# ℕ-cube days III

Chalmers University 4-5 December 2015

organized by Dennis Eriksson, Per Salberger, Amos Turchet, Martin Westerholt-Raum
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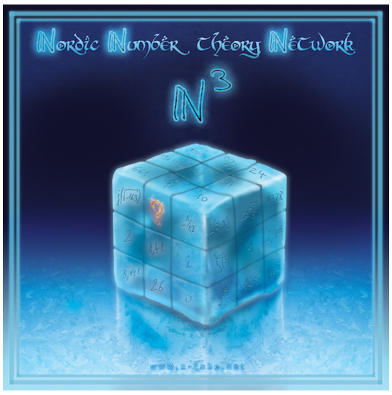


UNIVERSITY OF GOTHENBURG

CHALMERS

## PROGRAM

Location: Euler

| TIME | Friday 4th | Saturday 5th |
|---|---|---|
| 09:10 - 10:00 | | **Fabien Pazuki** |
| 10:00 - 10:30 | | Coffee Break |
| 10:30 - 11:20 | | **Jürg Kramer** |
| 11:30 - 12:20 | | **Gerard Freixas** |
| 12:20 - 13:15 | | |
| 13:15 - 14:05 | **Terry Gannon** | |
| 14:15 - 15:05 | **Harald Helfgott** | |
| 15:05 - 15:35 | Coffee Break | |
| 15:35 - 16:25 | **Jan Bruinier** | |
| 16:35 - 17:25 | **Pietro Corvaja** | |
| 19:00 | Social Dinner | |

## Abstracts

Time: Friday 4th 15:25;
Speaker: **Jan Hendrik Bruinier** (Technical University of Darmstadt)
Title: Classes of Heegner divisors in generalized Jacobians
*Abstract*: In parallel to the Gross-Kohnen-Zagier theorem, Zagier proved that the traces of the values of the j-function at CM points are the coefficients of a weakly holomorphic modular form of weight 3/2. Later this result was generalized in different directions and also put in the context of the theta correspondence. We recall these results and report on some newer aspects, which arise from considering classes of Heegner divisors in generalized Jacobians. This is joint work with Y. Li.

Time: Friday 4th 16:35;
Speaker: **Pietro Corvaja** (University of Udine)
Title: Torsion varieties and Betti maps for sections of abelian schemes.
*Abstract*: Given an abelian scheme $\mathcal{A} \to S$ and a section $\sigma : S \to \mathcal{A}$, we study the subvarieties of $X \subset S$ where $\sigma$ takes torsion values; these varieties will be called torsion subvarieties. Among some new results, we prove the finiteness of torsion hypersurfaces, outside trivial cases. Some applications will be provided to seemingly unrelated problems. This is a joint work with D. Masser and U. Zannier.

Time: Saturday 5th 11:30;
Speaker: **Gerard Freixas i Montplet** (C.N.R.S. - Institut de Mathmatiques de Jussieu)
Title: Flat line bundles and Arakelov geometry.
*Abstract*: In this talk I will deal with Arakelov geometry on arithmetic surfaces. This theory, initiated by Arakelov and then extended by Gillet-Soulé, gives arithmetic analogues of intersection numbers of line bundles on surfaces. These are no longer integers, but real numbers with some Diophantine meaning (e.g. heights). One needs to"complete" line bundles with the data of an hermitian metric, for such intersection products to be defined. In this setting, a major result is a Riemann-Roch type formula, that involves a real spectral invariant (holomorphic analytic torsion). Sometimes line bundles naturally come with flat connections, but not with metrics (for instance, rational points of universal vector extensions of jacobians). In joint work with R. Wentworth, we extend Arakelov geometry on arithmetic surfaces to line bundles with flat connections, and we prove the corresponding Riemann-Roch type formula. The theory is now complex valued, and the Riemann-Roch formula involves now a variant of analytic torsion, used by Hitchin in the theory of Higgs bundles.

Time: Friday 4th 13:15;
Speaker: **Terry Gannon** (University of Alberta)
Title: Modular forms and almost-nice vertex operator algebra.
*Abstract*: Modular forms and almost-nice vertex operator algebra Abstract: Vertex operator algebras are a translation into algebra of a very simple class of quantum field theories (called conformal field theories) relevant to string theory. They were introduced by Borcherds to help explain Monstrous Moonshine, and for this he was awarded a Fields Medal in 1998. I'll begin my talk by sketching in broad strokes the representation theory of nice (aka "rational") vertex operator algebras, and its relation to modular forms. This part of the story is now well-understood and lies at the heart of Moonshine. Then I will turn to the next simplest class of vertex operator algebras (the logarithmic $C_2$-cofinite ones), which is only now becoming understood. If I have time, I'll describe the modular form-like quantities arising in even more general vertex operator algebras. My talk won't assume familiarity with vertex operator algebras (or conformal field theory or string theory).

Time: Friday 4th 14:15;
Speaker: **Harald Andrés Helfgott** (Universität Göttingen)
Title: The ternary Goldbach conjecture.
*Abstract*: The ternary Goldbach conjecture (1742) asserts that every odd number greater than 5 can be written as the sum of three prime numbers. Following the pioneering work of Hardy and Littlewood, Vinogradov proved (1937) that every odd number larger than a constant $C$ satisfies the conjecture. In the years since then, there was a succession of results reducing $C$, but only to levels much too high for a verification by computer up to $C$ to be possible ($C > 10^{1300}$). Ramare and Tao solved the corresponding problems for six and five prime numbers instead of three. I have managed to give a full proof of the conjecture; we will go over the main ideas in the proof.

Time: Saturday 5th 10:30;
Speaker: **Jürg Kramer** (Humboldt-Universität zu Berlin)
Title: Sup-norm bounds of automorphic forms.
*Abstract*: In our talk we will present recent results on optimal sup-norm bounds on average for cusp forms of arbitrary even weight for any Fuchsian subgroup of $PSL_2(\mathbb{R})$. Furthermore, based on new results on the analytic continuation of a partial hyperbolic heat kernel, we will also discuss potential sup-norm bounds for Maass forms.

Time: Saturday 5th 9:10;
Speaker: **Fabien Mehdi Pazuki** (University of Copenhagen)
Title: Northcott property for regulators of abelian varieties.
*Abstract*: Let $A$ be an abelian variety defined over a number field $K$. One can define a regulator associated with the Mordell-Weil group $A(K)$, which plays an important role in the strong form of the Birch and Swinnerton-Dyer Conjecture for instance. We show that under a conjecture of Lang and Silverman, this regulator verifies the following property: up to isomorphisms, there is only finitely many simple abelian varieties of dimension $g$, defined over $K$, with positive rank over $K$ and bounded regulator. On the way, we give unconditional inequalities between the Faltings height of $A$, the primes of bad reduction of $A$ and the Mordell-Weil rank of $A(K)$.