ADDITIVE NUMBER THEORY CONFERENCE

November 17 – 20, 2004

University of Florida, Gainesville, FL 32611

ABSTRACTS

S. D. Adhikari, Harish Chandra Research Institute, Allahabad
11:30 - 11:50AM, FRIDAY, NOVEMBER 19

Some Zero-sum Problems in Combinatorial Number Theory
We consider a rather recently established area in Combinatorial Number Theory referred to as 'Zero-sum Combinatorics'. Originating from a beautiful theorem of Erdős, Ginzberg and Ziv about forty years ago, it has found various ramifications and generalisations, with several interesting results and many unanswered questions. After giving an introduction to these questions and mentioning some early results, we report some recent results and generalizations in some new directions.

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C. Adiga, University of Mysore, India
3:30 - 3:50PM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
Sums of squares and sums of triangular numbers and their relationship
The study of representations of an integer as sums of squares is one of the most beautiful problems in the theory of numbers. In this talk, we first briefly review some of the advances in this area. We then describe how basic bilateral hypergeometric series summation formulas such as Rmanujan's summation formula and transformation formula due to W.N. Bailey plays an important role in the theory of representations of numbers by sums of squares and triangular numbers. Finally, we present a general relation between sums of squares and sums of triangular numbers. This talk is based on joint work with Shaun Cooper and Jung Hun Han.

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Scott Ahlgren, University of Illinois
4:00 - 4:20PM, WEDNESDAY, NOVEMBER 17

Fourier coefficients of half-integral weight modular forms modulo p
We discuss non-vanishing theorems for Fourier coefficients of half-integral weight modular forms mod p, and applications to classical conjectures in additive number theory.

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Jaclyn Anderson, University of Wisconsin
2:00 - 2:20PM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
An Asymptotic Formula for the t-core Partition Function and a Conjecture of Stanton
For a positive integer t, a partition is said to be a t-core if each of the hook numbers from its Ferrers-Young diagram is not a multiple of t. In 1996, Granville and Ono proved the t-core partition conjecture, that $a_t(n)$, the number of t-core partitions of n, is positive for every non-negative integer n as long as $t \geq 4$. As part of their proof, they show that if $p \geq 5$ is prime, the generating function for $a_p(n)$ is essentially a multiple of an explicit Eisenstein Series together with a cusp form. This representation of the generating function leads to an asymptotic formula for $a_p(n)$ involving L-functions and divisor functions. In 1999, Stanton conjectured that for $t \geq 4$ and $n \geq t+1$, $a_t(n) \leq a_{t+1}(n)$. Here we prove a weaker form of this conjecture, that for $t \geq 4$ and n sufficiently large, $a_t(n) \leq a_{t+1}(n)$. Along the way, we obtain an asymptotic formula for $a_t(n)$ which, in the cases where t is coprime to 6, is a generalization of the formula which follows from the work of Granville and Ono when $t = p \geq 5$ is prime.

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George Andrews, Pennsylvania State University
8:30 - 9:20AM, WEDNESDAY, NOVEMBER 17

Partitions with Short Sequences and Ramanujan's Mock Theta Functions
In a recent paper "Integrals, Partitions and Cellular Automata" in the Transactions of the American Mathematical Society, Holroyd, Liggett and Romik evaluated an intriguing definite integral and applied it to a variety of probability models. The application to integer partitions concerned partitions in which no sequence of consecutive integers of length k appears ($k = 2, 3, \dots$). The authors note that in one instance, a proof of their result can also be based on a little known partition theorem of P.A. MacMahon. Our object in this talk will be to introduce these ideas and to develop the study of such partitions from a purely combinatorial, q-series point of view. Surprisingly one of Ramanujan's mysterious mock theta functions arises quite naturally.

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Claus Bauer, Dolby Labs
11:00 - 11:20AM, THURSDAY, NOVEMBER 18

Hua's theorem on sums of five prime squares in arithmetic progressions
Hua has shown that all integers equal to 5 modulo 24 can be presented as the sum of five prime squares. Here, we investigate a generalization of this problem. We require the prime numbers to be belong to given residue classes modulo k and investigate for which size of k this equaltion is solvable.

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Alex Berkovich, University of Florida
5:00 - 5:20PM, FRIDAY, NOVEMBER 19

Infinite products with nonnegative coefficients
In this talk I discuss certain infinite products which have a natural combinatorial origin. While these products are power series with nonnegative coefficients, this nonnegativity is not obvious from the definition. Implications include an elementary proof of the Andrews-Lewis mod 3 conjecture. This talk is based on recent joint work with Frank Garvan.

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Bruce C. Berndt, University of Illinois
10:00 - 10:20AM, WEDNESDAY, NOVEMBER 17

Ramanujan's congruences for the partition function modulo 5, 7, and 11
Using an idea from Ramanujan's unpublished manuscript on the partition and tau functions, we provide new proofs for these famous congruences.

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Bruce C. Berndt, University of Illinois
Special Mathematics History Lecture
3:00 - 3:50PM, THURSDAY, NOVEMBER 18

Ramanujan: his life, friends, notebooks, and identities for the Rogers-Ramanujan functions
Ramanujan was born in southern India in 1887 and died there in 1920 at the age of 32. He had only one year of college, but his mathematical discoveries, made mostly in isolation, have made him one of the most influential mathematicians for nearly 100 years. A brief account of Ramanujan's life will be presented. Particular attention will be given to his friends, for whom we shall provide short biographical sketches. Most of Ramanujan's mathematical discoveries were recorded without proofs in notebooks, and a description and history of these notebooks and his famous lost notebook will be given. The geneses of many of Ramanujan's discoveries remain hidden behind an impenetrable fog. As one example, in the only mathematical content of the lecture, we shall discuss his famous 40 identities for the Rogers-Ramanujan functions. The lecture will be accompanied by overhead transparencies depicting Ramanujan, his home, his school, his notebooks, and those influential in his life, including his mother and wife.

