2016 Clay Research Awards

The joint Award to **Mark Gross** and **Bernd Siebert** is made in recognition of their groundbreaking contributions to the understanding of mirror symmetry, in joint work generally known as the 'Gross-Siebert Program'. It has its origins in surprising predictions of non-perturbative dualities in string theory: that the properties of certain interesting geometries, notably Calabi-Yau manifolds, are reflected in counter-intuitive ways in partner geometries ('mirror manifolds').

The Gross-Siebert program builds on an earlier, differential-geometric, proposal of Strominger, Yau, and Zaslow, in which the Calabi-Yau manifold is fibred by special Lagrangian tori, and the mirror by dual tori. The program's central idea is to translate this into an algebro-geometric construction in an appropriate limit, involving combinatorial data associated with a degenerating family of Calabi-Yau manifolds. It draws on many areas of geometry, analysis and combinatorics and has made a deep impact on fields such as tropical and non-archimedean geometry, logarithmic geometry, the calculation of Gromov-Witten invariants, the theory of cluster algebras and combinatorial representation theory. Remarkable results independent of mirror symmetry are now emerging, notably in the geometric compactification of moduli spaces of K3 surfaces, in the construction of theta functions on Fano and Calabi-Yau varieties, and in proofs of Looijenga's conjecture on the smoothability of certain surface cusps and of the positivity of Laurent coefficients conjecture.

The Award to **Geordie Williamson** is made in recognition of his groundbreaking work in representation theory and related fields. In particular, the award recognises two major breakthroughs. First, his proof, with Ben Elias, of Soergel's conjecture on bimodules associated to Coxeter groups. This established the combinatorial result that the coefficients of the Kazhdan-Lusztig polynomials are non-negative, as well as yielding a new proof of Kazhdan and Lusztig's conjectured character formula for representations of complex semi-simple Lie algebras.The second is the construction (building on earlier work with Ben Elias and Xuhua He) of counterexamples to the expected bounds in Lusztig's conjectured character formula for rational representations of algebraic groups in positive characteristics that grow exponentially with the rank of the group.

Clay Mathematics Institute

Clay Research Conference

Andrew Wiles Building

University of Oxford

28 September 2016

10:00 **David Ben-Zvi**
      Representation Theory as Gauge Theory
      Introduced by Kobi Kremnitzer

11:00 Coffee

11:30 **Bill Minicozzi**
      The mean curvature flow
      Introduced by Gerhard Huisken

12:30 Lunch

14:00 **János Kollár**
      Celestial surfaces and quadratic forms
      Introduced by Balázs Szendrői

15:00 Coffee

15:30 **Manjul Bhargava**
      *What is the Birch and Swinnerton-Dyer Conjecture, and
      what is known about it?*
      Introduced by Andrew Wiles

16:30 **Alessio Corti**
      The work of Mark Gross and Bernd Siebert

      Raphael Rouquier
      The work of Geordie Williamson

      Thomas Clay
      Presentation of the 2016 Clay Research Awards

17:30 Reception

David Ben-Zvi is the Joe B. and Louise Cook Professor of Mathematics at the University of Texas at Austin. He obtained his PhD from Harvard University in 1999, under the supervision of Edward Frenkel. In 2007 he gave the LMS Invited Lectures, on *The Geometric Langlands Correspondence.* He was elected a Fellow of the American Mathematical Society in 2012.

Bill Minicozzi is Professor of Mathematics at MIT. He obtained his PhD from Princeton in 1990 under the supervision of Richard Schoen. He was appointed J. J. Sylvester Professor of Mathematics at Johns Hopkins in 2002 before moving to MIT in 2012. He is a Fellow of the American Mathematical Society. With Toby Colding, he was awarded the 2010 Oswald Veblen Prize in Geometry for their work on minimal surfaces.

János Kollár is the Donner Professor of Science at Princeton University. He obtained his PhD from Brandeis University in 1984, under the supervision of Teruhisa Matsusaka. He is a Member of the National Academy of Sciences and a Fellow of the American Mathematical Society. In 2006 he was awarded the Cole Prize in Algebra "for his outstanding achievements in the theory of rationally connected varieties and for his illuminating work on a conjecture of Nash". He was a plenary speaker at the 2014 ICM in Korea.

Manjul Bhargava is the R. Brandon Fradd Professor of Mathematics at Princeton University and the Stieltjes Professor of Number Theory at Leiden University. He obtained his PhD from Princeton University in 2001, under the supervision of Andrew Wiles. He is a Member of the National Academy of Sciences and a Fellow of the American Mathematical Society. His outstanding contributions to number theory have been recognised by many prizes, including the Clay Research Award (2005),the SASTRA Ramanujan Prize (2005), the Cole Prize (2008), and the Fields Medal (2014).