



# Newsletter

Autumn 2010

## Canadian Number Theory Association

Report on Eleventh Meeting

by David McKinnon (Waterloo)

The Canadian Number Theory Association's biennial meetings are amongst the largest meetings of the world's leading number theorists. The eleventh meeting was no exception, attracting 130 participants from Europe, North America, and Australia. The meeting began on Sunday, July 11, with a plenary talk by Zeev Rudnick entitled "Eigen-functions and sums of squares", and proceeded through the week with 82 other lectures on a variety of topics in number theory, including  $\mathfrak{o}$ -minimal structures, vanishing of L-functions, rational points on algebraic varieties, and Diophantine approximation.

One of these lectures, on Wednesday, July 14, was given by Valentin Blomer, recipient of the 2010 Ribenboim Prize for distinguished research in number theory by a mathematician who is Canadian or who has close connections to Canadian mathematics. His prize lecture was entitled "On the Ramanujan Conjecture", and described Dr. Blomer's impressive work on generalizations of the conjecture and their proofs. The conjecture, which was proven in 1973 by Deligne, states that if  $p$  is prime, then the Fourier coefficient  $\tau(p)$  of the cusp form  $\Delta(z)$  of weight 12 satisfies  $|\tau(p)| \leq 2p^{11/2}$ . In his talk, Dr. Blomer described his joint work with Farrell Brumley in proving a natural generalization of the conjecture to the groups  $GL_n$  over arbitrary number fields.

Most of the plenary lectures were, of course, not prize lectures. Michael Bennett's lecture featured a novel approach to solving an infinite family of Thue-Mahler equations, extending work of Darmon and Granville. Jan-Hendrik Bruinier gave an impressive algebraic talk, in which he described the calculation

of special values of modular functions associated to Shimura curves. Kevin Buzzard gave an overview of the  $p$ -adic Langlands program and recent progress towards some proofs. Hershy Kisilevsky's talk dealt with the variation in the rank of the Mordell-Weil group of an elliptic curve as the number field of definition varies. Kristin Lauter discussed the problem of how to count certain kinds of simultaneous embeddings of certain number rings into quaternion algebras over totally real fields, which relates to a famous formula of Gross and Zagier and the intersection pairing on a Hilbert modular surface.

An application of model theory to number theory was the main theme of Jonathan Pila's plenary lecture. He described a novel idea of Umberto Zannier to use  $\mathfrak{o}$ -minimal structures to solve diophantine equations, and uses it to prove the Andre-Oort conjecture for products of modular curves. Zeev Rudnick, on the other side of number theory, probed the boundary with mathematical physics by using diophantine techniques to describe the set of eigenfunctions of the Laplacian operator on flat tori. In a similar vein, Kannan Soundararajan's talk described applications of number theory to quantum chaos, including problems that lie in the intersection of the two fields. In particular, Dr. Soundararajan discussed the proof of a conjecture of Rudnick and Sarnak that the high-energy eigenfunctions of the Laplacian on the quotient of the complex upper half-plane by an arithmetic subgroup of  $SL_2(\mathbb{R})$  are equidistributed.

In all, the meeting featured ten plenary lectures, in addition to Dr. Blomer's prize lecture and Ken Ono's public lecture on Ramanujan and his discovery of mock theta functions. This sounds fairly technical for a public audience, but Dr. Ono's talk was very accessible, featuring photographs of his research trips

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# News

## CNTA Meeting (cont'd from p.1)

to India, and a very down-to-earth description of Ramanujan's mathematics. Dr. Ono also gave a plenary lecture aimed at professional number theorists, in which he described the uses of Ramanujan's mock theta functions in the study of special values of L-functions.

There were also 22 invited lectures, each roughly 35 minutes in length, and 49 lectures contributed by other participants, each of roughly 15–20 minutes in length. The pace of the meeting was very pleasant, with plenty of mathematical energy generated by the talks, and yet plenty of time before, after, and between talks to allow for the interesting mathematical discussions that are some of the greatest fruits of mathematical conferences.

