

Burton Richter

Burton Richter, influential experimental particle physicist and international scientific leader, died from congestive heart failure on 18 July 2018 in Palo Alto, California.

Burt is indelibly linked to the 1974 discovery of a new type of subatomic particle. It was observed in two quite different experiments: One, under Burt, was performed at SLAC on the weekend of 9–10 November. It continued for several years and revealed new physics of the standard model, and its approach became an exemplar for future collider experiments. The other, led by MIT's Samuel Ting, was done at Brookhaven National Laboratory and used more conventional approaches. On 11 November, Ting happened to be visiting SLAC and met Burt; in their ensuing discussion, they each described their team's analysis of what turned out to be the same particle, now called J/ψ . They issued a joint announcement of the discovery, which immediately created intense activity among particle physicists. Public recognition came soon after, and in 1976 Richter and Ting received the Nobel Prize in Physics.

Burt was born in Brooklyn, New York, on 22 March 1931 to immigrant parents. He entered MIT in 1948, settled on physics, and graduated in 1952. He stayed on and used the 350 MeV MIT electron synchrotron for his PhD research. Helping run that machine sparked Burt's interest in accelerator physics.

In 1956 Burt accepted a postdoc position with Wolfgang Panofsky at Stanford University's High Energy Physics Laboratory; he was attracted by the potential of its Mark III linear electron accelerator. Another freshly minted PhD, Gerard O'Neill, then at Princeton University, visited Panofsky in 1957 to discuss two powerful ideas: that head-on collisions of particle beams produce substantially higher energies than a fixed target struck by a single accelerated beam and that accelerated electron beams naturally avoid

certain instabilities that limit performance of proton accelerators due to damping by synchrotron radiation. O'Neill asked whether Stanford would consider building an electron–electron collider to validate those concepts.

Panofsky supported the idea; Burt changed his research to focus on colliding beams; a small team of physicists joined with Burt and O'Neill to work on what became the first-ever colliding beam experiment (CBX); and the Office of Naval Research supported the project in 1958. The technical challenges were substantial, but by the time it ended in 1965, the CBX published scientific results on electron–electron scattering and provided a technical basis for all future colliders.

By 1965 Stanford's two-mile linear accelerator project, SLAC, directed by Panofsky, was nearly complete. Burt, now a professor and group leader at SLAC, said he always tried to hire physicists whom he thought were smarter than he was. Burt conducted high-energy-physics research and led the design of SLAC's first electron–positron collider, SPEAR. Such colliders have distinct advantages over the CBX in potential and practicality: More interesting physics questions can be addressed, and a single storage ring can contain both counter-rotating beams. When SPEAR finally received funding in 1970, Italian, French, and Soviet labs were already operating e^+e^- colliders; the Italian collider at Frascati had observed surprising results that would be confirmed and extended at SPEAR.

Burt's strategic leadership came to the fore with SPEAR. Incorporating his CBX experience, he oversaw the accelerator design, engineering, and construction efforts. He had the vision to recognize that a new scale for experimental collaborations would be needed to build a suitable detector and analyze its data. Accordingly, he recruited a second SLAC experimental group, led by Martin Perl, and groups, led by William Chinowsky, Gerson Goldhaber, and George Trilling, from Lawrence Berkeley Laboratory (LBL). Thus began the SLAC–LBL collaboration.

A new type of particle-detector system would be needed to exploit SPEAR: a magnet and tracking chamber ideally covering the entire 4π solid angle surrounding the collision point to measure

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momenta, other sensors to determine energies and directions of neutral particles, and means to determine particle identities. Despite challenges, Burt was unwavering in his vision to build a 4π magnetic detector, a vital capability missing at the earlier colliders.

The SLAC–LBL collaboration, its magnetic detector, and SPEAR came together and began accumulating data in 1973. The ψ discovery, J results, and a rapid confirmation by the Frascati collider were published simultaneously in *Physical Review Letters* in December 1974. Among the other significant discoveries made at SPEAR was the τ lepton, for which Perl received one-half of the 1995 Nobel Prize in Physics.

For the remainder of his life, Burt used his skills to serve science in various capacities. He was SLAC's laboratory director after Panofsky's retirement in 1984, and he developed new collider concepts. In 1994 he served as president of the American Physical Society. Burt influenced US science policy by publicly advocating for all fields of science in Congress and the press, and as a member of JASON he advised US agencies on technical matters related to national security. His 2010 book *Beyond Smoke and Mirrors: Climate Change and Energy in the 21st Century* is an original and accessible work. His was a rich scientific life, well lived.

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