

interference effects that served as a forerunner for a number of theoretical and experimental discoveries in K-meson physics.

A problem that occupied Sachs's central interest over many years was that of the violation of *CP* and time-reversal invariance. He began a series of important papers on the subject—even before the experimental discovery in 1964—and he continued to write on this subject until his death. He was keen on emphasizing the distinction between *CP* and *T* violation, which continues to get blurred. The ultimate origin of these symmetries and their violation was what directed much of his thinking on the subject. His most recent speculation, based upon a study of the structure of the quantum chromodynamics vacuum and the so-called strong *CP* problem, related the observed *CP* violation in the K-K bar system to a possible *T*-violating electric dipole moment of the neutron, and made a prediction for the latter that could be tested in the near future.

In 1987, he wrote a scholarly book entitled *The Physics of Time Reversal* (University of Chicago Press) about which he was particularly proud. For years, his office clock ran backward.

Outside the field of physics research, Sachs is noted for his contributions to questions relating to national and international energy policies, for his services on physics advisory panels, his active role in the National Academy of Sciences, and for creating the division of particles and fields of the American Physical Society.

Sachs was a wonderful colleague. He devoted himself to recognizing, supporting, and encouraging independent thinking, particularly in his younger colleagues. He frequently took on beginning graduate students for their first year, immersing them in the full range of theoretical physics before they went their specialized ways. It is a fitting tribute that the most promising of the entering graduate students in physics at Chicago are now honored with Sachs fellowships. We speak for all his colleagues and former students in expressing deep sadness at his passing.

ROGER HILDEBRAND

BRUCE WINSTEIN

University of Chicago

Chicago, Illinois

KAMESHWAR WALI

Syracuse University

Syracuse, New York

William Bernstein

William Bernstein, a former research professor at Rice University's department of space physics and



WILLIAM BERNSTEIN

astronomy, died on 6 March in Houston, Texas, of complications from quadruple heart bypass surgery.

Born in New York City on 26 June 1924, Bill earned a BS in physics at New York University in 1944. After the US entered World War II, he volunteered for the US Army, and served as a technical sergeant installing mountaintop radars in California. After the war, he undertook graduate work in nuclear physics at the University of Wisconsin in Madison. However, his PhD studies were curtailed when he had to attend to family business when his father died.

From 1948 until 1955, Bill investigated medical radiation problems at what was then the Brookhaven Laboratory. He then spent the next four years working on Project Matterhorn at Princeton University's Plasma Physics Laboratory, where he performed experiments associated with Martin Kruskal's theories.

Bill returned to Southern California in 1959 to continue research in plasma physics—this time, at the research laboratory of Hughes Aircraft Corp.

Having moved to TRW Systems in 1965, Bill led a team that fired one of the earliest Javelin rockets from Wallops Island, Virginia, to explore the upper atmosphere and ionosphere before, during, and after a total solar eclipse. These investigations, which took place on 6, 7, and 8 March 1970, included the first-ever direct measurements of the precipitation of energetic (about 10 keV) neutral hydrogen atoms into Earth's atmosphere.

Other rocket flights that Bill oversaw were launched from above the Arctic Circle and performed coordinated measurements of electrons, protons, electric and magnetic fields, and hydrogen Balmer-line emissions. Bill thoroughly enjoyed mounting these ex-

peditions, during which he picked up an interest in Inuit soapstone sculptures, as well as an aversion to wind-chill factors lower than -60°F .

At TRW, Bill was part of an informal group of plasma physicists who started a world-class effort to apply plasma theory to space and ionospheric physics. Maintaining his interest in fusion research, he made several sabbatical visits in 1964–65 to the Culham Laboratory in England.

Moving to NOAA's Space Disturbances Laboratory in 1971, Bill led a team that simulated the fundamental aspects of magnetosphysics. To continue that work, he took a position in 1980 as a research professor at Rice University.

These studies were conducted in large vacuum chambers, starting at NASA's Lewis Research Center's facility in Plum Brook, Ohio, in December 1974 and continuing in the 90-foot chamber at NASA's Johnson Space Center (JSC) in Houston. The results clarified aspects of electron beam behavior that arise when accelerated electrons interact with a weakly ionized plasma in a very low background pressure equivalent to the ionosphere's E-region and with a uniform magnetic field of 1.5 gauss. Previous work along this line had been performed only in laboratory fusion devices. During the first experimental run at JSC, Bill and his colleagues observed a beautiful beam-plasma discharge in the chamber that led to a thorough investigation of its onset conditions and associated steady state phenomena. Bill's successful direction of this project, which culminated in the publication of many papers, was perhaps his greatest accomplishment.

As a member of the research faculty at Rice, Bill advised a number of graduate students. A demanding adviser, he cared very deeply about their welfare.

Bill was a brilliant scientist, a concerned citizen, a man of broad culture, and a valued colleague. Despite his stern appearance, he was a very warm person who impressed everyone with his understanding and stimulating intellect. He wanted to learn more and believed in learning through research. A firm humanist, he had a lively interest in political and social issues and deeply held convictions on them.

We shall remember and miss him as a warm friend and colleague and as a superb and meticulous scientist.

MURRAY DRYER

HAROLD LEINBACH

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