2011 ATKIN MEMORIAL LECTURE AND WORKSHOP: ABSTRACTS OF TALKS

APRIL 29, 30 AND MAY 1, UIC

Friday, April 29, 2011.

Atkin Memorial Lecture "The arithmetic of modular forms for noncongruence subgroups" by Winnie Li (Penn State)

Abstract: The understanding of the arithmetic of modular forms for noncongruence subgroups pales when compared to that of congruence subgroups. In large part, this is due to the lack of effective Hecke operators, as conjectured by Atkin. The first pioneering work on noncongruence modular forms was done by Atkin and Swinnerton-Dyer in 1971, who proposed p-adic congruence relations replacing the usual 3-term recursive relations satisfied by eigenforms of the Hecke operator at p. In 1985 Scholl attached to noncongruence forms a family of Galois representations, bridging the congruence and noncongruence worlds. In this talk we shall survey historical development and recent progress on noncongruence forms with emphasis on the ASD congruences and modularity of Scholl representations.

Saturday, April 30, 2011.

1. "An introduction to the Fontaine-Mazur conjecture" by Matthew Emerton (Northwestern).

Abstract:

2. "Recent progress on the automorphy of Galois representations" by Toby Gee (Northwestern)

Abstract: We will survey recent progress on the automorphy and potential automorphy of p-adic Galois representations.

3. "Relative p-adic Hodge theory" by Kiran Kedlaya (MIT and UC San Diego)

Abstract: The subject of p-adic Hodge theory concerns the relationship between different types of objects associated to algebraic varieties over p-adic field via cohomology theories, notable etale and de Rham cohomology. Relative p-adic Hodge theory extends this study to families of varieties. Much progress has been made in recent years (and months) in extending known results of p-adic Hodge theory, such as the (rational) de Rham-etale comparison theorem, to the relative setting. I'll describe a formalism in which such results can be derived, originally introduced by Faltings, extended by Andreatta and Brinon, and put in its current form by myself, R. Liu, and Scholze. I'll also mention a sample application to the theory of (congruent) modular forms: the geometric construction of overconvergent p-adic modular forms by Andreatta, Iovita, Pilloni, and Stevens.

4. "Unpublished computation data of Atkin on noncongruence forms and beyond" by Ling Long (Iowa State).

Abstract: In the development of noncongruence modular forms, computation data, especially those by A.O.L. Atkin, have played a central guiding role. In this talk, we will reveal unpublished computation data of Atkin in this area sorted by different themes. We will then discuss certain interpretations and theoretical results, and conclude with some future research directions, both computational and theoretically.

5. "Automorphy of certain Galois representations of GO_4 type" by Tong Liu (Purdue).

Abstract: Let $V : \mathrm{Gal}(\overline{\mathbb{Q}}/\mathbb{Q}) \to GO_4(\overline{\mathbb{Q}}_p))$ be a continuous Galois representations. We prove the (potential) automorphy of V under some standard Fontaine-Mazur assumptions and some other technical restrictions on V. Our method allows us to deal with some cases that Hodge-Tate weights are not regular, for example, certain representations coming from noncongruence modular forms.

Sunday, May 1, 2011.

1. "Weakly Holomorphic Vector Valued Modular Forms" by Jitendra Bajpai (Alberta)

Abstract: Let G be any genus-0 finite index subgroup of the modular group and ρ be any rank-d representation of G then I will show that the space of weakly holomorphic vector-valued modular forms of any weight-w is free module of rank d over an appropriate ring of weakly holomorphic modular functions and its relation with noncongruence modular forms.

2. "Computations with Coleman integrals" by Jennifer Balakrishnan (MIT)

Abstract: The Coleman integral is a p-adic line integral that can encapsulate valuable information about the arithmetic and geometry of curves and abelian varieties. For example, certain integrals allow us to find rational points or torsion points; certain others give us p-adic height pairings. I'll present a brief overview of the theory, describe algorithms to calculate some of these integrals, and illustrate these techniques with numerical examples computed using Sage.

3. "Rational Equivariant Forms" by Abdelkrim El Basraoui (CRM-CICMA and Concordia University)

Abstract: Functions commuting with a certain action get a particular attention and have been of interest for a long time. For instance, in representation theory intertwining operator do carry this property.

In number theory and specifically in the theory of modular forms this property manifests in the action of the modular subgroups. The aim of this talk is to introduce the notion of *equivariant forms* for a modular subgroup and then focus on the *rational equivariant forms*. This talk will be divided into two parts. In the first part we give the origin of this new type of functions. Properties and structure of the set of rational equivariant forms will constitute the second part. If time permits, we will give some applications of rational equivariant forms. This is joint work with A. Sebbar.

4. "Algebraic curves of $GL(2)$-type" by Jerome W. Hoffman (LSU)

Abstract: We discuss various constructions of algebraic curves over number fields whose Galois representation on cohomology factors through $GL(2)$. In genus 2 we are interested in those that have real multiplication (RM) and quaternion multiplication (QM). Families of curves with RM (resp. QM) are parametrized by Humbert surfaces (resp. Shimura curves). Explicit examples are discussed..

5. "Congruences arising from noncongruence cusp forms" by Jonas Kibelbek (Penn State)

Abstract: Atkin and Swinnerton-Dyer were the first to observe p-adic congruences among noncongruence cusp form Fourier coefficients. We will consider several examples of these congruences, discuss methods for proving these congruences hold (p-adic Galois representations and formal groups), and look at applications of these congruences.

6. "Malcev's Theorem on Nilpotent Groups" by Aaron Silberstein (Harvard)

Abstract: Malcev proved a correspondence between torsion-free, finitely-generated, nilpotent groups and Lie algebras which forms the basis of much in the arithmetic and geometric study of fundamental groups (including modular groups). We indicate how to prove this theorem, and some of its applications.

6. "Computing log-characteristic cycles using ramification theory" by Liang Xiao (Chicago)

Abstract: There is an analogy among vector bundles with integrable connections, overconvergent F-isocrystals, and lisse l-adic sheaves. Given one of the objects, the property of being clean says that the ramification is controlled by the ramification along all generic points of the ramified divisors. In this case, one expects that the Euler characteristics may be expressed in terms of (subsidiary) Swan conductors; and (in first two cases) the log-characteristic cycles may be described in terms of refined Swan conductors.

7. "Integral of Borcherds type" by Luanlei Zhao (Madison)

Abstract: Following S. Kudla, J. Bruinier and T. Yang, we compute the integral of an automorphic Green functions coming from vector valued harmonic Maass forms for the dual pair $(O(n); Sp(1))$ over the negative 2-planes with signture $(r, 2)$ for $0 < r < n$, which is of interest in Arakelov geometry. Specially, we generalize their results in different respects.