Alberta Number Theory Days VIth meeting
June 12 - 14, 2015

MEALS

Breakfast and Lunches are complimentary, at **Vistas Main Dining Room** on the 4th floor of Sally Borden Building. Meal tickets are included in your welcoming package.
Breakfast buffet: 7:00-9:30am.
Lunch buffet: 11:30am-1:30pm.

For other meal options at the Banff Centre, there are food outlets on The Banff Centre campus such as
- Vistas Main Dining Room on the 4th floor of Sally Borden Building (dinner buffet: 5:30-7:30pm, $27.72),
- Le Café (ground floor, Sally Borden Building),
- the Maclab Bistro (Kinnear Centre).
You will also find a good selection of restaurants in the town of Banff which is a 10-15 minute walk from Corbett Hall.

Beverages and snacks are available in the lounge on a cash honor system.

FACILITIES

2-day workshops are welcome to use BIRS facilities (2nd Floor Lounge, TCPL, Reading Room) until 15:00 on Sunday, although participants are still required to checkout of the guest rooms by 12 noon.
There is no coffee break service on Sunday afternoon, but self-serve coffee and tea are always available in the 2nd floor lounge of Corbett Hall.

SCHEDULE

Lectures: All lectures will be held in the lecture theater in the TransCanada Pipelines Pavilion (TCPL). An LCD projector, a laptop, a document camera, and blackboards are available for presentations.

Coffee Breaks: As per daily schedule, in the foyer of the TransCanada Pipeline Pavilion (TCPL).

June 12: Friday Evening

16:00 Check-in begins (Front Desk - Professional Development Centre - open 24 hours)
Lecture rooms available after 16:00
19:30 Informal gathering in 2nd floor lounge, Corbett Hall (if desired).

June 13: Saturday Morning

8:45-9   Opening Remarks.

9-10   William Casselman (University of British Columbia)
Title: *Newton Polygons and Ramification*

10-10:30   Coffee Break, TCPL

10:30-11:30   Thomas Creutzig (University of Alberta)
Title: *Logarithmic Hopf links and modular forms*

11:30-12:15   Anna Puskas (University of Alberta)
Title: *Demazure-Lusztig operators, crystals and metaplectic Whittaker functions*

June 13: Saturday Afternoon

2-3   Julia Gordon (University of British Columbia)
Title: *Product formulas for the size of an isogeny class of elliptic curves*

3-3:30   Coffee Break, TCPL

3:30-4:30   Clifton Cunningham (University of Calgary)
Title: *Lifting Hilbert modular forms to spin modular forms*

4:30 - 5:30   Stephan Ehlen (McGill University)
Title: *On Two Arithmetic Theta Lifts*

June 14: Sunday Morning

9:15-10   Mark Bauer (University of Calgary)
Title: *Cubic Irrationalities and a Ramanujan-Nagell Analogue*

10-10:35   James Parks (University of Lethbridge)
Title: *The asymptotic constant for amicable pairs of elliptic curves*

10:35- 11:00   Coffee Break, TCPL

11-12   Amir Akbary (University of Lethbridge)
Title: *On the greatest prime factor of some divisibility sequences*

Checkout by 12 noon.

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ABSTRACTS
(in alphabetic order by speaker surname)

Speaker: **Amir Akbary** (University of Lethbridge)
Title: *On the greatest prime factor of some divisibility sequences*
Abstract: Let $P(m)$ denote the greatest prime factor of m. For integer $a > 1$, M. Ram Murty and S. Wong proved that, under the assumption of the ABC conjecture,

$$P(a^n - 1) \gg_{\epsilon,a} n^{2-\epsilon}$$

for any $\epsilon > 0$. We study analogues results for the corresponding divisibility sequence over the function field $\mathbb{F}_q(t)$ and for some divisibility sequences associated to elliptic curves over the rational field $\mathbb{Q}$.

This is a joint work with Soroosh Yazdani.

Speaker: **Mark Bauer** (University of Calgary)
Title: *Cubic Irrationalities and a Ramanujan-Nagell Analogue*
Abstract: In this talk we consider a cubic analogue of the Ramnujan-Nagell equation. In particular, we show that by constructing explicit restricted irrationality measures for the cube root of two that are, in some very real sense, better than expected it is possible to derive meaningful and interesting bounds on the difference between the cube of an integer and powers of 2. These measures naturally yield results about certain Diophantine equations.

This is joint work with Michael Bennett.

Speaker: **William Casselman** (University of British Columbia)
Title: *Newton polygons and ramification*
Abstract: I shall explain the characterization of ramification groups in terms of Newton polygons, following an old suggestion of Tate and a recent paper of Jonathan Lubin. If time permits, I'll also explain either Lubin's proof of Sen's theorem on p-adic dynamics or the use of Newton polygons to compute local Galois groups (following Romano, Greve, and Pauli).

