

# Karl Mahlburg

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**Citizenship:** USA

**Birth Date:** February 6, 1980.

## **Positions and Affiliations:**

- Assistant Professor, Louisiana State University, 2011 –.
- NSF Math Institutes Postdoctoral Fellow (administered by the Mathematical Sciences Research Institute); Visiting Research Fellow, Princeton University, 2009 – 2011.
- C.L.E. Moore Instructor, Massachusetts Institute of Technology, 2006 – 09.

## **Education:**

- Ph.D., Mathematics, University of Wisconsin-Madison, 2006.  
Advisor: Ken Ono  
Thesis: *Congruences for the coefficients of modular forms and applications to number theory*
- M.A., Mathematics, University of Wisconsin-Madison, 2003.
- B.S., Mathematics with Highest Distinction, Harvey Mudd College, 2001.

## **Research Interests:**

- Number Theory
- Modular Forms
- Theory of Partitions and  $q$ -series
- Combinatorics
- Probability
- Percolation

## **Publications:**

1. (with A. Benjamin, G. Levin, and J. Quinn) *Random approaches to Fibonacci identities*, The American Mathematical Monthly **107** (2000), 511–16.
2. (with J. Getz) *Partition identities and a theorem of Zagier*, Journal of Combinatorial Theory (A) **100** (2002), 27–43.

3. (with K. Ono) *Arithmetic of certain hypergeometric modular forms*, Acta Arithmetica **113** (2004), no. 1, 39–55.
4. *The overpartition function modulo small powers of 2*, Discrete Mathematics **286** (2004), no. 3, 263–267.
5. *More congruences for the coefficients of quotients of Eisenstein series*, Journal of Number Theory **115** (2005), no. 1, 89–99.
6. *Partition congruences and the Andrews-Garvan-Dyson crank*, Proceedings of the National Academy of Sciences **102** (2005), no. 43, 15373–76.
7. (with K. Bringmann and F. Garvan) *Partition statistics and quasiharmonic Maass forms*, International Mathematics Research Notices, 2009, no. 1, 63–97.
8. (with K. Bringmann) *Inequalities between crank and rank moments*, Proceedings of the American Mathematical Society **137** (2009), 2567–2574.
9. (with T. Kemp, A. Rattan and C. Smyth) *Enumeration of non-crossing pairings on bit strings*, Journal of Combinatorial Theory (A) **118** (2011), 129–151.
10. (with K. Bringmann) *An extension of the Hardy-Ramanujan method and applications to partitions without sequences*, American Journal of Mathematics **133** (2011), 1151–1178.
11. (with K. Bringmann and R. Rhoades) *Asymptotics for crank and rank moments*, Bulletin of the London Math. Soc. **43** (2011), 661–672.
12. (with K. Bringmann) *Improved bounds on metastability thresholds and probabilities for generalized bootstrap percolation*, Transactions of the American Mathematical Society **364** (2012), 3829–3859.
13. (with K. Bringmann and A. Mellit) *Convolution bootstrap percolation models, Markov-type stochastic processes, and mock theta functions*, to appear in International Mathematics Research Notices.
14. (with K. Bringmann, A. Holroyd, and M. Vlasenko) *k-run overpartitions and mock theta functions*, to appear in Quarterly Journal of Mathematics.
15. (with K. Bringmann and R. Rhoades) *Asymptotic expansions for crank and rank moments*, to appear in Proceedings of the Cambridge Philosophical Society.

**Submitted papers and preprints:**

- (with K. Bringmann) *Coefficient formulas for traces of affine Lie superalgebras*, submitted.

- (with C. Smyth) *Symmetric polynomials and quasi-mean inequalities*, submitted.
- (with K. Bringmann) *Asymptotic inequalities for positive crank and rank moments*, submitted.
- (with K. Bringmann) *Asymptotics for stacks and related functions*, preprint.

### **Colloquia and Plenary Talks:**

- *The Andrews-Garvan crank and partition congruences*, Plenary address, International Conference on Number Theory and Mathematical Physics and SASTRA Ramanujan Award Presentation, Kumbakonum, India, December 20-22, 2005.
- *The Andrews-Garvan-Dyson crank and partition congruences*, Colloquium, Temple University, January 23th, 2006.
- *Modular forms in number theory*, Colloquium, Harvey Mudd College, December 7, 2006.
- *The arithmetic of the coefficients of automorphic forms and applications in number theory*, Colloquium, University of Talca, Chile, March 3, 2009.
- *Asymptotics for crank and rank moments*, Plenary address, International Conference on number theory and mock theta functions, SASTRA University, Kumbakonam, India, December 22, 2009.
- *Partitions, probability, and percolation*, Plenary address, Prospects in  $q$ -series and modular forms Conference, University College, Dublin, Ireland, July 14, 2010.
- *Noncrossing partitions and general Catalan objects*, Colloquium, University of Talca, Chile, December 9, 2010.
- *Percolation, probability, and partitions*, Colloquium, Wesleyan University, April 21, 2011.
- *Percolation, probability, and partitions*, Colloquium, University of North Texas, May 2, 2011.

