

## In Remembrance

*(The following article originally appeared in the Wednesday, April 4, 2001, issue of MIT Tech Talk, reprinted here by kind permission.)*

### Nobelist Clifford Shull is dead at 85

Professor Emeritus Clifford G. Shull, co-recipient of the 1994 Nobel Prize in physics, died on March 31 at Lawrence Memorial Hospital in Medford following a brief illness. He was 85 and lived in Lexington.

Professor Shull shared the Nobel Prize with Professor Bertram S. Brockhouse of McMaster University in Ontario. “Clifford G. Shull has helped answer the question of where atoms ‘are,’ and Bertram N. Brockhouse the question of what atoms ‘do,’” the Nobel citation said.

Professor Shull received the prize for his pioneering work in neutron scattering, a technique that reveals where atoms are within a material, like ricocheting bullets reveal where obstacles are in the dark.

When a beam of neutrons is directed at a given material, the neutrons bounce off or are scattered by atoms in the sample being investigated. The neutrons’ directions change depending on the location of the atoms they hit, and a diffraction pattern of the atoms’ positions can then be obtained.

Understanding where atoms are in a material and how they interact with one another is the key to understanding a material’s properties. “Then we can think of how we can make better window glass, better semiconductors, better microphones. All of these things go back to understanding the basic science behind their operation,” Professor Shull, then 79, said on the day of the Nobel announcement.

The Nobel citation noted that thousands of people now work in the field of neutron scattering, using the technology to study ceramic superconductors, the structure of viruses, surfaces of relevance to catalytic exhaust cleaning and more.

University of Toronto President and former MIT Dean of Science Robert J.



Birgeneau said of Professor Shull, “He was one of the leading solid state physicists of the 20th century as well as an outstanding educator. Even after retirement he continued to oversee his famous neutron diffraction experiment at the MIT reactor. Cliff’s death represents a great loss to science, to MIT and to me personally.”

#### PHYSICS PIONEER

Professor Shull’s pioneering work on neutron diffraction began about 50 years before he became a Nobel winner.

He started in 1946 at what is now Oak Ridge National Laboratory. At that time, he said, “Scientists at Oak Ridge were very anxious to find real honest-to-goodness scientific uses for the information and technology that had been developed during the war at Oak Ridge and at other places associated with the wartime Manhattan Project.”

Professor Shull teamed up with the late Ernest Wollan, and for the next nine years they explored ways of using the neutrons produced by nuclear reactors to probe the atomic structure of materials.

He said the most important problem he worked on at the time dealt with determining the positions of hydrogen atoms in materials.

“Hydrogen atoms are ubiquitous in all biological materials and in many other inorganic materials,” Professor Shull once said, “but you couldn’t see them with other techniques. With neutrons it turned out that that was completely different, and we were very pleased and happy to find that we could learn things about hydrogen-containing structures.”

As he refined the scattering technique, Professor Shull studied the fundamental properties of the neutron itself. He also initiated the first neutron diffraction investigations of magnetic materials. This yielded information about the magnetic properties of materials at the atomic level, opening up an entirely new field of study.

“If there is a ‘central clearing house for thermal neutron physics’ or a ‘father of neutron scattering’ in the United States, it is Professor Shull,” wrote Professor Anthony Nunes (PhD 1969), professor of physics at the University of Rhode Island, in a biographical article published in 1986. Professor Shull was Professor Nunes’s thesis advisor at MIT.

In his 1986 article published in *Physica*, Professor Nunes said Professor Shull’s “abilities as an experimental physicist are amplified and extended by his completely candid relations with coworkers” who “find him to be modest to a fault. He is very careful to ‘give credit where credit is due,’ usually citing originators of ideas even in casual conversation.

“I consider the intellectual stimulation, the unending optimism and the

simple scientific fun of my student years with this man to be priceless,” concluded Professor Nunes.

Professor Shull was the fourth member of the MIT physics faculty to receive the Nobel Prize in physics and the 15th present or former faculty member to receive a Nobel Prize. One staff member and 11 alumni also have won Nobels.

He came to MIT as a full professor in 1955 and retired in 1986.

Professor Shull’s awards include the Buckley Prize, which he received from the American Physical Society in 1956, and election to the American Academy of Arts and Sciences (1956) and the National Academy of Sciences (1975). In 1993 he received the Royal Swedish Academy of Sciences’ Gregori Aminoff prize for his “development and application of neutron diffraction methods for studies of atomic and magnetic structures of solids.”

Born in Pittsburgh in 1915, Professor Shull received the BS from Carnegie Institute of Technology (now Carnegie Mellon University) in 1937. He entered Carnegie Tech to study aeronautical engineering, but after six months found himself drawn to physics. He received the PhD from New York University in 1941.

He was a teaching assistant at NYU from 1937-41, a research physicist with the Texas Company (now Texaco) in Beacon, NY, from 1941-46, and a research physicist at Oak Ridge from 1946-55.

His hobbies included stamp collecting, camping, hiking, coin collecting, model trains and golf, said his son, Robert D. Shull (SB 1968).

Professor Shull is survived by his wife of 60 years, Martha-Nuel Summer; three sons, John, Robert and William; and five grandchildren. One grandson, Craig M. Shull, received the SB in mechanical engineering from MIT in 1996. ●