

KATHRIN BRINGMANN TO RECEIVE 2009 SASTRA RAMANUJAN PRIZE

The 2009 SASTRA Ramanujan Prize will be awarded to Professor KATHRIN BRINGMANN of the University of Cologne, Germany and the University of Minnesota, USA. This annual prize, which was established in 2005, is for outstanding contributions to areas of mathematics influenced by the genius Srinivasa Ramanujan (1887-1920). The age limit for the prize has been set at 32 because Ramanujan achieved so much in his brief life of 32 years. The \$10,000 prize will be awarded on Dec 22, 2009, during an International Conference on Number Theory at SASTRA University in Kumbakonam, India, Ramanujan's hometown.

Professor Bringmann has done revolutionary work in the areas of modular forms and mock theta functions by herself and in collaboration with several mathematicians. Mock theta functions were discovered by Ramanujan shortly before he died and he communicated his findings in his last letter to G. H. Hardy of Cambridge University. These are now considered to be among Ramanujan's deepest contributions. Mock theta functions are like theta functions in the sense that their coefficients can be evaluated very accurately like those of the theta functions. Ramanujan found transformation formulas for certain classes of mock theta functions. Yet, the exact connections between mock theta functions and theta functions has remained a mystery all these years until recently. Indeed the great physicist and mathematician Freeman Dyson of the Institute for Advanced Study said that the mock theta functions provide tantalizing hints of a grand synthesis still to be discovered and that this is a challenge for the future. The first breakthrough came in the 2003 PhD thesis of Sander Zwegers written under the direction of Professor Don Zagier in Bonn, in which Zwegers used certain identities of George Andrews to rewrite mock theta functions in terms of Lambert series and indefinite theta series. Zwegers showed how the mock theta functions of Ramanujan fit into the theory of real analytic modular forms. From here, Kathrin Bringmann in collaboration with Ken Ono and others obtained far reaching results. In Bringmann's papers these connections with modular forms are made explicit, further questions concerning asymptotics and congruences are addressed, and a comprehensive theory relating holomorphic cusp forms to Maass forms is developed. We now highlight a few of her fundamental contributions.

Kathrin Bringmann's PhD thesis of 2004, written under the direction of Professor Winfried Kohnen at the University of Heidelberg, contains important results on two difficult problems: (i) The Ramanujan-Petersson Conjecture for the coefficients of Siegel cusp forms whose weight is the dimension of the genus group plus one, and (ii) generalizations of the work of Gross, Kohnen and Zagier on the existence of lifting maps between spaces of Jacobi forms and elliptic modular functions. The results in her thesis appeared in *Mathematische Zeitschrift* (2006) and the *Journal of the London Mathematical Society* (2006).

After completing her PhD, Bringmann began work on several major projects with Ken Ono at the University of Wisconsin, and others. In a pathbreaking paper in the *Annals of Mathematics*, Bringmann and Ono, inspired by work of Zwegers and Zagier, show that Ramanujan's 22 mock theta functions are special cases of infinite families of weak Maass forms of weight $1/2$. This paper is a major step in resolving Dyson's challenge and also explains many infinite families of congruences for the partition function. In another seminal paper in *Inventiones Mathematicae* (2006), Bringmann and Ono use Maass forms of weight $1/2$ to obtain exact formulas for the coefficients of one of Ramanujan's third order mock theta functions, and as a consequence obtain exact formulas for the number of partitions with even and odd ranks. This settles the 40 year old Andrews-Dragonette Conjecture. In yet another landmark paper that appeared in the *Proceedings of the National Academy of Sciences* (2007), Bringmann and Ono define maps that lift homomorphic cusp forms of half integral weight to harmonic weak Maass forms, and this theory includes the weight $3/2$ Maass forms which contains all of Ramanujan's mock theta functions; in this project, Bringmann also had a significant collaboration with Jeremy Lovejoy. One of her joint papers with Lovejoy that appeared in the *International Mathematics Research Notices* (2007) concerns connections between Dyson's rank for partitions, overpartitions, and weak Maass forms.

In the 1980s George Andrews and Frank Garvan showed that the Mock Theta Conjectures are equivalent to certain identities which involve linear combination of Eulerian series; these identities were proved by Hickerson (1988). In a paper in the *Journal of the American Mathematical Society* (2008), Bringmann, Ono and Robert Rhoades have explained these identities and other similar ones by utilizing ideas in the Bringmann-Ono *Annals of Mathematics* and *Inventiones Mathematicae* papers. Some other significant papers of Bringmann include her work with Frank Garvan and Karl Mahlburg on partition statistics and quasi-harmonic Maass forms that appeared in *International Mathematics Research Notices* (2008), her work with Amanda Folsom and Ken Ono on q-series and $3/2$ weight Maass forms in *Compositio Mathematica* (2009), and her recent work with Sander Zwegers on rank- crank type partial differential equations and non-holomorphic Jacobi forms in *Mathematics Research Letters*.

Kathrin Bringmann was born on May 8, 1977 in Muenster, Germany. She passed the State Examinations in Mathematics and Theology at the University of Wuerzburg, Germany, in 2002, and obtained a Diploma in Mathematics with top honors at Wuerzburg in 2003. She then joined the University of Heidelberg where she received her PhD in 2004. During 2004-07, she was Van Vleck Assistant Professor at the University of Wisconsin where she began her great collaboration with Professor Ken Ono. After briefly serving as an Assistant Professor at the University of Minnesota, she has now joined the University of Cologne, Germany, as Professor. Earlier this year, she was awarded the prestigious Krupp Prize - a 1 million Euro research grant for a five year period awarded to young professors. The SASTRA Ramanujan Prize comes on the heels of the Krupp Prize.

Bringmann emerged as the top choice from a pool of brilliant young mathematicians from around the world. The international panel of experts who formed the 2009 SASTRA Ramanujan Prize Committee are: Chair - Krishnaswami Alladi (University of Florida), Bruce Berndt (University of Illinois at Urbana-Champaign), Jonathan Borwein (Dalhousie University, Canada and University of Newcastle, Australia), Dorian Goldfeld (Columbia University), Stephen Milne (Ohio State University), Wolfgang Schmidt (University of Colorado), and Jeffrey Vaaler (University of Texas).

Previous winners of the [SASTRA Ramanujan Prize](#) are [Manjul Bhargava and Kannan Soundararajan in 2005](#) (two prizes), [Terence Tao in 2006](#), [Ben Green in 2007](#), and [Akshay Venkatesh in 2008](#). Thus the SASTRA Ramanujan Prize continues to recognize

spectacular and path breaking research accomplishments by very young mathematicians. This year's prize winner Kathrin Bringmann has done spectacular work in an area that is most closely associated with Ramanujan, namely the mock theta functions, and in collaboration with Ken Ono has made major strides towards resolving Freeman Dyson's great challenge regarding the mock theta functions.

Krishnaswami Alladi
Chair, 2009 SASTRA Ramanujan Prize Committee

OTHER LINKS

- [Article in The Hindu](#), India's National Newspaper, on Bringmann's SASTRA Prize Lecture.

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