### **Invited Talks and Seminars:**

- *The Andrews-Garvan crank and partition congruences*, Combinatorics Seminar, University of Pennsylvania, March 29th, 2005.
- *The Andrews-Garvan crank and partition congruences*, Combinatorics Seminar, University of Minnesota-Minneapolis, April 1st, 2005.
- *The Andrews-Garvan crank and partition congruences*, Combinatorics/Algebra Seminar, Iowa State University, April 4th, 2005.

- *The Andrews-Garvan crank and partition congruences*, Combinatorics/Number Theory Seminar, Ohio State University, May 13th, 2005.
- Special Colloquium Series Speaker at the Research Experience for Undergraduates in computational number theory and combinatorics, Clemson University, June 8–11, 2005.
- *The Andrews-Garvan crank and partition congruences*, Algebra Seminar, SUNY-Buffalo, October 11th, 2005.
- *The Andrews-Garvan-Dyson crank and partition congruences*, Algebra Seminar, Massachusetts Institute of Technology, October 11, 2006.
- *The Andrews-Garvan-Dyson crank and partition congruences*, Algebra Seminar, Boston University, October 30, 2006.
- *Maass forms and generalizations of Dyson's rank*, Number Theory Seminar, Johns Hopkins University, January 31, 2007.
- *Maass forms and generalizations of Dyson's rank*, Illinois Number Theory Fest, University of Illinois, May 16–20, 2007.
- *Durfee symbol congruences and higher rank moments*, Combinatorics Seminar, Pennsylvania State University, August 22, 2007.
- *Partitions statistics and weak Maass forms*, Number Theory Seminar, M.I.T., October 11, 2007.
- *Asymptotics for partitions without sequences*, Quebec-Vermont Number Theory Seminar, McGill University, April 17, 2008.
- *Arithmetic of the coefficients of automorphic forms*, Number Theory Seminar, Princeton University, October 23, 2008.
- *The Hardy-Ramanujan method and asymptotic for partitions without sequences*, Algebra Seminar, University of Cologne, January 20, 2009.
- *Asymptotics for crank and rank moments*, Number Theory Seminar, Johns Hopkins University, April 14, 2009.
- *Asymptotics for crank and rank moments*, International Conference: Mock theta functions and applications in combinatorics, algebraic geometry, and mathematical physics; Max Planck Institute for Mathematics, Bonn, May 26, 2009.
- *Asymptotics for crank and rank moments*, Algebra Seminar, Emory University, October 19, 2009.

- *Mock theta functions, q-series, combinatorial probability, and percolation models*, Algebra Seminar, Emory University, February 4, 2010.
- *Partitions, probability, and percolation*, Workshop on mock modular forms in combinatorics and arithmetic geometry, American Institute of Mathematics, Palo Alto, California, March 8 – 12, 2010.
- *Percolation, Probability, and Partitions*, Research Seminar, Microsoft Research Theory Group, Seattle, May 13, 2010.
- *q-series, a mock theta function, and probability*, Number Theory Seminar, Max Planck Institute, Bonn, July 28, 2010.
- Number Theory Seminar, Yale University, October 19, 2010.
- *Asymptotics for mock theta functions and probability sequences*, Workshop on the Arithmetic of Quadratic Forms and Integral Lattices, Futrono, Chile, December 13–14, 2010.
- *Mock modular forms and coefficient asymptotics for characters of affine Lie superalgebras*, First International Meeting of the American Mathematical Society and the Sociedad de Matematica de Chile, Universidad de la Frontera, Pucón, Chile, December 15–18, 2010.
- *Percolation, partitions, and probability*, Special Colloquium/Recruitment Talk, Ohio State University, January 5, 2011.
- *Asymptotics for the coefficients of Kac-Wakimoto characters*, The Number theory of partitions Conference, Emory University, January 23, 2011.
- *Mock theta functions, partitions, probability, and percolation*, Recruitment Talk, University of Missouri-Columbia, January 25, 2011.
- *Percolation, partitions, and probability*, Special Colloquium/Recruitment Talk, Louisiana State University, February 2, 2011.
- *Percolation, partitions, and probability*, Research Seminar/Recruitment Talk, University of Sydney, Australia, February 10, 2011.
- *Mock Jacobi forms and moment asymptotics*, School and Conference on Modular Forms and Mock Modular Forms and their Applications in Arithmetic, Geometry and Physics, The Abdus Salam International Center for Theoretical Physics, Trieste, Italy, March 14, 2011.
- *Coefficient asymptotics for Kac-Wakimoto characters*, NY Workshop on the Symmetric Group, Graduate Center of the City University of New York, September 9, 2011.

