

Pre-AMS Workshop Program on Number Theory and Representation Theory

The University of Iowa, March 17-18, 2011

All talks are in 114 MacLean Hall

Thursday, March 17, 2011

- 12:00-5:50pm, tea in B13 MacLean Hall.
- 2:00-2:50pm, Zhefeng Xu, (Northwest University)
- 3:00-3:50pm, A. Raghuram (Oklohoma State University)
- 4:00-4:50pm, Daniel File (The University of Iowa)
- 5:00-5:50pm, Youness Lamzouri (University of Illinois at Urbana-Champaign)

Friday, March 18, 2011

- 8:00-11:50am, tea in B13 MacLean Hall.
- 9:00-9:50am, Jonas Kibelbek (Pennsylvania State University)
- 10:00-10:50am, Scott Ahlgren (University of Illinois at Urbana-Champaign)
- 11:00-11:50pm, Ramin Takloo-Bighash (University of Illinois at Chicago)

ABSTRACTS

Thursday, March 17, 2011

- **2:00-2:50pm, Zhefeng Xu, (Northwest University)**

Title: Mean value of Dirichlet character sums

Abstract: Let q be a positive integer, χ a Dirichlet character modulo q . Character sums

$$\sum_{n \leq x} \chi(n)$$

play an important role in the classical analytic number theory. In this talk, I will introduce some asymptotic properties of mean value of character sums over some special incomplete intervals such as $x = q/4$, $x = q/8$ or $x = q/p$, here p is a fixed prime.

- **3:00-3:50pm, A. Raghuram (Oklohoma State University)**

Title: Arithmetic of automorphic forms... an invitation

Abstract: A fundamental arithmetic result about modular forms is that the space $S_k(N)$ of cusp forms of weight k and level N has a basis consisting of forms with integer Fourier coefficients. This result combined with Eichler-Shimura isomorphism is at the heart of classical results on the special values of L-functions attached to modular forms. In this talk, I will describe this same result via the language of automorphic representations. It roughly takes the form that cuspidal cohomology for $GL(2)$ has a rational structure. My aim will be to give enough definitions and examples, keeping the talk reasonably self-contained, so that one can see the parallel between rational structures on cohomology and classical rational basis. (There are notes by Dr. Raghuram available.)

- **4:00-4:50pm, Daniel File (The University of Iowa)**

Title: An Introduction to Siegel modular forms and theta series

Abstract: In this introductory talk I will define Siegel modular forms and give basic examples. I'll also describe the integral representation of Andrianov and Kalinin for the standard L-function of a Siegel modular form.

- **5:00-5:50pm, Youness Lamzouri (University of Illinois at Urbana-Champaign)**

Title: Introduction to the analytic theory of L-functions.

Abstract: The analytic theory of L-functions has become a central part of modern number theory due to its diverse connections to several arithmetic, algebraic and geometric objects. For example the Riemann zeta function encodes deep information on the distribution of prime numbers. Another example is the connection between Dirichlet L-functions and Class numbers of imaginary quadratic fields. In this talk, I will present many examples of L-functions and discuss their analytic properties. Then I will give several applications of L-functions to concrete problems in number theory.

Friday, March 18, 2011

- **9:00-9:50am, Jonas Kibelbek (Pennsylvania State University)**

Title: Formal Groups and Atkin and Swinnerton-Dyer Congruences

Abstract: We examine the arithmetic structure of the Fourier coefficients of cusp forms. Specifically, we use formal group theory to extend the Atkin and Swinnerton-Dyer congruences to certain cases of noncongruence subgroups $\Gamma \subset SL_2(\mathbb{Z})$ whose modular curves X_Γ are defined over some finite extension K of \mathbb{Q} , applying a theorem of Ditters.

We associate to any space $S_k(\Gamma)$ of cusp forms a formal group law $\mathcal{F}_{\Gamma,k}$. In the case that Γ is a congruence subgroup of $SL_2(\mathbb{Z})$, this formal group law is defined over the ring of integers of a number field. We show that $\mathcal{F}_{\Gamma,2}$ is integral at almost all places in the case that the modular curve X_Γ is an elliptic or hyperelliptic curve, using Čech cohomology. From this, we prove a more general form of Atkin and Swinnerton-Dyer congruences at a strongly ordinary place \mathfrak{p} for weight 2 cusp forms for such Γ ; the resulting congruences are twisted by the Frobenius automorphism at \mathfrak{p} .

- **10:00-10:50am, Scott Ahlgren (University of Illinois at Urbana-Champaign)**

Title: Modular and mock modular forms

Abstract: Modular forms have played a central role in number theory for many years. Mock modular forms are a more recent object of intensive study (these must be completed by a “non-holomorphic part” in order to enjoy automorphic properties). I will survey some of the important properties of these types of functions and highlight some applications to problems in number theory.

- **11:00-11:50pm, Ramin Takloo-Bighash (University of Illinois at Chicago)**

Title: Applications of p-adic integration to counting

Abstract: In this talk I will explain how p-adic integration, combined with Tauberian theorems, can be used to count subrings and subgroups.