

port News, Virginia, was honored as the state's outstanding scientist of 1998. The award is one of five given each year by the Science Museum of Virginia and the Commonwealth of Virginia to outstanding scientists and industrialists.

OBITUARIES

Joseph Ballam

Joseph Ballam, associate director of the research division of the Stanford Linear Accelerator Center (SLAC) for 19 years, died in Stanford, California, on 14 December 1997 of emphysema. He was 80 years old.

Born in Boston, Ballam earned his BS in physics in 1939 from the University of Michigan, whose cosmopolitan community of physicists kindled his enduring interest in basic physics. After one semester at MIT, Ballam joined the US Navy's Bureau of Ships, where he worked during World War II principally on underwater mine sweeping and infrared signaling.

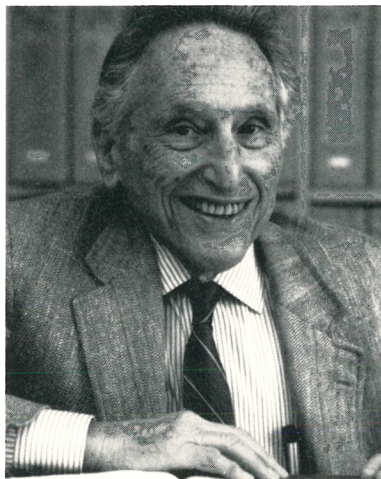
After the war, Ballam became a member of Robert Brode and Bill Fretter's cloud chamber group at the University of California's Berkeley campus. He then joined Berkeley's Radiation Laboratory. Ballam's PhD, which he received in 1951, was on the proton component of cosmic rays at sea level.

Ballam spent the years 1951–52 as an instructor at Princeton University, where he continued his cloud chamber work in cosmic rays—this time at high altitude. He also studied strange particles at the Brookhaven Cosmotron. He continued his research on pion scattering, using a propane bubble chamber, after joining the physics faculty at Michigan State University in 1952.

In 1961, Ballam joined SLAC as an associate professor and the first associate director of the research division. After Sidney Drell predicted large yields of secondary beams from high-energy photons, Ballam extended and confirmed those predictions through measurements at the Cambridge Electron Accelerator. In that way, he greatly extended SLAC's experimental program, of which he was a key early planner.

Ballam oversaw the construction of a wide variety of advanced particle detectors. As an active leader of a research group at the laboratory, he initiated a double-headed hydrogen bubble chamber program. A rapid-cycling hybrid hydrogen bubble chamber, which measured 40 inches in diameter, was designed and built. Inside the chamber, photographs could be triggered by electronic detectors. He also arranged for the transfer from

Stephen Hawking was chosen to deliver the second White House Millennium Lecture in early March on the theme of science and creativity in the 21st century. Hawking is the Lucasian Professor of Mathematics at the University of Cambridge.



JOSEPH BALLAM

Lawrence Berkeley Laboratory to SLAC of Luis Alvarez's large bubble chamber, which was converted into an 82-inch chamber operating at high expansion rate.

The 82-inch chamber was installed in diverse hadron beams, whereas the 40-inch chamber operated in photon beams of original designs. At first, monochromatic gamma rays resulting from electron-positron annihilation were used, followed later by backscattered high-intensity laser photons from high-energy electron beams. The two chambers developed such high productivity that for some time they saturated the worldwide data analysis capacity by producing as many as six million photographs per year. Ballam was personally involved in studies of the photoproduction of Vector mesons, the first measurements of photoproduction of charmed particles at high energies and other photoproduction studies.

When colliding-beam physics got under way, Ballam joined the Mark II detector group at the SLAC Positron Electron Asymmetric Ring. He took part in the early experiments at the SLAC Linear Collider, including studies of the parameters at the Z_0 resonance, measurements of the strong coupling constant and various particle searches. Until his death, Ballam participated personally in SLAC's research and remained a collaborator in GLAST, a second-generation gamma-ray astronomy detector.

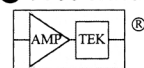
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Ballam was an unusually effective director of SLAC's research. He established a first-rate computation department and his counsel on computation in high-energy physics was widely sought. As chairman of a subcommittee of the Department of Energy's High Energy Physics Advisory Panel, he was responsible for developing projections of the nation's computing needs for high-energy physics. He also advised Fermilab on upgrading computational facilities and counseled on computation at the proposed Superconducting Super Collider. After retiring in 1982, Ballam served as an adviser to the director of SLAC.

Joe Ballam had a rare and wonderful gift for gaining the respect, admiration and warm affection of his colleagues, even while making the necessary tough decisions as an associate director. His success lay in his ability to act decisively while remaining kind, patient and understanding under great pressure—and never sacrificing his sense of justice and fairness. His contributions will be long remembered and his many friends and associates miss him deeply.