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Matt Boylan, University of Illinois
3:30 - 3:50PM, WEDNESDAY, NOVEMBER 17

Arithmetic of the partition function
Ramanujan discovered many interesting properties of the partition function. Perhaps the most famous properties are the Ramanujan congruences

$$\begin{aligned} p(5n+4) &\equiv 0 \mod 5, \\ p(7n+5) &\equiv 0 \mod 7, \\ p(11n+6) &\equiv 0 \mod 11. \end{aligned}$$

Since Ramanujan's work, congruences for $p(n)$ have been widely studied. Using the theory of modular forms modulo ℓ, we show that these congruences are the only ones of the form $p(\ell n + a) \equiv 0 \mod \ell$. As a corollary, we prove many cases of a famous conjecture of Newman on the distribution of values of $p(n)$ among residue classes mod M.

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David M. Bradley, University of Maine
4:00 - 4:20PM, FRIDAY, NOVEMBER 19

On q-Analogs of Multiple Zeta Values and other Multiple Harmonic Series
An example of a multiple harmonic sum is $Z_n(s,t,u) := \sum_{n\ge k\ge j\ge m\ge 1} k^{-s}j^{-t}m^{-u}$. Here, the sum is over all positive integers k, j, m satisfying the indicated inequalities, which in some cases may be strict instead of weak as shown. The bound n is either a positive integer or infinite. The variables s, t, u are unrestricted if n is finite, but are usually assumed to be positive integers, with $s > 1$ if n is infinite to ensure convergence. In general, we may have an arbitrary finite number of variables instead of three. The q-analog of a positive integer k is $[k]_q := \sum_{j=0}^{k-1} q^j = (1-q^k)/(1-q)$, $0 < q < 1$. Naively, one can obtain a q-analog of multiple harmonic sums by replacing the summation indices by their respective q-analogs. However, this approach needs to be modified in order to yield interesting results. I shall discuss what sorts of results can be obtained with appropriate modifications, outline a few of the techniques used to prove them, and hopefully give an indication of why researchers are interested in this subject.

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Kathrin Bringmann, University of Wisconsin
3:00 - 3:20PM, WEDNESDAY, NOVEMBER 17

On Fourier coefficients of Siegel cusp forms with small weight
Let $f \in S_k(\Gamma_g)$ be a Siegel cusp form of degree g and weight k on Γ_g, the Siegel modular group. We want to prove the following:
Let $g \ge 2$ be an integer and suppose that $k \ge g+1$; let $F \in S_k(\Gamma_g)$ with Fourier coefficients $a(T)$, where T is a positive definite symmetric half-integral $g \times g$ matrix. Then we have

$$a(T) \ll_{\epsilon,F} (\det T)^{k/2-1/(2g)-(1-1/g)\alpha_g+\epsilon} \qquad (\epsilon > 0),$$

where $\alpha_g^{-1} := 4(g-1) + 4\left\lfloor \frac{g-1}{2} \right\rfloor + \frac{2}{g+2}$ and where the constant implied in $\ll_{\epsilon,F}$ only depends on ϵ and F.
For the proof one can use the Fourier-Jacobi decomposition of F

$$F(Z) = \sum_{m>0} P_m(\tau, z) e^{2\pi i \operatorname{tr}(m\tau')},$$

were the summation extends over all positive definite symmetric half-integral $(g-1) \times (g-1)$ matrices. Then the coefficients $P_m(\tau, z)$ are Jacobi cusp forms. The case $k > g+1$ is treated by Böcherer and Kohnen. They use certain Poincaré series for the Jacobi group and develop a kind of Petersson coefficient formula. Unfortunately these series fail to converge absolutely in the case $k = g+1$. Therefore we use the so-called Hecke trick and multiply every summand of the Poincaré series with a factor depending on a complex variable s, such that the new series $P_{k,m;(n,r),s}$ is again absolutely convergent for $\sigma =$Re(s) sufficiently large. Moreover this factor is chosen such that the new series is again invariant under the slash operation of the Jacobi group. Now the method is the following one: we compute the Fourier expansion of the Poincaré series $P_{k,m;(n,r),s}$, show that it is even absolutely and locally uniformly convergent in a larger domain of C, that contains the point $s = 0$ if $k = g+2$ and take it as a new definition for the Poincaré series in this larger domain. What is left to show is that these series are Jacobi cusp forms and that the Petersson coefficient formula is still valid. Afterwards we can show very easily the desired estimate.

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Stefano Capparelli, University La Sapienza, Rome
3:00 - 3:20PM, FRIDAY, NOVEMBER 19

Principal subspaces of standard modules
We survey some results about the principal subspaces of standard modules and their relevance for the study of partition identities.

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O-Yeat Chan, University of Illinois
10:00 - 10:20AM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
Some asymptotics of cranks
We use the circle method to prove some asymptotic formulas for the coefficients of quotients of theta functions related to the crank generating function. Our result implies a conjecture of Andrews and Lewis as well as the completeness of a list of tables found on pages 179 and 180 of Ramanujan's Lost Notebook.

