## Science Headlines

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# Missing Link in Nature's Building Blocks Found

By Rachel Brand

CHICAGO (Reuters) - Scientists announced on Friday that they found the first direct evidence of a missing link in the basic building blocks of nature by using the world's most powerful particle accelerator.

The link, called the tau neutrino, is one of a family of 12 elementary particles believed to be the most fundamental, or simple and structureless, objects on earth.

''This is one of the two missing particles in the Standard Model of physics. It brings us to a completion,'' Ken Heller, University of Minnesota physics professor said. Scientists consider the other particle, the Higgs, a linchpin in the model.

While the discovery has no obvious practical implications, advances in particle physics apply to materials science and computer software engineering research.

An international team of 54 physicists from the United States, Japan, South Korea and Greece collaborated on the 10-year experiment, using the world's most powerful particle accelerator, Fermilab's Tevatron located in suburban Chicago.

The scientists shot a beam containing what they hoped were tau neutrinos at a three-foot thick block of iron sandwiched with layers of photographic emulsion.

Of one trillion tau neutrinos beamed, one interacted with an iron nucleus and produced a tau lepton, leaving a millimeter-long tell-tale track in the emulsion.

Three years of painstaking research was required to confirm that the tau neutrino caused the track. This confirmed the tau neutrino's existence as the last missing member of the 12 elemental particles known as nature's building blocks.

While confirming the widely-held Standard Model theory of elementary particles that describes what the universe is made of, the discovery also sparks some questions.

The Standard Model says that all matter consists of six leptons and six quarks. Thought to be 100 million times smaller than an atom, if they have mass at all, these particles form the stuff of mountains, galaxies and molecules.

Perhaps best known of the leptons is the electron, whose charge forms the basis of electronics.

The Standard Model says that when some leptons decay, they transform into other particles: quarks and a neutrino. By carefully analyzing the tau lepton's decay in radioactive matter, physicists in the past theorized that the tau neutrino must exist.

But tau neutrinos have been hard to detect because they produce no electric charge and pass through the universe almost without a trace.

There has been a lot of indirect evidence that the tau neutrino existed but never before has its existence been proven, Professor Heller said.

Scientists said the next step is to determine if the tau neutrino has mass. If so, the discovery would link tau neutrinos to the dark matter, or matter between stars, in the galaxy but contradict parts of the Standard Model.

''It would not be a big change, but rather an extension of the model,'' Heller explains.

It might also explain to astrophysicists and astronomers why galaxies do not spin apart.

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