WOLFGANG K. H. PANOFSKY

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Joseph Walter Mather

On the evening of 5 November 1996, the noted experimental plasma physicist Joseph Walter Mather died at his home in Los Lunas, New Mexico, at the age of 76.

Born in Hartford, Connecticut, Joe had completed two years of junior college when the US entered World War II late in 1941. He joined the US Army and, after basic training, was sent to New York University for a year of further study. The Army Corps of Engineers then assigned Joe to Oak Ridge, Tennessee, to work on the thermal diffusion process for separating uranium-235 as part of the Manhattan Project. In 1943, Joe was transferred to Los Alamos, New Mexico, where he was assigned to the project's electronics group.

Following his military service, Joe earned a BS degree in physics from Rensselaer Polytechnic Institute in 1948 and a PhD in nuclear physics from the Berkeley campus of the University of California in 1952. Returning to Los Alamos, Joe joined the Controlled Thermonuclear Fusion Research (CTR) program, where he worked with John Marshall, among others. Joe's early contribution was the design and building of a 100 kV linear pinch device known as Columbus II, which led to the eventual build-

ing of the 5-megajoule Scyllac facility.

In 1963, Joe and Marshall were working on a plasma gun concept, dubbed the Marshall gun, in Jim Tuck's group. The idea was to launch a high-temperature, high-density plasma into a stabilizing and confining magnetic field. The coaxial device used an annular puff of deuterium midway along the center electrode to form the initial current path upon application of the fast capacitor bank voltage. Neutron and x-ray detectors monitored the plasmas continuously. The puff valve leaked one day and filled the vacuum chamber with deuterium gas at a low pressure. When the capacitor bank fired, a pinched, high-density plasma formed off the end of the center electrode and the radiation monitors went off-scale! Thus the device now known as the dense plasma focus, or DPF (and sometimes as the Mather gun), was born. The discovery with a different geometry was made nearly simultaneously and independently by Nikolai V. Filippov of the USSR, whom Joe met much later.

On 17 June 1965, while still in the CTR program, Joe planned and carefully executed a DPF experiment for the production of 14 MeV neutrons from a deuterium-tritium mixture at a rate of 80 to 100 times the production of neutrons from the pure deuterium gas discharges. That was most likely the world's first controlled D-T fusion reaction. A separate group, P-7, was formed on 1 July 1966 under sponsorship of the Department of Defense's Defense Atomic Support Agency (DASA), to study the production of soft x rays from the high-density, high-temperature plasmas. Art Williams and Glen Livermore joined Joe in forming this new group, which left the fold of the CTR program and became a part of the physics division at what is now Los Alamos National Laboratory (LANL).

The group's first device, DPF-1, was an 18 kJ device with six capacitors and six vacuum switches. Continuous improvements through several versions led to a 1 MJ system, DPF-6 1/2, which produced 2×10^{12} neutrons per discharge from 720 kJ and a 3.2 megamp peak current. The DPF program at LANL ended in 1974, when the Pentagon stopped funding it in favor of a competing technology, though DPF technology continues to be of great interest worldwide.

From the mid-1960s to the mid-1970s, Joe's P-7 group made many significant contributions to the field of pulsed power and pinched plasma technology and to the development of high-voltage technologies.

When he left LANL in 1975, Joe had his first bypass surgery. But he



JOSEPH WALTER MATHER

recovered fully and went on to build his own home, first in Taos and then in Los Lunas, New Mexico, to be a little closer to his cardiologist. He joined the University of New Mexico in 1981 as a research professor in the department of chemical and nuclear engineering and later in the department of physics and astronomy, where he mentored graduate students in conducting hands-on research.

Bothered by the fact that the pinches in DPF are notoriously less reproducible at different locations, Joe teamed up with Harjit Ahluwalia to try to find the answer. They concluded that the geomagnetic field possibly plays an important role in the problem, which still has not been appreciated by the plasma physics community.

Joe loved science, especially plasma physics, with the same passion that he hated war and the development of nuclear arsenals. Throughout his life, he served both causes with a deep sense of urgency and compassion. Those of us whose lives were enriched by the experience of interacting with him miss him and will remember this humane man for the rest of our lives.

HARJIT S. AHLUWALIA

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KENNETH D. WARE

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Earl Wadsworth McDaniel

Earl Wadsworth McDaniel, a pioneer in atomic collision physics and gaseous electronics, died in Atlanta on 4 May 1997 of a brain aneurysm. His influence will be felt for many years through his seminal research contribu-