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Song Heng Chan, University of Illinois
4:00 - 4:20PM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
On Ramanujan's $_1\psi_1$ summation formula and Sears' transformations.
We'll present a proof of Ramanujan's $_1\psi_1$ summation formula and use the same method to give a proof of Sears' transformations of basic hypergeometric series.

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Sylvie Corteel, CNRS University of Versailles
9:00 - 9:20AM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
An iterative bijective approach to generallizations of Schur's theorem
We start with a bijective proof of Schur's theorem due to Alladi and Gordon and describe how a particular iteration of it leads to some very general theorems on colored partitions. These theorems imply a number of important results, including Schur's theorem, Bressoud's generalization of a theorem of Göllnitz, two of Andrews' generalizations of Schur's theorem, and the Andrews-Olsson identities. This is joint work with Jeremy Lovejoy.

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Jean-Marc Deshouillers, University of Bordeaux II
8:30 - 9:20AM, THURSDAY, NOVEMBER 18

Subset sums modulo a prime
For a set A of residues modulo a prime p, when is it - or isn't it - possible to represent all residues as a sum of distinct elements of A, when is it not possible to represent 0 in a non-trivial way ?... Harmonic analysis and Combinatorics will show their power to tackle these Number theoretic questions.

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Dennis Eichhorn, Cal St Hayward
3:30 - 3:50PM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Partition functions do not concentrate too heavily modulo M
Combining work of Ahlgren, Nicolas, Ruzsa, Serre, and Sarkozy, we know that $p(n)$ cannot concentrate too heavily in either residue class modulo 2. Berndt, Yee, and Zaharescu gave infinite families of partition functions that share this property. Also, the work of Ahlgren, Boylan, Brunier, and Ono provides a lower bound for how often $p(n)$ fills each residue class modulo any prime P other than 3, which trivially implies that $p(n)$ cannot concentrate too heavily in any single residue class modulo P. In light of this, it is natural to ask whether or not the aforementioned infinite families of partition functions can concentrate in a single residue class modulo any M. In this talk, we explore the answer to that question. A special case of our results will be a theorem about $p(n)$ modulo 3.

Shalom Eliahou, Universite du Littoral Cote d'Opale, Calais
12:00 - 12:20PM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Optimally small sumsets in groups
Let G be a group. We denote by $\mu_G(r,s)$ the least possible cardinality of a sumset $A.B$ in G, where A and B range over all subsets of G of cardinality r and s, respectively. (For instance, if G is of prime order p, then $\mu_G(r,s) = \min(r+s-1,p)$ by the Cauchy-Davenport theorem.) The talk will review current knowledge on the function μ_G, including recent progress for a few classes of groups (abelian, dihedral), as well as for some ranges of the parameters r, s.

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Jayce Getz, University of Wisconsin
8:30 - 8:50AM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Systems of orthogonal polynomials arising from the modular j-function (joint work with S. Basha, H. Nover, and E. Smith)
Let $S_p(x) \in F_p[x]$ be the polynomial whose zeros are the j-invariants of supersingular elliptic curves over F_p. Generalizing a construction of Atkin described in a recent paper by Kaneko and Zagier, we define an inner product $\langle , \rangle_\psi$ for every $\psi(x) \in Q[x]$. Suppose a system of orthogonal polynomials $\{P_{n,\psi}(x)\}_{n=0}^{\infty}$ with respect to $\langle , \rangle_\psi$ exists. We prove that if n is sufficiently large and $\psi(x)P_{n,\psi}(x)$ is p-integral, then $S_p(x)|\psi(x)P_{n,\psi}$ over $F_p[x]$. Further, we obtain an interpretation of these orthogonal polynomials as a p-adic limit of polynomials associated to p-adic modular forms.

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Basil Gordon, UCLA
1:30 - 2:20PM, THURSDAY, NOVEMBER 18

The return of the mock theta functions
The mock theta functions were originally introduced by Ramanujan in 1920, in his last lecture to G.H. Hardy. This talk traces the development of the subject from that time to the present, focus1ng on efforts to construct a general theory. In particular, recent work of R.J. McIntosh and the speaker on extensions of the mock theta (non-)conjectures and their application to modular group transformation theory is discussed.

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Georges Grekos, Université Jean Monnet, St Etienne, France
10:30 - 10:50AM, FRIDAY, NOVEMBER 19

On weighted densities
(This work is joint with Rita Giuliano-Antonini (I-Pisa) and Ladislav Misik (CZ-Ostrava)) We consider weighted densities of sets of natural numbers. The weight function is n^α where α is a real number, $\alpha \geq -1$. Thus $\alpha = 0$ furnishes the usual asymptotic (or natural) density and for $\alpha = -1$ we get the logarithmic density. We study the continuity of the upper and of the lower density, with respect to the parameter α.

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Jim Haglund, University of Pennsylvania
3:30 - 3:50PM, FRIDAY, NOVEMBER 19

A Combinatorial Formula for the Macdonald Polynomials
We discuss a recent result of the speaker, M. Haiman and N. Loehr, which gives a combinatorial formula for the coefficient of a monomial in the Macdonald polynomial. The formula was first discovered by the speaker using experimental methods. Corollaries include a new proof of the Lascoux-Schutzenberger cocharge formula for Hall-Littlewood polynomials and a combinatorial formula of Sahi and Knop for Jack symmetric functions.

