Workshop Calabi-Yau Motives

28.-30.01.2019

Speakers:

Spencer Bloch (University of Chicago)

Periods associated to limiting mixed Hodge structures at MUM points

Golyshev and Zagier showed in a number of examples that the presence of a MUM point and a conifold point in a variation of Hodge structure led to some interesting periods. I will sketch how to interpret such periods as being periods of the limiting mixed Hodge structure at the MUM point. This is joint work with M. Vlasenko.

Alessio Corti (Imperial College London)

What Laurent polynomials are mirror to Fano manifolds? a status report

Slawomir Cynk

Hilbert modular double octic Calabi-Yau 3-fold

I will discuss modularity of a Calabi-Yau threefold X with h1;2 = 1, i.e. the Hodge numbers of H3(X) equal (1; 1; 1; 1). The restriction of the Galois representation on H3(X) to Gal(_Q= Q[p 2]) decomposes into the direct sum of the Galois representation for a Hilbert modular form for Q[p2] of weight [4,2] and level 6 p 2O.

The Calabi-Yau X is a resolution of singularities of the double covering of P3 branched along an arrangement of eight planes (arrangement No. 250 in Meyer's list).

The proof is based on a careful study of geometric properties of X, which allows us to _nd a birational map to a Kummer _bration associated to two rational elliptic surfaces. As a consequence we _nd a birational map on X which acts as multiplication by p 2 on H0;3_H3;0

and by p 2 on H1;2 _ H2;1. Joint work with M. Schüutt and D. van Straten

Neil Dummigan (University of Sheffield)

Moduli of congruences appearing in L-values

The congruence in question is A(F,p)=a(f,p)+p+p^2(mod q), where F is a genus 2, weight 3 Siegel cuspidal eigenform of paramodular level, f is a genus 1, weight 4 cuspidal eigenform, and A(F,p), a(f,p) are Hecke eigenvalues at any good prime p.

I will explain how according to the Bloch-Kato conjecture, q^2 should appear in the denominator of L(2,F,spin) and q in the numerator of L(3,f) (suitably normalised). I will explore the relation of the former to recent work of Ryan and Tornaria on a generalisation of Boecherer's conjecture, and the latter to recent work of J. Brown and H. Li.

Valery Gritsenko (Université de Lille)

Infinite series of anti-symmetric paramodular forms of weight 3

A finite number of anti-symmetric paramodular forms of weight 3 for polarisations t=122, 167, 173, 197, 213, and 285 were constructed in terms of theta-blocks and Borcherds products in my paper with Cris Poor and David Yuen. In particular, using the paramodular form for t=122 we can give a formula for the new paramodular form of weight 3 for polarisation 61. In this talk I present an infinite series of anti-symmetric paramodular forms of weight 3. This is our joint project with Haowu Wang (Lille).

Pierre Lairez (ICTP Trieste)

Numerical periods in effective algebraic geometry

Building upon Mezzarobba's library for numerical analytic continuation, we can now compute the periods of quartic surfaces to arbitrary precision, and consequently many algebraic invariants: Picard group, endomorphism ring, number of embedded smooth rational curve of a given degree, etc. We start compiling a database of K3 surfaces with their invariants. This talk will aim at a hands-on presentation of the tools involved and a presentation of several examples of the database. (Joint work with Emre Sertöz)

Gonzalo Tornaria (University of Texas) – via skype

Paramodular forms as orthogonal modular forms A computational approach

The main goal of this talk is to describe a method to compute eigenvalues of (conjecturally) paramodular forms of weight 3.
In fact I will explain how to use neighbouring lattice methods to construct spaces of algebraic modular forms for orthogonal groups together with their Hecke operators.
In the case of SO(3) this construction is well known to correspond to classical modular forms of weight 2, by lifting to Brandt matrices (i.e. quaternionic modular forms) and the Eichler correspondence (aka Jacquet-Langlands). This involves the fact that Spin(3) is an inner form of SL(2).
In the case of SO(5) we have that Spin(5) is an inner form of Sp(2), whence it is fair to expect that quinary orthogonal modular forms correspond to Siegel modular forms of genus 2.
In this way, I learned from Hein and Voight, one can construct spaces of orthogonal modular forms that should correspond to spaces of paramodular forms of weight 3.
Note that these spaces will contain lifts of classical modular forms. However it was noted by Hein-Ladd-Tornaría that it is easy to compute a smaller subspace which will contain all the non-lifts in the space. I will also explain this idea.
Finally I will show the example of level N=61, which is the smallest conductor for which there is a non-lift paramodular form of weight 3.
In his phd thesis Jeffery Hein gives examples for prime levels p = 61, 73, 79, 89, 113, 167, 173, 197, and computes the Euler factors for primes up to 100. In the case of p = 61, I have also computed the eigenvalues for T_p for primes up to 1699.
This method is one quite promising way to construct a database of L-functions (on the automorphic side) corresponding to our objects of interest (a 'Gsp(2) Cremona table').

Rainer Weissauer (Universität Heidelberg)

Eichler-Shimura Theory for Siegel modular varieties

Roughly speaking the theory of Eichler-Shimura relates eigenvalues of the Frobenius at p on the cohomology of Siegel modular varieties (for p prime to the level) to the eigenvalues of Hecke operators at p on spaces of certain holomorphic Siegel cusp forms. We give a survey on what is known with special emphasis on the cases genus g=1 and g=2 and discuss the corresponding l-adic Galois representations.

Noriko Yui (Queen's University)

Four-dimensional Galois representations arising from certain Calabi–Yau threefolds

We consider the (irreducible) four-dimensional Galois representations arising from certain Calabi–Yau threefolds over Q with all the Hodge numbers of the third cohomology groups equal to 1. There are many examples of (families) of such Calabi–Yau threefolds. The modularity/automorphy of such Calabi–Yau threefolds will be the main topic of discussion. There are two venues to be considered. In one venue, we ought to count the number of rational points over finite fields of these Calabi–Yau threefolds to concoct their L-series. In the other venue, we ought to construct some modular varieties, in this case, conjecturally, Siegel modular forms of weight 3 and genus 2 on some paramodular subgroups of Sp(4,Z), and then compute their L-series. Such modular forms may be constructed using Borcherds forms. The ultimate aim is to establish a Langlands correspondence between the two L-series, thereby establishing the modularity/automorphy of such Calabi–Yau threefolds. This is a joint work with Yifan Yang (National Taiwan University).