TITLES AND ABSTRACTS

Roland Abuaf (IHES, Paris)
Hyper-Kaehler categories
Compact Calabi-Yau categories play a preeminent role in non-commutative geometry and in the mathematical background of string theory. Indeed, many manifestations of Kontsevich's Homological Mirror Symmetry conjectures are best understood when interpreted in the framework of 3-Calabi-Yau categories. In this talk, I want to introduce and discuss the basic properties of a new class of compact Calabi-Yau categories : the hyper-Kaehler categories. They are categorical analogues of compact hyper-Kaehler manifolds. The theory of non-commutative resolutions of singularities allows us to construct a large number of deformation classes of such categories in each dimension. For instance, I can construct at least 243 deformation classes of such categories in dimension 4 (compare with the only 2 deformation classes of hyper-Kaehler spaces of dimension 4 which are known in commutative geometry). If time permits, I would like to discuss a specific modular example (of dimension 4), for which Hochschild cohomology reveals some very intriguing features.

Marian Aprodu (IMAR, Bucharest)
Secant spaces and syzygies of special line bundles on curves
We discuss the interactions between syzygies of curves and the geometry of the secant loci in the symmetric products. We show that a regular behavior of these loci for special line bundles imply the vanishing of linear syzygies. The talked is mainly based on a joint work with Edoardo Sernesi.

Enrico Arbarello (Università degli Studi di Roma La Sapienza)
Surfaces with canonical sections and Brill-Noether-Petri curves
In a joint work with A. Bruno, G. Farkas and G. Saccà we use surfaces having one elliptic singularity, and canonical curves as hyperplane sections, to construct explicit examples of smooth Brill-Noether-Petri curves, of any given genus, defined over the rational numbers. This provides a negative answer to a question raised by Harris and Morrison. The work stems from a joint result with A. Bruno and E. Sernesi where we give a complete characterization of Brill-Noether-Petri curves that are hyperplane sections of K3 surfaces or of a limit thereof.

Marcello Bernardara (Université Paul Sabatier, Toulouse)
Categorical representability and rationality
This talk is aimed at introducing the notion of categorical representability and some examples and motivations that let us conjecture it to provide an obstruction to rationality. In particular, we will focus on some motivic motivation and on birational properties of geometrically rational surfaces, which were studied in a joint work with A.Auel. We will end by considering some threefold and fourfold examples under this perspective.

Samuel Boissière (Université de Poitiers)
Isogenies and transcendental Hodge structures of K3 surfaces
Every Hodge class on a product of two complex projective K3 surfaces induces a homomorphism of rational Hodge structures between the respective transcendental lattices. Under the hypothesis that this morphism is an isometry of rational quadratic spaces, Mukai, Nikulin and recently Buskin have proven that the corresponding Hodge class is algebraic, confirming the Hodge conjecture in this context. In this talk, I will show that the hypothesis of isometry is too restrictive by constructing geometrically

some families of isogenies between K3 surfaces whose transcendental Hodge structures are nonisometric. This is a collaboration with Alessandra Sarti and Davide Cesare Veniani.

Michele Bolognesi (Université de Montpellier)
Homological projective duality for determinantal varieties
Homological Projective Duality is an homological generalization of classical projective duality, introduced by Kuznetsov, which is the main tool to produce semi-orthogonal decompositions for the derived categories of projective varieties. In this talk I will discuss and prove HPD for several classes of linear determinantal varieties. By this we mean varieties that are cut out by the minors of a given rank of a $m \times n$ matrix of linear forms on a given projective space. As applications, we obtain pairs of derived-equivalent Calabi-Yau manifolds, and address a question by A. Bondal asking whether the derived category of any smooth projective variety can be fully faithfully embedded in the derived category of a smooth Fano variety. Moreover I will discuss the relation between rationality and categorical representability in codimension two for determinantal varieties. (joint work with M. Bernardara and D. Faenzi)

Ada Boralevi (SISSA, Trieste)
Spaces of matrices of constant rank via cones of morphisms and truncated graded modules
A space of matrices of constant rank is a vector subspace V, say of dimension n+1, of the set of matrices of size $a \times b$ over a field k, such that any nonzero element of V has fixed rank r. It is a classical problem to look for examples of such spaces of matrices, and to give relations among the possible values of the parameters a,b,r,n. In this talk I will report on joint projects with D. Faenzi, P. Lella, and E. Mezzetti, where we introduce two new methods to produce examples of such spaces. The techniques that I will explain involve vector bundles on projective spaces, the derived category of $\mathbb{P}^n$, and finitely generated graded modules over the ring of polynomials $k[x_0, \ldots, x_n]$.