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Heekyoung Hahn, University of Rochester
2:00 - 2:20PM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
Convolution sums of functions on divisors
In this talk, we derive convolution sums of functions for the divisor sums $\tilde{\sigma}_s(n) := \sum_{d|n}(-1)^{d-1}d^s$ and $\hat{\sigma}_s(n) := \sum_{d|n}(-1)^{n/d-1}d^s$ for certain s, which were first defined by Glaisher. We then discuss some formulae for determining $r_s(n)$ and $\delta_s(n)$, $s = 4, 8$, in terms of thses divisor functions, where as usual, $r_s(n)$ and $\delta_s(n)$ denote the number of representations of n as a sum of s squares and s triangular numbers, respectively.

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Paul Jenkins, University of Wisconsin
9:00 - 9:20AM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Kloosterman sums and traces of singular moduli
We give a new proof of some identities of Zagier relating traces of singular moduli to the coefficients of certain half integral weight modular forms. In addition, we derive a simple expression for writing twisted traces as an infinite series. These results imply a new proof of the infinite product isomorphism announced by Borcherds in his 1994 ICM lecture.

Chaohua Jia, Academia Sinica, Beijing, P. R. China
11:30 - 11:50AM, THURSDAY, NOVEMBER 18

On Goldbach's Problems
I shall introduce progress on some of Goldbach's problems such as three primes theorem in short interval, Goldbach numbers in short interval and so on. I also mention simply the research methods.

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Renling Jin, College of Charleston
10:00 - 10:20AM, FRIDAY, NOVEMBER 19

Recent Results on Inverse Problems
In the early 1960's G. Freiman revealed an interesting inverse phenomenon, which says that if $A+A$ is small, then A must have some arithmetic structure. Let A be a set of natural numbers, finite or infinite. In the talk, the arithmetic structure of A or $A+A$ is characterized when $A+A$ is small in terms of each of the following conditions: (1) A is finite, $|A|$ is large enough, and $|A+A| = 3|A|-3+b$ for some small non-negative integers b, (2) A is infinite, $\gcd(A - \min A) = 1$, the upper asymptotic density of A is less than 0.5, and the upper asymptotic density of $A+A$ is 1.5 times the upper asymptotic density of A, (3) A is infinite and the upper Banach density of $A+A$ is less than 2 times the upper Banach density of A.

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Soon-Yi Kang, KIAS, Korea
2:30 - 2:50PM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
The continuous symmetric Hahn polynomials found in Ramanujan's lost notebook
Askey and Wilson found ${}_3F_2$ Hahn polynomials which are orthogonal with respect to a positive absolutely continuous weight function. More than a half century earlier, Ramanujan recorded the Stieltjes transform of this weight function in terms of a continued fraction in his lost notebook. We provide two different proofs for this integration. One applies theories of the Hamburger moment problem. The other uses elementary integration techniques and a couple of transformation formulas for hypergeometric functions.

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Christian Krattenthaler, Universite Claude Bernard, Lyon
10:30 - 10:50AM, WEDNESDAY, NOVEMBER 17

Hypergeometrics and linear forms of zeta values
Rivoal has recently proved that there are infinitely many values of the Riemann zeta function at odd integers which are irrational. More results in this direction have been found, among which is Zudilin's, saying that one number among $\zeta(5)$, $\zeta(7)$, $\zeta(9)$, $\zeta(11)$ is irrational. All these results depend on an arithmetic study of certain linear forms of zeta values. These linear forms are constructed using

certain (very-well-poised) hypergeometric series. Using (variations of) an old identity of Andrews between a single hypergeometric sum and a multiple hypergeometric sum, we are able to prove many of the existing conjectures on the arithmetic of such linear forms of zeta values. Ultimately, this work may lead to an improvement of Zudilin's result. This is joint work with Tanguy Rivoal.

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Angel Kumchev, University of Texas at Austin
11:30 - 11:50AM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Exceptional sets in the Waring-Goldbach problem
I will give a brief survey of recent improvements on the classical bounds for cardinalities of exceptional sets in the Waring-Goldbach problem. A typical example is the following result: The number of integers $n \leq X$ such that $n \equiv 4(\mod 24)$ and n cannot be represented as the sum of four squares of primes is $O(X^{5/14+\epsilon})$.

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James Lepowsky, Rutgers University
2:00 - 2:50PM, FRIDAY, NOVEMBER 19

Vertex operator algebras and partitions
I will survey interesting relations between vertex operator algebra theory and the theory of partitions, including early and recent developments.

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Jeremy Lovejoy, LaBRI, Universite Bordeaux I
8:30 - 8:50AM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
Extending partition theorems of Schur and Gollnitz to overpartitions
Partition theorems of Schur and Gollnitz have been extensively studied in recent years. Here we discuss the possibility of proving analogues of these results for overpartitions.

