

The New York Times

April 18, 2006

FINDINGS

A Real Flip-Flopper, at 3 Trillion Times a Second

By [DENNIS OVERBYE](#)

Have trouble making up your mind?

Physicists at the Fermi National Accelerator Laboratory reported what would seem to set a new standard for vacillation last week: a subatomic particle that reverses identity three trillion times a second, switching into its upside-down mirror-image evil-twin antimatter opposite and then back again.

The measurement of this yin-yang dance was a triumph for Fermilab's Tevatron, which smashes together trillion-volt protons and antiprotons to create fireballs of primordial energy, and for the so-called Standard Model, a suite of theories that explains all that is known to date about elementary particles and their interactions.

"This finding is only the beginning of many more exciting scientific discoveries," said I. Joseph Kroll, a physicist at the University of Pennsylvania.

Dr. Kroll was part of the 700-member multinational team known as the Collider Detector Facility collaboration that did the definitive analysis, confirming an earlier estimate by a rival Fermilab group, the DZero collaboration.

The indecisive particle, known as a strange neutral B meson, is composed of a pair of smaller particles called quarks, which come in six different whimsically

named types or "flavors." The meson contains a so-called bottom quark and a strange anti-quark, but the rules of quantum and quark physics allow quarks to change flavors. As a result the meson can flip over to its antiparticle, a strange quark and a bottom anti-quark.

Physicists hope that studying such behavior in this and other particles may help them understand why the universe is overwhelmingly matter and not antimatter, as well as gain a clue to whatever deeper theory may underlie the Standard Model, which leaves out gravity, among other things.

And there is the rub. As with many weird things in modern physics, the problem with the bipolar particle is why it is not even weirder. According to some versions of a popular theory known as supersymmetry, the meson should be oscillating even more rapidly than it does.

Physicists are a bit frustrated that their results keep agreeing with the Standard Model and so far show no hint of supersymmetry.

Lisa Randall, a [Harvard](#) theorist not involved in the experiments, said: "We don't know what it means. It might mean that supersymmetry is not there, or that it is at higher energies than we think. Or it may be that we are on the wrong track altogether."

Young-Kee Kim of the University of Chicago, a spokeswoman for the Collider Detector Facility collaboration, said, "Our real hope was for something bizarre." Nature is tough, she said, but physicists are pretty tough, too. "We keep fighting," Dr. Kim said.