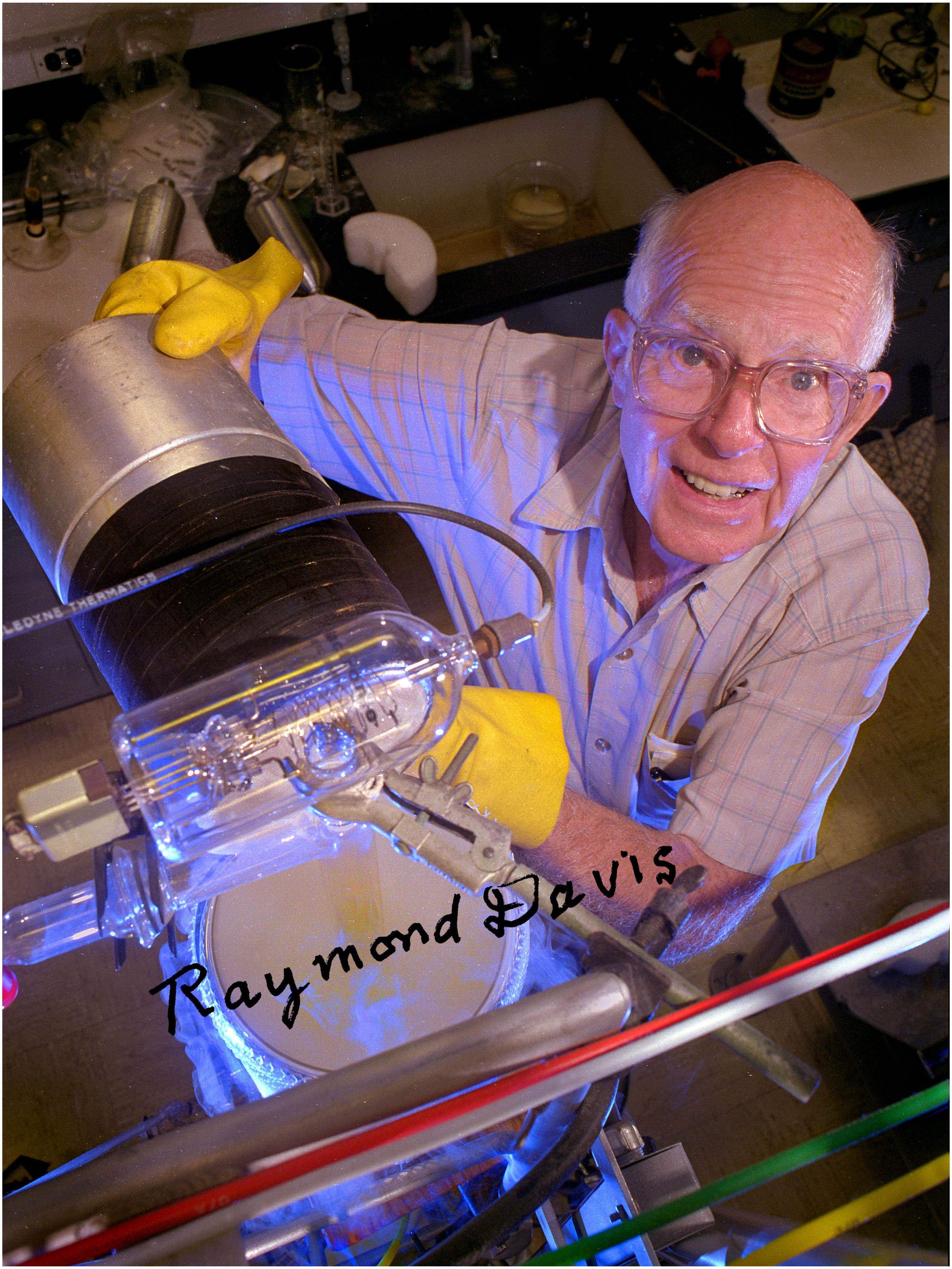
LEDYNE THERMATICS
Raymond Davis

Brookhaven's Ray Davis Awarded 2002 Physics Nobel Prize

Raymond Davis Jr., a retired chemist at the Department of Energy's Brookhaven National Laboratory, has won the Nobel Prize in Physics for detecting solar neutrinos, ghostlike particles produced in the nuclear reactions that power the sun. Davis shares the prize with Masatoshi Koshiba of Japan, and Riccardo Giacconi of the U.S.

In awarding the prize to Davis and Koshiba, the Royal Swedish Academy of Sciences cited both "for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos." Giacconi was cited "for pioneering contributions to astrophysics, which have led to the discovery of cosmic X-ray sources."

