XXXIV
International Fall Workshop on Geometry and Physics

SEPTEMBER 1–4, 2026

Tarragona, Catalonia, Spain

UNIVERSITAT ROVIRA i VIRGILI

GDFT NET

GEOMETRY, DYNAMICS AND FIELD THEORY NETWORK

https://webs-deim.urv.cat/~34ifwgp/ • 34ifwgp@gmail.com

1 General information

The International Fall Workshops on Geometry and Physics have been held annually since 1992, uniting Spanish and Portuguese geometers and physicists, along with a growing number of international participants. These meetings provide a unique forum for the exchange of ideas across fields such as Differential Geometry, Applied Mathematics, and Theoretical Physics. A key feature of the IFWGP is the active involvement of enthusiastic young researchers, fostering collaboration and innovation in the mathematical sciences.

Venue and dates

The conference takes place on September 1–4, 2026. All scientific activities will be held in the room *Sala de juntes* of the **Universitat Rovira i Virgili**, located at Av. Catalunya 35, 43002 Tarragona (Catalonia, Spain).

Contact

For any questions, please contact the organizers at `34ifwgp@gmail.com` or visit the conference website: `https://webs-deim.urv.cat/~34ifwgp/`.

Programme overview

The conference consists of two courses given by renowned researchers, nine invited talks, twelve contributed short talks, and a poster session.

Social programme

The **cultural activity** will feature a tour of Roman Tàrraco, including admission to both the Circus and the Praetorium. Participants will meet at Portal del Roser at 18:00 on September 3rd. Organizers will guide attendees from the conference site after the final session of the day.

The **conference dinner** will take place on September 3rd in Les Coques, at 20:30. The address is Carrer de Sant Llorenç, 15, 43003 Tarragona. Please note that the conference dinner costs €50 and will be collected in cash upon registration on the first day.

2 Schedule

	Tue 1	Wed 2	Thu 3	Fri 4
08:30–09:00	Registration			
09:00–09:30	Opening ceremony	N. Román	N. Román	N. Román
09:30–10:00	N. Román			
10:00–10:30		J. M. Figueroa	G. Oliveira	L. Vitagliano
10:30–11:00	N. Sansonetto			
11:00–11:30	*Coffee break*	*Coffee break*	*Coffee break*	*Coffee break*
11:30–12:30	A. B. Tumpach	A. B. Tumpach	A. B. Tumpach	A. B. Tumpach
12:30–12:50	J. Clemente	M. Graf	C. Stoica	C. Bell
12:50–13:10				Poster talk
13:10–13:30				A. Ibort
13:30–13:50	Lunch	Lunch	Lunch	
13:50–14:00				Closing ceremony
14:00–15:00				
15:00–15:20	Z. Wang	R. Izquierdo	M. Díaz	
15:20–15:40		O. Cosserat	M. Dell'Acqua	
15:40–16:00		J. Torrente	A. López-Gordón	
16:00–16:30	*Coffee break*	*Poster session + coffee break*	J. de Lucas	
16:30–16:50	H. Benziadi			
16:50–17:10	T. Schmah			
17:10–17:30	O. Kubů			
17:30–17:50	H. C. Nguyên		Cultural activity	
17:50–19:30				
19:30–20:00				
20:00–			Conference dinner	

3 Courses

An introductory course on geometric field theories: the multisymplectic setting

Narciso Román-Roy

Universitat Politècnica de Catalunya, Spain

This course provides an introduction to the multisymplectic formulation of first-order classical field theories. Multisymplectic geometry offers the most general and powerful framework for a covariant description of such theories. The course begins with a concise overview of geometric field theories and introduces the fundamental concepts of multisymplectic manifolds, together with the geometry of first-order jet bundles and bundles of differential forms that form the mathematical setting of the multisymplectic approach.

Within this framework, the Lagrangian formalism for first-order classical field theories is developed, covering both regular and singular cases, and the corresponding Hamiltonian formalism is constructed for regular and almost-regular theories. The course also addresses the basic notions of symmetries and conservation laws, and illustrates the general theory through a selection of relevant examples drawn from modern physics.

