

# Curriculum Vitae – Andreas Holmstrom

(For current contact details, see my webpage: [www.andreasholmstrom.org](http://www.andreasholmstrom.org))

## RESEARCH INTERESTS

Interactions between homotopy theory and arithmetic geometry. L-functions and zeta functions, in particular special values. Cohomology theories in algebraic and arithmetic geometry. Motivic stable homotopy theory, in particular over arithmetic base schemes. Brown representability theorems in algebraic geometry. The Beilinson regulator, Arakelov geometry, higher arithmetic Chow groups.

## PUBLICATIONS

See the last page of this CV for the list as of June 2010, and see my webpage for an updated list.

## MATHEMATICAL EDUCATION

2007-2010 PhD program, University of Cambridge, United Kingdom. Advisor: Prof. Tony Scholl.

2005-2006 Certificate of Advanced Study in Mathematics (“Part III”), University of Cambridge. Graduated with Distinction.

2001-2005 MSc in Engineering Physics, Royal Institute of Technology (KTH), Stockholm, Sweden.

2004-2005 Exchange student at École Polytechnique Fédérale de Lausanne, Switzerland.

## WORK EXPERIENCE

2007-2010 Supervising undergradates in Cambridge in the following courses: Riemann surfaces; Groups, rings and modules; Number theory; Algebraic geometry.

Jan 2007 - Jan 2008 Marie Curie Early Stage Researcher, EU Arithmetic Algebraic Geometry network / University of Cambridge.

Oct-Dec 2006 Lecturer, University of Nairobi. Taught Linear algebra and Introduction to abstract algebra. Numerous other part-time and summer jobs during my studies.

## ORGANISATIONAL RESPONSIBILITIES

- Initiated and co-organised a successful graduate student conference on homotopy theory in Cambridge in Dec 2007, with 30 participants from more than ten countries.
- Initiated and organised a study group on motivic stable homotopy theory in Cambridge in early 2010.

## LANGUAGES

- Fluent in English, Swedish and Norwegian.
- Good knowledge of French.
- Basic knowledge of German.

## TALKS GIVEN

### Invited seminar talks

- Arakelov motivic cohomology and special values of zeta functions, Sheffield Topology Seminar, Apr 2010.
- Higher arithmetic Chow groups and zeta functions, Nottingham Number Theory Seminar, March 2010.
- L-functions in number theory. University of Nairobi Colloquium talk, Nov 2006.

### Conference talks

- Arakelov motivic cohomology and zeta values, At Motives and homotopy theory of schemes, Oberwolfach, May 2010.
- Simplicial sheaves and cohomology theories. At the Algebra and Geometry graduate student conference, KTH, Stockholm, May 2009.
- What is a geometric category? At the Young Researchers in Mathematics conference, Cambridge, April 2009.
- Brown representability and arithmetic geometry. At the Graduate Homotopy theory conference, Cambridge, Dec 2007.

### Talks at graduate student seminars and study groups in Cambridge:

- Motivic homotopy theory over general base schemes, Feb 2010.
- Homotopy theory over Spec  $\mathbf{Z}$ . Nov 2009.
- L-functions in arithmetic geometry. Oct 2009.
- What are simplicial sheaves? Feb 2009.
- Global Langlands functoriality. March 2008.
- Galois representations from torsion points on elliptic curves. Nov 2007.
- Cohomology theories in algebraic geometry. June 2007.
- Complex multiplication and modular curves. Feb 2007.
- Iwasawa theory. Spring 2006.
- What is étale cohomology? March 2006.

### Other talks:

- The Beilinson conjectures. Two talks at the London Number Theory Study Group, Jan 2010.
- Elliptic curves over  $\mathbf{C}$ . Graduate seminar, Ecole Polytechnique Fédérale de Lausanne, spring 2005.
- L-functions and Tate's thesis. Presentation of MSc thesis, KTH, Stockholm, Sep 2005.

## CONFERENCE PARTICIPATION

- Motives and homotopy theory of schemes, Oberwolfach, May 2010
- Cohomology of algebraic varieties, Hodge theory, Algebraic cycles, Motives, Paris, April 2010
- Focused workshop on  $F_1$ -geometry, Granada, Nov 2009.
- Advanced School on Homotopy theory and Algebraic geometry, Seville, Sep 2009.
- Motivic homotopy theory, Münster, July 2009.
- Algebraic K-theory and Motivic Cohomology, Oberwolfach, June 2009.