The Nobel laureates will be awarded their prizes at a ceremony in Stockholm, Sweden, on December 10. The prize consists of a diploma, a medal and 10 million Swedish kroner (roughly 1 million U.S. dollars) shared among the recipients.

"Neutrinos are fascinating particles, so tiny and fast that they can pass straight through everything, even the earth itself, without even slowing down," said Davis. "When I began my work, I was intrigued by the idea of learning something new. The interesting thing about doing new experiments is that you never know what the answer is going to be!"

Davis was the first scientist to detect solar neutrinos, the signature of nuclear fusion reactions occurring in the core of the sun. Devising a method to detect solar neutrinos based on the theory that the elusive particles produce radioactive argon when they interact with a chlorine nucleus, Davis constructed his first solar neutrino detector in 1961, 2,300 feet below ground in a limestone mine in Ohio. Building on this experience, he mounted a full-scale experiment 4,800 feet underground, in the Homestake Gold Mine in South Dakota. In research that spanned from 1967-1985, Davis consistently found only one-third of the neutrinos that standard theories predicted. His results threw the field of astrophysics into an uproar, and, for nearly three decades, physicists tried to resolve the so-called "solar neutrino puzzle."

Biography

Raymond Davis Jr. earned a 1937 B.S. and 1940 M.S. from the University of Maryland, and a Ph.D. in physical chemistry from Yale University, 1942. After his 1942-46 service in the U.S. Army Air Forces and two years with the Monsanto Chemical Company, he came to Brookhaven National Laboratory in 1948 to join the staff of the Chemistry Department. He received tenure in 1956 and was named senior chemist in 1964. Retiring from the Laboratory in 1984, Davis joined the University of Pennsylvania in 1985, but maintains an active appointment at Brookhaven as a research collaborator in the Chemistry Department.

A member of the National Academy of Sciences and the American Academy of Arts and Sciences, Davis has won numerous scientific awards, including the 1978 Cyrus B. Comstock Prize from the National Academy of Sciences; the 1988 Tom W. Bonner Prize from the American Physical Society; the 1992 W.K.H. Panofsky Prize, also from APS; the 1999 Bruno Pontecorvo Prize from the Joint Institute for Nuclear Research in Dubna, Russia; the 2000 Wolf Prize in Physics, which he shared with Masatoshi Koshiba, University of Tokyo, Japan; the 2002 National Medal of Science; and the Nobel Prize in Physics in 2002 (shared with Masatoshi Koshiba of Japan, and Riccardo Giacconi of the U.S).

From 1971-73, he was a member of the National Aeronautics & Space Administration's Lunar Sample Review Board, and was involved in the analysis of lunar dust and rocks collected by the crew of Apollo 11 on NASA's historic first flight to the moon.

Davis was born in Washington, D.C., on October 14, 1914. He and his wife Anna are residents of Blue Point, New York. They have five grown children.

Solar Neutrino Experiments

Neutrinos are ghostlike particles that were postulated by Wolfgang Pauli in 1930 on purely theoretical grounds and, until recently, were believed to have zero mass. They are thought to be produced in the nuclear reactions that provide the sun's energy. They rain down on each square inch of the earth at the rate of about 400 billion per second.

Raymond Davis Jr. started investigating neutrinos that were produced in Brookhaven's Graphite Research Reactor and at a reactor at the Savannah River Plant in South Carolina, in the 1950s. But these experiments were really the prelude to Davis's major triumph, which came in the early 1970s, when he successfully detected solar neutrinos in a new experiment based in Lead, South Dakota (image at right). See more images of the detector.

A solar neutrino was expected to produce radioactive argon when it interacts with a nucleus of chlorine. Davis developed an experiment based on this idea by placing a 100,000-gallon tank of perchloroethylene, a commonly used dry-cleaning chemical and a good source of chlorine, 4,800 feet underground in the Homestake Gold Mine in South Dakota and developing techniques for quantitatively extracting a few atoms of argon from the tank.

The chlorine target was located deep underground to protect it from cosmic rays. Also, the target had to be big because the probability of chlorine's capturing a neutrino was ten quadrillion times smaller than its capturing a neutron in a nuclear reactor. Despite these odds, Davis's experiment confirmed that the sun produces neutrinos, but only about one-third of the number of neutrinos predicted by theory could be detected.

This so-called "solar neutrino puzzle" gave birth to different experiments by scientists around the world, all working to confirm the solar neutrino deficit. First came Kamiokande in Japan, then SAGE in the former Soviet Union, GALLEX in Italy, and then Super Kamiokande. Finally, in 2001-2002, scientists working at SNO, the Sudbury Neutrino Observatory in Ontario, Canada, found strong evidence that the neutrino has the ability to oscillate, or change form, among its three known types: the electron, muon and tau neutrinos.

BROOKHAVEN
NATIONAL LABORATORY