- *Coefficient asymptotics for Kac-Wakimoto characters*, Texas-Oklahoma Representations and Automorphic forms Conference (TORA), University of North Texas, Denton, September 18, 2011.
- *Markov processes and  $q$ -series*, Symposium on modular forms, mock theta functions, and applications, University of Cologne, Germany, March 1, 2012.
- *Asymptotic formulas for overpartitions with  $k$ -runs*, American Mathematical Society 2012 Spring Western Section Meeting, University of Hawaii at Manoa, March 3, 2012.

**Other conference talks and presentations:**

- *Partition identities and a theorem of Zagier*, Number Theory Seminar, University of Wisconsin-Madison, Fall 2001.
- *Partition identities and a theorem of Zagier*, Combinatorics Seminar, University of Wisconsin-Madison, Spring 2002.
- *Partition identities and a theorem of Zagier*, Canadian Number Theory Association Meeting VII, Montreal, Canada, June 2002.
- *Partition identities and a theorem of Zagier*, AMS Special Session on Q-Series in Number Theory and Combinatorics, AMS Regional Meeting, Baton Rouge, Louisiana, March 2003.
- *Partition identities and a theorem of Zagier*, Midwest Number Theory Conference for Graduate Students and Recent PhDs, Madison, Wisconsin, October 2003.
- *Partition identities and a theorem of Zagier*, Integers Conference, Carrollton, Georgia, November 2003.
- *Arithmetic of Certain Hypergeometric Modular Forms*, Canadian Number Theory Association Meeting VIII, Toronto, June 2004.
- *Cranks revisited and higher partition congruences*, Combinatorics Seminar, University of Wisconsin-Madison, Fall 2004.
- *Cranks revisited and higher partition congruences*, Special Year in Mathematics Additive Number Theory Conference, University of Florida, Gainesville, November 2004.
- *Cranks revisited and higher partition congruences*, Midwest Number Theory Conference for Graduate Students and Recent Ph.D.'s II, University of Illinois, Urbana-Champaign, February 2005.
- *The Andrews-Garvan crank and partition congruences*, Special Session on Q-Series and Partitions, AMS Sectional Meeting, San Francisco State University, April 29-30, 2006.

- *Partition statistics and quasiweak Maass forms*, Special Session on Automorphic Forms and Related Topics, AMS/MAA Joint Meetings, San Diego, January 6, 2008.
- *Asymptotics for partitions without sequences*, Partitions,  $q$ -series, and Modular Forms Workshop and Conference, University of Florida, March 14, 2008.
- *Partition statistics and quasiweak Maass forms*, Special Session on L-functions and Automorphic Forms, AMS Section Meeting, Courant Institute of New York University, March 16, 2008.
- *The Hardy-Ramanujan method and asymptotic for partitions without sequences*, Special session on automorphic forms and related topics, AMS-MAA Joint Meetings, Washington, D.C., January 7, 2009.
- *Asymptotics for crank and rank moments and Garvan's conjecture*, Conference on Quadratic forms, sums of squares, theta functions and integral lattices, University of Florida, March 14, 2009.
- *Asymptotics for crank and rank moments and Garvan's conjecture*, Special Session on  $q$ -series, AMS Regional Meeting, Urbana-Champaign, Illinois, March 27, 2009.
- *Asymptotics for crank and rank moments*, INTEGERS Conference, University of West Georgia, Carrollton, Georgia, October 15, 2009.
- *Partitions, Probability, and Percolation*, Automorphic Forms Workshop, University of Hawaii, March 25, 2010.
- *Asymptotic expansions for Kac-Wakimoto characters*, Postdoctoral Seminar, Mathematical Sciences Research Institute, Berkeley, California, March 28, 2011.
- *Coefficient asymptotics for Kac-Wakimoto characters*, Algebra and Number Theory Seminar, Louisiana State University, September 13, 2011.
- *Enumeration of Non-crossing pairings on bit strings*, Combinatorics Seminar, Louisiana State University, November 4, 2011.
- *Stack Asymptotics*, Automorphic Forms Workshop 26, Pacific Institute of Mathematical Sciences, Vancouver, British Columbia, April 29, 2012.