There was also a brief meeting in the middle of the conference to decide the future of CNTA. It was already known that the Twelfth Meeting, in 2012, would be held in Lethbridge, but during the week it was also agreed that for its Thirteenth Meeting in 2014, the Association would return to Ottawa, at Carleton University.

The CNTA Eleventh Meeting was generously funded by the Atlantic Association for Research in the Mathematical Sciences (AARMS), and also by the Centre de Recherche Mathématique (CRM), the National Security Agency (NSA), the University of Acadia and the Number Theory Foundation (NTF).

## Summer At the Atlantic Algebra Centre

by Yuri Bahturin

In the fall of 2009 the Atlantic Algebra Centre invited Dr Vlastimil Dlab, FRSC, Professor of Carleton University. From October 4–10, he delivered the 9th AAC mini course "Representations of finite-dimensional algebras". As usual for the fall semester minicourses, this was attended also by the students of the regular graduate course, this time "Advanced linear algebra". Later the material of the minicourse was used in some presentations given by the students of this course, at the end of semester. The minicourse was

attended by undergraduate honours students, graduate students and the faculty. One of the audience was Dr Kenneth Price of University of Wisconsin, USA, who visited AAC for about a month. He and another visitor from USA, Dr Alon Regev of University of Illinois, gave talks at our Algebra Seminar.

In October 2009 we received from Springer-Verlag the copies of a special issue of the Journal "Acta Applicandae Mathematicae" composed of the papers submitted to the AAC organized International Workshop "Groups, Rings, Lie and Hopf Algebras II". The workshop was held in August 2007 at Bonne Bay Marine Station of Memorial University. The guest editors of the issue were Yuri Bahturin and Mike Parmenter.

Since September 1, 2009 AAC has hosted an AARMS postdoctoral fellow Dr Eugene Chibrikov. In addition to AARMS funding his stay is supported by a grant from AAC and personal discovery grants of several faculty members. Recently we were happy to learn that another AAC backed candidate, Dr Alexei Gordienko of Moscow State University, is among the winners of 2010 AARMS postdoctoral competition and will come to AAC as of September 1, 2010.

Other activities of AAC have included the 10th AAC mini course by a famous algebraist, Professor Donald Passman of University of Wisconsin – Madison, USA, during the last week of March 2010. He spoke on the basics and the latest progress in the solution of a hard problem of semiprimitivity in group algebras. The minicourse was integrated with a regular course, named "Ring Theory", delivered at MUN in Winter semester, 2010. Also, close to this time, AAC carried out the Fourth Undergraduate Algebra Competition for the students of universities of Atlantic Canada. As usual, the three winners were awarded book prizes.

From July 18 – 23, 2010, AAC hosted an International Workshop "Infinite-dimensional Lie Algebras". This was the "second edition" of the International Workshop "Locally finite Lie algebras" held at Banff International Research Station from August 30 - September 04, 2003. This time the organizing Committee included Yuri Bahturin (MUN), Slava Futorny (University of Sao Paulo, Brazil), Mikhail Kochetov (MUN) and Ivan Penkov (Jacobs University Bremen, Germany). The invited lectures

were given by prominent mathematicians from Germany, Russia, UK and USA. As usual, AAC supported young participants: undergraduate and graduate students and postdoctoral fellows. The venue of the workshop was Bonne Bay Marine Station of MUN, which has proved to be such an excellent place back to August 2007. For more information please visit: [www.math.mun.ca/~aac](http://www.math.mun.ca/~aac).



## UNB Students achievements in Robotics

by Carl Thibault and Tyler Edwards

Collaborations Based Robotics and Automation (COBRA) Team is a highly motivated group pressing forward to develop autonomous cooperation between ground and air vehicle systems. The vision of supervisor Dr. Howard Li, at the University of New Brunswick, that cars will drive autonomously with aerial robot support is no longer limited to science fiction.

