was 17, he went to Zürich, Switzerland, and attended a secondary school there. He graduated and subsequently completed one semester at the Swiss Federal Institute of Technology. In 1935, he accompanied his mother to the US, where he later became an American citizen. His parents eventually settled in Cambridge and Deutsch enrolled at MIT, where he received his BS in physics in 1939 and his PhD in physics in 1941. In only 6 years, he had completed a course of study that customarily takes 11 years. His doctoral thesis, prepared under the guidance of Robley D. Evans, was entitled "A Study of Nuclear Radiations by Means of a Magnetic Lens Beta-Ray Spectrometer."

Deutsch began his career at MIT in 1941 as an instructor of physics. He joined the Manhattan Project and worked at Los Alamos beginning in 1943. Three years later, he returned to MIT, where he spent the remainder of his professional life.

The next several years were notable for Deutsch's achievements. He was the physicist who first realized the importance of Hartmut Kallmann's 1947 discovery of organic scintillators and introduced their use in the US. Deutsch used them as a magic wand, performing nuclear spectroscopy experiments that beforehand would have been almost impossible. Thus he was the first to measure the angular correlation of two successive gamma rays. In 1951, Deutsch discovered the "ultimate atom"—positronium—which consists of an electron bound to a positron. In the next couple of years, he and his collaborators measured the most important properties of positronium's ground state, namely its hyperfine splitting (the singlet–triplet energy difference) and the triplet state's lifetime. Hyperfine splitting, which is about twice as large as one would conclude from naive estimates, is one of the most striking manifestations of quantum electrodynamics. Through this outburst of creativity, Deutsch dominated the field at that time. Many decades passed before anything substantially new was learned about positronium.

Around 1960, Deutsch switched to particle physics. Among the many topics he investigated were the Compton effect of the proton (at Cornell University) and the excited states of lambda hypernuclei (at Brookhaven National Laboratory). Although those experiments were successful, the glories of his positronium days were never recaptured. Perhaps this field did not quite correspond to his personal style, as he was used to doing everything down to the last detail with his own hands. He became a full professor at MIT in 1953, and headed MIT's Laboratory for Nuclear Science from 1973 to 1979. Following his retirement from MIT in 1987, he helped to prepare and set up the Borexino solar neutrino experiment at Italy's Gran Sasso National Laboratory.

Deutsch was a great teacher, both in the classroom and as a thesis adviser. Among his many students was Nobel laureate Henry Kendall (see his obituary in PHYSICS TODAY, February 2000, page 70). Deutsch also was a sharp debater who mixed incisive criticism with Viennese charm. While he was totally committed to physics, he enjoyed gardening and cooking (especially stir-frying).

Those who knew him will cherish their souvenirs, and those whom he considered his friends will always be proud of that.

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Abraham Klein

Abraham Klein

Abraham Klein, a theoretical physicist and emeritus professor at the University of Pennsylvania and a leading figure in the community of nuclear theorists, died 19 January 2003 of complications from a stroke.

Born on 10 January 1927, Abe graduated from Brooklyn College of the City University of New York in 1947 with a BA in physics. His career started with his entrance to Harvard University, where he received an MA in physics in 1948. Under Julian Schwinger, Abe earned his PhD in just three years with a dissertation on the problem of one-meson exchange potential.

Abe stayed five more years at Harvard, first as an instructor and later as a junior fellow of the Society of Fellows, during which time he did research in field theory. At the beginning, still under Schwinger's tutelage, he studied the higher-order corrections to the hyperfine structure and the Lamb shift in hydrogen. He also studied the fine structure of positronium. However, his most important contribution during that period was the reexamination—done solely by him—of the two-nucleon potential problem that Maurice Levy had worked out earlier. That contribution marked the beginning of Abe's long-term interest in nuclear force.

Even though Abe had few direct interactions with Schwinger, Schwinger had a profound influence on Abe's thinking. Throughout his career, Abe continued to make use of the techniques in field theory that Schwinger had developed.

In 1955, after turning down an assistant professorship offered by Harvard, Abe decided to accept a tenured position at Penn, where he remained until his retirement in 1994. That choice shaped his future career. Far away from Harvard with its stimulating environment, Abe had to find his own orientation. He did so by testing different subjects, from field theory to solid-state physics, and by touching on the many-body problem. By Abe's own admission, the first six years at Penn were difficult. Aside from having to help with the care of his new house, he had to carry a heavy teaching load and guide half a dozen PhD candidates.