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Karl Mahlburg, University of Wisconsin
9:30 - 9:50AM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
A New Approach to Cranks
Most combinatorialists and number theorists are familiar with Ramanujan's celebrated congruences for the partition function - namely, that $p(5n+4) \equiv 0 \mod 5$, $p(7n+5) \equiv 0 \mod 7$, and $p(11n+6) \equiv 0 \mod 11$. There are many different proofs and generalizations of these formulae (including infinite families of related congruences), which follow from methods in q-series, theta functions, and modular

forms to list a few. However, most of these methods do not give any combinatorial insight as to why the congruences hold. Dyson's rank function gives a simple statistic on partitions that verifies the congruences modulo 5 and 7, by showing that, for example,

$$N(m, 5, 5n + 4) = p(5n + 4)/5$$

where $N(m, N, n)$ is the number of partitions of n whose rank is congruent to m modulo N, and m ranges through the residues modulo 5. The mod 11 case remained conjectural for fourty years, until Andrews and Garvan found their famous crank function and showed that

$$M(m, 11, 11n + 6) = p(11n + 6)/11,$$

where $M(m, N, n)$ is defined analogously to the case of the rank. In this talk, I present a new result that shows that the crank function provides a combinatorial proof of infinitely many congruences. The main theorem states that for any prime $l > 3$, there is an arithmetic progression $An + B$ such that $N(m, l, An + B) \equiv 0 \mod l$ for each $0 \leq m < l$. This provides a proof that $p(An + B) \equiv 0 \mod l$, as the partitions are grouped into classes whose sizes are all divisible by l. The proof uses the theory of modular forms in a manner similar to that found in Ono's seminal work on partition congruences.

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Pierre Mathieu, Physics Department, Laval University
4:30 - 4:50PM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
New partitions form physics
I describe two new types of partitions that have popped up recently in physical problems. The first one corresponds to pseudo-partitions that have been dubbed 'jagged partitions', in which the usual non-increasing condition on parts $n_i \geq n_{i+1}$ has been replaced by the weaker requirement $n_i \geq n_{i+1} - 1$ and $n_i \geq n_{i+2}$. In the two distinct physical contexts in which they appear (particular classes of conformal field theories), they are further subject to special conditions at distance $K - 1$, where the parameter K is either even or odd according to the type of models considered. The generating function that counts such restricted jagged partitions is related to multi-sums first introduced by Bressoud.
Supersymmetric quantum many-body problems of the Calogero-Moser-Sutehrland-type are at the origins of the second new type of partitions. These models lead to supersymmetric extensions of the defining eigenvalue problem for the Jack polynomials. They involve both commuting and anticommuting variables. The resulting eigenfunctions, called Jack superpolynomials, are labeled by superpartitions. A superpartition is the juxtaposition of two partitions, one of which being composed of distinct parts. The concept of superpartitions is the cornerstone of the emerging theory of symmetric superpolynomials.

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Christian Mauduit, CNRS, Marseille
12:00 - 12:20PM, THURSDAY, NOVEMBER 18

On the repartition of some q-additive functions
The aim of this talk is to give a survey on recent results concerning the arithmetic structure of sequences of integers generated by q-additive functions. In particular, we will describe the combinatorial, arithmetical and statistical properties of sequences of integers with an average sum of digits. This work was initiated in a joint paper with Andras Sarkozy concerning the arithmetic structure of these sequences of integers and recently developped in collaboration with Etienne Fouvry for the estimate of related exponential sums. We will also show the link between these sequences and the more general concept of automata over an infinite alphabet.

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Richard McIntosh, University of Regina
2:30 - 2:50PM, THURSDAY, NOVEMBER 18

Mordell integrals and mock theta functions
The modular transformation formulas for mock theta functions involve Mordell integrals. If two mock theta functions have the same Mordell integrals in their transformation formulas at q and at $-q$, then they differ by an ordinary theta function. Computer algebra can then be used to find that theta function. This leads to a conjectured relation involving the two mock theta functions. It is not necessary to know the modular transformation formulas. Mordell integrals can often be obtained using asymptotic and numerical methods.

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Antun Milas, University at Albany, SUNY
11:00 - 11:20AM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Superconformal Characters and Weber Functions
It is known that for every rational vertex operator algebra the vector space spanned by irreducible characters forms a $SL(2, \mathbb{Z})$–module. To such a module we will associate a canonical automorphic form (a certain Wronskian). We will show that vertex operator (super)algebra techniques can be used to compute Wronskian(s) associated to (super)conformal minimal models. As a consequence various (modular) q–series identities can be proven (certain Macdonald-Dyson identities, Jacobi's Four Square Theorem, a Carlitz's modular identity, etc.).

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Stephen C. Milne, Ohio State University
11:30 - 11:50AM, WEDNESDAY, NOVEMBER 17

New Lambert series formulas for 12 and 20 squares, and multiple basic hypergeometric series
We first discuss how basic hypergeometric series in one and several variables lead to formulas for sums of squares, including our recent work on infinite families of such formulas. After a review of our formulas for 16 and 24 squares, we present our new expansion of $\vartheta_3(0,-q)^{12}$ and $\vartheta_3(0,-q)^{20}$ as 2 by 2 determinants of double power series, where $\vartheta_3(0,q)$ is the classical theta function with j-th term q^{j^2}. We then express the double power series involved as linear combinations of classical Lambert series. The resulting Lambert series expansions here, as well as our earlier analogous 2 by 2 determinant expansions of $\vartheta_3(0,-q)^{16}$ and $\vartheta_3(0,-q)^{24}$, directly extend (and contain) Jacobi's classical formulas for 2, 4, 6, and 8 squares to 12, 16, 20, and 24 squares, respectively.

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Alexander Moreto, University of Valencia, Spain
10:00 - 10:20AM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Somo problems on partitions that arise from representation theory
It is well-known that the dimensions of the representations of the symmetric group of degree n can be obtained from the Young diagrams associated to the partitions of n by the so called hook formula. Several problems on arbitrary finite groups have been reduced to questions on the symmetric group, for which the hook formula plays an essential role. In this talk, we discuss some of these problems, with the hope that they can be solved with methods from combinatorics and number theory.

