Tobias Berger

Title: An Eisenstein ideal for imaginary quadratic fields

Abstract: For certain algebraic Hecke characters χ of an imaginary quadratic field F we define an Eisenstein ideal in a Hecke algebra acting on cuspidal automorphic forms on $\mathrm{GL}_2(\mathbf{A}_F)$ and prove a bound for its index in terms of the special L-value $\mathrm{L}^{\mathrm{alg}}(0,\chi)$. From this we obtain a lower bound for the size of the Selmer group of a p-adic Galois character associated to χ. The method we use is to show that p-divisibility of $\mathrm{L}^{\mathrm{alg}}(0,\chi)$ implies a congruence mod p between a multiple of an Eisenstein cohomology class associated to χ (in the sense of G. Harder) and a cuspidal cohomology class in the cohomology of a hyperbolic 3-orbifold. Implementing this requires bounding the denominator of the Eisenstein cohomology class, which we do by analytic methods, and using the geometry of the Borel-Serre compactification of these spaces to control torsion in the compactly supported cohomology of degree 2. We then use the work of R. Taylor *et. al.* on associating Galois representations to cuspidal automorphic representation of $\mathrm{GL}_2(\mathbf{A}_F)$ to construct elements in Selmer groups.

Brian Conrad

Title: Root numbers and ranks in positive characteristic.

Abstract: For a global field K and an elliptic curve $\mathcal{E}_\eta$ over $K(T)$, Silverman's specialization theorem implies

$$\mathrm{rank}(\mathcal{E}_\eta(K(T))) \leq \mathrm{rank}(\mathcal{E}_t(K))$$

for all but finitely many $t \in \mathbf{P}^1(K)$. If this inequality is strict for all but finitely many t, the elliptic curve $\mathcal{E}_\eta$ is said to have *elevated rank*. All known examples of elevated rank for $K = \mathbf{Q}$ rest on the parity conjecture for elliptic curves over $\mathbf{Q}$, and the examples are all isotrivial.

Some additional standard conjectures over $\mathbf{Q}$ imply that there does not exist a non-isotrivial elliptic curve over $\mathbf{Q}(T)$ with elevated rank. In positive characteristic, an analogue of one of these additional conjectures is false. Inspired by this, for the rational function field $K = \kappa(u)$ over any finite field κ with characteristic $\neq 2$, we construct an explicit 2-parameter family $E_{c,d}$ of non-isotrivial elliptic curves over $K(T)$ (depending on arbitrary $c, d \in \kappa^\times$) such that, under the parity conjecture, each $E_{c,d}$ has elevated rank. The unconditional determination of the generic rank uses a mixture of arithmetic, geometric, and cohomological methods. This is joint work with K. Conrad and H. Helfgott.

Henri Darmon

Title: Stark-Heegner points: a progress report

Abstract: I will discuss Stark-Heegner points and the most recent progress in calculating them efficiently and in establishing their basic properties.

Matthew Emerton

Title: Hecke algebras completed at Eisenstein primes and explicit class field theory

Abstract: In this talk I will discuss joint work with Frank Calegari, in which we give a deformation theoretic interpretation of the completion at Eisenstein primes of Hecke algebras acting on weight two modular forms of prime level. Via this identification, we are able to relate the ramification indices of these completions to the structure of certain class groups. Combined with some calculations of Merel, this yields some new results on the structure of these class groups: for example, if N is a prime congruent to 1 mod p, we give a simple numerical criterion for the class group of $\mathbf{Q}(N^{1/p})$ to have p-rank greater than or equal to 2.

C.F.Gauss

Title: On quadratic residues

Abstract: If p is a prime number of the form $4n + 1$, $+p$ will be a residue or non-residue of any prime number which taken positively is a residue or nonresidue of p. If p is of the form $4n + 3$, $-p$ will have the same property.

Since almost everything that can be said about quadratic residues depends on this theorem, the term *fundamental theorem* which we will use from now on should be acceptable.

In this talk, we establish the fundamental theorem and if time remains, we will provide some numerical examples to illustrate its usefulness.

Ben Howard

Title: Nonvanishing of Heegner cycles for higher weight modular forms.

Abstract: Given an elliptic curve E over the rationals, one can construct special Heegner points on E defined over dihedral Galois extensions. Work of Cornut and Vatsal shows that these points are generically nontrivial, verifying a conjecture of Mazur. We generalize this result, replacing E with the cohomology of the Galois representation attached to a modular form of any even weight.

Michael Larsen

Title: The inverse Galois problem for p-adic groups

Abstract: TBA

Ken Ono

Title: Hilbert class polynomials and traces of singular moduli

Abstract: TBA

Chris Skinner

Title: Main conjectures for modular forms

Abstract: TBA

Kannan Soundararajan

Title: Moments and large values of L-functions

Abstract: TBA

Hui June Zhu

Title: TBA

Abstract: TBA