Conference on Arithmetic Algebraic Geometry on the occasion of Gerd Faltings' 60th birthday

Program

Tue, 10 Jun 2014

09:00 - 10:00	*Registration*
10:00 - 11:00	N. Katz (Princeton University) *Some equidistribution conjectures on curves*
11:00 - 11:30	*coffee break*
11:30 - 12:30	Jan-Hendrik Evertse (Leiden) *On Schmidt's Subspace Theorem*
14:30 - 15:30	*coffee break*
15:30 - 16:30	Christian Liedtke (TU München) *Supersingular K3 surfaces are unirational*
17:00 - 18:00	Andrew Wiles (Oxford) *Class groups of imaginary quadratic fields*
19:00 - 22:00	University Club Bonn *Conference dinner*

Wed, 11 Jun 2014

10:00 - 11:00	Richard Taylor (IAS Princeton) *Galois representations attached to torsion in the cohomology of automorphic vector bundles, after Boxer*
11:00 - 11:30	*coffee break*
11:30 - 12:30	Hélène Esnault (FU Berlin) *Boundedness for representations of the fundamental group*
14:00 - 14:30	*coffee break*
14:30 - 15:30	Peter Schneider (Münster) *Torsion theories for Iwahori-Hecke modules in characteristic p*
15:30 - 16:30	Emmanuel Ullmo (IHES) *The hyperbolic Ax-Lindemann conjecture*
16:30 - 17:00	*refreshments*
17:00 - 18:00	Michael Larsen (Bloomington) *Some Variants of Jordan's Theorem*

Thu, 12 Jun 2014

10:00 - 11:00	Shou-Wu Zhang (Princeton University) *Gross-Zagier formula: why is it right?*
11:00 - 11:30	*coffee break*

11:30 - 12:30	Luc Illusie (Paris-Sud) *Around the Thom-Sebastiani theorem*
14:30 - 15:30	*coffee break*
15:30 - 16:30	Jean-Michel Bismut (Paris-Sud) *Hypoelliptic Laplacian and Hodge theories*
16:30 - 17:00	*break*
17:00 - 18:00	Peter Scholze (U Bonn) *p-adic cohomology of the Lubin-Tate tower*
19:00 - 21:00	MPIM Tea Room *Reception*

Fri, 13 Jun 2014

10:00 - 11:00	Adrian Vasiu (Binghamton) *Purity of crystalline strata*
11:00 - 11:30	*coffee break*
11:30 - 12:30	Jean-Marc Fontaine (Paris-Sud) *Gauges and p-torsion sheaves in characteristic p*
14:30 - 15:30	*coffee break*
15:30 - 16:30	Ching-Li Chai (U Penn, Philadelphia) *Sustained p-divisible groups*
16:30 - 17:00	*break*
17:00 - 18:00	Gérard Laumon (CNRS and Paris-Sud) *On the relative cohomology of the Hitchin fibration*

Abstracts

N. Katz

Some equidistribution conjectures on curves

We will formulate two sorts of equidistribution conjectures on curves, and discuss the numerical evidence for their truth in the case of elliptic curves.

Jan-Hendrik Evertse

On Schmidt's Subspace Theorem

Schmidt's Subspace Theorem is a higher dimensional generalization of Roth's Theorem on the approximation of algebraic numbers by elements from a given number field. It asserts that the set of solutions in $P^n(K)$ (K number field) of a particular Diophantine inequality is contained in finitely many proper linear subspaces of $P^n(K)$. I would like to discuss quantitative versions giving an explicit upper bound for the number of subspaces, and go into ideas of Faltings that went into the proof.

Christian Liedtke

Supersingular K3 surfaces are unirational

We show that supersingular K3 surfaces are related by purely inseparable isogenies. As an application, we deduce that they are unirational, which confirms conjectures of Artin, Rudakov, Shafarevich, and Shioda. The main ingredient in the proof is to use the formal Brauer group of a Jacobian elliptically fibered K3 surface to construct a family of "moving torsors" under this fibration that eventually relates supersingular K3 surfaces of different Artin invariants by purely inseparable isogenies. If time permits, we will show how these "moving torsors" exhibit the moduli space of rigidified supersingular K3 crystals as an iterated projective bundle over a finite field.