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Jennifer Morse, University of Miami
9:30 - 9:50AM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Facts and figures about k-Schur functions
The k-Schur functions arose in our study of an open problem on Macdonald polynomials. These symmetric functions provoked a k-refinement of classical ideas in symmetric function theory such as Pieri rules, Kostka numbers, the Young lattice, and Young tableaux. For example, the chains in the k-Young lattice are induced by the Pieri rules experimentally satisfied by k-Schur functions. We show that the k-Young lattice is isomorphic to the weak order on minimal coset representatives of the affine symmetric group modulo a maximal parabolic subgroup. Consequently, a bijection between k-tableaux and reduced words for these coset representatives naturally arises. We will also discuss how our work suggests that coefficients for the Macdonald polynomials may be q,t-enumerated by reduced words for affine permutations. This is joint work with Luc Lapointe.

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Melvyn Nathanson, Lehman College (CUNY)
8:30 - 9:20AM, FRIDAY, NOVEMBER 19

Sidon sets and representation functions of additive bases for the integers
The set A of integers is called an asymptotic basis if all but finitely many numbers can be represented as the sum of two elements of A. The representation function $r_A(n)$ counts the number of representations of an integer n as a sum of two elements of A. Nathanson showed that if $f(n)$ is any function from the integers to the set of nonnegative integers together with infinity, and if $f(n)$ has only finitely many zeros, then there exist infinitely many sets A with representation function $r_A(n) = f(n)$ for all integers n. It is known that for any such function $f(n)$ there exist arbitrarily sparse asymptotic bases with representation function equal to $f(n)$, but it is not known how dense such sets can be. We use Sidon sets to construct bases A with counting function $A(x) \gg x^{\sqrt{2}-1-o(1)}$. This is joint work with Javier Cilleruelo.

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Jean-Louis Nicolas, Universite Claude Bernard, Lyon
10:30 - 10:50AM, THURSDAY, NOVEMBER 18

Partitions without small parts
Let $r(n,m)$ (resp. $q(n,m)$) denote the number of partitions of n into parts (resp. into distinct parts) each of which is at least m. Improving on preceding results given by J. Dixmier, P. Erdos, M. Szalay, G. Freiman, J. Pitman and myself, E. Mosaki, A. Sarkozy and I have obtained an asymptotic estimate for $\log r(n,m)$ (and for $\log q(n,m)$) according to the powers of $n^{-1/2}$ if $m \ll n^{1/2}$ and to the powers of m/n if $m \gg n^{1/2}$ which is valid in the range $1 \leq m \leq n/(logn)^3$. The main idea is to apply the saddle point method to the generating function, and then to use the Euler-MacLaurin summation formula.

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Kevin O'Bryant, University of California, San Diego
4:00 - 4:20PM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
The Parity of the Partition Function
A folklore conjecture states that the set of n such that $p(n)$ (the unrestricted partition function) is odd has density 1/2. In joint work with Joshua Cooper and Dennis Eichhorn, we give solid heuristics for why this is the case, and prove that it is indeed the case for functions satisfying recurrences similar to Euler's Pentagonal Number recurrence.

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Ken Ono, University of Wisconsin
2:00 - 2:50PM, WEDNESDAY, NOVEMBER 17

Values of modular functions
In this talk I will describe joint work with Jan Bruinier and Paul Jenkins. I will generalize the observation that $e^{\pi\sqrt{163}}$ is nearly an integer by giving exact formulas for traces of values of the $j(z)$ function over CM points. In particular, I will present a uniform distribution result which gives an amusing description of a 'popular' integer in number theory.

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Scott Parsell, Butler University
5:00 - 5:20PM, THURSDAY, NOVEMBER 18

Some higher-dimensional additive problems
We discuss new estimates for the number of integer solutions of certain systems of symmetric equations. We then indicate how these estimates are used within the Hardy-Littlewood method to study higher-dimensional versions of Waring's problem and to count linear spaces of fixed dimension lying on the hypersurface defined by an additive equation.

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Jukka Pihko, University of Helsinki, Finland
12:00 - 12:20PM, FRIDAY, NOVEMBER 19

The Musketeers of Mathematics: Portrait of a Team
The purpose of my talk is to explain how the collaboration between Georges Grekos (St.-Etienne), Labib Haddad (Paris), Charles Helou (Penn State University), and myself (Helsinki) got started. The story gives a beautiful example of the transitivity of the friendship relation.

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B. Ramakrishnan, Harish Chandra Research Institute, Allahabad
10:30 - 10:50AM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Lacunarity of Two-Eta-Products
We discuss the lacunarity of modular forms which are two-eta-products. i.e., $\eta^r(z)\eta^s(mz)$ for $m = 3, 4, 5, 7$, where $r + s$ is even, $rs \neq 0$. Further, using a theorem of Granville and Ono on the $t - core$ partion, we also show that there are no lacunary non-cusp forms corresponding to the eta-products $\eta^r(z)\eta^s(mz), m \geq 4$. This talk is based on the speaker's work in collaboration with Shaun Cooper and Sanoli Gun.

