

resulting spectrum, Davidsen and colleagues were able to detect and measure a long-sought hotter component of the intergalactic medium.

Davidsen played a leading role in developing, in 1979, the joint Association of Universities for Research in Astronomy–Johns Hopkins proposal that led to the siting of the Space Telescope Science Institute on the Johns Hopkins campus. This event led to an expansion of astrophysics in the physics department and an overall growth in what is now known as the department of physics and astronomy.

Davidsen's leadership in the astrophysics community was evident in his dedicated work on many panels, boards, and committees. He served as interim dean of the Krieger School of Arts and Sciences at Johns Hopkins in 1997 and, at the time of his death, was serving a term as chair of the Sloan Digital Sky Survey project's advisory council. In addition to being the principal investigator of HUT, he was a coinvestigator on the Hubble Space Telescope Faint Object Spectrograph team and many other instrumentation projects. In 1979, the American Astronomical Society awarded Davidsen the Helen B. Warner Prize.

Davidsen's coworkers will remember his consummate gentlemanly manner. Rarely seen in jeans or heard to raise his voice, he had an unselfish concern for students and more junior colleagues. Yet a contrasting side of him was rarely evident to scientific colleagues: He was a talented, albeit amateur, rock musician and rode a Harley-Davidson motorcycle for relaxation. Far too prematurely, the astrophysics community has lost a great colleague and friend.

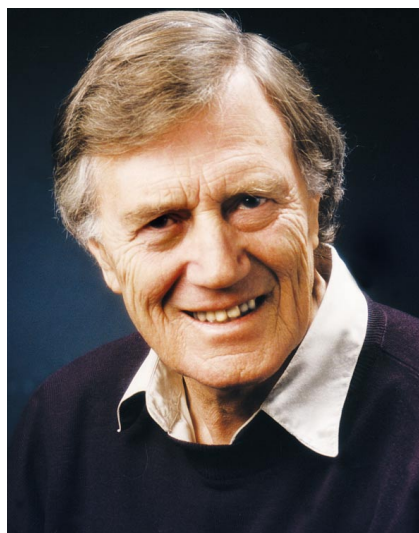
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Bruce Sween Liley

Bruce Sween Liley, one of the pioneer physicists in the UK's fusion research program, died on 19 May 2001 in Hamilton, New Zealand, after a long and stoic battle with a debilitating respiratory illness. During the 15 or so years of his career when he was closely involved in experimental fusion research, Liley played an important and highly original role in the long and continuing quest for nuclear fusion power.



BRUCE SWEEN LILEY

Liley was born on 7 September 1928 in Havelock North, New Zealand. He obtained an MSc in mathematics in 1951 from Otago University College, University of New Zealand, and a master's degree in physics in 1955 from Auckland University College (now the University of Auckland).

Liley worked on a team that was developing George Thomson's ideas for building a thermonuclear reactor to produce power from the fusion reactions of hydrogen discovered in the 1930s by Mark Oliphant and Ernest Rutherford. Thomson received a patent in 1948 to produce useful power from these reactions and started a group, led by one of us (Ware), at Imperial College London to work on this idea. When the UK fusion program was classified in 1951 because of fears that the research could lead to a source of neutrons for breeding plutonium, the group moved to the Associated Electrical Industries (AEI) Research Laboratory at Aldermaston. Another fusion research group, this one at Oxford University, later moved to the Atomic Energy Research Establishment at Harwell and became the forerunners of the present Culham Laboratory.

Liley joined the team at AEI shortly after its start and quickly became the leading theoretician supporting the experimental program. While at AEI, he enrolled as a graduate student at the nearby Reading University and did theoretical research for his PhD, which he earned in 1963. His research involved adapting Harold Grad's 13-moment approximation to obtain transport equations for a fully ionized plasma, and his findings were published in *Reviews of*

Modern Physics in 1960. Those equations are still being used in present research.

Thomson's patent evolved into the Sceptre series of devices—which, like the Harwell machine Zeta, would nowadays be called reversed field pinches—ending with Sceptre IV in 1959–60. Although a theoretician by training, Liley was at the heart of this work. He proposed and helped design an alternative to the Sceptre–Zeta approach: a levitron, which was essentially a current-carrying ring suspended in a vacuum chamber. But, before Liley's apparatus could be properly exploited, AEI decided to close the laboratory in 1963 because of funding problems. The entire team was dispersed, many to fusion laboratories around the world.

That same year, Liley joined the Australian National University (ANU) in Canberra to work in the Research School of Physical Sciences that had been formed by Oliphant after World War II. Liley's team built a device similar to that at AEI but with much stronger toroidal magnetic fields. Liley called his new device a "slow toroidal theta-z pinch." In modern terminology, the slow theta-pinch aspects would be referred to as adiabatic compression of the toroidal field. The experiment LT-1—which, on acquiring upgrades of its power supplies also upgraded its name to LT-2 and LT-3—was a pilot for what Liley later hoped would be a much larger experiment along these lines.