### Teaching Activities:

- Teaching Assistant for Math 171, 217 (Calculus), UW-Madison, 2004 – 2005.
- Recitation Instructor for Math 18.01A/18.02A (Calculus), M.I.T., Fall 2006.
- Lecturer for Math 18.02A (Multivariable Calculus), MIT, Spring 2007.

- Recitation Instructor for Math 18.02 (Multivariable Calculus) Recitations, MIT, Fall 2007.
- Lecturer for Math 18.786 (Algebraic Number Theory), MIT, Spring 2008.
- Lecturer for Math 18.781 (Introduction to the Theory of Numbers), MIT, Fall 2008.
- Lecturer for Math 18.01 (Single Variable Calculus), MIT, Spring 2009.
- Lecturer for Math 2020 (Solving Discrete Problems) and Math 4181 (Elementary Number Theory), LSU, Fall 2011.

### **Directed Research and Advising:**

- Assistant Instructor for UW-Madison Research Experience for Undergraduates, Summer 2005, 2006.
- Alex Arkhipov, Directed Reading/Research: *Combinatorial Partition Theory*, Undergraduate Research Opportunities Program, MIT, Summer 2007.
- Matthew Garcia, Directed Reading: *An Adelic Approach to Class Field Theory*, Undergraduate Research Opportunities Program, MIT, Spring 2008.
- Ethan Sterling, Directed Research: *The Bounded Thrackle Conjecture*, Undergraduate Research Opportunities Program, MIT, Summer 2008.

### **Professional Activities:**

- Referee Work for:  
Advances in Mathematics, Annals of Combinatorics, Ars Combinatoria, Discrete Mathematics, Electronic Journal of Combinatorics, European Journal of Combinatorics, INTEGERS - Electronic Journal of Combinatorial Number Theory, Journal für die Reine und Angewandte Mathematik, Journal of Combinatorial Theory Series A, Journal of Number Theory, London Mathematical Society, Mathematical Research Letters, Proceedings of the American Mathematical Society, Proceedings of the National Academy of Sciences, The Ramanujan Journal; (24 total papers refereed).
- Reviewer for Grants:  
National Science Foundation, National Security Agency; (3 grants reviewed).
- Reviewer for AMS Mathematical reviews; (14 reviews written).
- Member of the American Mathematical Society, 2002 – .
- Member of Graduate Program Committee, UW-Madison, 2005.
- Member of the Wisconsin Teaching Assistants' Association, 2005.



- Co-Organizer, Louisiana State University Algebra and Number Theory Seminar, 2011 – .
- Co-Advisor for Putnam Exam Problem Solving Sessions, Louisiana State University, 2011 – .

### **Grants and Fellowships:**

- UW-Madison VIGRE Fellowship, 2001–02, 2005-2006.
- NSF Graduate Fellowship, 2002–2005.
- Clay Mathematics Institute Liftoff Fellow, Summer 2006. Host: George Andrews at Pennsylvania State University.
- Recommended for National Science Foundation Postdoctoral Research Fellowship, 2006.
- NSA Young Investigator Grant, 2008–2010. \$34,000.
- National Science Foundation Mathematical Institute Postdoctoral Research Fellowship, 2009–11.
- Alexander von Humboldt Foundation Research Fellowship for Postdoctoral Researchers, 2010–12.
- Louisiana State University Council on Research Summer Stipend, 2012. \$5,000.

### **Awards and Honors:**

- Harvey S. Mudd Merit Scholarship, 1997–2001.
- Robert C. Byrd Scholarship, State of Colorado, 1997–2001.
- Harvey Mudd Scholar-Athlete of the Year, 2001.
- 61st William Lowell Putnam Examination Honorable Mention, Spring 2001.
- William and Margaret Radley Prize in the Humanities (Harvey Mudd), Spring 2001.
- Graduated with Honors in Mathematics and Humanities and Social Sciences (Harvey Mudd), Spring 2001.
- UW-Madison Excellence in Mathematical Research Award, Spring 2005.
- Inaugural Proceedings of the National Academy of Sciences *Paper of the Year Award*, presented at the National Academy of Sciences, 2006.

### **Other Interests:**

- Basic German and Spanish speaking and reading.
- Volunteer pianist at Wisconsin Governor's Mansion, 2003 – 2005.
- Vegetarian cooking.