The first sabbatical that Abe took—in Paris—was salutary. He went to the Laboratory of Theoretical Physics and High Energies, chaired by Levy, at the Université de Paris–Sud. It was there that I first met Abe. That sabbatical year turned out to be a watershed of his future work.

Abe met a number of nuclear theorists at Orsay, including some on leave from the US. At the time, Abe was struggling with the question of the existence of deformed solutions (nuclei) described by rotationally invariant Hamiltonians. He was unaware of the existence of the Hill–Wheeler projection method, and in fact, his ignorance on the subject, together with his interaction with the colleagues he had just met, led him to develop a formalism now known as the Kerman–Klein formalism. Abe considered that his most important contribution to theoretical physics. The formalism involves both the equation of motion method and the spectral decomposition of operator products. Essentially, the method allows the restoration of the broken symmetry. It has been applied with success to quite diverse physical problems, notably to the study of nuclear collective motions, which was its first motivation, and to the plasma oscillation and solitons in field theory.

Another subject to which Abe devoted considerable time and effort was boson mapping of Lie algebras. Originally, boson mapping was designed for studying the anharmonicity of nuclear vibrations, but the formalism that has been developed was general enough to be applicable to other physical problems.

In the last two decades of his life, Abe worked in collaboration with Aurel Bulgac, Niels R. Walet, and me on developing a theory for the large-amplitude collective motions of systems with many degrees of freedom. His aim initially was to study nuclear motions, such as nuclear fission, but the formalism he developed, based on classical mechanics and subsequent quantization, was quite general. He successfully applied the formalism to the cases of a few degrees of freedom and to a model of chemical reactions. However, he still explored its implementation in nuclear studies; that was his original motivation and his most difficult task.

Although Abe was a leading figure in the community of nuclear theorists, nuclear theory was not the only subject on which he focused. Even after his sabbatical year at Orsay and his decision to plunge into nuclear physics, Abe continued to return periodically to field theory and related problems. His published papers in that area did not bring him the fame he obtained with nuclear theory. He truly enjoyed doing physics, which gave him, as he used to say, "real pleasure."

Abe was a devoted husband, father, and grandfather. He and his wife Murielle shared interests in cultural events, particularly theater, and in reading. Abe liked sports. At Brooklyn College, he had been captain of a very successful wrestling team. Later, he enjoyed playing tennis and jogging.

Abe was a bon vivant. He liked good food, enjoyed good companions, and treasured friendships. Among his closest friends were collaborators and former students. Those of us in the physics community miss this gentleman. I consider myself lucky to have had him as a teacher and lifelong friend.

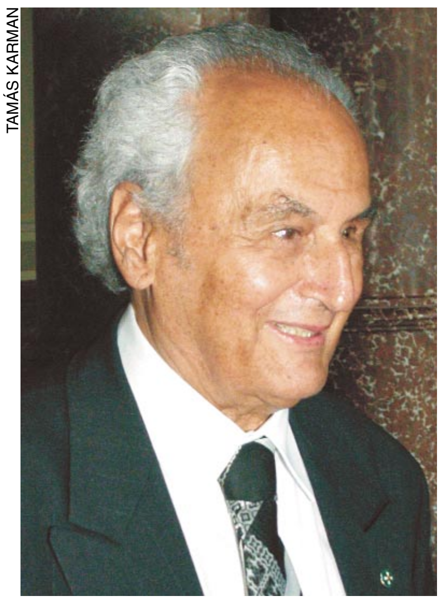
Giu Do Dang
Université de Paris–Sud
Orsay, France

George Marx

Distinguished theoretical physicist and physics educator George Marx died of cancer on 2 December 2002 in Budapest, Hungary. George was one of the pioneers of astroparticle physics. He was among the first to postulate lepton-charge conservation and to recognize the importance of neutrinos in astrophysics. In his native Hungary in 1972, he organized the first neutrino conference, which, for the next decade, became the meeting ground for physicists on both sides of the iron curtain.

George was born György Marx in Budapest on 25 May 1927. He received his first degree in physics, mathematics, and astronomy at Eötvös Loránd University Budapest in 1950. However, showing early signs of brilliance, he had prepared his PhD thesis before taking the first degree, and was awarded the PhD by the same university later that same year. His thesis, "Nonstatic Gravitational Fields," was guided by Károly Novobátzky. Six years later, he obtained the *habilitation* in relativistic dynamics from the Hungarian Academy of Sciences.

For all his professional life, George was excited about the astrophysical importance of neutrinos. He wrote



TAMÁS KARMAN

George Marx