Geometry of infinite-dimensional manifolds and applications to integrable systems

Alice Barbora Tumpach

Wolfgang Pauli Institut Vienna, Austria, and Lille University, France

This lecture is an introduction to geometric structures on infinite-dimensional manifolds, with applications to the study of integrable systems. We will start with basic notions of manifolds and fiber bundles with model spaces Hilbert, Banach or Fréchet spaces, and then explore geometric structures on infinite-dimensional manifolds, in particular symplectic and Poisson structures. We will show that the Leibniz rule for a Poisson bracket on a Banach manifold does not imply the existence of a Poisson tensor. The existence of a Hamiltonian vector field on a Banach manifold endowed with a Poisson tensor is also not guaranteed. We will review possible definitions of Poisson structures in the infinite-dimensional context that are general enough to include non-trivial examples, avoid possible pitfalls and include all weak symplectic Banach manifolds. Examples of some Banach Poisson–Lie groups and their homogeneous spaces related to the Korteweg–de Vries hierarchy will be presented. In particular, the construction of a Banach–Poisson–Lie group structure on the unitary group of a Hilbert space will serve as a guide for other unitary groups, like the restricted unitary group. We will show that the restricted Grassmannian inherits a Bruhat–Poisson structure from the restricted unitary group, and that the action of a triangular Banach Lie group on it by "dressing transformations" is a Poisson map which generates the Korteweg–de Vries hierarchy.

4 Invited talks

Deformation of symmetry and persistence of dynamics

Cristina Stoica

Wilfrid Laurier University, Canada

We use the deformation of symmetry on cotangent bundles from the Euclidean plane to two-dimensional constant-curvature surfaces to investigate the continuation of local dynamics aspects in Hamiltonian systems. For a fixed curvature sign, the curved problem is set up either on the sphere or on the hyperbolic plane, both with radius $R = 1/\varepsilon$, recovering flat space in the limit as $\varepsilon \to 0$. The symmetry of these spaces is taken into account by using the contraction of Lie algebras from $\mathfrak{so}(3)$ or $\mathfrak{so}(2,1)$ to $\mathfrak{se}(2)$. We use Riemannian exponential coordinates centred at the North pole together with the pull-back of the associated momentum map and the symplectic form. Within this geometric setting we use a local slice construction and prove the persistence from flat to curved spaces of non-degenerate relative equilibria and relative periodic orbits of general cotangent bundle Hamiltonian systems. We apply the resulting framework to the Newtonian n-body problem.

Homogeneous boundaries of geometric structures

Luca Vitagliano

Università di Salerno, Italy

Under appropriate homogeneity conditions, a hypersurface in a symplectic manifold inherits from the ambient a contact or a cosymplectic structure. There are similar statements for Poisson manifolds as well as for complex manifolds. Using ideas from the homogeneous symplectic approach to contact geometry, we present a very general theorem putting all these statements under the same umbrella. This also allows generalizations, e.g., to Kähler Geometry, Dirac Geometry, Generalized Complex Geometry, etc. This is joint work with Alfonso Tortorella.

Non-lorentzian spacetimes

José Miguel Figueroa-O'Farrill

University of Edinburgh, United Kingdom

I will review the notion of a kinematical group and summarise the classification of spatially isotropic homogeneous kinematical spacetimes obtained in 2018/2019 with Stefan Prohazka and will report on work in progress with Juanma Lorenzo Naveiro on the much more involved classification of coisotropy-one homogeneous kinematical spacetimes.

Stochastic reduction on Lie groups with Cartan–Schouten connections

Zibo Wang

University of Chinese Academy of Sciences, China

In this work, we develop a geometric framework for stochastic reduction on Lie groups endowed with Cartan–Schouten connections. We first derive explicit expressions for the mean covariant derivative and stochastic parallel transport. Building on these results, we formulate a connection-dependent stochastic variational principle and reduce both the variational principle and the associated stochastic Euler–Lagrange equations. This leads to stochastic Euler–Poincaré equations that explicitly capture the effects of torsion and curvature.

Singularity theorems from a mathematical perspective

Melanie Graf

University of Hamburg, Germany

The classical singularity theorems of R. Penrose and S. Hawking from the 1960s are beautiful examples of mathematical results in Lorentzian Geometry with wide physical relevance for General Relativity showing that any spacetime with a smooth Lorentzian metric satisfying certain energy conditions and causality assumptions must be geodesically incomplete. Despite their great success these classical theorems still had and have some drawbacks both in their assumptions and conclusions. Focusing on the assumptions side of the picture I will review the classical theorems and

some recent mathematical progress allowing us to relax some of the usual demands placed on the metric regularity as well as the classical pointwise energy conditions, which makes the theorems applicable to a wider class of physically relevant situations.

Hybrid quantum-classical field theory: classical gravity with quantum matter sources

Jesús Clemente-Gallardo

Universidad de Zaragoza, Spain

Einstein's General Relativity can be formulated as a Hamiltonian field theory with constraints for globally hyperbolic spacetimes using the Poisson structures of the field's phase spaces (gravitational and matter fields). In this talk, we will summarize some recent works of our group where this classical geometrodynamic theory is generalized to include quantum matter fields as sources for the classical gravitational field. In this way, the classical gravitational field and the quantum matter influence each other's evolution, defining a coupled hybrid field theory where the gravitational and quantum degrees of freedom have their dynamics inextricably coupled. The most remarkable physical feature of the construction is the description of a dynamical backreaction of quantum matter on geometry and vice versa.