Speaker: **Thomas Creutzig** (University of Alberta)
Title: *Logarithmic Hopf links and modular forms*
Abstract: Representations of a regular vertex operator algebra or conformal field theory form a modular semi-simple tensor category. The categorical $SL(2, \mathbb{Z})$-action is generated by the Hopf link and twist corresponding to the elments S and T of the modular group. This action coincides with the modular group action on the space of trace functions. Further the Hopf link defines representations of the fusion ring of the vertex operator algebra.

If the vertex operator algebra has indecomposable but reducible modules then nothing is known about a similar modular story. I will introduce what I call logarithmic Hopf links, explain how they relate to representations of the fusion ring and especially in an example how they relate to modular group action on the space of trace and pseudo trace functions.

Speaker: **Clifton Cunningham** (University of Calgary)
Title: *Lifting Hilbert modular forms to spin modular forms*
Abstract: In this talk I will explain how Hilbert modular forms for totally real fields of degree n determine automorphic representations of forms of the group $GSpin(2n + 1)$ over $\mathbb{Q}$. Using examples, I will show that the automorphic representations obtained in this way may or may not be holomorphic.

Joint work with Lassina Dembele.

Speaker: **Stephan Ehlen** (McGill University)
Title: *On Two Arithmetic Theta Lifts*

Abstract: In his 1997 *Annals* paper 'Central Derivatives of Eisenstein Series and Height Pairings', Kudla constructs Green's functions for special cycles on Shimura curves. The construction generalizes to higher dimensional orthogonal and unitary Shimura varieties. We show how to obtain these Green?s functions as regularized theta lifts of certain 'truncated' Poincar series. This construction allows us to apply the well-developed methods for such theta lifts. In particular, we are able to study their CM values and show a direct relation to Bruinier's automorphic Green functions (which are regularized theta lifts of harmonic weak Maass forms). One of the interesting applications in arithmetic geometry is that our results imply the modularity of the difference of two arithmetic generating series for Kudla-Rapoport cycles on unitary Shimura varieties.

This is joint work with Siddarth Sankaran.

Speaker: **Julia Gordon** (University of British Columbia)
Title: *Product formulas for the size of an isogeny class of elliptic curves*

Abstract: Consider the question: how likely is a random elliptic curve over the finite field $\mathbb{F}_p$ to have exactly N rational points, where N is a given integer in the appropriate range? In 2003, Gekeler gave an explicit answer based on a heuristic that was too strong to be literally true, thus the answer appeared somewhat mysterious. We provide an explanation for this formula by making an explicit and very natural connection with a formula of Langlands and Kottwitz which expresses the size of an isogeny class of principally polarized abelian varieties in terms of an adelic orbital integral. Then we discuss a possible extension of Gekeler's computations from elliptic curves to abelian varieties.

This is joint work with Jeff Achter.

Speaker: **James Parks** (University of Lethbridge)
Title: *The asymptotic constant for amicable pairs of elliptic curves*

Abstract: Let E be an elliptic curve defined over $\mathbb{Q}$. If p is a prime of good reduction then we define the group of points on the reduced elliptic curve over $\mathbb{F}_p$ as $E_p(\mathbb{F}_p)$. Silverman and Stange defined a pair of distinct primes (p, q) such that $|E_p(\mathbb{F}_p)| = q$ and $|E_q(\mathbb{F}_q)| = p$ as amicable pairs. In this talk we consider the function that counts such pairs on average over a family of elliptic curves and discuss results related to the constant obtained in the asymptotic result.

Speaker: **Anna Puskas** (University of Alberta)
Title: *Demazure-Lusztig operators, crystals and metaplectic Whittaker functions*

Abstract: We will discuss the study of metaplectic p-adic Whittaker functions in terms of Demazure-Lusztig operators. These operators appear in relevant results in the non-metaplectic setting: the work of Brubaker, Bump and Licata in describing Iwahori-Whittaker functions, Tokuyama's theorem and the Demazure character formula. Their metaplectic versions, introduced in joint work with Gautam Chinta and Paul E. Gunnells, satisfy similar formulae. They provide a combinatorial tool to link two metaplectic generalizations of the Casselman-Shalika formula. The two approaches represent the spherical Whittaker function either as a sum over a Weyl group (Chinta-Offen and McNamara) or as a sum over a highest weight crystal (Brubaker-Bump-Friedberg and McNamara). By generalizing Tokuyama's theorem in terms of metaplectic Demazure-Lusztig operators, we show that these approaches produce the same result. Additionally, we will report on recent joint work with Manish Patnaik to express metaplectic Iwahori-Whittaker functions in terms of Demazure-Lusztig operators.