FIVE FRANKLIN INSTITUTE MEDALISTS HONORED FOR PHYSICS-RELATED WORK

The Franklin Institute presented its annual medals in a ceremony in Philadelphia on 29 April. The medalists included Frederick Reines of the University of California, Irvine; Gerald E. Brown of the State University of New York, Stony Brook; Rolf Landauer of the IBM T. J. Watson Research Center in Yorktown Heights, New York; John W. Hardy of Litton Itek Optical Systems in Lexington, Massachusetts; and Harold P. Furth of the Princeton Plasma Physics Laboratory.

Reines received the Franklin Medal for "the experimental discovery of the neutrino and the subsequent detailed study of its properties and interactions, including the first detection of neutrinos from a supernova." In 1953, with his collaborator Clyde Cowan of Los Alamos National Laboratory, Reines placed an 80-gallon tank of liquid scintillator next to a fission reactor at the Hanford Laboratory in Washington. An array of 90 photomultiplier tubes recorded events in the scintillating liquid and, for the first time, detected neutrinos—specifically, electron antineutrinos from inverse beta decay. Because the neutrino signal was weak, Reines and Cowan redesigned and improved their detector and moved it to a reactor at the Savannah River National Laboratory in South Carolina in 1956. There they compiled definitive evidence for the neutrino's existence.

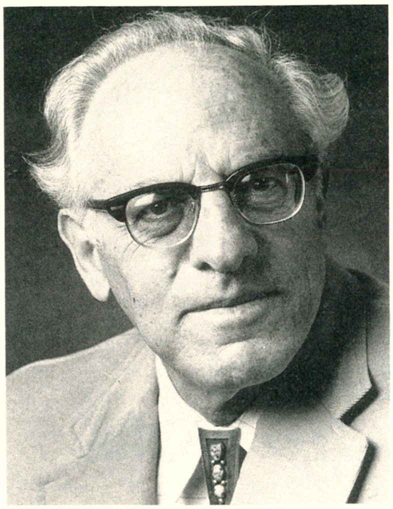
Since those experiments Reines has done extensive studies of neutrino physics. Among other things, he has detected neutrinos produced in the Earth's atmosphere and the scattering of neutrinos by electrons. Experiments done by Reines have tested some of the conservation laws, including conservation of electric charge, lepton number and baryon number. He is a primary investigator with the Irvine–Michigan–Brookhaven collaboration that set up an 8000-ton water tank to detect Čerenkov radiation from possible proton decay. The IMB experiment has failed to find any evidence of proton decay, thus setting tight upper bounds on the proton's possible decay rate and showing that baryon number may indeed be conserved. The detector was in place to register neutrinos from the explosion of supernova 1987A, a phenomenon that sparked a new field of neutrino astronomy.

Reines got his PhD in theoretical physics from New York University in 1944. He then worked at Los Alamos until 1959, when he became head of the physics department at Case Western Reserve University. After seven years there he moved to the University of California, Irvine, where he was a physics professor and also the dean of physical sciences for eight years. He retired in 1988.

Brown was given the John Price Wetherill Medal in recognition of his "contributions in many important areas in the fields of theoretical physics and astrophysics." A theoretical atomic physicist, Brown worked on problems in quantum electrodynamics in the 1950s. With Geoffrey Ravenhall of the University of Birmingham in England, he developed the Brown–Ravenhall method to analyze the problem of two relativistic electrons without autoionization. In the early 1960s and 1970s Brown developed theories of nuclear structure. The Brown–Bosterli theory, done with Mark Bosterli, then at the University of Minnesota, introduced a way to calculate the nuclear giant resonances—the collective modes of vibration of a nucleus that produce alterations in its density. The Kuo–Brown theory, developed with Thomas T. S. Kuo, then a postdoc at Princeton, provided a means to solve the Schrödinger equation for a nuclear system by reducing an infinite dimensional matrix to a set of matrix elements representing the effective nucleon interactions. In the 1970s and 1980s Brown made extensive studies of mesonic and subnuclear degrees, and his theories laid the foundation for much subsequent work in nuclear physics. With Hans Bethe and Gordon Baym, Brown developed a theory of supernovas, based on nuclear processes, that is an important approach to the collapse of stars with large mass—on the order of 18 solar masses.

