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## Leon Lederman (1922–2018)



Leon Lederman, legendary physicist, educator and Director Emeritus of Fermilab, died peacefully in his sleep on October 3, 2018 in Rexburg, Idaho, USA. He was 96 years old. Lederman is survived by his wife of 37 years, Ellen Carr Lederman, three children from his first marriage and five grandchildren.

Lederman was awarded the 1988 Nobel Prize, along with Mel Schwarz and Jack Steinberger, for discovering that there were two kinds of neutrinos. The experiment was carried out in 1962 at the Brookhaven National Laboratory; it was a key to unlock the structure of the Standard Model of Particle Physics. We now understand that there are three families of quarks and leptons, with a neutrino in each family. In 1977, at Fermilab, Lederman and his team discovered another key component of the Standard Model, the b-quark, one of the two quarks that constitute the third family of quarks and leptons.

Lederman had an uncanny sense for important physics. He got an early start with the discovery of the long-lived K meson using his Wilson cloud chamber at the Nevis synchrotron, proving Murray Gell-Mann's elegant description of the puzzle that K particles presented at the time. He launched key measurements of the anomalous magnetic moment of the muon,  $g-2$ , that created a lineage of experiments extending to today. The latest incarnation of  $g-2$  measurements is being done today at Fermilab to understand whether there is anything beyond the Standard Model. His ability to be at the center of the important questions of the day is not only demonstrated by his own discoveries but by how close he got to others. He did the confirming experiment showing the non-conservation of parity, and he almost discovered the J/Psi particle in a pioneering Brookhaven experiment where the "Lederman shoulder, observed with too coarse a resolution", turned out later to be interpreted as the J/Psi particle. Later, that actual discovery by Sam Ting and Burton Richter led to their Nobel Prize. Lederman's missing the J/psi and

hence the discovery of the charm quark and a second Nobel Prize provided an endless supply of humorous quips for his unmatched storytelling.

In 1979, Lederman was appointed director of Fermilab, succeeding Fermilab's founding director, Robert Wilson. It was a very difficult time for Fermilab, with budgetary problems, relational problems with its federal funding agency and with uncertain plans for the future. Europe with the CERN laboratory was pulling ahead of the United States, aiming for the discovery of the W-boson. Building on Wilson's vision and early R&D on superconducting accelerators, Lederman rallied the laboratory behind the plan to build the Energy Doubler that later would become a 2 TeV collider, the Tevatron. In masterly work with the funding agency and with Congress he secured the funding for the Tevatron during difficult budgetary times. Lederman changed the culture of Fermilab from the Wilsonian quick-and-cheap, cut-all-corners-and-fix-later approach to a more rigorous execution that has served the laboratory well ever since. The resulting program of the Tevatron collider, with the CDF and D0 detectors, defined the energy frontier in the world and became a magnet for huge international collaborations. In 1995, Fermilab was able to announce the discovery of the elusive top quark, the highest-mass particle ever discovered. In another major contribution, Lederman initiated a much tighter connection between the field of particle physics and cosmology, creating at Fermilab one of the strongest groups that link quarks to the cosmos.

In the 1980s, Lederman was a major proponent of moving to much higher energies, a factor of ten to twenty beyond what was possible with the Tevatron. At these energies something new had to happen or something fundamental in our theories would break down. He originally called it the Deserttron because he thought to build a facility of such size would require a vast desert. Subsequently the project became the Superconducting Super-Collider, or SSC. The Higgs particle could be one of the new particles found at those energies, a major discovery finally achieved by the LHC in 2012. Supersymmetry could be another one, not yet shown to exist.

Lederman's support for the SSC did not stop when the decision was made to site the SSC in Waxahachi, Texas, instead of Illinois. Nor did it stop when the SSC was cancelled and the energy frontier moved to the LHC. Today Fermilab is a major collaborator in developing both detectors and accelerators for the LHC.

Lederman's love of learning had roots in his childhood, with a father who "revered learning." His quick-witted humor he attributed to his mother who, he reported, was the funniest one in the family. He was committed to education all his life, not only in formal settings but in his own approach to reach the public. In both New York City and Chicago, already in his eighties, he would set up a booth with a hand sketched sign reading "Ask a Nobel Prize Winning Physicist!" and, with his white mane ruffled by the breeze, proceeded to answer any question a passerby would ask. The most diverse public, of all ages, would gather around to listen, charmed by his easygoing manner. At Fermilab he created Saturday Morning Physics for high school students, the Lederman Science Center to connect with the public and local schools, the Child Care Center to support parents of Fermilab staff, the Summer Institute for Science Teachers to encourage and improve science instruction in high schools and was instrumental in securing public support and funding to create the Illinois Mathematics and Science Academy (IMSA), an innovative publicly-funded residential high school for gifted students. When questioned by politicians on why they should create an elite institution with public funds, Lederman would disarm them with: "would you like everybody to sing opera?"

Lederman ended his tenure as Director of Fermilab in 1989 and became a professor at the University of Chicago and later at the Illinois Institute of Technology. He always stayed connected to the students at IMSA, serving as resident scholar from 1998 to 2012. During my tenure as Director of Fermilab (2005–2013) he was of immense help in connecting me with the multiple communities he had helped forge in his many years at Fermilab.

Piermaria Oddone  
Fermilab Director Emeritus