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FERMILAB COMPLETES PUZZLE OF UNIVERSE

10-YEAR PURSUIT OF TAU NEUTRINO

By Ronald Kotulak
Tribune Staff Writer
July 21, 2000

Like finding in your grandmother's crowded attic a mysterious toy that your mother had told you enticing stories about, physicists at Fermilab have discovered evidence of a long-suspected elementary particle that helps confirm their view of the universe.

The particle, called the tau neutrino, is the last remaining particle to be documented among a family of six leptons that includes the familiar electron, the particle that makes electricity and chemistry possible.

The discovery, which took 10 years to achieve, is scheduled to be announced Friday at a conference at Fermilab, 30 miles west of Chicago. The collaboration included 54 physicists from the United States, Japan, Korea and Greece.

"The tau neutrino has been the missing piece for many years, and until recently we couldn't figure out any way to look for it," said Fermilab physicist Gina Rameika, who participated in the particle hunt. "This confirms our view of the Standard Model and that it is right on target."

The Standard Model is an attempt to account for everything we know in the universe, from matter to energy. It says that matter comes in the form of six quarks and six leptons, which combine to make up people, planets and galaxies. In addition there are particles for each of the four forces: gravity, weak

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and strong nuclear forces, and electromagnetism.

Physicists previously found evidence for all of the particles of matter except the tau neutrino.

"This completes the picture of the subatomic constituents of matter," said physicist Phil Yager of the University of California, Davis. "It's really important to see that this thing does in fact exist and that it behaves the way we expected it to."

It is unlikely that discovery of the tau neutrino will lead to any practical benefits soon, but the manner in which it was found can be employed to explore a new world of physics that scientists now believe lurks beyond the Standard Model.

One of the things they will be looking for is whether neutrinos have mass. The Standard Model says no. But there is some suspicion that they might have an infinitesimally small amount of mass. If so, such a discovery could solve one of the mysteries of cosmology, the question of what keeps galaxies from spinning apart.

Neutrinos flood the universe, so if they have some mass they could account for the gravity that holds galaxies together. But it would also mean that the Standard Model would have to be revised to accommodate the mass of neutrinos.

Every second millions of neutrinos pass through our bodies without making contact with any of the atoms that make up our flesh and bones. Only rarely does a neutrino strike something and leave a brief trail.

Using Fermilab's powerful Tevatron particle accelerator, physicists fired beams of neutrinos into a 3-foot-thick target of iron plates. One out of 1 million million tau neutrinos interacted with an iron nucleus, broke up and produced a different type of lepton, called the tau, which left a measurable track.

"We finally have direct evidence that the tau neutrino is one of the building blocks of nature and that it reacts with other particles in accordance with our current scientific theory of particle interactions," said Byron Lundberg, spokesman for the Direct Observation of the Nu Tau (DONUT) experiment.

Although other experiments had provided indirect evidence of the tau neutrino, this is the first to provide direct evidence. Four direct observations of the tau neutrino have been made. The findings will also be reported next week at the 30th International Conference of High Energy Physics in Osaka, Japan.

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