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Wednesday, March 24, 2004

DISCOVERY AT BROOKHAVEN LAB: A subatomic sensation

In a finding that could rewrite physics theory, LI scientists see particles acting in unpredictable ways

BY EARL LANE
WASHINGTON BUREAU

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WASHINGTON - Talk about patience. For 14 years, starting in 1988, physicists at Brookhaven National Laboratory searched painstakingly for evidence of an extremely rare decay mode of a fleeting subatomic particle called the K meson.

We're talking needle-in- a-haystack rare. Yesterday, the team reported it had identified just the third example of the rare decay in some 7.8 trillion K meson events produced by a particle accelerator at the lab. The first rare decay was reported in 1997, the second in 2002.

The latest event was identified in data taken in 2002. It has taken the team until now to find the event in the stored data and verify it.

K mesons are elusive particles that exist for only 12 billionths of a second before decaying. While only three of the rare decays have been found, the results are intriguing to physicists and may hint at the possibility of some "new physics," as the theorists like to say.

Under a theory called the Standard Model that predicts how subatomic particles behave, "We are only entitled to one event," instead of three, said Brookhaven's Steven Kettell, a spokesman for the team.

Researchers will need more examples before they can say there is a discrepancy with the theory. If the pattern were to hold up, Kettell said, it would be a sign the theory needs

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the pattern were to hold up, Kettell said, it would be a sign the theory needs revision with the likely addition of new particles and interactions in the subatomic zoo.

The Department of Energy, which funds Brookhaven Lab, did not provide money for the experiment beyond 2002 and it stopped that year. The physics team has been seeking at least $3.7 million a year for three years from the National Science Foundation to resume the experiment, Kettell said.

There are complementary studies under way elsewhere involving another, heavier variety called the B meson. Theorist Yuval Grossman of Technion University in Israel said it is important to have results from both types of experiments. Were the Brookhaven experiment to eventually find 30 events where only 10 were predicted, he said, "that would be a clear sensation." Such definitive results, he said, would require new particles and interactions to explain them. A possibility, he said, would be a theory called supersymmetry, which posits a partner for every particle of matter and every carrier of force. It says, for example, that quarks, building blocks of the nucleus, should have equivalents called squarks; photons, carriers of the electromagnetic force, should have photinos.

The Brookhaven team used a sophisticated detector the size of a house to sort through subatomic debris for the rare events in which a K meson decayed into another particle called a pi meson and a pair of neutrinos.

While it may seem surprising that just a few events can lead to new frontiers, Grossman noted the work at Brookhaven in the early 1960s in which physicists, in a few dozen events involving K mesons, found a flaw in the central belief that the universe is completely symmetrical, and won the Nobel Prize in 1980.