Long wait for neutrino pays off for physicists

Subatomic unit is important in confirming particle theory

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Twenty years of patience will be rewarded today when an international team of physicists announces the first observations of an elusive subatomic particle long considered a basic building block of nature.

The particle, called the tau neutrino, is the last of three neutrinos to be detected.

The neutrinos are an integral part of the so-called Standard Model of particle physics, which is a theoretical description of the building blocks of the universe and the interactions between these subatomic bricks.

Physicist Vittorio Paolone was already a leader of the experiment conducted at the Fermi National Accelerator Laboratory outside Chicago when he joined the University of Pittsburgh in 1997.

Online neutrino chart

The team included more than 50 scientists from the United States, Japan, Korea and Greece.

Paolone, who could not be reached for comment yesterday, will be attending a symposium at Fermilab this afternoon to discuss results that will have scientists breathing a collective sigh of relief.

"It was driving people crazy for 20 years," said Neville W. Reay, a senior scientist with the project and a distinguished professor of physics at Kansas State University.

"Suppose you tried really, really hard and you didn’t see it? Then a lot of the accepted theory would be in some difficulty."

Neutrinos are very difficult to produce and detect.

They pass through objects as massive as the Earth without leaving a trace because they don’t possess an electrical charge and exert only the weakest of forces on other objects.

"According to the latest theory of the universe, going through you right now are billions and trillions of neutrinos," Reay said. "But they don't bother you because they don't interact."

Despite such indifferent natures, electron neutrinos were discovered in 1952 and muon neutrinos in 1962. But tau neutrinos remained elusive.

Their existence was suggested in 1978 when researchers at Stanford University found a charged particle called a tau lepton, which is produced by a tau neutrino.

In 1997, the Fermilab team generated an intense beam of neutrinos, which theoretically had to include trillions of the tau variety.

The beam was passed through plates coated with an emulsion that recorded particle interactions.

"Once you produce a beam of these particles, you have a very small chance that one of them -- hopefully a couple -- is going to interact with your detector," said Eugene Engels, an emeritus professor of physics at the University of Pittsburgh.

He discussed the experiment with Paolone, but he did not participate in the experiments.

The Fermilab scientists said that about one out of 1 million million tau neutrinos interacted with the nucleus of an iron atom to produce a tau lepton, which left a track 1 millimeter long in the emulsion.

A tau lepton's lifespan is about 1 trillionth of second.

Just as shrapnel veers into different paths from the trajectory of the whole bullet, the decay of the tau lepton produces a kink in the trail recorded in the emulsion, Engels explained.

After a hunt of several years, the physicists found four such kinked tracks, indicating that many neutrinos had interacted with iron nuclei in the experiment.

This particular discovery completes one important picture of the way matter is constituted," Engels said.

"To physicists and to scientists in general, this is extremely important."

Now, scientists can better investigate any departures from the Standard Model.

If something doesn't fit that theory, it could open up new concepts in physics.

Engels said that his colleague Paolone will next try to find out if neutrinos have mass.

An answer to that controversial question could have a profound impact on the understanding of cosmology.