NEWS from

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SOLAR ENERGY GENERATION THEORY BEING TESTED IN BROOKHAVEN NEUTRINO EXPERIMENT

Upton, L.I., New York, Sept. 14, 1967--A Brookhaven Laboratory team of scientists, headed by Dr. R. Davis, Jr., has gone 4850 feet into the earth to learn more about what is going on deep inside the sun.

Known as the Brookhaven Solar Neutrino Experiment, the effort combines some rather unsophisticated facilities such as a 100,000 gallon tank of cleaning fluid (tetrachloroethylene) in the Homestake Gold Mine in South Dakota and a 12-inch Navy gun barrel at the Brookhaven Laboratory, Upton, Long Island. In combination with some sophisticated instrumentation, the net result is a kind of "telescope" that permits the Brookhaven scientists to look into the heart of the sun.

At the center of the sun, where the temperature is 30 million degrees F, a process known as fusion takes place, producing energy in the form of heat, light and neutrinos. Heat and light are familiar to man, but neutrinos are not. We know they are weightless, they have no electrical charge, and they travel at the speed of light. We also know they have the ability to pass through matter with only a slight chance of being captured or absorbed. Earth is almost as nothing in their path. For example, Dr. Davis and his group calculate that ten billion-billion neutrinos pass through their 20-ft diameter by 48-ft long tank every day, yet they capture only about two neutrinos per day. It is because of these properties that Enrico Fermi coined the name "neutrino" or "little neutral one."

Knowing more about the neutrino will yield more knowledge of what is happening deep in the sun and the processes by which it produces light and heat to to sustain life on our planet. Most of our knowledge of solar neutrinos is based on theory, and not on observation and measurement of neutrino radiation, which the Brookhaven team is doing.

Initial results are reported in a paper, "The Brookhaven Solar Neutrino

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Experiment" being presented in Chicago at the American Chemical Society meeting on September 14. Authors of the paper are Dr. R. Davis, Jr., Dr. D. S. Harmer, K. C. Hoffman, and N. B. Munhofen, all of Brookhaven National Laboratory.

The paper describes the method of neutrino observation and the initial results. The detection of neutrinos in the tank of tetrachloroethylene depends upon the production of the radioactive isotope Argon-37 (half-life 35 days). This happens when a neutrino passing through the tank reacts with an atom of chlorine-37 to produce an atom of Argon-37 plus an electron. (This is the equivalent to a neutrino capture.) The Argon-37 that is produced is then trapped in a special charcoal filter, from which it is removed and returned to Brookhaven where it is detected in a special counter mounted inside a 12-inch thick Navy gun barrel.

For accurate results, it is necessary to reduce the background radiation to as low a level as possible. Hence, the tank was placed deep underground to shield it from cosmic radiation and the counter was mounted in the thick gun barrel, which acts as a shield. Additional precautions, however, are taken to eliminate interferences from unrelated nuclear processes that could also produce Argon-37 in the tank and possibly result in a false neutrino reading.

Various elements, when they decay, are capable of producing neutrinos, but there is a definite energy level for each neutrino, and chemists use this method of identifying the neutrino source. In the Brookhaven experiment, the only neutrinos having enough energy to produce Argon-37 plus an electron from chlorine-37 are those produced in the decay of Boron-8, which is part of the thermonuclear process taking place in the sun.

The theoretical forecast had led scientists to believe that the neutrino emission from the sun would allow from 1.5 to 5 captures per day. In the single experiment performed to date, Dr. Davis reports that the capture rate in the underground tank was less than 2 neutrinos per day. Knowing this plus the efficiency of neutrino capture, allowed Dr. Davis and his group to calculate the flux from the Boron-8 decay to be ~~approximately 60~~ less than 12 million solar neutrinos per square inch per second at the earth's surface. Previous calculations had predicted the flux could be anywhere from 40 million to 150 million solar neutrinos per square inch per second at the earth's surface.

Dr. Davis stressed that this was only the first experimental run, and that additional measurements must be made extending over a period of several years.

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equal to 2 million/cm²/sec.
updated info from R Davis
on 2/2/68

Because of the low rate of neutrino capture, their removal from the tank filter and subsequent analysis at Brookhaven Laboratory can be done only three times per year. The results should provide an experimental test of the present theory of the solar energy generation processes.

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