A k-contact description of finite-dimensional jet geometry

Javier de Lucas

University of Warsaw, Poland

In this talk, we demonstrate that jet geometry, typically linked to Cartan distributions rather than strictly geometric contact forms, can be understood through k-contact geometry—a recent extension of contact geometry to field theory. We show that the Cartan distribution of any finite-dimensional jet manifold is a k-contact distribution, thus describing jet geometry and its core tools via k-contact geometry. This framework naturally unifies and expands existing techniques, such as providing a local k-contact Hamiltonian description for Lie symmetries. We also establish a generalised k-contact Darboux theorem that characterises k-contact manifolds locally equivalent to jet manifolds. Our approach allows k-contact geometry to be applied to the study of partial differential equations, Lie symmetries, characteristics, Bäcklund transformations, and general reduction schemes, including λ-symmetries, extensions for reductions by non-local symmetries, and many other mathematical and physical research areas.

Geodesics, Electrostatics and Solids

Gonçalo Oliveira

Instituto Superior Técnico, Lisbon, Portugal

Based on recent joint work with Christopher Fillmore and Herbert Edelsbrunner I will explain how to beat the world record for the number of closed geodesics of index one on a K3 surface. Such geodesics are related to some conjectures originating in the Physics literature and their construction is related to an open problem in electrostatics posed by Maxwell in 1873.

Separability and integrability

Alberto Ibort

Universidad Carlos III de Madrid, Spain

Recently, F. Magri has proposed a new geometrical framework for the notion of separation of variables and, consequently, the explicit integration of vector fields on manifolds. In this talk we will discuss Magri's idea, the geometrical framework that allows to construct such separation variables explicitly and how all these ideas are related to the more standard notion of integrability. Weierstrass' integration of the triaxial ellipsoid will be our guiding example along the talk.

---

5 Contributed talks

Einstein gravity as an action-dependent field theory

Callum Bell

Lancaster University, United Kingdom

There exists a beautiful interplay between symplectic and contact geometry, which arises naturally when a physical theory possesses a particular kind of scaling symmetry, known as a dynamical similarity. The invariants of the symmetry generator form an autonomous subsystem of the symplectic theory, and their evolution is described by a contact Hamiltonian. Physically, we identify the symmetry transformation as a rescaling of a degree of freedom associated with a choice of overall system scale. Such a rescaling does not affect the observable physics, and the corresponding degree of freedom is redundant for the description of the dynamical evolution of the observables. Classical Einstein gravity is an example of a theory which possesses a scaling symmetry. We show how the identification of this symmetry allows general relativity to be cast as an action-dependent field theory. Finally, we discuss some interesting consequences in simple cosmological settings.

Harmonic maps into principal bundles and generalized magnetic mappings

Habib Benziadi

Universidad de Salamanca, Spain

In this talk, we introduce a geometric framework for studying harmonic maps into principal bundles endowed with Kaluza–Klein metrics. This leads naturally to the notion of generalized magnetic maps, which extend classical magnetic geodesics and Wong's equations from particles to higher-dimensional objects interacting with arbitrary gauge fields. We show that every Kaluza–Klein metric is completely determined by a principal connection, a metric on the adjoint bundle, and a metric on the base manifold. Using this structure, we derive the Euler–Lagrange equations for harmonic maps into principal bundles and characterize their horizontal and vertical

components. A central result of the work is that generalized magnetic maps arise as projections of Kaluza–Klein harmonic maps and that their moduli space is obtained as a quotient by a natural gauge symmetry. We further establish a gauge variation formula, a harmonic gauge-fixing equation, and an existence theorem for generalized magnetic maps. Finally, we investigate the influence of the geometry of the fibers on these equations and construct explicit families of examples based on the complex and quaternionic Hopf fibrations $S^3 \to S^2$ and $S^7 \to S^4$. Among these families, we identify the unique uncharged solutions, namely the standard Clifford torus and the standard spherical harmonic immersion of $S^3 \times S^3$ into S^7.

DOI: 10.1016/j.geomphys.2026.105780.

Infinitesimal symmetries in Newton–Cartan gravity

Jose Torrente Teruel

Universidad de Córdoba, Spain

Galilean spacetimes [1] provide a natural geometric framework for the study of non-relativistic physics and have recently attracted renewed attention in connection with geometric mechanics, Newton–Cartan theory, and non-relativistic gravity [2]. In this contribution, we study the geometric structure of Galilean spacetimes admitting conformally Leibnizian vector fields, namely vector fields whose flows generate conformal transformations of the underlying Leibnizian structure [3]. Special emphasis is placed on the interplay between the existence of infinitesimal symmetries and the intrinsic geometry of the spacetime, inducing particular local and global geometric properties.

