coupled to additional matter fields) as a gauge PDE with boundaries, which implements Penrose's description of asymptotically simple spacetimes. We then derive the minimal model of the gauge PDE induced on the boundary and observe that it provides the Cartan (frame-like) description of a (curved) conformal Carrollian structure on the boundary in the case of asymptotically flat spacetimes. In the case of asymptotically (A)dS spacetimes, this construction can be interpreted as a gauge-theoretic extension of the Fefferman–Graham construction.

Time: 18:20 – 18:40
Speaker: Benner, Julius (Charles University Prague)
Title: Codifferential Calculi and quantum homogeneous spaces
Abstract: In this talk, we introduce the concept of codifferential calculus - a structure dual to differential calculus - that encapsulates the features of both classical and quantum differential geometry, and is motivated to serve as an abstract framework for both classical and quantum BGG sequences. We demonstrate that many foundational results from differential calculi extend naturally to this dual setting. For instance, in the case of equivariant codifferential calculi over quantum homogeneous spaces, Hermisson's classification of calculi in terms of quantum tangent spaces admits a direct dual formulation. Moreover, if the right coaction on the quantum tangent space is trivial, the corresponding codifferential calculus admits a description via a quadratic coalgebra. As a motivating example, we consider the Podleś sphere equipped with its standard noncommutative differential structure.

Time: 18:40 – 19:00
Speaker: Razzaq, Junaid (Charles University, Prague)
Title: Complex Structures for the Full Quantum Flag Manifold of Quantum SU(3)
Abstract: In a recent work (due to P. Somberg and R. O Buachalla), Lusztig's positive root vectors (with respect to a distinguished choice of reduced decomposition of the longest element of the Weyl group) were shown to give a quantum tangent space for every A-series Drinfeld–Jimbo full quantum flag manifold. Moreover, the associated differential calculus was shown to have classical dimension, giving a direct q-deformation of the classical anti-holomorphic Dolbeault complex of full flag manifold. In this talk, we will examine in detail the rank two case, by studying the associated □-differential calculus and its non-commutative complex geometry. We find that the number of almost-complex structures reduces

from 8 (that is 2 to the power of the number of positive roots of sl3) to 4 (that is 2 to the power of the number of simple roots of sl3). Moreover, each of these almost-complex structures is integrable, which is to say, each of them is a complex structure.

2.6 Saturday, September 20, 2025

Time: 9:00 – 9:30
Speaker: Castellani, Leonardo (East Piedmont University and INFN Torino)
Title: L - infinity structure of Free Differential Algebras and d=11 Supergravity
Abstract: We discuss free differential algebras (FDA's), a generalization of the Cartan-Maurer equations for the group manifold vielbein, appropriate for theories containing p-forms. Their dual formulation is an extension of Lie algebras, called L - infinity algebras, and we illustrate this duality in a simple example. Finally we review the FDA structure and the dual L - infinity structure of d=11 supergravity.

Time: 9:30 – 10:00
Speaker: O'Connor, Denjoe (Dublin IAS)
Title: Gauged Matrix Models

Time: 10:30 – 11:00
Speaker: Rivasseau, Vincent (IJClab, University Paris-Saclay)
Title: Tensor Track IX: Cumulants
Abstract: Assuming some familiarity with quantum field theory and with the tensor track approach that we presented in the previous series "Tensor Track I-VIII", we provide, as usual, the developments in tensors models of the last two years. Then we expose the fundamental work on the loop vertex expansion and loop vertex regularization and our recent papers of the theory of cumulants.

Time: 11:00 – 11:30
Speaker: Martin, Carmelo Perez (Universidad Complutense de Madrid)
Title: Entanglement, scattering and NCQED
Abstract: I shall discuss the generation of entanglement through scattering in NCQED with charge-zero massless fermions

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Time: 12:00 – 12:30
Speaker: Tsuchiya, Asato (Shizuoka University)
Title: Emergence of (3+1)-dimensional expanding spacetime in the Lorentzian type IIB matrix model
Abstract: The type IIB matrix model is a promising candidate for a nonperturbative formulation of superstring theory. Recently we performed complex Langevin simulations of the Lorentzian version of the model with Lorentz symmetry "gauge-fixed". In this talk, we show some numerical results that suggest the emergence of a smooth (3+1)-dimensional expanding spacetime.

Time: 12:30 – 13:00
Speaker: Asano, Yuhma (University of Tsukuba)
Title: Path integral for the closed superstring and the matrix model
Abstract: The IKKT matrix model, which is proposed as a non-perturbative formulation of superstring theory, has an issue typical of 0-dimensional theory—ambiguity in the definition of its path integral. To tackle this issue, we revisit the path integration for perturbative superstring theory. In this talk, we will derive the Minkowskian path integral equivalent to the Polyakov's Euclidean path integral for critical closed string theory, and discuss the "stringy causality" realised in the path-integral formulation. We then obtain the matrix model with a property like the stringy causality by matrix regularisation of the path integral.