Over the span of 16 months the research team has gone from an idea to half a dozen remotely operated agents. Undergraduate students have been involved in assembling a custom ground vehicle from a mini ATV for traversing rough terrain and GPS waypoint navigation. The integration of custom and open source software has resulted in a model airplane with the ability to auto stabilize itself and simultaneously interface with the ground control station.

Other COBRA members are working on different pieces of the puzzle such as development of algorithms for multi agent simultaneous localization and mapping (SLAM), and multi agent path planning. The preliminary results are encouraging and demonstrate the soaring abilities of the team. We have the right people for the right job says Dr. Li

With Cobra's latest addition, a quad rotor helicopter, slated for lift off in a matter of days, progress is continuing to skyrocket for this talented group of researchers. This technology is being developed to implement methods that use the strengths of different vehicles to complete missions that can save lives on the battlefield, fight forest fires and assist in rescue operations home and abroad.



## Dalhousie Student wins second prize at international conference

Sam Stewart, interdisciplinary PhD student supervised at Dalhousie by Raza Abidi and Allen Finley, won the Second Prize at the student paper competition at MEDINFO 2010 in Cape Town, South Africa 12-15 Sept 2010. This is a massive achievement as MEDINFO is the top international health informatics conference. Sam competed against students from around the world and he came a close second. The title of winning paper is "Pediatric Pain Management Knowledge Linkages: Mapping Experiential Knowledge to Explicit Knowledge".

# Recent and Upcoming Events

## APICS meetings on Mathematics and Computer Science

Organizer: Paul Muir  
October 15-17, 2010 at Saint Mary's University  
contact Paul Muir (paul.muir@smu.ca)

## Special Session in Graphy Theory at the APICS Conference

Organizer: Paul Muir  
October 15-17, 2010 at Saint Mary's University  
contact Paul Muir (paul.muir@smu.ca)

## Category Theory "Octoberfest"

Organizers: Peter Selinger, Dorette Pronk  
October 23-24, 2010 at Dalhousie University  
contact Peter Selinger (selinger@mathstat.dal.ca)

## Combinatorial Algebra Meets Algebraic Combinatorics

Organizers: Sara Faridi, Tony Geramita, Adam Van Tuyl  
January 21-23, 2011 at Lakehead University  
contact Sara Faridi (faridi@mathstat.dal.ca)

## 2011 East Coast Combinatorial Conference

Organizers: Nancy Clarke, Jim Diamond  
May 4-5, 2011 at Acadia University  
contact Nancy Clarke (nancy.clarke@acadiu.ca)

## Canadian Undergraduate Mathematics Conference 2011

Organizers: A. Papillon, A. Deschenes, L. Pelletier, D. Maheux, F. Gourdeau  
June 15-19, 2011 at Laval University  
contact Dominique Maheux (dominique.maheux.1@ulaval.ca)

**Coast to Coast Seminar Series** (Autumn Theme - The Marine Environment and Climate Change: problems and possible solutions)

### William Hsieh (UBC) - Sept 21, 2010

Applying machine learning methods to climate variability

### Randall Martin (Dalhousie) - Oct 5, 2010

Insight into Lower Atmospheric Composition from Remote Sensing and Modeling

### Francis Zwiers (Victoria) - Oct 19, 2010

Anthropogenic Influence on Long Return Period Daily Temperature Extremes at Regional Scales

### Marlon Lewis (Dalhousie) - Nov 2, 2010

A sea of change

### Ken Denman (Victoria) - Nov 16, 2010

How will marine ecosystems adapt to a future ocean that will be warmer, more stratified, more acidic and less oxygenated?

### Richard Pelletier (Toronto) - Nov 30, 2010

Climate Impacts of Freshwater Forcing of the Ocean General Circulation

All Seminars take place at 3:30pm (Atlantic Time). For connection details ask the technician of your videoconferencing facility to contact Scott Wilson (Scott.Wilson@Dal.ca)

## AARMS Board of Directors

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*"Mathematics consists in proving the most obvious thing in the least obvious way."*

*- George Polya*