Andrew Wiles

Class groups of imaginary quadratic fields

Richard Taylor

Galois representations attached to torsion in the cohomology of automorphic vector bundles, after Boxer

I will report on work of George Boxer in which he has constructed Hasse like invariants on the closure of Ekedahl-Ooort strata, which cut out the open stratum. This answers in the affirmative a question of Oort as to whether the open Ekedahl-Oort strata (in the minimal compactification) are affine. It also allows Boxer to attach Galois representations to torsion in the (Zariski) cohomology of automorphic vector bundles on certain Shimura varieties. This in turn leads to a new construction of Galois representations for torsion in the Betti cohomology of locally constant sheaves on certain arithmetic locally symmetric spaces.

Hélène Esnault

Boundedness for representations of the fundamental group

Deligne's finiteness theorem for lisse $\bar{\mathbb{Q}}_\ell$-sheaves ver finite fields for bounded rank and bounded ramification suggests the existence of boundedness theorems for other categories as well, notably for algebraic flat connections over the complex numbers and stratifications in characteristic $p > 0$. We will report on what we understand so far (work in progress).

Peter Schneider

Torsion theories for Iwahori-Hecke modules in characteristic p

By work of Bernstein and Borel the smooth representation theory of a p-adic reductive group G with characteristic zero coefficients is very closely related to the module theory of the corresponding Iwahori-Hecke algebra H. With characteristic p coefficients this relation is much more complicated and still mysterious. I will introduce a canonical torsion pair in the module category of H (but which depends on G) whose associated class of torsion free modules allows a natural fully faithful embedding into the category of smooth mod p representations of G. This is work in progress with R. Ollivier.

Emmanuel Ullmo

The hyperbolic Ax-Lindemann conjecture

The hyperbolic Ax Lindemann conjecture is a functional transcendental statement which describes the Zariski closure of "algebraic flows" on Shimura varieties. We will describe the proof of this conjecture and its consequences for the André-Oort conjecture. This is a joint work with Bruno Klingler and Andrei Yafaev.

Michael Larsen

Some Variants of Jordan's Theorem

Jordan's theorem on finite subgroups of $GL_n(C)$ asserts that each such group is contained in an algebraic subgroup of GL_n which is toral-by-finite and of bounded complexity. As such, it exemplifies the idea of trying to relate various kinds of linear groups to linear algebraic "envelopes" of some kind. I will discuss some variations on this theme.

Shou-Wu Zhang

Gross-Zagier formula: why is it right?

In his eccentrically written paper in 1952, Heegner showed that the 1000 years old congruent number problem is soluble for all prime p (or $2p$) congruent to 5, 7 (or 6) mod 8, by constructing some rational points on certain elliptic curves of infinite order. In 1986, Gross and Zagier proved a formula which relates the heights of Heegner points and derivatives of L-series. At the ICM in 1986, Faltings asked: "Alles in allem handelt es sich um eine schöne Entdeckung, welche wir aber leider noch nicht "erklären" können: Warum ist sie richtig?" In this talk, I will present a partial answer to Faltings' question. More precisely, I will present a representation theoretical framework (initiated by Gross) in which the Gross-Zagier formula and Waldspurger formula (on periods integrals of automorphic forms) can be viewed simultaneously. I will show how this framework be used to prove a general Gross-Zagier formula, and a general p-adic Waldspurger formula, and a general p-adic Gross-Zagier formula. If time permits, I will describe recent applications of Gross-Zagier formula to the congruent number problem, BSD conjecture, and the proposed generalization of Gross-Zagier formula to higher dimensional Shimura varieties.

