2009 Cole Prize in Algebra

CHRISTOPHER HACON and JAMES M^{c}KERNAN received the 2009 AMS Frank Nelson Cole Prize in Algebra at the 115th Annual Meeting of the AMS in Washington, DC, in January 2009.

Citation

The 2009 Frank Nelson Cole Prize in Algebra is awarded to Christopher Hacon and James M^{c}Kernan for their groundbreaking joint work on higher-dimensional birational algebraic geometry. This work concerns the minimal model program, by which S. Mori and other researchers made great progress in understanding the geometry of three-dimensional projective algebraic varieties in recent decades. The case of dimension greater than three, however, remained largely open. The work of Hacon and M^{c}Kernan has transformed the study of the minimal model program in higher dimensions, in particular regarding the existence and termination of flips and the finite generation of the canonical ring. Specifically, the prize is awarded for two joint papers of theirs: "Boundedness of pluricanonical maps of varieties of general type", *Invent. Math.* **166** (2006), 1–25, and "Extension theorems and the existence of flips" (in *Flips for 3-folds and 4-folds*, 76–110, Oxford Lecture Ser. Math. Appl., 35, Oxford Univ. Press, Oxford, 2007). The former paper, in addition to proving the result referred to in the title, also established their key lifting lemma for sections. The latter manuscript, which drew on their earlier paper, proved the inductive step on the existence of flips.

Biographical Sketch: Christopher Hacon

Christopher Hacon was born in Manchester, England, in 1970. He received his undergraduate degree in mathematics from the Università di Pisa and the Scuola Normale Superiore di Pisa in 1992, and he received his Ph.D. in mathematics from UCLA in 1998. His advisor was Robert Lazarsfeld. He was a postdoc at the University of Utah (1998–2000) and an assistant professor at the University of California, Riverside (2000–2002), and he has been a professor at the University of Utah since 2002. He received a Sloan Fellowship in 2003, an AMS Centennial Fellowship in 2006, and the Clay Research Award in 2007. His research interests are in algebraic geometry and, in particular, in the classification of higher-dimensional algebraic varieties.

Biographical Sketch: James M^{c}Kernan

James M^{c}Kernan was born in London, England, in 1964. He received his B.A. in mathematics from the University of Cambridge in 1985, while attending Trinity College, and his Ph.D. in mathematics from Harvard University under the supervision of Joseph Harris in 1991. He then held temporary positions at the University of Utah (1991–1993), the University of Texas at Austin (1993–1994), and Oklahoma State University, Stillwater (1994–1995). He joined the faculty at the University of California, Santa Barbara, in 1995 and the faculty at the Massachusetts Institute of Technology in 2007. In 2007 he received the Clay Research Award. His research interests are in algebraic geometry, especially birational geometry and the classification of algebraic varieties.

Response: Christopher Hacon and James M^{c}Kernan

The minimal model program is an attempt to extend the classification of complex projective surfaces achieved by the Italian school of algebraic geometry at the beginning of the twentieth century to higher-dimensional complex projective varieties. The main idea is to produce an optimal representative of any smooth projective variety via a finite sequence of well understood birational maps called flips and divisorial contractions. This representative is called a minimal model. In dimension three this program was completed by S. Mori with his work on the existence of 3-dimensional flips.

In higher dimensions the main problem is to show that flips always exist and that there is no infinite sequence of flips.

Christopher Hacon

It had always been our hope to say something significant about this problem. This dream became a reality when, by combining ideas of V. Shokurov and Y.-T. Siu, we were able to prove that flips exist in any dimension and that (under mild technical assumptions) carefully chosen sequences of divisorial contractions and flips always give a birational map to a minimal model.

We are very happy that the Selection Committee decided to recognize this field of research. We would like to stress that our accomplishments are based on a long series of beautiful results obtained by Y. Kawamata, J. Kollár, S. Mori, M. Reid, V. Shokurov, Y.-T. Siu, and many others. We are also in debt to our co-authors C. Birkar and P. Cascini, who were instrumental in the completion of a significant part of this program, and to A. Corti for many useful conversations on the minimal model program.

One of the nicest things about receiving this award is that it gives us an opportunity to publicly acknowledge the invaluable aid we have received from others. Christopher Hacon would like to thank Aleksandra, Stefan, Ana, Sasha, and Kristina Jovanovic-Hacon, D. Hacon, C. Peters, and G. Gianelli for their support, love and encouragement; F. Catanese, R. Lazarsfeld, and J. Kollár for inspiring him to work in the field of higher-dimensional birational geometry; the mathematics department at the University of Utah (in particular A. Bertram, H. Clemens, and J. Carlson) for hiring him (twice!) and providing a wonderful research environment; and the NSF [National Science Foundation], NSA [National Security Agency], AMS, and the Clay and Sloan Foundations for their generous financial support. James McKernan would like to thank his family for their support. He would also like to thank his advisor J. Harris, for inspiring him with so much beautiful projective geometry; J. Kollár and S. Mori for their support and encouragement over the whole of his career; V. Shokurov, who is always so generous with his ideas; and Y. Kawamata and M. Reid for their help. He would like to thank the mathematics department at the University of California, Santa Barbara—where a considerable amount of this work was done—for providing such a great environment to do research; and the mathematics department at the Massachusetts Institute of Technology. He is also very grateful to the NSF, NSA, and the Clay Foundation for their generous financial support.

James McKernan

About the Prize

The Cole Prize in Algebra is awarded every three years for a notable research memoir in algebra that has appeared during the previous six years. The awarding of this prize alternates with the awarding of the Cole Prize in Number Theory, also given every three years. These prizes were established in 1928 to honor Frank Nelson Cole on the occasion of his retirement as secretary of the AMS after twenty-five years of service. He also served as editor-in-chief of the *Bulletin* for twenty-one years. The Cole Prize carries a cash award of US$5,000.

The Cole Prize in Algebra is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2009 prize, the members of the selection committee were: Alexander Beilinson, David Harbater (chair), and Victor Kac.

Previous recipients of the Cole Prize in Algebra are: L. E. Dickson (1928), A. Adrian Albert (1939), Oscar Zariski (1944), Richard Brauer (1949), Harish-Chandra (1954), Serge Lang (1960), Maxwell A. Rosenlicht (1960), Walter Feit and John G. Thompson (1965), John R. Stallings (1970), Richard G. Swan (1970), Hyman Bass (1975), Daniel G. Quillen (1975), Michael Aschbacher (1980), Melvin Hochster (1980), George Lusztig (1985), Shigefumi Mori (1990), Michel Raynaud and David Harbater (1995), Andrei Suslin (2000), Aise Johan de Jong (2000), Hiraku Nakajima (2003), and János Kollár (2006).