- British-Nordic Congress of Mathematicians, Oslo, June 2009.
- Algebra and Geometry (Nordic graduate student conference), KTH, Stockholm, May 2009.
- Young Researchers in Mathematics, Cambridge, April 2009.
- The Grothendieck conference, IHES, Jan 2009.
- Workshop on Diophantine approximation and Arakelov theory, Fields Inst., Toronto, Oct 2008.
- Homotopical group theory and topological algebraic geometry, Bonn, June 2008.
- Workshop on Noncommutative constructions in arithmetic and geometry, London, June 2008.
- The Abel Symposium on Algebraic Topology, Oslo, Aug 2007.
- Motives and algebraic cycles, Fields Institute, Toronto, March 2007.
- Homotopy theory of schemes, Fields Institute, Toronto, March 2007.
- LMS/EPSRC short course: Topics in Arithmetic Geometry, London, Aug 2006.

### **COMPETITIONS**

Was awarded an Honourable mention at the IMO (International Mathematical Olympiad) 2000 in South Korea. I also participated in IMO 1999 in Romania, and have ranked among the very best students in Sweden in numerous other competitions in programming, physics, and mathematics.

### **GRANTS AWARDED**

**For the PhD program:** (approximate figures)

- Royal Swedish Academy of Sciences (Magnusons): € 15 000.
- Sixten Gemzeus foundation: € 11 000.
- Cambridge European Trusts: € 17 000.
- Johan and Jakob Söderberg foundation: € 14 000.

**For my undergraduate studies:**

Smaller amounts (up to € 3000) from each of the following sources: Oscar Ekman Foundation for Sweden Abroad, KTH General Funds, Söderman's Extra, The C E Wikström Foundation, Ahlner's, Österby's, ERASMUS support, Sandviken foundation for excellence in studies at KTH, The Swedish Association for Graduate Engineers.

### **OTHER ACTIVITIES**

- Am running the mathematical blog "Motivic Stuff".
- Member of the Swedish Mathematical Society.
- Member of the London Mathematical Society.
- Member of the American Mathematical Society.
- Fellow of the Cambridge Philosophical Society.

# Publications

## PREPRINTS

### 1. Arakelov motivic cohomology I (joint with Jakob Scholbach)

Abstract: This is the first in a series of papers developing a good theory of Arakelov motivic cohomology for arithmetic schemes. The main motivation for this theory comes from the study of special values of L-functions and zeta functions. Compared with previous approaches to higher arithmetic Chow groups by Feliu, Burgos and Goncharov, the main advantage in our approach is that we can work over an arithmetic base like  $\text{Spec } \mathbf{Z}$  rather than just over a number field, which is crucial for any applications to special values. This improvement is due mainly to the fact that we use the work of Cisinski, Déglise, Ayoub and Riou on motivic stable homotopy theory over very general base schemes. Using this theory, we can not only give a good definition of Arakelov motivic cohomology, but also give unconditional proofs of many of the structural properties one could hope that these new cohomology groups should satisfy. The key input in our definition is the construction of a motivic ring spectrum representing Deligne cohomology, together with a new definition of the Beilinson regulator.

## PREPRINTS IN PREPARATION

### 2. Arakelov motivic cohomology II: Comparison theorems (joint with Jakob Scholbach)

Abstract: We continue the study of Arakelov motivic cohomology, comparing our new construction of the Beilinson regulator with classical definitions, and discussing the relation between Arakelov motivic cohomology groups and higher arithmetic Chow groups.

### 3. Products in Arakelov motivic cohomology (joint with Peter Arndt)

Abstract: Using recent results of Hornbostel on model structures on algebras over operads, we define a product structure on Arakelov motivic cohomology.

### 4. $A^1$ -representability of Bloch-Ogus theories

Abstract: We discuss the general problem of constructing motivic ring spectra representing Bloch-Ogus cohomology theories.

### 5. Gluing of cohomology theories for arithmetic schemes

Abstract: We show that objects in the motivic stable homotopy category over  $\text{Spec } \mathbf{Z}$  satisfies a gluing formalism similar to the situation for étale sheaves or perverse sheaves. This gives a way of constructing cohomology theories for arithmetic schemes starting from the data of a cohomology theory over  $\mathbf{Q}$  and a cohomology theory over each finite prime, together with certain “gluing maps”.