We establish characterization and decomposition results under several geometric assumptions, focusing on classes of torse-forming, torqued, and concircular vector fields. These conditions lead naturally to decomposition into product structures and provide geometric criteria for identifying Galilean generalized Robertson–Walker and Galilean twisted spacetimes [4]. Our results highlight the role of conformal Leibnizian symmetries as a unifying mechanism linking symmetry, curvature, and global structure in non-relativistic geometry, thereby contributing to the broader understanding of Galilean geometric models arising in mathematical physics.

[1] A. N. Bernal and M. Sánchez, Leibnizian, Galilean and Newtonian structures of space-time. J. Math. Phys. 44, 1129–1149 (2003).
[2] J. Figueroa-O'Farrill, Non-lorentzian spacetimes. Differ. Geom. Appl. 82, 101894 (2022).
[3] D. de la Fuente, R. M. Rubio and J. Torrente-Teruel, Geometric structure of Galilean spacetimes admitting a conformally Leibnizian vector field. Phys. Scr. 100, 095001 (2025).
[4] D. de la Fuente, R. M. Rubio and J. Torrente-Teruel, On Twisted Spacetimes: a new class of Galilean cosmological models. Adv. Nonlinear Stud. 26, 1–21 (2026).

Multisymplectic manifolds with boundaries

Marco Díaz Maceda

Universidad Autónoma de Madrid, Spain

In this talk, I will present a new formalism for studying the field theories on manifolds with boundary. Based on the ideas of relative cohomology [Margalef-Bentabol & Villaseñor, 2021], I will extend the definition of multisymplectic structures to manifolds with boundary. We will see how this structure reproduces the field equations of variational principles with boundary. I will explain how to generalize the observables, the graded Poisson brackets, and the conserved charges to manifolds with boundary. Moreover, I will present the Lagrangian formalism, deriving the Poincaré–Cartan form and the Euler–Lagrange equations. Finally, I will illustrate the formalism with several examples.

Homogeneous Darboux and Frobenius theorem on graded manifolds

Asier López-Gordón

Instytut Matematyczny PAN, Poland

Gradings appear in geometry and physics in a plethora of scenarios, such as vector bundles, higher-order tangent bundles, Lie algebroids or AKSZ sigma models. A natural and simple way to encode a grading on a manifold is a smooth action of the multiplicative monoid of real numbers, known as a homogeneity structure. Using the homogeneity structure, we can easily prove a Frobenius theorem for graded involutive distributions. As a particular case, we recover the Frobenius theorem for $\mathbb{N}$-graded manifolds due to Bursztyn, Cueca, and Mehta. This is joint work with Janusz Grabowski.

Collective perturbations of Hamiltonian systems

Tanya Schmah

University of Ottawa, Canada

We consider perturbations of a G-symmetric Hamiltonian H by collective terms of the form $f \circ J$, where J is an equivariant momentum map for the G action. In general this breaks the symmetry, however the perturbed dynamics retain symmetry-related features and in particular can be reconstructed in two stages from the symmetry-reduced unperturbed motion. If the perturbations are stochastic and the original system is deterministic, then the perturbed dynamics are given by a stochastic phase acting on the unperturbed system. For example, in the Kepler problem with angular stochastic perturbations, the perturbed dynamics retain deterministic radial dynamics. On a Lie group, we consider a sum of two collective terms, corresponding to left and right translations. One example is a rigid body with spatial torque. Another is a continuum model with applications to image registration, generalising the Large Deformation Diffeomorphic Metric Mapping (LDDMM) framework. This work is joint with Archishman Saha and Cristina Stoica.

Stackel lifts, symplectic-Haantjes structures, and integrable systems

Ondřej Kubů

ICMAT-CSIC, Spain

We present the Stackel lift, a geometric framework unifying and extending the Riemannian and Lorentzian Eisenhart lifts. Given an n-dimensional separable Hamiltonian, the Stackel lift constructs an integrable system on a higher-dimensional cotangent bundle by lifting the associated Stackel matrix. The connection between Stackel geometry and the Eisenhart programme was not previously made systematic, and the link to Haantjes geometry had not been established.

We prove that Hamiltonian systems arising from momentum-dependent Stackel matrices are endowed with a non-trivial symplectic-Haantjes structure. The Haantjes operators are constructed explicitly from the lifted Stackel data and account for the separability of the lifted system in a coordinate-free manner, connecting the Stackel–Eisenhart programme to the symplectic-Haantjes manifold theory of Tempesta and Tondo.

