tained his interest in elementary particle physics, but concentrated his work on arms control. He worked as a staff physicist for the Federation of American Scientists in 1987–89 and participated in a cooperative project with the Committee of Soviet Scientists for Peace and against the Nuclear Threat. He maintained a strong interest in arms control for the rest of his life, contributing articles to *Science and Global Security*.

Starting in 1989, he became associated with the Center for International Security and Arms Control (now International Security and Cooperation) at Stanford. There, he worked on numerous issues on the technical aspects of nuclear nonproliferation and published a book, *The Politics and Technology of Nuclear Proliferation* (University of Washington Press, 1998), which constitutes a basic reference on the subject.

Mozley was a quiet, but exceedingly effective leader in high-energy particle physics. As an experimental physicist, he was inventive, hardworking, and resourceful. Throughout his career, he tackled important problems that challenged human ingenuity. Always deeply and genuinely concerned for everyone, he was respected by coworkers and colleagues for his fair and honest approach to problems. His contributions to science, his gracious personality, and his friendly cooperation will be long remembered by everyone who knew him.

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James Albert Phillips

James Albert Phillips, a pioneer in fusion physics at Los Alamos, died of a heart attack on 1 December 1998, in Los Alamos, New Mexico.

Jim was born on 17 May 1919, in Johannesburg, South Africa, where his parents were American missionaries. After arriving in the US in 1935, he attended Carleton College, receiving a BS in mathematics in 1942. He earned his MS and PhD in nuclear physics at the University of Illinois in 1943 and 1949, respectively. While still a graduate student, he worked on the Manhattan Project in Oak Ridge, Tennessee, where he supervised ten employees working on the Calutron isotope separator.

In November 1949, Jim joined a small group in Los Alamos's physics division that was measuring the fusion

James Albert Phillips

cross-sections of hydrogen and helium isotopes. In 1952 the same physicists formed a pioneering group under James Tuck to study harnessing the fusion energy of the hydrogen bomb for peaceful uses. The program started out as the classified project Sherwood, and the group was sometimes jokingly referred to as Friar Tuck and his merry men. In those early days of fusion research, Jim made important contributions to the long series of experiments that explored the basic properties of toroidal pinches (then known as perhapsatrons) and linear pinches (Columbus pinches).

In March 1957, Jim became the leader of P-14, an experimental group whose aim was to explore the potential of the stabilized Z-pinch as a path to a fusion reactor. In 1958, this group constructed a fully operational toroidal Z-pinch PS-4 that was transported, assembled, and demonstrated at the first Atoms for Peace Conference in Geneva, Switzerland. Further research on toroidal pinch experiments continued under Jim's leadership. In the face of serious difficulties, which resulted in rather cool plasmas, the group's toroidal Z-pinch studies were halted in 1961.

During the next five-year period, Jim's group studied a series of other topics, some of which exploited the late John Marshall Jr's coaxial plasma accelerator (gun) to inject plasma into magnetic bottles. Among the topics was an axisymmetric magnetic cusp formed by a pair of equal radii coils slightly separated along a common axis. This configuration was later replaced by the caulked surface cusp, which was formed by a solenoid, an interior poloidal current ring, and an axial conductor along the axis. The aim of latter configuration was to mitigate the observed high plasma loss by outward flow along the field lines in the cusp region. The study of the coaxial gun by Jim's group led to the Mather dense plasma focus, which remains a potent neutron source to this day.

In 1966, Jim and his group reconsidered the Z-pinch approach. Realizing that, with short current rise times, theta pinches could achieve plasma temperatures above 1 keV, they conjectured that shorter rise times would also enable Z-pinches to overcome the temperature limitations that had brought their Z-pinch research to an end five years before. The group then developed new engineering techniques (magnetic energy storage and transfer) to shorten the current rise times in Z-pinches to produce strong shock heating. At that time, new theory predicted stability would be enhanced by means of a reversed toroidal magnetic field in the outer region of the pinch. Together, the new engineering and theory led to the ZT series of shock-heated reversed-field pinches (RFPs), of which the first, ZT-1, was constructed under Jim's direction in 1972.

Jim's contributions to physics were not confined to Los Alamos. He served as chairman of the division of plasma physics of the American Physical Society in 1967 and as Southwestern regional secretary for the APS in 1970–75. And in 1975–79, he took a leave of absence to head the physics section at the International Atomic Energy Agency in Vienna, Austria. When he returned, he was made a laboratory fellow and continued his career as a team leader for RFP startup. He conceived and demonstrated experimentally a new slow ramp startup technique on the last Los Alamos RFP, ZT-40M.

After retiring in 1987, Jim continued his work as a laboratory associate. He spent many hours analyzing the Los Alamos RFP database, as well as data received from his numerous colleagues in the RFP experimental groups in Italy, Japan, Sweden, at the University of Wisconsin, and the University of Colorado. Armed with insights from these studies, he developed new ideas for improving the design and operation of the RFP. At the time of his death, Jim was preparing a paper, with the two of us as coauthors, which included a model of the observed RFP sawteeth field fluctuation waveforms as being produced by a rotating helical kink.

A cheerful, optimistic person, Jim was always ready to talk about physics, or any other topic, and is missed by those who experienced his warm personality.

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