Chiara Camere (Università degli Studi di Milano)
Calabi–Yau quotients of irreducible holomorphic symplectic manifolds
In this talk I will explain how to construct Calabi–Yau manifolds starting from irreducible holomorphic symplectic manifolds endowed with nonsymplectic automorphisms of prime order. Then I will restrict to dimension four and describe the geometry of the Calabi–Yau fourfolds obtained as resolutions of quotients of fourfolds of $K3^{[2]}$-type by a non-symplectic involution: this construction generalizes that of double EPW covers. This is joint work in progress with Alice Garbagnati and Giovanni Mongardi.

Frédéric Campana (Université de Lorraine)
Positive foliations and fibrations with (orbifold) rationally connected fibres
Foliations with positive minimal slope relatively to a movable class on a complex projective manifold X are shown to correspond exactly to fibrations with rationally connected fibres, extending results by Miyaoka and Bogomolov-Mc Quillan. The proof permits to cover the case of smooth 'orbifold pairs' (X,D) as well, once the notions of tangent bundle, foliation, rational connectedness, and 'rational quotient' are suitably defined in this broader context. This is joint work with M. Paun, relying on previous joint work with T. Peternell.

Emre Coskun (Middle East Technical University, Ankara)
Vector Bundles via Derived Category Methods
Derived categories have been used heavily in recent decades to investigate vector bundles on projective varieties, and their moduli spaces. In this talk, we describe some of these methods; and we present recent results (joint work with Ozhan Genc) concerning the construction of Ulrich bundles on Veronese surfaces.

Olivier Debarre (ENS, Paris)
Periods of Gushel-Mukai varieties
Beauville and Donagi proved in 1985 that the primitive middle cohomology of a smooth complex cubic fourfold and the primitive second cohomology of its variety of lines, a smooth hyperkähler fourfold, are isomorphic as integral Hodge structures. We prove an analogous statement for smooth Gushel–Mukai varieties of dimension 4 (resp. 6), i.e., smooth dimensionally transverse intersections of the cone over the Grassmannian Gr(2, 5), a quadric, and two hyperplanes (resp. of the cone over Gr(2, 5) and a quadric). The associated hyperkähler fourfold is now a smooth double cover of a sextic fourfold called an EPW sextic. This is joint work with Alexander Kuznetsov.

Daniele Faenzi (Université de Bourgogne)
On the representation type of projective varieties
By analogy with the representation theory of quivers, one says that a projective variety X is of finite type if its homogeneous coordinate ring R has finitely many maximal Cohen-Macaulay (CM) indecomposable modules; also X is tame if these modules vary in families of dimension 1 at most, or wild if the dimension of these families is unbounded. I will show that, if R is CM and X is not a cone, then X is wild except for a number of completely classified cases. If time allows I will describe CM modules on a few tame varieties.

Laurent Gruson (Université de Versailles)
Invariants of smooth germs of curve in a projective space, by Caroline Gruson and Laurent Gruson.
We study the action of the projective group $PGL(A)$ on the variety of smooth germs of curve in the projective space $\mathbb{P}A^\vee$. An old result of Halphen (1880) states that this action has a slice acted on by the group $\mathbb{Z}/3\mathbb{Z}$. Using this slice, one gets a $\mathbb{Z}/3\mathbb{Z}$-graded polynomial ring in an infinite set of indeterminates. We try to follow Halphen by describing these indeterminates through an recursive procedure.

Martin Gulbrandsen (Universitetet i Stavanger)
Degenerations of Hilbert schemes of points
Based on joint work with Lars Halle (Copenhagen) and Klaus Hulek (Hannover).

In the context of compact hyperkähler manifolds, a natural but largely open question is how the Hilbert scheme of n points on a K3 surface degenerates, say to a normal crossing. Motivated by this, and based on the techniques of Li on expanded degenerations and Li–Wu's stacky degenerations of Hilbert and Quot schemes, we present a GIT construction of degenerations: We identify a (large) class of strict normal crossing degenerations $X \to C$, to which we associate a degeneration of the Hilbert scheme of n points in the fibres X_t with good properties. The (GIT) construction is fairly explicit, and allows for detailed study, e.g. of the combinatorial structure of the degenerate Hilbert scheme.

Frédéric Han (Université Paris 7)
Sur les transformations birationnelles de P3 de degré 3 et 4
Nous donnerons des éléments de classification des transformations birationnelles de P3 définies par des cubiques. On comparera ensuite ces résultats à ceux obtenus récemment pour les quarto-quartiques de P3. (Travaux en commun avec J. Deserti)

Grzegorz Kapustka (Universität Zürich)
Hyperkahler fourfolds and Kummer surfaces
We discuss the geometry of hyper-Kähler fourfolds constructed from the Hilbert scheme of conics on Fano fourfolds being the double cover of $\mathbb{P}^2 \times \mathbb{P}^2$ branched over an (2, 2)-divisor. This is a joint work with A. Iliev, M. Kapustka, K. Ranestad.

