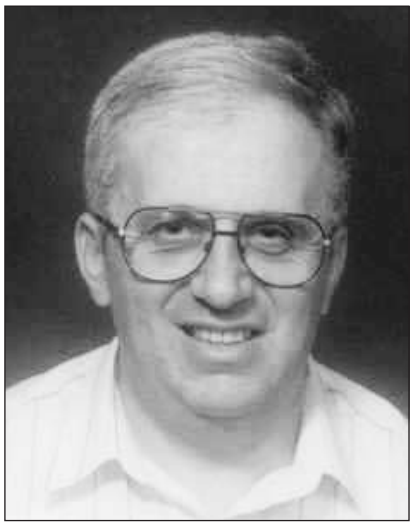
Margulis and Novikov Receive 2005 Wolf Prize



Gregory A. Margulis

Sergei P. Novikov

On January 18, 2005, the Wolf Foundation announced that the 2005 Wolf Prize in Mathematics will be awarded to Gregory A. Margulis of Yale University "for his monumental contributions to algebra, in particular to the theory of lattices in semi-simple Lie groups, and striking applications of this to ergodic theory, representation theory, number theory, combinatorics, and measure theory" and to Sergei P. Novikov of the University of Maryland, College Park, and the L. D. Landau Institute for Theoretical Physics "for his fundamental and pioneering contributions to algebraic and differential topology on one hand, and to mathematical physics on the other hand." Margulis and Novikov will share the $100,000 prize, which will be presented by the president of the State of Israel, Moshe Katsav, at a special ceremony at the Knesset (parliament) in Jerusalem on May 22, 2005.

Gregory A. Margulis

At the center of the work of Gregory Margulis lies his proof of the Selberg-Piatetskii-Shapiro Conjecture, affirming that lattices in higher rank Lie groups are arithmetic, a question whose origins date back to Poincaré. This was achieved by a remarkable tour de force, in which probabilistic ideas revolving around a noncommutative version of the ergodic theorem were combined with p-adic analysis and with algebraic geometric ideas showing that "rigidity" phenomena, earlier established by Margulis and others, could be formulated in such a way ("superrigidity") as to imply arithmeticity. This work displays stunning technical virtuosity and originality, with both algebraic and analytic methods. The work has subsequently reshaped the ergodic theory of general group actions on manifolds.

In a second tour de force, Margulis solved the 1929 Oppenheim Conjecture, stating that the set of values at integer points of an indefinite irrational nondegenerate quadratic form in more than three variables is dense in R^n. This had been reduced (by Rhagunathan) to a conjecture about unipotent flows on homogeneous spaces, proved by Margulis. This method transformed to this ergodic setting a family of questions till then investigated only in analytic number theory.

A third dramatic breakthrough came when Margulis showed that Kazhdan's "Property T" (known to hold for rigid lattices) could be used in a single arithmetic lattice construction to solve two apparently unrelated problems. One was the solution to a problem posed by Rusiewicz, about

finitely additive measures on spheres and Euclidean spaces. The other was the first explicit construction of infinite families of expander graphs of bounded degree, a problem of practical application in the design of efficient communication networks.

Margulis's work is characterized by extraordinary depth, technical power, creative synthesis of ideas and methods from different areas of mathematics, and a grand architectural unity of its final form. Though his work addresses deep unsolved problems, his solutions are housed in new conceptual and methodological frameworks of broad and enduring application. He is one of the mathematical giants of the last half century.

Born in 1946 in Russia, Margulis received his Ph.D. in 1970 from Moscow State University. Starting in 1970, he was associated with the Institute for Problems in Information Transmission at that university, first as junior scientific worker, later as senior staff member, and from 1986 until he left in 1991, as leading scientist. Since 1991, Margulis has been a professor of mathematics at Yale University. He received the Fields Medal in 1978. He is a foreign honorary member of the American Academy of Arts and Sciences and a member of the U.S. National Academy of Sciences.

Sergei P. Novikov

Sergei P. Novikov is awarded the Wolf Prize for his fundamental and pioneering contributions to topology and to mathematical physics. His early work in algebraic and differential topology includes such milestones as the calculation of cobordism rings and stable homotopy groups, proof of the topological invariance of rational Pontrjagin classes, formulation of the "Novikov Conjecture" on higher signature invariants, and proof of the existence of closed leaves in two-dimensional foliations of the 3-sphere.

In the early 1970s Novikov turned his attention to mathematical physics, initially contributing to general relativity and conductivity of metals. He constructed a global version of Morse theory on manifolds and loop spaces that had novel applications to quantum field theory (multivalued action functionals). His most significant achievements in mathematical physics flow from his introduction of algebraic-geometric methods to the study of completely integrable systems. These include a systematic study of finite-gap solutions of two-dimensional integrable systems, formulation of the equivalence of the classification of algebraic-geometric solutions of the KP equation with the conformal classification of Riemann surfaces, and work (with Krichever) on "almost commuting" operators that appear in string theory and matrix models ("Krichever-Novikov algebras", now widely used in physics).

Novikov made a fundamental and striking contribution to two separate fields in mathematics, while he is one of those rare mathematicians who brings deep, key mathematical ideas to bear on difficult pivotal problems of physics, in ways that are stunning and compelling for both mathematicians and physicists.

Born in Russia in 1936, Sergei P. Novikov graduated from Moscow State University in 1960. In 1965, he received his Ph.D. in physics and mathematics from the Steklov Institute of Mathematics in Moscow. Since 1971, Novikov has been head of the Mathematical Division at the L. D. Landau Institute for Theoretical Physics in Moscow. Since 1992, he has been a professor in the Department of Mathematics and at the Institute for Physical Science and Technology at the University of Maryland, College Park. Novikov received the Lenin Prize of the USSR in 1967 and the Fields Medal in 1970. In 1981, he was elected as a full member of the Academy of Sciences of the USSR. He is a foreign associate of the U.S. National Academy of Sciences.

About the Wolf Prize

The Israel-based Wolf Foundation was established by the late German-born inventor, diplomat, and philanthropist Ricardo Wolf. A resident of Cuba for many years, Wolf became Fidel Castro's ambassador to Israel, where he lived until his death in 1981. Five annual Wolf Prizes have been awarded since 1978 to outstanding scientists and artists "for achievements in the interest of mankind and friendly relations among peoples, irrespective of nationality, race, color, religion, sex, or political view." The prizes of $100,000 in each area are given every year in four out of five scientific fields in rotation: agriculture, chemistry, mathematics, medicine, and physics. In the arts, the prize rotates among architecture, music, painting, and sculpture. To date, a total of 224 scientists and artists from twenty-one countries have been honored.

—From Wolf Foundation announcements

For a list of previous Wolf Prize winners in mathematics, see the Web page `http://www.aquanet.co.il/wolf/wolf5.html`.