Luc Illusie

Around the Thom-Sebastiani theorem

For germs of holomorphic functions $f : \mathbf{C}^{m+1} \to \mathbf{C}$, $g : \mathbf{C}^{n+1} \to \mathbf{C}$ having an isolated critical point at 0 with value 0, the classical Thom-Sebastiani theorem describes the vanishing cycles group $\Phi^{m+n+1}(f \oplus g)$ (and its monodromy) as a tensor product $\Phi^m(f) \otimes \Phi^n(g)$, where $(f \oplus g)(x, y) = f(x) + g(y)$, $x = (x_0, ..., x_m)$, $y = (y_0, ..., y_n)$. I will discuss algebraic variants and generalizations of this result over fields of any characteristic, where the tensor product is replaced by a certain local convolution product, as suggested by Deligne. The main theorem is a Künneth formula for $R\Psi$ in the framework of Deligne's theory of nearby cycles over general bases.

Jean-Michel Bismut

Hypoelliptic Laplacian and Hodge theories

The hypoelliptic Laplacian is a family of operators acting on the total space of the tangent bundle (or a larger bundle) of a manifold. It is supposed to interpolate in the proper sense between the classical elliptic Hodge Laplacian and the geodesic flow. It is not self-adjoint. In certain cases, the full spectrum of the original Laplacian remains rigidly embedded in the spectrum of the deformation. I will explain how such operators arise naturally in the evaluation of semisimple orbital integrals for real reductive groups. Chern-Weil theory will appear as another sort of degenerate Hodge theory. Finally, I will describe the role of the hypoelliptic Laplacian in complex geometry.

Peter Scholze

p-adic cohomology of the Lubin-Tate tower

We prove a finiteness result on the p-adic cohomology of the Lubin-Tate tower, of potential interest in the p-adic Langlands program.

Adrian Vasiu

Purity of crystalline strata

Given an F-crystal C over a scheme S of positive characteristic p, one can associate many reduced locally closed subschemes T of S defined by the property that a suitable invariant of F-crystals is constant on the fibres of C over points of S. A basic problem is to study different properties of such locally closed subschemes T.In this talk, we present a survey of purity results for locally closed subschemes T of S, including some of them which were obtained by us and by the graduate student Jinghao Li.

Jean-Marc Fontaine

Gauges and p-torsion sheaves in characteristic p

Let k be a perfect field of characteristic p. φ-gauges over k are, in an appropriate sense, finite sub quotients of F-isocrystals. I'll explain how one can associate to such a φ-gauge a p-torsion sheaf over k for a suitable topology. This construction which is a part of a joint work with Uwe Jannsen extends the construction of the finite and flat commutative group scheme associated to a Dieudonné module. The Q_p sheaves we get by passing to the limit are linked to natural objects of p-adic Hodge theory and of perfectoid spaces.

Ching-Li Chai

Sustained p-divisible groups

In 1999 Frans Oort introduced the notion of "geometrically fiberwise constant p-divisible groups" and used it to define (central) leaves in moduli spaces of abelian varieties with additional structures in characteristic $p > 0$. This is a "pointwise" definition, in line with the definition of many natural stratification structure on moduli spaces.In this talk we will report a notion of "sustained p-divisible groups" over general base schemes in characteristic $p > 0$ and its basic properties, obtained in joint work in progress with Oort. This newer definition coincides with the previous one when the base scheme is (noetherian and) reduced, and helps in studying differential properties of leaves.

Gérard Laumon

On the relative cohomology of the Hitchin fibration

This is joint work with Pierre-Henri Chaudouard. The main tool in Ngô Bao Châu's proof of the Langlands-Shelstad fundamental lemma, is a theorem on the support of the relative cohomology of the elliptic part of the Hitchin fibration. For $\mathrm{GL}(n)$ and a divisor of degree $> 2g - 2$, the theorem says that the relative cohomology is completely determined by its restriction to any dense open subset of the base of the Hitchin fibration. In the talk I would like to present in this particular case, our extension of that theorem to the whole Hitchin fibration, including the global nilpotent cone.