



## IN MEMORIAM

Gilbert Shapiro  
Professor of Physics  
Berkeley  
1934 — 2001

Gilbert Shapiro, a faculty member in the University of California, Berkeley Department of Physics for almost 40 years, died at his home in Moraga, California, in December 2001. He first came to Berkeley in 1963 as a staff member at the Lawrence Radiation Laboratory (now the Lawrence Berkeley National Laboratory, the "Rad Lab") to engage in research in elementary particle physics. Gil's interests and style fit well into the heady, exciting time for particle physics as old concepts were being overtaken by surprising new experimental results. He joined the Berkeley physics department two years later. His productive career came to an end while he was still vigorously active in teaching and research, when he succumbed to the cancer that had been first diagnosed two years earlier.

Gil was born in 1934 in Philadelphia to parents of moderate means. He was introduced to science at the Franklin Institute on his 13th birthday, when his parents gave him a membership in the Institute as a bar mitzvah present. Remarking on this in his typical straightforward, honest and direct way, Gil said, "It was great because I could go there and watch baseball games on television." Experience with exhibits at the Institute had an important influence in directing him toward the serious study of science. The next step was attending Central High School, a long established Philadelphia public school with the highest academic standards and extraordinarily demanding entrance criteria.

In 1955, having received a B.A. from the University of Pennsylvania, he started graduate study in physics at Columbia University, supported by a fellowship awarded him by the National Science Foundation. In 1958 he was awarded a John Tyndall Fellowship to complete his graduate study. At that time Columbia was a leading institute for high- energy physics, and its Nevis Cyclotron Laboratory facility in the Hudson River Valley north of New York City was the site of a number of major discoveries. Gil was naturally attracted there to pursue research in high- energy physics. Mentored by Professors R. L. Garwin and A. M. Sachs, he made a precise measurement of the magnetic moment of the muon. His Ph.D. thesis, "Accurate Determination of the  $\mu$  + Magnetic Moment," was submitted to and accepted by the Columbia faculty in 1959. The results were published in Volume 2 of Physical Review Letters that year. Most important about this work was its determination of the vacuum dynamic contribution to a static property of the  $\mu$  + particle, which had been predicted by quantum electrodynamics. This was just the first example of many instances, continuing throughout his career, of his addressing fundamental problems of broad general importance. Together with L. Lederman, Gil refined and expanded measurements of muon mass and magnetic moment while a postdoctoral research associate at Nevis in 1960 and 1961. In 1962 they published a summary paper, "Fundamental Constants of the Muon," in Vol. 125 of the Physical Review. While a graduate student at Columbia Gil met and courted Harriet Lerman, a student at Hunter College across the street from the Physics Department. They were married in 1958. Their son Jim was born in 1960.

On joining the staff at the "Rad Lab," Gil turned his attention from problems of weak interactions to those of the rather different strong interactions of hadrons. He joined with Professors Owen Chamberlain and Carson Jeffries to build the first polarized target for high- energy physics. Its initial use was in a pion- proton scattering experiment in 1963 at the "Rad Lab's" 184- inch synchro- cyclotron. The target was a technological tour de force application of the basic ideas of dynamic nuclear polarization that had been developed by

Jeffries at Berkeley and independently by Professor Anatole Abragham at Saclay in France. With it, Gil and colleagues obtained a rich store of detailed results on spin- dependent effects in high- energy scattering processes. During the following 15 years Gil was a senior member of a research group that carried out numerous experiments with polarized targets at the synchro- cyclotron and the Bevatron accelerator at the "Rad Lab." Later he continued this work at the Fermi National Laboratory (FNAL) in Illinois and at the Stanford Linear Accelerator Center (SLAC). The polarized target work pioneered by Chamberlain and Shapiro at Berkeley spawned similar developments at practically all the major high- energy physics facilities in the world, and a whole industry of polarized target research soon evolved at accelerator facilities in France, England, Switzerland, Japan and the (then) Soviet Union. Gil was an active participant in numerous international conferences in the field.

In addition to the study of interactions of hadrons, the technique was used to determine the fundamental intrinsic parity of strange particles. With colleagues at SLAC, Gil made an innovative application of the polarized target to search for evidence of time reversal invariance in scattering of electrons. This was an important test of one of the most basic symmetries and conservation laws in physics. He had a deep and abiding interest in physics with polarized targets, but he didn't hesitate to involve himself in other projects when the physics interested him. As particle physics experiments evolved into greater complexity and sophistication, requiring massive collaborations and mixtures of talent, Gil made valuable contributions to such efforts. He worked with the Time Projection Chamber group that produced important results on high- energy electron- positron and photon- photon interactions at the SLAC storage ring SPEAR during the decade of the 1980s. In the next decade he joined the SLAC Large Detector group to determine the properties of the 91 GeV Z- Boson resonantly produced at the SLAC Linear Collider. This experiment also produced the single most accurate determination of the weak mixing angle, and thereby provided what is still the most sensitive test of the Standard Model. In another project at SLAC, he and collaborators studied deep inelastic scattering of polarized electrons from which they obtained information on the spin structure of the neutron. His last research effort was in planning an imaginative use of cosmic- ray neutrinos to map the earth's density through its mantle and core, in effect a CAT scan of our planet.

Gil devoted much of his teaching efforts to sharing with a wide lay public his passion for physics and developing for them an appreciation for basic scientific fact and methodology. His characterization of the descriptive Physics 10 courses that he taught as "Physics for Football Players" indicates the kind of audience he wanted to reach. He penned *Physics Without Math*, published in 1979, as a descriptive text for courses based on his lecture material. *A Skeleton in the Darkroom*, an entertaining account of extraordinary serendipitous observations, followed eight years later. He used this book as the basis for a freshman seminar he taught in the 1990s. To reach an even wider audience he served for a year as vice president of the East Bay Skeptics Society, a group associated with the International Committee for the Investigation of Claims of the Paranormal. Gil had no patience with charlatans and others who misinterpreted science, and he delighted in debunking false and misleading claims.

Gil had a deep commitment to helping students both in his teaching and outside the classroom. He served for many years on the Committee on Undergraduate Scholarship and Honors of the Berkeley Academic Senate. He made annual spring trips to Los Angeles to interview prospective Regents Scholars. He cared about his students and always made himself available to help them. His record of service to the University, especially to the Berkeley campus and the Department of Physics, was laudable.

Science hardly filled Gilbert's life completely. He enjoyed simple California pleasures, most often with his family, to whom he was devoted. His favorite local spot to visit was Muir Woods in Marin County. He loved to walk through the redwoods. Further afield were holidays at Death Valley and the Grand Canyon. The family accompanied Gil to Washington and to Baja California to witness and be awed by solar eclipses. Later in life he was especially delighted to visit with his grandchildren and their parents, his daughter Suzy and her husband Ted Gross, in Baltimore and deluge them with gifts. He loved classical music and had season tickets for the San Francisco Opera. An avid fan of all sports, he followed the Oakland A's and the San Francisco Giants, attended World Cup soccer matches when they came to the Bay Area, and loved Golden Bears basketball, too.

Professor Shapiro is survived by his wife, Harriet Shapiro, their three children, James, Dinah, and Dr. Susan Gross, son- in- law Ted Gross, and two grandchildren, Rebecca and Steven Gross.

William Chinowsky  
Herbert Steiner