We illustrate the framework on magnetic systems separable in cylindrical coordinates, described within the Stackel setting via a modified Stackel basis. Explicitly momentum-dependent lifting matrices produce Hamiltonians associated with Finsler and Hamilton geometries, as well as models interpretable as gravitational waves, with potential applications in modified gravity. We also indicate how the same Haantjes geometry governs separation of variables for the generalized Zernike superintegrable hierarchy, where the lift-form property of the Haantjes operators determines which members of the family admit separation coordinates reachable by extended point transformations.

A geometric approach to multilocal observables on multiconfiguration spaces

Hai Châu Nguyên

Institut Camille Jordan, France

In classical field theory, multilocal observables are naturally indexed by configurations of points on a spacetime M and admit two natural products: a fibrewise (Hadamard) product encoding pointwise multiplication of local observables, and a Cauchy product encoding the combination of observations at separate points. Recently, Frabetti, Kravchenko and Ryvkin organized this structure as a Poisson 2-algebra bundle over open (diagonal-free) configuration spaces. We extend their framework to the multiconfiguration spaces M^n/S_n using the language of S_n-equivariant vector bundles over M^n. The main result is that any skew kernel $k\colon V \boxtimes V \to I_\otimes$ induces a Poisson 2-algebra structure on the associated symmetric algebra bundle, and we illustrate the construction on $M = \mathbb{R}$ with the canonical symplectic fibre $F = Q \oplus Q^*$, recovering the standard Poisson bracket of classical mechanics. The framework is intended as a foundation for a future treatment of distributional sections and a geometric approach to renormalization.

From Broad-integrability to Euler–Jacobi theorem and back

Nicola Sansonetto

University of Verona, Italy

Integrability has been and still is an active field of research in the Hamiltonian framework (both in finite and infinite dimensions). On the other hand its investigation drove less attention outside the Hamiltonian setup, at least until the last decades, when has attracted the attention of the community interested in nonholonomic mechanics and more recently in plasma. Despite being less studied, there are notions of integrability that extend to non-Hamiltonian framework. In this talk I will focus on two notions of non-Hamiltonian integrable systems: Broad and Euler–Jacobi integrability. We first show that the first notion is stronger. We then investigate which possible 'non-evident' properties one can add to the Euler–Jacobi Theorem to make the dynamics broadly integrable.

`https://arxiv.org/abs/2503.21950`

`https://iopscience.iop.org/article/10.1088/1361-6544/ae341c`

On the Spencer cohomology and integrability of multisymplectic structures

Rubén Izquierdo

ICMAT-CSIC, Spain

Multisymplectic geometry provides a geometric framework to express the equations of motion of classical field theories, in analogy with how symplectic geometry is used in classical mechanics. A multisymplectic form encodes key structures of a given theory, including symmetries, conserved quantities, and the Poisson bracket.

In the study of these structures, the use of adapted (or Darboux) coordinates is of central importance. However, unlike in symplectic geometry, the closedness of a multisymplectic form is not sufficient to guarantee the existence of flat coordinates. Indeed, there are examples of closed forms of constant linear type that are not flat, such as those arising in G_2-structures.

These issues can be understood in a unified way through the theory of G-structures. In this talk, I will introduce the basic notions of G-structures and structure tensors. I will then explain how this framework can be used to construct forms whose integrability depends strictly on conditions of order k, for arbitrary k. Finally, if time permits, I will discuss some possible directions and ideas related to integrability.

Deformation of Lagrangian submanifolds and numerical analysis

Oscar Cosserat

ICMAT, Spain

It is fruitful to interpret the small step of a numerical method as a deformation parameter. In the context of symplectic geometry, the parallel between mathematical physics and numerical analysis goes even further and relates deformations of Lagrangian submanifolds with symplectic integrators, variational integrators or Poisson integrators. In this talk, I will provide examples of such interplays. Finally, I will mention two ongoing projects: the search for a differential graded algebra in the problem of deformation of Lagrangian submanifolds (ongoing with D. Calaque) and the use of Lagrangian submanifolds in the computational dynamics of variational PDEs (ongoing with S. Leyendecker, D. Martín de Diego, R. Sato, T. Wang).

GenDis: transformations between Lagrangians of different order

Matteo Dell'Acqua

University of Munich, Germany

Over the last 25 years, numerous modifications of General Relativity have been proposed to address outstanding problems in cosmology. Disformal transformations and their generalizations (henceforth GenDis) are emerging as powerful tools for the classification of such modified gravity theories. GenDis are characterized by relating Lagrangians of different order. Understanding their properties would enable the systematic construction of higher-order gravity theories while controlling physically relevant features such as symmetries, global stability, and the number of propagating degrees of freedom.