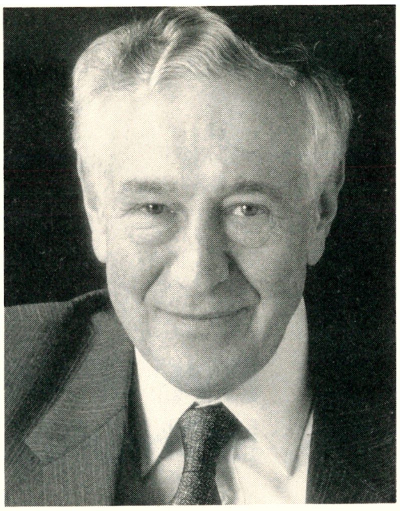
Brown earned his physics PhD at Yale University in 1950 and his DSc at the University of Birmingham in 1957. In 1960, after a few years on the physics faculty at Birmingham, Brown became a physics professor at the Nordic Institute of Theoretical Atomic Physics in Copenhagen, a position he held until 1985. He also held concurrent positions in the physics departments of Princeton University (1964–68) and the State University of New York, Stony Brook (1968 to the present). In 1988 he was named Distinguished Professor of Physics at Stony Brook.

The Franklin Institute bestowed the Stuart Ballantine Medal on Landauer for "his numerous seminal contributions to theoretical condensed matter physics and in particular for providing essential insights into the mechanism of electronic conduction in composite materials and into the physical origin of electron localization phenomena." In the early 1950s Landauer considered binary metallic mixtures and developed a theory for the conductivity and polarizability of inhomogeneous materials. A few years later he started developing what is now called the Landauer formula, which calculates conductance from the quantum mechanical



Frederick Reines

Gerald E. Brown

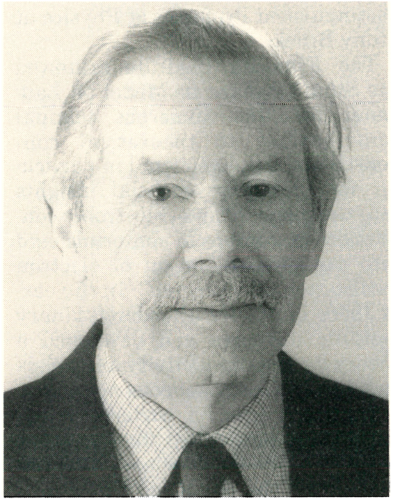


Rolf Landauer

transmission of electrons through the sample and which has become particularly useful for the small samples widely investigated in recent years. He showed that at low temperatures, when phonon scattering of electrons is unimportant, the electrical resistance of one-dimensional metals increases exponentially with length, not linearly as at higher temperatures. This effect is a symptom of the localization of electron wavefunctions resulting from the presence of lattice defects. Landauer has also contributed to the understanding of nonequilibrium steady states and to the application of thermodynamics and statistical mechanics to computing.

Landauer received his doctorate in physics from Harvard in 1950. After two years with the Lewis Research Center, then of the National Advisory Committee for Aeronautics and now part of NASA, he joined IBM's research division. In 1969 he was appointed an IBM fellow after holding a variety of research and management positions.

John W. Hardy



Hardy received the Albert A. Michelson Medal for "the design of the first fully successful adaptive optics system—the Real Time Atmospheric Corrector System," as well as for his "contributions to the technology of adaptive optics, for his seminal publications in this field and for his successful efforts to incorporate adaptive optics in a new generation of astronomical telescopes." The RTAC system was conceived in 1972 as a solution to the problem of imaging objects in space through Earth's atmosphere. Atmospheric turbulence distorts telescopic images: Due to small temperature variations, the index of refraction of the air changes, causing light from distant objects to travel different optical path lengths and producing phase distortion of the wavefronts. In the RTAC system, the telescope aperture is divided into a number of zones, each approximately the size of the turbulence coherence length—typically 10 cm at visible wavelengths. A shearing interferometer measures simultaneously the wavefront gradients in each zone, a parallel data processor reconstructs the wavefront from the individual gradient measurements and computes the corrections required in each zone, and a small deformable mirror with piezoelectric actuators then corrects for the wavefront. The RTAC system was first demonstrated in the laboratory in December 1973 and field-tested the following year. Hardy was the chief engineer for the Defense Advanced Research Project Agency's Compensated Imaging System, a large adaptive optics system that was built by Itek and has been in operation since 1982 at the 1.6-m telescope at the Air Force Maui Optical Station on Mt. Haleakala, Hawaii. He has published numerous papers on the application of adaptive optics to ground-based astronomy.

Hardy earned his BSc in engineering in 1946 from the University of London. After serving in the British Army, he worked at British Telecommunications Research until 1956, when he moved to the US. In 1960 he joined what is now Litton Itek Optical Systems, where he worked until retiring in 1990.

