New Evidence of a Heavy Neutrino

Sometimes you see it; sometimes you don't. The ghostly neutrino has again brought its puzzling vanishing act to center stage.

New experimental data, obtained independently at three laboratories, hint at the existence of a type of neutrino with a mass significantly greater than theorists had anticipated. Yet other research teams conducting similar searches have so far uncovered no such evidence.

Despite this controversial uncertainty in the data, the mere possibility that a subatomic particle with such surprising characteristics may exist has sent tremors racing through the particle physics and astrophysics communities. Theorists are already hard at work studying ways of modifying the "standard model" of particle physics to accommodate a heavy neutrino and exploring how its existence would fit into current models of how the universe evolved to its present state.

"There are many problems in astrophysics having to do with neutrinos," says physicist Eric B. Norman of the Lawrence Berkeley (Calif.) Laboratory. If the heavy neutrino exists, "there must be some new physics involved."

Norman, who heads one of the teams that saw hints of this mysterious particle's existence, described his group's findings this week at a meeting of the American Physical Society in Washington, D.C.

The controversy started in 1985 when John J. Simpson of the University of Guelph in Ontario reported a tiny anomaly in his measurements of the energies of beta particles, or electrons, emitted during the radioactive decay of tritium atoms. He attributed this slight deviation from the expected result to the presence of a subatomic particle — possibly a neutrino — with a mass (expressed in energy units) of 17 kiloelectron-volts (keV). Although small compared with the 511-keV mass of an electron, this was substantially larger than expected for a neutrino.

Nine subsequent experiments by other research groups failed to confirm Simpson's result. But Simpson continued his work, and in 1989 he reported results from two new experiments — one involving tritium and the other the radioactive isotope sulfur-35 — that again pointed to a 17-keV particle.

These findings caught the attention of Norman and his co-workers. In an attempt to settle the question, the California team designed an experiment in which they measured the energy released by beta particles spit out by decaying carbon-14 atoms embedded in a germanium crystal. By housing the carbon-14 beta-particle sources inside the germanium detector, they hoped to get a cleaner, less ambiguous signal than that attainable in experiments in which the source and detector are separated.

To their surprise, the researchers detected an effect remarkably similar to that reported by Simpson. They observed a tiny "kink" in the beta-particle energy spectrum — a deviation invisible to the eye but made apparent by painstaking statistical analysis. "As soon as we had the first month's worth of data, the effect was there," Norman says. And as the data continued to come in, the effect became more evident.

This led to a lengthy search for an explanation. "Like almost everyone, we were extremely skeptical," Norman says. "We examined maybe two dozen possible, conventional explanations for this effect, but none of them could explain it. We [now] believe the effect is real."

Similar results with different equipment and isotopes come from Andrew Hime and N.A. Jelley of the University of Oxford in England and from physicists at the Rudjer Bošković Institute in Zagreb, Yugoslavia. At the same time, researchers at Caltech in Pasadena and other investigators have again failed to detect the anomaly in the beta-particle energy spectrum.

Even the positive reports furnish little information about the identity of the particle causing the apparent kink in the spectrum. If it exists, the particle must be electrically neutral, have a mass of roughly 17 keV and interact weakly with ordinary matter.

One possibility is a heavy neutrino — perhaps even the neutrino thought to be associated with the tau particle, a massive cousin of the electron. Alternatively, the particle may be one unknown to physics. Both of these options present difficulties. Because the existence of a totally new fundamental particle has such serious ramifications, physicists have so far tended to concentrate on the neutrino hypothesis.

The particle itself remains elusive. "We are going to be doing a lot more experiments," Norman says, "and so are others."

— I. Peterson

A little less fat won't cut cancer risk

Small sacrifices to reduce dietary fat — such as leaving the butter off your bread — may be good for your heart but probably won't reduce your risk of colon, breast or prostate cancer, according to the results of a 17-year study of the link between diet and cancer.

Researchers with the Centers for Disease Control (CDC) in Atlanta found no difference in the risk of these three cancers among 13,330 men and women whose diets were analyzed twice between 1971 and 1987 as part of the National Health and Nutrition Examination Study. Colon, breast and prostate cancer proved just as likely to develop in the people with the lowest fat intake as in those who ate higher levels of fat.

"Although it is a good idea to reduce fat intake, ... modest reductions will not appreciably alter the cancer rate for breast, prostate and colon," said study director Tim E. Byers last week at the annual meeting of the Federation of American Societies for Experimental Biology, held in Atlanta.

He points out, however, that individuals with the lowest dietary fat levels in his study still ate more fat than the American Heart Association or National Research Council recommends. All participants consumed between 32 and 38 percent of their total calories in the form of fat; the recommended maximum is 30 percent. The average U.S. diet derives 38 percent of its calories from fat.

Byers says the new findings support animal studies and cancer-rate comparisons among countries with varying levels of fat consumption, which have suggested that people need to slash their fat intake to between 20 and 25 percent of total caloric intake in order to lower their cancer risk. A study of women in northwest Italy, for instance, showed that those who derived less than 30 percent of their calories from fat had half the normal rate of breast cancer for that region (SN: 2/18/89, p.102).

John H. Weisburger, a cancer prevention researcher at the American Health Foundation in Valhalla, N.Y., adds that Byers' report dovetails with his own findings in animals. "It has been our experience that if the lowest fat intake was not lower than 30 percent, you wouldn't see a decrease [in cancer rates]," he told SCIENCE NEWS.

A diet of 20 percent fat, says Byers, would feature large portions of fruits and vegetables, virtually no cooking fat, and only small servings of extremely lean meat. But he urges people not to abandon attempts to trim their fat intake if they find they can't stick to such spartan fare. In the battle against heart disease and obesity, he stresses, modest fat reductions still pay off.

— C. Ezzell

Science Service, Inc. is collaborating with JSTOR to digitize, preserve, and extend access to *Science News*. www.jstor.org