The New York Times **Science** July 1, 2003

A Subatomic Discovery Emerges From Experiments in Japan

By KENNETH CHANG

Slamming high-energy particles of light into carbon atoms, physicists have unexpectedly produced a new type of subatomic particle.

Protons and neutrons, the building blocks of atoms, are made of smaller particles known as quarks, which come in six varieties. A proton, for example, consists of three quarks — two so-called up quarks and one down quark. Physicists know of slews of particles containing two or three quarks.

Now they believe they know of a particle containing five quarks that perhaps could have been common in the very early universe. (No one has yet conclusively found particles with four or six or more quarks.)

The experiments, performed at the Spring-8 laboratory in Osaka, Japan, three years ago, were intended to examine two-quark particles known as mesons. At a conference in Australia, a Russian theoretical physicist, Dr. Dimitri Diakonov, approached the director of the experiments, Dr. Takashi Nakano, of the Research Center for Nuclear Physics at Osaka University, and told Dr. Nakano that he should look through the data for signs of five-quark particles.

"Dimitri Diakonov was very confident of that," Dr. Nakano said. Dr. Nakano and his collaborators looked, and they found a peak in their graphs corresponding to the mass of the five-quark particle that Dr. Diakonov had predicted. "He was right," Dr. Nakano said. "Actually, I was very surprised."

Dr. Kenneth H. Hicks, a professor of physics at Ohio University and another member of the Spring-8 collaboration, said that even with the data matching the prediction, he did not believe it.

"There's been a general bias in the community against this particle existing," Dr. Hicks said.

When months of checking the apparatus produced no alternative explanation, the scientists concluded that they had indeed found a five-quark particle. The particle would consist of two up quarks, two down quarks and one known as an anti-strange quark.

The findings will be reported Friday in the journal Physical Review Letters.

Dr. Hicks and other researchers then reviewed data from similar experiments at the Thomas Jefferson National Accelerator Facility in Newport News, Va., and again found the same signs of a five-quark particle. Physicists in Russia have also found similar evidence.

The basic theory of how quarks behave, known as quantum chromodynamics, or Q.C.D., does not prohibit five-quark particles, but no one had seen any in three decades of searching, so physicists

wondered if their theory was incomplete.

"It immediately removes a worry that there might be something missing from Q.C.D. that forbids things," said Dr. Andrew Sandorfi of the Brookhaven National Laboratory on Long Island, who was not involved in any of the experiments. "It's not overwhelming proof yet, but it's highly suggestive."

Future experiments are needed to determine other properties of the particle and to rule out the possibility that the data resulted from some other effect.

Dr. Hicks said the new particles could potentially affect theories of the very early universe or even exist in the cores of some stars. "Does that have any dramatic effect?" he said. "I don't know. No one's paid any attention, because in 30 years, no one's seen them."

RELATED ARTICLES

- Elusive Particles Continue to Puzzle Theorists of the Sun, (June 9, 1998) $
- Finances Worry Neutrino Researchers, (June 6, 1998) $
- Mass Found in Elusive Particle; Universe May Never Be the Same, (June 5, 1998) $
- Neutrino Hunters Cast Nets Far and Deep, (December 3, 1996) $

Find more results for Japan and Physics .

TOP SCIENCE ARTICLES

- The Mystery of Itch, the Joy of Scratch
- Few Habitats, Many Species and a Debate on Preservation
- Vaccination Graduates to an Older Crowd
- Monkey See, Monkey Speak: Facial Expressions as a Guide to Speech
- Under the Arctic Ice, a Seabed Yields Some Fiery Secrets