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Jeremy Rouse, University of Wisconsin
2:30 - 2:50PM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
Vanishing and Non-Vanishing of Traces of Hecke Operators
Using a reformulation of the Eichler-Selberg trace formula, due to Frechette, Ono, and Papanikolas, we consider the problem of the vanishing (resp. non-vanishing) of traces of Hecke operators on spaces of even weight cusp forms with trivial Nebentypus character. For example, we show that for a fixed operator and weight, the set of levels for which the trace vanishes is effectively computable. Also, for a fixed operator the set of weight for which the trace vanishes (for any level) is finite. These results motivate the "generalized Lehmer conjecture," that the trace does not vanish for even weights $2k \geq 16$ or $2k = 12$.

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Andras Sarkozy, Eotvos Lorand University, Budapest
10:00 - 10:20AM, THURSDAY, NOVEMBER 18

On arithmetic properties of summands of partitions
In 1941 Erdos and Lehner published a paper on the distribution of the size and number of summands of partitions. Since that numerous papers have been written on statistical properties of partitions. Recently C. Dartyge and I have written 2, C. Dartyge, M. Szalay and I 3 joint papers on arithmetic properties of summands of (both unrestricted and unequal) partitions. We studied the distribution of the summands in residue classes; the proportion of the squarefree parts; the distribution of the number of prime factors of the summands, etc. In my talk I'll give a survey of these 5 papers.

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Anne Schilling, University of California, Davis
4:30 - 4:50PM, THURSDAY, NOVEMBER 18

New explicit expression for $A_n^{(1)}$ supernomials
The $X = M$ conjecture of Hatayama et al. states that the generating function X of highest weight elements in tensor products of Kirillov-Reshetikhin crystals graded by energy can be expressed in terms of a fermionic formula M. In terms of physics, this identity expresses the equivalence between the corner-transfer method and the Bethe Ansatz. We will give a proof of this conjecture for tensor products of symmetric powers by proving a direct statistic preserving bijection for simply-laced algebras, and then use the method of virtual crystals and fermionic formulas to prove the conjecture for nonsimply-laced algebras. This is based on work in collaboration with Mark Shimozono (to appear soon).

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James Sellers, Pennsylvania State University
3:00 - 3:20PM, SATURDAY, NOVEMBER 20
(Room: LIT 125)
A Connection Between Binary Partitions and Non-Squashing Partitions
In a recent note, Mike Hirschhorn and I proved that the number of partitions of n of the form $n = p_1 + p_2 + \cdots + p_k$ with $1 \leq p_1 \leq p_2 \leq \cdots \leq p_k$ and $p_1 + \cdots + p_j \leq p_{j+1}$ for $1 \leq j \leq k-1$ is equal to the number of binary partitions of n. In this talk, I will discuss more recent work with N. J. A. Sloane in which these partitions are related to a certain box-stacking problem (and are then known as non-squashing partitions). I will close by discussing work with Oystein Rodseth and Kevin Courtright on arithmetic properties of a certain family of non-squashing partitions which are closely linked to Churchhouse's results on binary partitions from the late 1960's.

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Drew Sills, Rutgers University
4:30 - 4:50PM, WEDNESDAY, NOVEMBER 17

Rogers-Ramanujan-Bailey Type Identities
The Rogers-Ramanujan identities were first discovered by L.J. Rogers in 1894. These identities, and identities of similar type have fascinated mathematicians for generations, and have found applications in combinatorics, Lie theory, and statistical physics. During the World War II era, W. N. Bailey undertook a careful study of Rogers' work, and in the process simplified and extended it. He discovered what is now known as "Bailey's lemma," the fundamental engine for producing Rogers-Ramanujan type identities, via the insertion of so-called "Bailey pairs." I, in turn, recently decided to revisit Bailey's work, and realized that all of the Bailey pairs considered by Bailey are in fact instances of a more general object, which I have named the "standard multiparameter Bailey pair" (SMPBP). Once the SMPBP was identified, it became clear that there were many elegant double-sum Rogers-Ramanujan type identities which had not been previously discovered, which were in some sense "neighbors" of Bailey's own identities. Furthermore, it turns out that many of the identities (both classical and new) which follow as corollaries of the SMPBP can be interpreted combinatorially in terms of a mild generalization of Basil Gordon's famous combinatorial generalization of the Rogers-Ramanujan identities.

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Jose Antonio Perdigao Dias da Silva, Universidade de Lisboa, Portugal
11:00 - 11:20AM, FRIDAY, NOVEMBER 19

Weak Sidon Sets and Matroid Theory
We present a class of sets that have the whose maximal Sidon subsets have the same cardinality.

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Jaebum Sohn, Yonsei University, Seoul, Korea
3:00 - 3:20PM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
Some continued fractions in Ramanujan's lost notebook
In this talk we first give the value of a periodic continued fraction which was recorded incorrectly by Ramanujan on page 341 of his lost notebook. Next, we describe several pairs of equivalent continued fractions in which one is the odd part of the other. One of the results is for the Rogers-Ramanujan continued fraction which was recently proved by Berndt and Yee. Finally, using the Bauer-Muir transformation we prove the equivalence of two continued fractions. One was recorded on page 44 in Ramanujan's lost notebook, and the other is found in the unorganized pages at the end of Ramanujan's second notebook.

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Dennis Stanton, University of Minnesota
4:30 - 4:50PM, FRIDAY, NOVEMBER 19

(q,t)-binomial coefficients
Motivated by the invariant theory of $GL_n(q)$ on the polynomial ring in n variables over a finite field, a (q,t)-binomial coefficient is defined. A combinatorial interpretation for the (q,t)-binomial coefficient is given, as a generating function for partitions. As a corollary, a new interpretation of the integer which is the q-binomial coefficient, when q is a positive integer, as counting partitions, is given.

