

UC SANTA BARBARA

# THE *Current*

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## **New Type of Neutrino May Exist Say Scientists**

A collaboration of university scientists and researchers working at Los Alamos Laboratory in New Mexico has published a final result paper that describes controversial research regarding neutrinos.

Neutrinos are particles that rain down and pass through us from the sun and cosmic rays, in numbers of billions per second. They make up a small part of the "dark matter" of the universe.

David Caldwell, research professor of physics, of the University of California, Santa Barbara, who is a member of the group of researchers, said that if these latest results are right "they will shake up a lot of things."

The existence of neutrinos was first postulated 70 years ago by Wolfgang Pauli, and ever since then the physics world has been trying to find and analyze them. This latest experiment, published in the Physical Review, earlier this month, has results requiring a fourth type of neutrino, the sterile neutrino, which, according to Caldwell makes many physicists uncomfortable since it is impossible to detect directly, and very difficult to understand theoretically.

Caldwell explained that the article reports on results of an experiment that ran from 1993-1998. Data were collected from the Los Alamos Neutron Science Center accelerator, an intense source of low energy neutrinos. The Liquid Scintillator

Neutrino Detector (LSND) is a tank viewed by 1220 photo-multipliers and filled with 167 tons of baby oil. In the baby oil is dissolved 14 pounds of an organic scintillator so as to produce two kinds of light by which to identify charged particles produced in the tank by neutrino interactions.

While the three known types of neutrinos (designated electron, mu, and tau) have extremely weak interactions -- in other words it is very rare that they knock into other particles -- the sterile neutrino would have essentially no interactions at all.

Electron neutrinos from the sun do not reach the Earth in the number expected, and it is now rather clear that this is because they change into another type of neutrino. Similarly, observation of mu neutrinos produced in our atmosphere also show conversion or oscillation to another kind of neutrino.

It was first thought that neutrinos must be without mass, but given oscillation, they must have mass, like the electron and unlike photons which are without mass.

Caldwell went on to say that the oscillation observations actually measure the difference in mass between the initial neutrino and the one into which it converts. The problem is that those mass differences are quite different in the three cases: solar, atmospheric, and LSND. With three neutrino masses there can be only two independent mass differences. A fourth neutrino is required, yet other measurements show there can be only three having the normal weak interactions, hence the peculiar sterile neutrino.

Such new phenomena would have an enormous impact on the standard model of particle physics and would have very broad implications for future research in the fields of nuclear physics, high-energy physics, and astrophysics.

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