Mathematics People

EMS Awards Prizes

At the European Mathematical Congress, held in Budapest in July 1996, the European Mathematical Society awarded a number of prizes for outstanding contributions to mathematics. The prize winners are listed below, together with brief descriptions of their work.

ALEXIS BONNET works on a broad spectrum of problems in applied analysis. His results on the Mumford-Shah conjecture in the theory of computer vision constituted a breakthrough. This problem deals with a variational problem with a singular boundary set and proposes a finite representation of the optimum solution. Bonnet obtained the first finiteness result under additional assumptions, which is a major step in understanding this difficult free boundary value problem. In a different direction, his results on partial differential equations, in particular on flame propagation and combustion, are very significant.

WILLIAM TIMOTHY GOWERS's work has made the geometry of Banach spaces look completely different. Here are some of his spectacular results. He solved the notorious Banach hyperplane problem, to find a Banach space which is not isomorphic to any of its hyperplanes. He gave a counterexample to the Schroeder-Bernstein theorem for Banach spaces. He proved a deep dichotomy principle for Banach spaces which, if combined with a result of Komorowski and Tomczak-Jaegermann, shows that if all closed infinite-dimensional subspaces of a Banach space are isomorphic to the space, then it is a Hilbert space. He gave (jointly with Maurey) an example of a Banach space such that every bounded operator from the space to itself is a Fredholm operator. His mathematics is both very original and technically very strong. The techniques he uses are highly individual; in particular, he makes very clever use of infinite Ramsey theory.

ANNETTE HUBER developed a difficult and important theory, the theory of the derived category of mixed motivic realizations. The theory of motives was discovered by Alexandre Grothendieck in the 1960s. This important topic is still largely conjectural. The definition of mixed motives is one of the central problems of this theory. Annette Huber defines a derived category of the category of mixed realizations defined by Jannsen. She constructs a functor from the category of simplicial varieties to this derived category, whose cohomology objects are precisely the mixed realizations of the variety. She then defines an absolute cohomology theory, over which the usual absolute theories—absolute Hodge-Deligne and continuous étale cohomology—naturally factorize.

AISE JOHAN DE JONG has produced a large variety of deep results on various aspects of arithmetic algebraic geometry. His personal influence on the work in the field is impressive. His work is characterized by a truly geometric approach and an abundance of new ideas. Among others, his results include the resolution of a conjecture of Veys and the answer to a long-standing question of Mumford on moduli spaces. Resolution of singularities by modification is difficult and unknown in most cases; in a recent outstanding work, de Jong found an elegant method for the resolution of singularities by alterations, which is a slightly weaker question but sufficient for most applications. This basic method combines geometric insight and technical knowledge.

DMITRI KRAMKOV has important results in statistics and the mathematics of finance. He did fundamental work in filtered statistical experiments. In particular, he obtained a deep result on the structure of Le Cam's distance between two filtered statistical experiments and proved very general theorems about the structure of the limit experiments which cover many results in the asymptotic mathematical statistics of stochastic processes. Recently he proved a remarkable "Optional decomposition of supermartingales", which is an extension of the fundamental Doob-Meyer decomposition for the case of many probability measures. This unexpected result is rather difficult and refined technically and, from the conceptual point of view, very important. In the direction of mathematical finance, Kramkov obtained impressive results on pricing formulas for certain classes of "exotic" options based on geometric Brownian motion. He succeeded in computing explicit solutions for "Asian options" where the payoff is given by a time-average of geometric Brownian motion.

JIRI MATOUSEK's achievements have combinatorial and geometric flavor; his research is characterized by its breadth, by its algorithmic motivation, as well as by the difficulty of the problems he attacks. He gave constructions of epsilon-nets in computational geometry, which provide tools for derandomization of geometric algorithms. He obtained the best results on several key problems in computational and combinatorial geometry and optimization, such as linear programming algorithms and range searching. He solved several long-standing problems (going back to the work of K. F. Roth) in geometric discrepancy theory, in particular on the discrepancy of half-planes and of arithmetical progressions. He solved a problem by Johnson and Lindenstrauss on embeddings of finite metric spaces into Banach spaces. He also obtained sharp results on almost isometric embeddings of finite-dimensional Banach spaces using uniform distributions of points on spheres. In mathematical logic, he found a striking example of a combinatorial unprovable statement.