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Holly Swisher, University of Wisconsin
11:00 - 11:20AM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
Stanley's partition function and its relation to $p(n)$
Recently, Richard Stanley formulated a new partition function $t(n)$. This function counts the number of partitions π for which the number of odd parts of π is congruent to the number of odd parts in the conjugate partition π' (mod 4). G. E. Andrews has recently proven a nice generating function for $t(n)$ in terms of the generating function for $p(n)$, the usual partition function. He also showed that the (mod 5) Ramanujan congruence for $p(n)$ also holds for $t(n)$. In light of these results, it is natural to ask the following questions: What is the size of $t(n)$? Are there other congruences satisfied by both $t(n)$ and $p(n)$? We will address both of these questions.

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Padma Vathamma, University of Mysore, India
11:30 - 11:50AM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
Analytic proof of a partition identity involving three parameters
In this paper we give an analytic proof of the identity $A_{5,3,3}(n) = B^0_{5,3,3}(n)$ where $A_{5,3,3}(n)$ counts the number of partitions of n subject to certain restrictions on their parts, and $B^0_{5,3,3}(n)$ counts the number of partitions of n subject to certain other restrictions on their parts, both too long to be stated in the abstract. The identity was originally discovered by the author jointly with M. Ruby Salestina and S.R. Sudarshan in ["A new theorem on partitions," Proc.Int. Conference on Special Functions, IMSC, Chennai, India, September 23–27, 2002; to appear], where it was also given a combinatorial proof, thus answering a question of Andrews.

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Ole Warnaar, The University of Melbourne, Australia
5:00 - 5:20PM, WEDNESDAY, NOVEMBER 17

Hall–Littlewood functions and the A_2 Rogers–Ramanujan identities
I will present a new A_2 summation identity for Hall–Littlewood functions. Upon specialization this identity yields the A_2 Bailey lemma of George Andrews, Anne Schilling and the speaker, thus providing a symmetric function proof of the A_2 Rogers–Ramanujan identities.

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Guoce Xin, Brandeis University
12:00 - 12:20PM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
On MacMahon's partition analysis
In his famous book "Combinatory Analysis" MacMahon introduced partition analysis as a computational method for solving problems of counting solutions to linear Diophantine equations and inequalities, counting lattice points in a convex polytope, and computing Ehrhart quasi-polynomials. G.E. Andrews and his co-authors (1998), introduces the Omega package to solve such problems using computer, and gives a new life to this subject. I will in this talk present a new approach, which combines the theory of iterated Laurent series and a new algorithm for partial fraction decompositions, and leads to an algorithm, whose running time is much less than that of the Omega package. This talk is going to be mostly based on my paper, "A Fast Algorithm for MacMahon's Partition Analysis" (published by Electron. J. Combin., 11(2004) arXiv: math.CO/0408377).

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Ae Ja Yee, Pennsylvania State University
11:00 - 11:20AM, WEDNESDAY, NOVEMBER 17

Partitions with difference conditions and Alder's conjecture
The well-known Rogers-Ramanujan identities may be stated partition-theoretically as follows. If $c = 1$ or 2, then the number of partitions of n into parts $\equiv \pm c \pmod 5$ equals the number of partitions of n into parts $\geq c$ with minimal difference 2 between parts. In 1926, Schur proved that the number of partitions of n with minimal difference 2 between parts and no consecutive multiples of 3 equals the number of partitions into parts $\equiv \pm 1 \pmod 6$, and Bressoud proved the Schur theorem by establishing a bijection in 1981. In 1956, Alder conjectured that the number of partitions into parts differing by at least d is greater than or equal to the number of partitions of n into parts $\equiv \pm 1 \pmod{d+3}$. Euler's identity, the first Rogers-Ramanujan identity, and the Schur's theorem show that the conjecture is true for $d = 1, 2, 3$, respectively. In 1971, Andrews proved the conjecture holds for $d = 2^r - 1, r \geq 4$. In this talk, we will discuss the conjecture for $d \geq 32$.

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Hamza Yesilyurt, University of Florida
12:00 - 12:20PM, WEDNESDAY, NOVEMBER 17

Shifted and Shiftless Partition Identities
Let S be a subset of positive integers and $p(S, n)$ denote the number of partitions of n with parts in S. A k-shifted partition identity is a pair of sets S and T such that $p(S, n) = p(T, n - k)$ for all $n > k$. A shiftless identity has the form: $p(S, n) = p(T, n)$ for all $n \neq a$. We prove many shifted and shiftless partition identities most of which was previously conjectured by Garvan. This is a joint work with Frank Garvan.

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Brendan Younger, University of Wisconsin
10:30 - 10:50AM, SATURDAY, NOVEMBER 20
(Room: LIT 339)
A New Proof of the Ramanujan Congruences for the Partition Function
The three classical congruences for the partition function,

$$\begin{aligned} p(5n+4) &\equiv 0 \mod 5, \\ p(7n+5) &\equiv 0 \mod 7, \\ p(11n+6) &\equiv 0 \mod 11. \end{aligned}$$

have been proven via q-series identities, combinatorial arguments, and the theory of Hecke operators. A new proof of these congruences is presented which uses only basic results from the theory of modular forms on $SL_2(Z)$. Furthermore, the proof naturally encompasses all three congruences in a single argument.

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