Furth is this year's recipient of the Delmer S. Fahrney Medal. The award was given to him for "contributions to the field of plasma physics, for his scientific leadership in international research on controlled nuclear fusion and for his leadership of others as director of the Princeton Plasma Physics Laboratory." Furth showed that magnetic field lines inside well-conducting, hot plasmas can break in the presence of finite residual dissipation. The breaking allows instabili-

Harold P. Furth

ties to grow on characteristic time scales of fractional powers of the plasma resistivity. Furth has designed various experiments to explore and control such "tearing modes"; for example, with current-profile shaping and feedback control of the plasma. He also did pioneering work in neoclassical and anomalous transport. Furth has done experiments on the Adiabatic Toroidal Compressor tokamak, and he proposed using the large auxiliary heating power input of the Tokamak Fusion Test Reactor at Princeton to sustain the tail of a slightly non-Maxwellian deuteron–triton energy distribution. Experiments now in progress on the TFTR and on other large tokamaks are successfully testing this approach.

Furth received his PhD in physics from Harvard in 1960. He worked at Lawrence Livermore National Lab from 1956 until 1967. He then joined the staff of the Princeton Plasma Physics Lab and became a professor of astrophysics at Princeton University. He was director of the lab from 1981 to 1991.

LAWLER AND SPRUCH HONORED AT APS DIVISION MEETING

At the May meeting of the American Physical Society's division of atomic, molecular and optical physics, held in Chicago, James E. Lawler received the Will Allis Prize and Larry Spruch received the Davisson–Germer Prize.

The Allis Prize, which recognizes outstanding research on the microscopic or macroscopic behavior of ionized gases, was given to Lawler for "the elucidation of cathode fall phenomena in glow discharges through the measurement and analysis of spatial variations in the electric field, and for the development of new methods to determine atomic lifetimes and transition probabilities." Lawler was a pioneer in the development of optogalvanic spectroscopy, which he then used to study the electric field structure of glow discharge plasmas. His experimental and theoretical work on cathode fall phenomena has helped resolve classical problems in this area and also in the study of cold electrons trapped in the negative glow region.

After earning a PhD in physics from the University of Wisconsin, Madison, in 1978, Lawler was a research associate at Stanford University for two years. He then returned to Wisconsin, where he is now a professor of physics.

Larry Spruch received the Davisson–Germer Prize, which is given for outstanding work in atomic or surface physics, "in recognition of his numerous contributions to many areas of atomic physics, including variational principles and bounds, effective-range theory, statistical models of the atom, rearrangement collisions and retardation effects." Spruch is perhaps best known for the application of variational methods and associated bounds to problems in atomic few-body scattering experiments, which he carried out with coworkers. Most recently he and colleagues have studied retardation (Casimir) potentials for Rydberg atoms ($He^+ + e^-$) and Rydberg ions (such as $C^{+5} + e^-$ and $O^{+7} + e^-$, in storage rings) and, more generally, retardation effects involving electrons, atoms, ions and surfaces.

Spruch received a PhD in physics from the University of Pennsylvania in 1948 and then worked at MIT as a postdoctoral fellow. He moved to New York University in 1950 and is currently a professor of physics there.

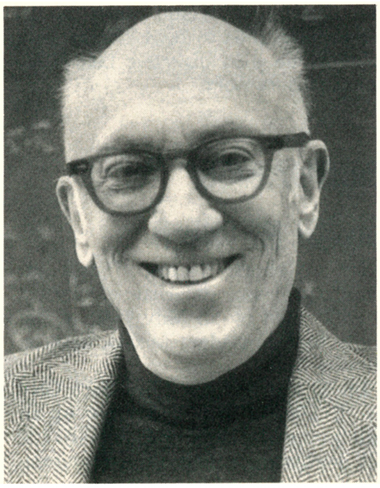
ASA APPLAUDS ACHIEVEMENTS IN ACOUSTICS

The Acoustical Society of America has awarded its Gold Medal, the society's highest honor, to Ira J. Hirsh, a Distinguished University Professor at Washington University. Hirsh, who received the medal at ASA's May meeting in Salt Lake City, was cited for "contributions to the understanding of the auditory process." During the 1950s Hirsh worked on the intelligibility of speech, auditory masking and auditory fatigue. Later he studied the perception of temporal order and the relation between temporal processing and other cognitive and communicative abilities. He is the author of *The Measurement of Hearing*, which became a standard text for audiologists and students in psychoacoustics.

Hirsh earned a PhD in experimental psychology in 1948 from Harvard, and he continued to work there for three more years. In 1951 he joined the research staff of Washington University's Central Institute for the Deaf, and from 1965 to 1983 he served as the institute's director of research. He is also a member of the psychology faculty at Washington, and from 1969 to 1973 he was dean of the universi-

James E. Lawler

Larry Spruch



Ira J. Hirsh