In this talk, I will present the main geometric features of GenDis within the mechanical framework. Focusing on the failure of GenDis to preserve the presymplectic structure of the Lagrangian systems they relate, I will provide an intrinsic characterization of this phenomenon and derive sufficient conditions to ensure dynamical equivalence at the level of the corresponding final constraint submanifolds. Remarkably, dynamical equivalence turns out to be sufficient to recover the preservation of the relevant geometric structures in the GenDis framework.

6 Posters

Symplectic groupoid multiplication and Poisson integrators

David Iglesias

Universidad de La Laguna, Spain

In this work, we study the role of local symplectic groupoid multiplication in the construction of approximation methods for Hamiltonian flows on the underlying Poisson manifold. We show it can be used to construct a novel multiplicative type of approximating sequences for the relevant Lagrangian bisection. We describe the corresponding theoretical results, their practical implementation into approximation methods on coordinate charts, and illustrative examples. (Joint work with Alejandro Cabrera and Juan Carlos Marrero.)

Projective geodesic extensions by conformal modifications in nonholonomic mechanics

Malika Belrhazi

University of Antwerp, Belgium

Projective geodesic extensions are reparametrizations of the trajectories of a nonholonomic mechanical system (with only a kinetic energy Lagrangian), in such a way that they can be interpreted as part of the geodesics of a Riemannian metric. We derive necessary and sufficient conditions for the existence of these extensions, in the case where the constrained Lagrangian remains preserved up to a conformal transformation. In that case we say that the nonholonomic trajectories are pregeodesics of this new Riemannian metric. When the nonholonomic system has a symmetry group (a Chaplygin system), we clarify the relation between projective geodesic extensions and closely related concepts, such as φ-simplicity, invariant measures and Hamiltonization.

Contact dynamics and Legendrian submanifolds in infinite dimensions

Fraser Sanders

University of Manchester, United Kingdom

There has recently been a small, but growing, interest in contact dynamics in infinite-dimensional settings. This allows one to define physical systems which are infinite-dimensional but also dissipative in some sense, for example the damped wave equation or the Klein–Gordon equation. It also has some links to multicontact dynamics and non-equilibrium thermodynamics.

In this poster I will outline how contact forms are defined in infinite dimensions, and give some elementary examples of them. I will then discuss some properties of infinite-dimensional contact manifolds and how they differ from their finite-dimensional cousins. Finally I will discuss some recent results including a class of Legendrian submanifolds, and progress towards a Bambusi–Darboux type theorem for infinite-dimensional contact forms.

Reduction of the time-dependent Elroy's Beanie

Carla Benítez García

Universidad de La Laguna, Spain

In a work in progress, we develop a new framework for the reduction of time-dependent Hamiltonian systems that generalizes previous approaches [1]. The proposed method combines the reduction of presymplectic structures of corank 1 and 2, leading to a broader reduction procedure for time-dependent systems. In this poster, we illustrate the theory by applying it to the reduction of a time-dependent Elroy's Beanie system.

[1] I. Lacirasella, J. C. Marrero, and E. Padrón. Reduction of symplectic principal $\mathbb{R}$-bundles. J. Phys. A, 45(32):325202, 29, 2012.

One tensor to bracket them all

Ángel Martínez-Muñoz

Universitat Rovira i Virgili, Spain

Poisson and Jacobi structures play a fundamental role in the geometric description of many systems arising in classical mechanics. In most cases, the corresponding bivector field is induced by a non-degenerate 2-covariant tensor field. In this poster, we present a unified framework for constructing the associated brackets by studying such tensor fields in detail.

More specifically, under suitable assumptions on the tensor, we derive a formula for computing the Schouten–Nijenhuis bracket of the associated bivector field in terms of the curvature of a certain distribution and the exterior derivative of a differential form. This expression provides the obstruction to the existence of Poisson and Jacobi structures. We use this to recover the classical brackets of symplectic, locally conformally symplectic, cosymplectic, contact, and cocontact geometries, and to characterize when fat bundles and almost cosymplectic structures of order p determine a Jacobi bracket.