LOIC MEREL proved an absolute bound for the torsion of elliptic curves, thereby giving a solution to a long-standing problem which was open for more than thirty years and which has resisted the efforts of the greatest specialists in elliptic curves. The group of torsion points of an elliptic curve over a number field is finite. Merel found a bound of the order of this group in terms of the degree of the number field; such a bound was known only in a very few cases: the case of the rational numbers (Mazur 1976), number fields of degree less than 8 (Kamienny-Mazur 1992), and number fields of degree less than 14 (Abramovitch 1993).

GRIGORY PERELMAN's work played a major role in the development of the theory of Alexandrov spaces of curvature bounded from below, giving new insight into the extent to which the results of Riemannian geometry rely on the smoothness of the structure. Now, mainly due to Perelman, the theory is rather complete. His results include a structure theory of these spaces, a stability theorem (new even for Riemannian manifolds), and a synthetic geometry á la Alexandrov. He proved a conjecture of Gromov concerning an estimation of the product of weights and the Cheeger-Gromov conjecture. This last problem attracted the attention and efforts of many geometers for more than twenty years, and the method developed by Perelman yielded an astonishingly short solution.

RICARDO PEREZ-MARCO solved several outstanding problems and obtained basic results in the theory of dynamics of nonlinearizable germs and nonlinearizable analytic diffeomorphisms of the circle and in the theory of centralizers, a natural complement of nonlinearizability. He discovered a new arithmetic condition under which a germ without periodic orbits is linearizable. He gave a negative answer to a question of Arnold on the linearizability of analytic diffeomorphisms of the circle without accumulating periodic orbits. Perez-Marco developed a theory of analytic nonlinearizable germs based on an important and useful compact invariant.

LEONID POLTEROVICH contributed in a most important way to several domains of geometry and dynamical systems, in particular to symplectic geometry. Polterovich ties together complex analytic and dynamical ideas in a unique way, leading to significant progress in both directions. In particular, he brings complex analysis into the realm of Hamiltonian mechanics, which marks a principally new step in this classical field. Among other results, he established (with Bialy) an anti-KAM estimate in terms of the Hofer displacement of a Hamiltonian flow. Polterovich found the first nontrivial restriction on the Maslov class of an embedded Lagrangian torus and (with Eliashberg) completely solved the knot problem in the real 4-space.

—EMS

CAREER Grants Awarded

The National Science Foundation (NSF) honored 346 outstanding faculty in fiscal 1996 with Faculty Early Career Development (CAREER) grants. The awardees were selected from nearly 1,865 applicants. NSF established the awards to help scientists and engineers develop simultaneously their contributions to research and education early in their careers. CAREER funds are awarded to junior-level faculty at colleges and universities. These awards are for 4–5 years and range from $200,000 to $500,000 each.

The names of the awardees in mathematics, their institutional affiliations, and the titles of their research projects are:

MIHIR BELLARE, University of California, San Diego, Cryptography Proof Checking and Approximation;

TASSO KAPER, Boston University, Dynamical Systems Theory Motivated by Bubbles Accelerators and Split-Operator Numerical Schemes;

PETER SMEREKA, University of Michigan, Effective Equations for Bubbly Flow;

KAREN SMITH, University of Michigan, Interactions of Commutative Algebras with Analysis, Geometry, and Computer Science; and

BONNIE RAY, New Jersey Institute of Technology, Bayesian and Nonparametric Methods for Time Series Analysis with Environmental and Economic Applications.

—from NSF Announcement

Erratum

The December 1996 issue of the *Notices* (page 1530) carried an announcement about the awarding of the Morgan Prize to Manjul Bhargava. The announcement erroneously stated that the prize was conferred during the Seattle Mathfest in August 1996. The prize was given at the Joint Mathematics Meeting in San Diego in January 1997.