Michał Kapustka (Universitetet i Stavanger)
Calabi-Yau threefolds in low codimension
I will present several new constructions and partial classification results concerning Calabi-Yau threefolds embedded in projective spaces of dimension ≤ 7. The talk will be based on joint works with G.Kapustka, S. Coughlan and Ł. Gołębiowski.

Emilia Mezzetti (Università degli Studi di Trieste)
Fano congruences of index three and alternating 3-forms
A congruence of lines in the n-dimensional projective space P(V) is a subvariety of dimension n-1 of the Grassmannian G(2,V). An interesting class of congruences can be obtained by associating to any general alternating 3-form ω on V the family X_ω of the lines annihilating ω. These congruences, that result to be Fano manifolds of index 3, have been studied in some particular cases by authors as Kapustka-Ranestad, Peskine, Han. After recalling a few examples, I would like to report on a joint work with Pietro De Poi, Daniele Faenzi and Kristian Ranestad, where we have established various general facts on these congruences. In particular, we have described the quadrics in the ideal of X_ω, their Hilbert schemes, the residual congruences in a general linear section of the Grassmannian and their fundamental loci.

Gianluca Occhetta (Università degli Studi di Trento)
A geometric characterization of flag manifolds
Let G be a semisimple algebraic group and B a Borel subgroup; the complete flag manifold G/B is a Fano manifold whose elementary contractions are smooth $\mathbb{P}^1$-fibrations. In particular the number of such fibrations is equal to $\rho(G/B)$, the Picard number of the manifold. We will show how these manifolds can be characterized by this property, namely that a smooth complex projective manifold X of Picard number n which admits n contractions $\pi_i : X \to X_i$ which are smooth $\mathbb{P}^1$-fibrations is isomorphic to a complete flag manifold G/B. This is a joint work with Roberto Munõz, Luis E. Solá Conde, Kiwamu Watanabe and Jaroslaw A. Wiśniewski.

Ziv Ran (University of California, Riverside)
Superficial fibres of generic projections
We consider a general fibre of given length in a generic projection of a variety. Under the assumption that the fibre is of local embedding dimension 2 or less, an assumption which can be checked in many cases, we prove that the fibre is reduced and its image on the projected variety is an ordinary multiple point.

Francesco Russo (Università di Catania)
Every cubic fourfold in $\mathcal{C}_{14}$ is rational
We shall investigate the divisor $\mathcal{C}_{14}$ inside the moduli space of smooth cubic hypersurfaces in $\mathbb{P}^5$, whose generic element is a smooth cubic containing a smooth quartic rational normal scroll. By showing that all degenerations of quartic scrolls in $\mathbb{P}^5$ contained in a smooth cubic hypersurface are surfaces with one apparent double point, we prove that every cubic hypersurface contained in $\mathcal{C}_{14}$ is rational.
In passing we shall review and put in modern terms some fundamental ideas of Fano, yielding new geometrical light on a lot of recent results on cubic fourfolds.

Alessandra Sarti (Université de Poitiers)
A relation between the moduli space of some irreducible holomorphic symplectic fourfolds and the moduli space of cubic threefolds
In a famous paper Allcock, Carlson and Toledo describe the moduli space of cubic threefolds as a ball quotient. Here we give an interpretation of these moduli spaces as moduli spaces of some special irreducible holomorphic symplectic fourfolds with a non-symplectic automorphism of order three. This is

part of a more general construction, that I will explain in the talk. It is a joint work with S. Boissi'ere and C. Camere.

Luis E. Solá Conde (Università degli Studi di Trento)
Flag bundles and homogeneity of Fano manifolds
Up to date, the only known examples of smooth projective varieties whose tangent bundle is nef, with ample determinant, are rational homogeneous spaces. In order to check if these are, in fact, the only varieties of this kind, a problem posed by F. Campana and T. Peternell, we have recently purposed a strategy consisting of using the rational curves contained in the variety to construct a flag manifold dominating the initial variety. In this talk we will illustrate this method by proving the homogeneity of manifolds whose family of minimal rational curves satisfies certain homogeneity conditions at every point.

The material presented belongs to a joint work with G. Occhetta e J. Wiśniewski (available online at http://dx.doi.org/10.1016/j.matpur.2016.03.006).

Alessandro Verra (Università degli Studi Roma Tre)
Geometry and rationality of moduli of Nikulin surfaces in low genus
The talk deals with some explicit constructions of Nikulin surfaces and of their moduli in low genus g. In particular the talk will focus on the genus 8 case. In this case the moduli space is irreducible and its rationality is proven. The proof relies on the classical geometry of six nodal cubic threefolds.