Hybrid quantum-classical master equations and consistent thermodynamics

Francisco Javier Pomar Villuendas

Universidad de Zaragoza, Spain

This work studies the statistical mechanics of hybrid quantum-classical systems within a geometric setting. Modelling the hybrid phase space as a Cartesian product of a (classical) symplectic manifold and a (quantum) Kähler manifold, Ehrenfest dynamics can be endowed with a symplectic Hamiltonian structure [J. Phys. A: Math. Theor. 44, (2011)]. Furthermore, Liouville's evolution for statistical densities can be recast into an infinite hierarchy of differential equations for the quantum moments of increasing order [Eur. Phys. J. Plus 138, (2023)]. A rigorous definition of hybrid entropy [Phys. Rev. E 102, (2020)] allows us to obtain an effective theory by truncating the infinite hierarchy via a maximum entropy criterion, yielding a closed system of equations for a subset of moments. In this work, we show that neither the full system of coupled equations nor its truncation preserves the hybrid canonical ensemble (HCE), thereby yielding thermodynamic inconsistency. However, we demonstrate that the dynamical deviation of the HCE is suppressed by a factor of $\hbar$ compared to other relevant observables, establishing the validity of the effective theory as a physically meaningful approximation. Finally, we discuss how a C*-algebraic Koopman formalism can resolve this issue and lead to a strictly consistent hybrid thermodynamics.

Compatible twisted multisymplectic Nijenhuis structures

Paulo Antunes

University of Coimbra, Portugal

We study the compatibility of twisted multisymplectic Nijenhuis structures on a Lie algebroid $A \to M$, via the correspondence between such structures and Nijenhuis morphisms $J = N + \Omega$ on the shifted exact Courant algebroid $(A \oplus \bigwedge^{p-1} A^*, \Theta = \mu + H)$. We introduce a notion of compatibility for two such morphisms $J = N + \Omega$ and $J' = N' + \Omega'$, and derive the explicit compatibility conditions on (A, μ) in terms of the geometric data (Ω, N, H) and (Ω', N', H).

Phase space quantization of anisotropic cosmologies: Taub and Kantowski–Sachs models

Alberto Molgado Ramos

Universidad Autónoma de San Luis Potosí, Mexico

We introduce an explicit construction of the non-diagonal and diagonal Wigner distributions for the homogeneous but anisotropic Taub and Kantowski–Sachs cosmological models within the framework of phase space deformation quantization. Conventional canonical quantization of these models via the Wheeler–DeWitt equation is inherently plagued by factor ordering ambiguities. To circumvent these issues, we employ the totally symmetric Weyl quantization map and the Moyal star product. By means of a canonical separation of the Hamiltonian constraint, we are able to resolve the formal convergence problems typically associated with the star product. Furthermore, to establish a rigorous connection with conventional quantum cosmology, we calculate the standard wave functions directly from the diagonal Wigner distributions, recovering the exact physical states in terms of modified Bessel functions in both cases.

Phase-space geometry of qubits: deformation quantization, star exponentials, and quantum teleportation

Oscar Jasel Berra Montiel

Universidad Autónoma de San Luis Potosí, Mexico

We develop a phase-space formulation of qubit systems based on the coadjoint orbits of SU(2) and the Stratonovich–Weyl correspondence, providing a deformation quantization of the sphere. The resulting star product reproduces the algebra of complexified quaternions, while its antisymmetric part induces the Lie–Poisson structure associated with the KKS symplectic form. Within this framework, quantum dynamics is formulated through star exponentials of Hamiltonian symbols, yielding an explicit representation of the quantum propagator. Several examples illustrate the construction of star exponentials and the induced Poisson geometry. Finally, this geometric phase-space formalism provides a natural framework for describing quantum teleportation as the teleportation of geometric structures encoded in phase space.

Applications of k-contact geometry to jet manifolds

Tomasz Sobczak

University of Warsaw, Poland

Jet manifolds provide the geometric framework for the study of partial differential equations and their symmetries. We recall the recently introduced k-contact formulation of finite-order jet manifolds, which provides a unified setting for many classical constructions in PDE theory. This poster focuses on applications of the k-contact framework to jet bundles introduced by Javier de Lucas, in particular the Hamiltonian description of the characteristics of Lie symmetries and the extension of reduction methods to evolutionary and λ-symmetries. This is joint work with Javier de Lucas.

Symmetries for connections and information geometry

Xavier Gràcia Sabaté

Universitat Politècnica de Catalunya, Spain

In information geometry, a family of probability distributions is regarded as a smooth manifold. Given a special function known as a divergence, one can naturally induce a Riemannian metric and a pair of conjugate connections that generally differ from the Levi-Civita connection. Following a brief review of information geometry—focusing on statistical manifolds, dually flat manifolds, and divergences—we analyze connections across varying levels of generality (general, linear, and affine) and study their symmetries and infinitesimal symmetries. As an application, we compute these symmetries for the statistical manifold associated with the normal distribution.