That larger experiment was not to be built during his residence in Canberra, but the pilot experiment was interesting in its own right. Having a strong toroidal field, the device Liley's team built operated in much the same way as the early Russian tokamaks. Deleterious periodic "disruptive instabilities" plagued both sorts of device. Eventually, extensive Russian efforts were devoted to successfully avoiding these instabilities and producing a hot, well-confined plasma. Liley's group decided to study the instabilities in detail; they produced important insights into the phenomenon, for example, that a disruption rapidly redistributed the current throughout the plasma column (see the article by David Bowers and others in *Plasma Physics*, vol. 13, 1971, page 1201). That phenomenon is still the most serious limitation to tokamak operation. Their work also stimulated development of the Ware pinch effect theory.

The LT-1 experiment, which became operational around 1965, can

justifiably be considered the first tokamak outside Russia. When the high temperatures and excellent confinement of the Russian T-3 experiment were confirmed in 1968, interest in the tokamak configuration swept the world, and Liley's group found themselves with what was then a hot research commodity: a tokamak. Two PhD students, David Bowers and Evan Bydder, worked with Liley on LT-1, and LT-3 was the machine on which three now senior physicists in US fusion research, James Strachan, Michael Bell, and one of us (Hutchinson), learned "to drive" a tokamak.

In 1969, Liley moved to Hamilton, where he became the Foundation Professor of Physics at the new University of Waikato. Although he continued theoretical work in fusion and continued to visit the group he had started at ANU, this move marked the start of a second career. Liley built a very successful physics department, struggling hard to encourage and provide excellence, success, integrity, and growth. He was instrumental in promoting various community activities, particularly in astronomy and local industry. He was an ardent supporter of the BSc (technology) program and other industry collaboration programs that were introduced to New Zealand by the Waikato University physics department. He also was a member of the Royal Commission on Nuclear Power Generation in New Zealand (1978).

Liley will be remembered internationally as a true research physicist who was determined to tackle important problems with original ideas and a lot of hard work.

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Timothy Edward Toohig

Following a meeting at SLAC, Timothy Edward Toohig died of an apparent heart attack on 25 September 2001. Before his death, Tim had been working for the US Department of Energy (DOE), monitoring the program at SLAC and at the Large Hadron Collider at CERN.

Tim was born on 17 February 1928



TIMOTHY EDWARD TOOHING

in Lawrence, Massachusetts. Following a stint in the US Army Air Corps in 1946–47, Tim entered Boston College. There, despite a long commute from Lawrence, he made time to engage in his emerging religious interests and to participate in the local physics club. He received a BS in physics at Boston College in 1951. In 1953, Tim earned an MS degree from the University of Rochester, where he specialized in optics.

Tim began his formal studies in Roman Catholicism in 1953, becoming a novitiate at Shadowbrook Seminary in Lenox, Massachusetts. In 1957, he enrolled as a graduate student in physics at Johns Hopkins University and simultaneously arranged to continue his religious studies at Woodstock College in Maryland. In due course, Tim became a member of Aihud Pevsner's research team that was engaged in bubble chamber experiments using the Bevatron at the University of California, Berkeley. During his early 1960s stay in Berkeley, Tim also became associated with students and faculty at the Newman Center. His involvement with team members in the physics experiment along with the fellowship he found in the religious community began to set a pattern for the unusual development of Tim's personality and influence, combining his talents as a scientist, a chaplain, a spiritual counselor, and a helpful friend to many.

A group at Berkeley during the early 1960s was beginning to consider a much larger accelerator that might be built in California, and Tim began to spend time on that project. In 1962, he received his PhD in elementary particle physics under the direction of his thesis adviser, Pevsner, from

Johns Hopkins; the title of his thesis was "Existence and Production of Eta and Omega Mesons." His attention returned to his religious studies at Woodstock College; in 1965, he was ordained a Jesuit priest.

Tim then joined the accelerator department at Brookhaven National Laboratory, where he assisted with the design and implementation of the slowly extracted external proton beam. He also joined a newly formed division that was created to assist experimental groups in the use of the Alternating Gradient Synchrotron. Furthermore, in his "spare time," Tim continued to work, as he had at Berkeley, on design studies for a new, higher-energy accelerator. In 1968, construction of that accelerator was authorized at a site near Batavia, Illinois. In 1970, Tim joined that project, becoming a member of the Fermilab experimental areas division.

Soon after Tim's arrival at Fermilab, his style—bringing to life new facilities, usually ahead of schedule and under budget—caught the attention of Director Robert R. Wilson, who promptly assigned him responsibility for the design and construction of the neutrino experimental area. There his work included the design and construction of a complex target and focusing system that produced the world's highest-energy neutrino beam at that time. Tim was an intrepid red-tape cutter and, when necessary, a consummate circumnavigator of burdensome and counterproductive rules. He even found a creative way to get Wilson his desired reflecting ponds by making them part of the Fermilab accelerator's cooling system.

Tim was a major participant in a US–Soviet experiment on the channeling of charged particle beams, a collaboration that started at Fermilab and later moved to Dubna and Serpukhov in Russia. Tim's extended presence in the Soviet Union to work on the experiments was a key factor in a collaboration that constituted a bright spot during the tense years of the cold war. Elements of that collaboration continue at Fermilab to this day.

During the 1970s and early 1980s, experiments at Fermilab and at its European counterpart, CERN, raised questions that could be answered only by creating particle collisions at energies far greater than existing accelerators could provide. In 1987, President Ronald Reagan endorsed an ambitious plan to build the Superconducting Supercollider (SSC), which would provide proton–proton collisions with an energy of 40 TeV,