

## **BIRATIONAL GEOMETRY AND ALGEBRAIC CYCLES**

***GLEN conference in Liverpool***

**25 – 26 June 2015**

(sponsored by the *London Mathematical Society* and *DMS Liverpool*)

### **VENUE:**

Walker Lecture Theatre, 1<sup>st</sup> Floor, Harrison Hughes Building

### **SCHEDULE:**

**25 June 2015**

**Carmelo Di-Natale (Cambridge) 12:00 – 1:00**

TITLE: Grassmannians in Derived Algebraic Geometry

ABSTRACT: The goal of this talk is to explain how to extend Grassmannians to the world of derived stacks, i.e. how to construct a satisfying derived enhancement of Grassmannian varieties. I will begin by discussing some background about derived geometric stacks and in particular I will focus on Artin-Lurie-Pridham representability theorem, which provides us with a "computational" criterion to check whether a simplicial presheaf of derived algebras is a derived geometric stack. Then I will use such a result in order to study derived moduli of perfect complexes and filtered perfect complexes over a base scheme; finally the derived Grassmannian will arise as some suitable homotopy limit of such stacks. Time permitting I will end by sketching how to use this derived version of the Grassmannian to obtain a derived version of Griffiths' period mapping.

**Hamid Ahmadinezhad (Bristol) 1:15 – 2:15**

TITLE: Birational Geometry of 3-folds: 1-cycles vs divisors

ABSTRACT: Birational rigidity has been around since the work of Iskovskikh and Manin on smooth quartic 3-folds. This notion has grown over the years and many more birationally rigid varieties have been discovered. In this talk, I give a brief overview of birational rigidity, from a Mori theory point of view. I recall some techniques that are used and give a different view on them based on the dualities of certain cones of 1-cycles and divisors. Time allowing, I will state some recent results and highlight an approach to the classification of terminal Fano 3-folds.

**2:15 – 2:45 Tea, coffee, refreshments**

**Alena Pirutka (Paris) 2:45 – 3:45**

TITLE: Rationality and unirationality - motivation, classical results and the example of Artin and Mumford

ABSTRACT: This talk aims to provide an introduction to classical questions on rationality and unirationality, giving a list of known results and methods. We will also discuss in details the example of Artin and Mumford of a unirational but nonrational variety. We will present the point of view of Colliot-Thélène and Ojanguren, where one uses the unramified Brauer group to establish the nonrationality.

**Alena Pirutka (Paris) 4:00 – 5:00**

TITLE: Chow and cohomological diagonal decomposition, universal Chow group and applications to quartic threefolds

ABSTRACT: Starting from the work of Bloch and Srinivas, one uses the properties of the diagonal class in the Chow group as an important tool to study some cohomological and geometrical properties. We will mostly discuss the properties of the so-called integral diagonal decomposition. The property to have an integral decomposition is related to the triviality of the Chow group of zero-cycles over all field extensions, which gives sometimes more flexibility. In particular, we will use these methods to show that many smooth quartic threefolds are not stable rational. Recall that in 1970th Iskovskikh and Manin have showed that no smooth quartic threefold is rational; some of them are known to be unirational. The main tool is the specialisation properties of the universal Chow group of zero-cycles. In fact, we will degenerate quartics to a singular variety birational to Artin-Mumford's example. We will also explain how to obtain examples over an algebraic closure of  $\mathbb{Q}$ .

**6:00 – conference dinner**

**26 June 2015**

**Alena Pirutka (Paris) 12:00 – 1:00**

TITLE: Around universal cycles and diagonal decomposition

ABSTRACT: In this talk we will continue to study the diagonal decomposition in the Chow groups, as well as in the cohomology. Following the work of Claire Voisin, we will provide an application for the existence of the universal codimension two cycle and the study of quartic double solids.

**Alena Pirutka (Paris) 1:15 – 2:15**

TITLE: Other obstructions : non stable rationality of many hypersurfaces

ABSTRACT: After considering the case of quartic threefolds, a natural question is to find other cases where one can apply the specialisation of the universal Chow group of zero-cycles. In other words, one wish to find some 'bad' singular varieties, meaning varieties having a resolution with some non trivial invariants which provide an obstruction for the stable rationality, such that in addition we have some control on singularities. This lecture will discuss Kollar's construction of cyclic covers in positive characteristic, where the obstruction is provided by some particular behavior of differential forms. Next we will study the work of Totaro, where he shows the non stable rationality of many hypersurfaces, by specialisation to Kollar's example. If time permits, we will also give an overview of some other recent results (the work of Beauville, the work of Claire Voisin on cubic hypersurfaces).

**2:15 – 2:45 Tea, coffee, refreshments**

**Joe Palacios (Liverpool) 2:45 – 3:45**

TITLE: Geometric symmetric powers in the stable motivic category

ABSTRACT: Symmetric powers of quasi-projective schemes can be extended, via left Kan extensions, to geometric symmetric powers of motivic spaces. In my talk, I will explain how geometric symmetric powers provide a  $\Lambda$  structure on the unstable  $A^1$ -homotopy category of schemes over a field. Moreover, in the rational stable motivic homotopy category, I will sketch a comparison of four types of symmetric powers of the suspension of a quasi-projective scheme over a field in which  $-1$  is a sum of squares

**Alice Rizzardo (Edinburgh) 4:00 – 5:00**

TITLE: An example of a non-Fourier-Mukai functor between derived categories of coherent sheaves

ABSTRACT: Orlov's famous representability theorem asserts that any fully faithful exact functor between the bounded derived categories of coherent sheaves on smooth projective varieties is a Fourier-Mukai functor. We will show that this result is false without the fully faithfulness hypothesis. This is joint work with Michel Van den Bergh.