Time: 17:00 – 17:30
Speaker: Sasakura, Naoki (Yukawa Institute for Theoretical Physics, Kyoto University)
Title: Universality of eigenvalue distributions of random tensors
Abstract: Eigenvalue distributions of random matrices are known to have universality under some loose conditions in

the large-N limit. It is an interesting question whether similar things would hold for eigenvalue distributions of random tensors. From explicit computations using quantum field theoretical methods, we show that eigenvalue distributions of various Gaussian random tensors have a universal expression in the large-N limit.

Time: 17:30 – 17:50
Speaker: Seko, Tatsuya (Shizuoka University)
Title: Regularization of matrices in the covariant derivative interpretation of the type IIB matrix model
Abstract: The covariant derivative interpretation of the type IIB matrix model, which is expected to give a non-perturbative formulation of superstring theory, enables to describe curved space-times. In this interpretation, matrices are treated as differential operators. However, regularization is needed to study quantum effects. Here, we develop a method to regularize the matrices to finite-size ones in the case of Kähler manifold. Our method can be used to derive geometry from the results of numerical simulations of the model.

Time: 18:10 – 18:30
Speaker: Maris, Valentine (ENS de Lyon)
Title: Star-products for Lie-algebraic noncommutative Minkowski space-times

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Time: 18:30 – 18:50
Speaker: Massar, Arthur (UC Louvain)
Title: Quantization of the Poincaré group as locally compact quantum group
Abstract: In this talk we will look at the construction of quantum Poincaré groups in the operator algebraic framework. We will consider Lie-Poisson structures which come from a triangular r-matrix of some specific form. Assuming an integrability condition, we will construct an explicit dual unitary 2-cocycle (i.e. an analytic twist) for each of them using Stachura's procedure. As a result we also get a star-product and a non-commutative Fourier transform on the Minkowski space. These quantizations have been called T-Poincaré groups by Mercati (with theta = 0), and include among others the rho-Poincaré group and the lightlike kappa-Poincaré group.

2.7 Sunday, September 21, 2025

Time: 9:00 – 9:30
Speaker: Lizzi, Fedele (Università di Napoli Federico II and INFN Sez. Napoli)
Title: Mixed in Translations
Abstract: A Lie group is a manifold, associated to each of its points there is an element of the group, represented as a transformation of a vector space. Geometrically points are the pure states of the commutative algebra of the functions on the manifold. Mixed states are instead represented by positive normalised probability densities. We consider the transformations connected to these mixed states, and find that they form a semigroup. We will then investigate the simplest case of one-dimensional translations, and find interesting surprises, including a novel way to see the connections between temperature and time for thermal states. The case of the quantum spacetime described by the Moyal product, and its Hopf algebra quantum symmetry will be discussed by Gaetano Fiore in the next talk.

Time: 9:30 – 10:00
Speaker: Fiore, Gaetano (Università di Napoli, and INFN - Sezione di Napoli)
Title: Generalized group structures for changes of quantum reference frames: the θ-Poincaré case

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Time: 10:30 – 11:00
Speaker: Driezen, Sibylle (ETH)
Title: Jordanian-twisted strings and spins: integrability and spectrum
Abstract: Integrability provides a rare tool for accessing strongly coupled quantum field theories. To move beyond familiar territory, it is important to explore cases where integrability takes on a genuinely new form. I will present recent work on Drinfel'd twists of the Jordanian type in the spin-chain formulation of the AdS5 ×S5 superstring. These twists can be seen as avatars of worldsheet non-Abelian T-duality, and correspond to noncommutative deformations of planar N=4 SYM. On the string side these deformations are Lax integrable, yet they lead to particle production, raising sharp questions about the scope and fate of integrability studies based on factorised S-matrices. From the spin-chain perspective, however, a different picture emerges: the spectrum can still be derived from a remarkably simple Baxter equation, which we show to agree with (semi-)classical string energies. This provides first evidence for a non-Abelian deformed AdS/CFT, and opens

a natural link with noncommutative gauge theories, an avenue where further exploration using integrability could be especially fruitful.

Time: 11:00 – 11:30
Speaker: Osten, David (Wroclaw University)
Title: Generalised Cartan Geometry
Abstract: In this talk, I present a Cartan-geometric framework for generalised geometries governed by a differential graded Lie algebra, extending previous results. The extended tangent bundle admits the action of both a global duality group and a local gauge group. This algebraic structure is implemented via a brane current algebra – the phase space Poisson structure of p-branes. Within this Cartan-inspired framework, we define a hierarchy of generalised connections and compute their linearised torsion and curvature tensors. This provides a systematic construction of curvature and torsion tensors in generic generalised geometries. Based on 2509.04595 w/ F. Hassler and A. Swash.