7 List of participants

Name	Affiliation
Francesca Angrisani	Sorbonne Université, France
Paulo Antunes	University of Coimbra, Portugal
Lluís Arola Fernández	Universitat Rovira i Virgili, Spain
Alejandra Artiles León	Universitat Rovira i Virgili, Spain
María Barbero Liñán	Universidad Politécnica de Madrid, Spain
Callum Bell	Lancaster University, United Kingdom
Malika Belrhazi	University of Antwerp, Belgium
Carla Benítez García	Universidad de La Laguna, Spain
Habib Benziadi	Universidad de Salamanca, Spain
Oscar Jasel Berra	Universidad Autónoma de San Luis Potosí, Mexico
Patrick Cabau	France
Jesús Clemente-Gallardo	Universidad de Zaragoza, Spain
Oscar Cosserat	ICMAT, Spain
Manuel de León Rodríguez	ICMAT, Spain
Javier de Lucas Araujo	University of Warsaw, Poland
Matteo Dell'Acqua	University of Munich, Germany
Marco Díaz Maceda	Universidad Autónoma de Madrid, Spain
José Miguel Figueroa-O'Farrill	The University of Edinburgh, United Kingdom
Xavier Gràcia Sabaté	Universitat Politècnica de Catalunya, Spain
Melanie Graf	University of Hamburg, Germany
David Iglesias Ponte	Universidad de La Laguna, Spain
Alberto Ibort	Universidad Carlos III de Madrid, Spain
Rubén Izquierdo López	ICMAT, Spain
Saša Krešić-Jurić	University of Split, Croatia
Ondřej Kubů	ICMAT-CSIC, Spain
Asier López Gordón	Instytut Matematyczny PAN, Poland
Juan Carlos Marrero	Universidad de La Laguna, Spain

Name	Affiliation
Ángel Martínez-Muñoz	Universitat Rovira i Virgili, Spain
Tom Mestdag	University of Antwerp, Belgium
Alberto Molgado	Universidad Autónoma de San Luis Potosí, Mexico
Hai Châu Nguyên	Institut Camille Jordan, France
Joana Nunes da Costa	Universidade de Coimbra, Portugal
Gonçalo Oliveira	Instituto Superior Técnico, Portugal
Edith Padrón Fernández	Universidad de La Laguna, Spain
Francisco Javier Pomar Villuendas	Universidad de Zaragoza, Spain
Xavier Rivas	Universitat Rovira i Virgili, Spain
Narciso Román-Roy	Universitat Politècnica de Catalunya, Spain
Fraser Sanders	University of Manchester, United Kingdom
Nicola Sansonetto	University of Verona, Italy
Tanya Schmah	University of Ottawa, Canada
Ivet Segú Torné	Universitat Rovira i Virgili, Spain
Tomasz Sobczak	University of Warsaw, Poland
Cristina Stoica	Wilfrid Laurier University, Canada
Jose Torrente Teruel	Universidad de Córdoba, Spain
Daniel Torres Moral	Universitat Politècnica de Catalunya, Spain
Alice Barbora Tumpach	Wolfgang Pauli Institut, Austria
Silvia Vilariño Fernández	Universidad de Zaragoza, Spain
Anna Maria Villanova	Universitat Politècnica de Catalunya, Spain
Luca Vitagliano	University of Salerno, Italy
Zibo Wang	University of Chinese Academy of Sciences, China
Kenzo Yasaka	University of Antwerp, Belgium
Alessandro Zampini	Università degli Studi di Napoli Federico II, Italy

8 Committees

Organizing committee

- Xavier Rivas (Universitat Rovira i Virgili, Spain)
- Xavier Gràcia (Universitat Politècnica de Catalunya, Spain)
- Lluís Arola (Universitat Rovira i Virgili, Spain)
- Ángel Martínez-Muñoz (Universitat Rovira i Virgili, Spain)
- Ivet Segú (Universitat Rovira i Virgili, Spain)
- Daniel Torres (Universidad Internacional de La Rioja, Spain)
- Annamaria Villanova (Universidad Internacional de La Rioja, Spain)

Scientific committee

- Fernando Barbero (CSIC, Spain)
- María Barbero (Universidad Politécnica de Madrid, Spain)
- Manuel de León (ICMAT, Spain)
- Ana Cristina Ferreira (University of Minho, Portugal)
- Isabel Fernández (University of Seville, Spain)
- Eduardo García Río (University of Santiago de Compostela, Spain)
- Jónatan Herrera (University of Córdoba, Spain)
- David Iglesias Ponte (University of La Laguna, Spain)
- Giuseppe Marmo (University of Napoli Federico II, Italy)
- Juan Carlos Marrero (University of La Laguna, Spain)
- David Martín de Diego (ICMAT, Spain)
- Joana Nunes da Costa (University of Coimbra, Portugal)
- Xavier Rivas (Universitat Rovira i Virgili, Spain)
- Miguel Sánchez Caja (University of Granada, Spain)
- Esmeralda Sousa Dias (Instituto Superior Técnico, University of Lisbon, Portugal)
- Silvia Vilariño (University of Zaragoza, Spain)