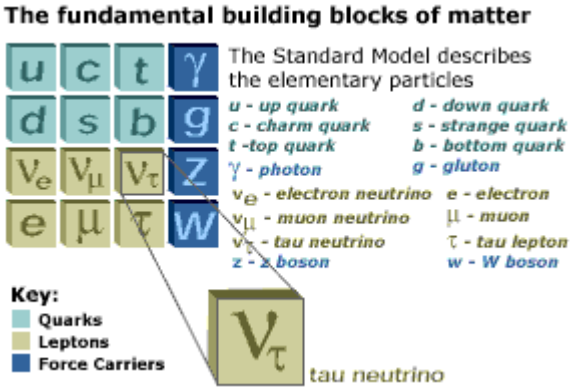
Thursday, 20 July, 2000, 20:44 GMT 21:44 UK

Science finds particle perfection



By BBC News Online science editor Dr David Whitehouse

Physicists have found the particle that completes our understanding of the fundamental building blocks of the Universe.

It is a ghostly particle called the tau neutrino. Its discovery will be announced on Friday by scientists at the US Fermilab Tevatron particle accelerator near Chicago.

According to the so-called Standard Model of particles, the tau neutrino completes our inventory of what everything is made of at the sub-atomic level.


Byron Lundberg next to the Donut detector: It was a tough experiment

For this landmark discovery the scientists who found it could well be awarded a Nobel Prize in a few years time.

"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 of the Direct Observation of the Nu

See also:

20 Jul 00 | Sci/Tech
Neutrinos fired through Earth's crust

05 Jun 98 | Sci/Tech
Ghostly particles rule the universe

30 Apr 98 | Sci/Tech
Getting to the heart of the matter

Internet links:

Donut; Direct Observation of the Nu tau

Fermilab

The Standard Model

The story of the neutrino

The BBC is not responsible for the content of external internet sites

Other top Sci/Tech stories:

Science finds particle perfection

Greenland's coastal ice thins fast

Cable TV proves fatal for possums

A 10 billion billion billion megaton bomb in space

'Slinky' magnetic loops seen on Sun

Tau (Donut) experiment, a collaboration of 54 physicists from the United States, Japan, Korea and Greece.

"It is one thing to think that there are tau neutrinos out there. But to really look for the rare incidence of a tau neutrino hitting an atomic nucleus and transforming into a tau lepton is a hard experiment to do."

Track with a kink

In 1997, Fermilab's Tevatron accelerator produced an intense neutrino beam which passed through the Donut experiment. In the target, one out of one million, million tau neutrinos interacted with an iron nucleus and produced a tau lepton, which left its one mm tell-tale signature.

Physicists say that the evidence for the tau neutrino is slight but convincing. They needed three years to identify it by detecting a tau lepton particle and its decay, the key to exposing the tau neutrino's secret existence.

> **Finding the tau neutrino is very important and very exciting**
>
> **Martin Perl, 1995 Nobel Prize winner**

"The tau lepton leaves a track, just as light leaves a mark on photographic film, but in three dimensions," explained Vittorio Paolone from the University of Pittsburgh. "The main signature of a tau lepton is a track with a kink, indicating the decay of the tau lepton shortly after its creation."

Bryon Lundberg added: "It was the proverbial needle in a haystack. The experiment recorded over six million potential interactions. By analysing signals from various components of the 15-metre- (50ft-) long detector, they discarded all but 1,000 candidate events. Of these, four events provided evidence for the tau neutrino.

With the tau's detection, matter's construction set is complete. The building blocks of the Universe consist of:

- **six quarks** - known as up, down, strange, charm, top, and bottom;
- **six leptons** - electron, electron neutrino, muon, muon neutrino, tau, and the newly discovered tau neutrino.

Other sub-atomic particles, such as the

Chicken health 'at risk'

Scientists 'locate' intelligence

When the web is not world-wide

Links to top Sci/Tech stories are at the foot of the page.

anti-matter counterparts of the quarks and leptons, the force-carrying particles called bosons (such as photons), and the Higgs Boson (which gives mass to some of the other particles) also appear in the Standard Model. However, the Higgs particle is not essential to the theory.

If others are impressed by the detail of the announcement, then the Donut scientists can, in time, expect high rewards.


The Tevatron: It has taken three years to track down the particle

The detection of the electron neutrino by Clyde Cowan and Frederick Reines gave Reines the 1995 Nobel Prize for physics. The discovery of the muon neutrino gave Leon Lederman, Melvin Schwartz, and Jack Steinberger the Nobel Prize in 1988.

Of this latest discovery Leon Lederman said: "The direct confirmation of the tau neutrino is an important and long-awaited result. Important because there is a huge effort underway to study the connections among neutrinos, and long awaited because the tau lepton was discovered 25 years ago, and it is high time the other shoe was dropped."

Stanford University physicist Martin Perl, winner of the 1995 Nobel Prize for discovering the tau lepton, said: "Finding the tau neutrino is very important and very exciting."

Although physicists expected to find the particle someday, the actual detection is a highly significant discovery and completes an important stage in our understanding of what everything around is made.

However, this not the final explanation of the way nature has constructed the cosmos. Scientists speculate that there might be so-called "supersymmetric" particles. If found, these would be accepted by the Standard Model but would not strictly be a part of it.

Links to other Sci/Tech stories

In This Section GO

^^ Back to top

News Front Page | World | UK | UK Politics | Business | Sci/Tech | Health | Education | Entertainment | In-Depth | Talking Point | Audio/Video

>To BBC Sport