Anton ALEKSEEV (Geneva Univ.)

Title: The Cartan model of equivariant cohomology and the Kirillov-Kostant-Souriau Poisson structure

Abstract: By definition, the equivariant cohomology of a $G$-space $M$ is the cohomology of the space $M_G := M \times_G EG$, where $EG$ is the total space of the universal $G$-bundle $EG \to BG$. In the case when $M$ is a manifold and $G$ is a compact connected Lie group, the celebrated theorem of H. Cartan shows how to compute the $G$-equivariant cohomology of $M$ over reals using differential forms on $M$. The Cartan model makes use of the Weil algebra $Wg = Sg^* \otimes g^*$. We will show that the dual of the Weil algebra can be naturally identified with the space of differential forms on $g^*$ whereas the differential and the $G$-action are defined by the Kirillov-Kostant-Souriau (KKS) Poisson structure. If time permits, we will discuss the generalization of this structure to the case of non-commutative Weil algebras and Lie group valued moment maps.

The talk is based on joint works with E. Meinrenken and C. Woodward.

Dmitri ALEKSEEVSKY (Moscow IITP)

Title: The Vinberg theory of homogeneous convex cones, 66 years later

Abstract: We review shortly the basic results of the theory of homogeneous convex cones, developed by E.B. Vinberg in the early 60s, which includes the theory of duality of convex cones, the classification of self-dual homogeneous convex cones in terms of compact Jordan algebras, description of homogeneous convex cones in terms of left symmetric algebras (Koszul-Vinberg algebras) and as the cones of positively defined matrices in Vinberg matrix T-algebra, application to description of homogeneous convex domains and homogeneous Kähler manifolds.

We consider different developments of these results and shortly discuss their applications to information geometry, multivariate statistical analysis, convex optimisation, homogeneous Riemannian and pseudo-Riemannian Hessian manifolds, and supergravity (description of homogeneous scalar target manifolds for $N = 2$ supergravity in dimension $D = 5, 4, 3$).

John BAEZ (Riverside UC)

Title: From Classical to Quantum and Back

Abstract: Edward Nelson famously claimed that quantization is a mystery, not a functor. In other words, starting from the phase space of a classical system (a symplectic manifold) there is no functorial way of constructing the correct Hilbert space for the corresponding quantum system. In geometric quantization one gets
around this problem by equipping the classical phase space with extra structure: for example, a Kaehler manifold equipped with a suitable line bundle. Then quantization becomes a functor. But there is also a functor going the other way, sending any Hilbert space to its projectivization. This makes quantum systems into specially well-behaved classical systems!

In this talk we explore the interplay between classical mechanics and quantum mechanics revealed by these functors going both ways.

Michel BRION (Grenoble Univ.)

Title: Automorphism groups of complex projective varieties

Abstract: Consider a complex projective algebraic variety X. The automorphism group Aut(X) is known to be a "locally algebraic group", extension of a discrete group by a complex connected algebraic group. The discrete part (the group of components of Aut(X)) is quite mysterious; in particular, it is not necessarily finitely generated, as shown by recent work of Lesieutre and Dinh-Oguiso. The talk will discuss some basic properties of automorphism groups, and then present classes of varieties for which the group of components of Aut(X) is an arithmetic group.

Misha GROMOV (Paris IHES)

Title: Probability and Dimension.

Abstract: I will try to expose a geometric view on some aspect of probability and its applications.

Patrick IGLESIAS-ZEMMOUR (Aix-Marseille Univ.)

Title: Symplectic Diffeology

Abstract: I will discuss how symplectic geometry can be extended to diffeology, where the spaces run from singular quotients to infinite dimension. We shall see how this formal framework works on a few examples: from the construction of the moment map in this context to the construction of a prequantized bundle as a quotient of the space of paths, for any parasymplectic form (closed 2-form) on (almost) any diffeological space. I will discuss also the parasymplectic structure of the space of geodesics, even when it is not a manifold etc.

Yann OLLIVIER (Paris Facebook)

Title: Are natural gradient and the extended Kalman filter the same thing?

Abstract: The natural gradient is a fundamental object of statistical learning, one of the most canonical iterative algorithms to learn the parameters of arbitrary statistical models. The extended Kalman filter is fundamental in many engineering applications involving signal processing or control, such as GPS tracking. This filter is a generic tool to estimate the current state of a dynamical system from noisy measurements of some part or some function of the system. In the nonlinear case,
the equations of the extended Kalman filter are complex and have been debated. We build a systematic correspondence between these two objects, viewing the extended Kalman filter as a natural gradient descent in the abstract space of trajectories of the system, and conversely the natural gradient as an extended Kalman filter on its parameter viewed as a static system.

**Vasily PESTUN (Paris IHES)**

Title: TBA  
Abstract: TBA

**Aissa WADE (Penn State Univ.)**

Title: Sur le problème d’intégration des variétés de Jacobi holomorphes.  
Abstract: En bref, une variété de Jacobi holomorphe est une variété complexe $X$ munie d’un fibré en lignes holomorphe $L$ avec un crochet de Lie sur le faisceau de sections holomorphes de $L$ définissant un opérateur bi-differentiel de premier ordre. En fait, les variétés de Jacobi holomorphe sont des cas particuliers de structures de Jacobi-Nijenhuis. Dans cet exposé, nous discutons le problème d’intégration des variétés de Jacobi holomorphes. Nous montrons qu’elles s’intègrent en des groupoides de contact complexes.

**Panel sessions:**

**SYMPLECTIC GEOMETRY AND LOCALIZATION TECHNIQUES IN MATHEMATICAL PHYSICS**, led by Damien Calaque  
with Anton Alekseev, Mathieu Anel, Patrick Iglesias-Zemmour, Vasily Pestun and Aissa Wade

One the one hand, Souriau’s work has emphasized the relevance of symplectic geometry in physics. On the other hand, various localization formulae have proven to be of importance both in mathematics and physics, culminating with various kinds of index theorems. Localization techniques are related to symplectic geometry via symplectic reduction and equivariant cohomology. The panel will discuss the historical importance of this circle of ideas, how they connect to some work of Cartan, Koszul and Souriau, and how they still influence the current research in mathematical physics.

The session will start with a short presentation of panel members. Each panel member will say a few words on his/her experience/relation with symplectic geometry and/or localization methods. Then the panel chair will give a brief presentation of the topic, which will be followed by an open and free discussion between panel members. We will finally conclude with a few questions from the audience.
TRIBUTE TO J-L KOSZUL AND J-M SOURIAU, led by Frédéric Barbaresco and Michel N’Guiffo-Boyom

- Dmitri ALEKSEEVSKY (Koszul-Vinberg Characteristic Function and Algebra)
- Misha GROMOV (Geometry and Probability, Fisher Metric)
- Yann OLLIVIER (Fisher Metric and Machine Learning)
- Patrick IGLESIAS-ZEMMOUR (Covariant Souriau Lie Group Thermodynamic)
- Michel N’GUIFFO-BOYOM (Koszul Vinberg, Koszul Homology, Information Geometry)
- Frédéric BARBAESCO (Koszul-Souriau-Fisher Metric, Lie Groups Thermodynamics)