for analyzing present-day femtosecond lasers. Hermann also began a series of significant accomplishments in integrated optics: He produced original analyses of waveguide coupling, invented the quarter-wave shift for distributed feedback devices, and invented and demonstrated the nonlinear waveguide Mach–Zehnder switch for ultrafast all-optical logic.

Hermann returned to the subject of noise in lasers and in optical fiber transmission systems during the 1980s. With Jim Gordon, he showed that quantum noise introduced by optical amplifiers places a limit on the long-distance transmission of solitons by causing timing jitter (the Gordon–Haus effect), and then, with Antonio Mecozzi, showed that the limitation could be overcome with the use of filters. In the early 1990s, with his student Yinchieh Lai, Hermann first developed theories for soliton squeezing and the quantum fluctuations of solitons.

The importance of Hermann's pioneering work became increasingly evident in recent years. He remained at the forefront of progress in the field. With students and colleagues at MIT, he carried out dramatic demonstrations of the squeezing of vacuum fluctuations in optical fibers and, in 2001, achieved signal noise reduction to as much as 6.1 dB below shot noise. He invented novel modelocked fiber lasers and provided theory for the operation of less-than-two-cycle pulse lasers. He pioneered the development of compact, high-index-contrast photonic circuits and cowrote the book *Passive Components for Dense Optical Integration* (Kluwer Academic, 2002) with Christina Manolatou. In a matter of months, he wrote his 560-page book *Electromagnetic Noise and Quantum Optical Measurements* (Springer, 2000) to present a unified description of classical and quantum noise. Of his more than 380 journal publications, he wrote an astounding 200 after age 65.

Hermann received many prizes and honorary degrees and was elected to both the National Academy of Engineering and the National Academy of Sciences. An immigrant who was deeply grateful for everything this country had permitted him to achieve, Hermann was particularly proud to receive the National Medal of Science from President Bill Clinton in 1995.

Hermann was an enthusiastic and devoted teacher. During each of the last six decades of his life, he taught both undergraduate and graduate courses, inspiring generations of students at every level. At the same time, he taught all of us—colleagues, students, and friends—about much more than science. We were awed by his command of literature, history, and language, and by his energy. He biked to and from work every day. He led us on long hikes and across-the-lake swims. We followed him to lectures on the cosmos, to local museums and art exhibits, and on his tour of campus sculpture. His door was always open and he always had time for us. He was a great colleague, mentor, and friend.

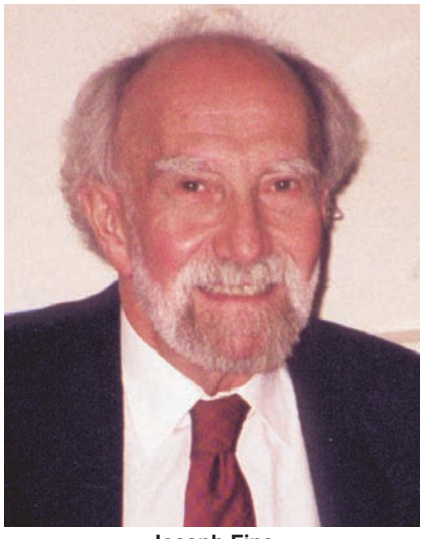
Erich P. Ippen
Massachusetts Institute of Technology
Cambridge

Joseph Fine

Joseph Fine, a NIST physicist who was best known for his work in the interaction of energetic ions with surfaces, died on 11 January 2003 in Silver Spring, Maryland, after a long struggle with cancer.

Fine was born in Montreal, Canada, on 7 August 1931; his family emigrated to the US when he was four years old. His interest in physics bloomed early, and he won first prize for his science fair project in the Georgia Science Talent Search. Fine received his BS (1953) and MS (1955), both in physics, from Emory University. In 1958, after having served two years in the US Army, he joined the National Bureau of Standards (now NIST) in Washington, DC. His initial work was in the free radicals program. With the encouragement of his boss, Milton Scheer, he pursued a PhD in theoretical physics at the Catholic University of America, and received his doctorate in 1974 under Tomoyasu Tanaka. His thesis, on two-electron systems and the formation of positive and negative ion states, inspired an interest in ion interactions. He pursued that interest experimentally at NBS/NIST for the rest of his career, first in the physical chemistry division and later in the surface science division.

Fine began investigating ion scattering from surfaces at a time when very little was understood about the physics of high-energy sputtering. He studied the mechanism of surface roughening that resulted from ion bombardment and determined the rate at which diffusion was enhanced by the creation of long-lived defects. Having obtained the deexcitation spectra of sputtered metal atoms from their Auger emission, he discovered that many of the atoms remained excited long after leaving the surface. With several collaborators, he also studied the continuum spectrum of electrons produced as a result of ion bombardment.



Joseph Fine

Later, Fine became interested in the difference between ion interactions with metals and those with ionic crystals, particularly the alkali halides. He and his coworkers discovered that unusual features in the electron spectra of ion-bombarded halides were the result of a complex sequence of lattice collisions and electron transfer. The resulting atoms left in autoionizing states account for a wide variety of surface chemical reactions, dissociation, and defect production.

In 1986, Fine introduced the first NBS/NIST standard reference materials for applications in surface analysis. That effort has had a lasting impact on thin-film technology. A series of papers in which he characterized those multilayer materials is widely cited in a broad range of studies on secondary ion mass spectroscopy, interface degradation by ion bombardment, and sputter depth profiling. Following the establishment of the American Society for Testing and Materials committee on surface science in 1976, he chaired the ASTM's standard reference materials subcommittee for many years.

A careful experimenter who excelled in designing instruments, Fine developed a laser resonance fluorescence system sensitive enough to detect the atoms desorbed from surface layers at room temperature. With Denes Marton, he invented an optical scanning scattering microscope that won an R&D 100 Award in 1990. For his achievements in surface science and in standards, he was awarded the US Department of Commerce's Bronze Medal (1982) and Silver Medal (1986).

Joe's love of physics was infectious and cosmopolitan. He supervised the theses of several graduate students, and a large number of postdocs and guest workers from his overseas collaborations profited from passing through his laboratory. His enthusiasm spilled over into other activities such as ultra-faithful stereo sound reproduction and classic cars. He owned a Ferrari and a Bugatti, and visitors to his home were always delighted to discover a famous Formula I race car in the family room. Joe is remembered by his colleagues for his warmth, conviviality, and generosity of spirit, both in the workplace and at meetings around the world.

Terrence Jach
Cedric Powell
National Institute of Standards and Technology
Gaithersburg, Maryland

Daniel Richard Frankl

Daniel Richard Frankl, an emeritus professor of physics at the Pennsylvania State University, died on 1 June 2003 in State College, Pennsylvania.

Born on 6 September 1922, in the Bronx, New York, Frankl entered an accelerated wartime program at the Cooper Union for the Advancement of Science and Art in New York City. There, he received a BS in chemical engineering in 1943 and subsequently worked for the US Rubber Co as a process development engineer until 1950. He then entered Columbia University and received a PhD in physics in 1953. His thesis research, under the direction of Thomas A. Read Jr, concerned internal friction in ionic crystals; it gave support to the then quite new concept of dislocations in solids.

After receiving his doctorate, Frankl spent the next 10 years with the Sylvania Electric Co (later General Telephone & Electronics) on Long

Daniel Richard Frankl