A 'Golden Channel' for New Physics

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A group of physicists has dubbed a particular particle decay, the decay of the Bs meson into a neutral kaon and neutral antikaon, as a “golden channel” for new physics, suggesting that probing and studying the decay could lead to brand-new insight into the physics laws that govern the tiniest bits of matter. The scientists discuss their ideas, and how this decay could be studied in the future, in the January 25, 2008, edition of *Physical Review Letters*.

The group states that the BS decay may open a rare window to a physics concept called CP symmetry, where C stands for charge (i.e. negative, positive, or neutral) and P for parity. Parity is a mathematical characteristic of a particle that, in effect, gives the particle a “handedness.” For example, when I look in the mirror and raise my right hand, my reflection raises her left. Although we are otherwise essentially identical, we have different handedness. Thus, parity is one way to distinguish between very, very similar particles.

In the context of the “big picture,” talking about CP symmetry really means talking about the symmetry of matter and antimatter in the universe, or, rather, the lack thereof. That is, after the Big Bang, equal amounts of matter and antimatter should have been produced. But scientists' observations of certain galaxies show that they appear to contain much more matter than antimatter. Therefore, after the Big Bang, something happened that caused the imbalance.

This big-picture scenario of CP violation can be probed on the smallest scale by studying certain particle decays, those in which a quark changes

from one variety, or “flavor,” to another. There are six quark flavors: up, down, charm, strange, top, and bottom (also known as beauty).

“In particular, the bottom-to-strange transition is among the most sensitive probes of new physics,” said the paper's lead author, physicist Marco Ciuchini, to *PhysOrg.com*. Ciuchini works at Roma Tre University in Rome, Italy, and is also affiliated with Italy's National Institute for Nuclear Physics (INFN).

Ciuchini and his colleagues suggest that this rare BS decay, which involves a bottom-to-strange transition, could be studied at the Large Hadron Collider, the world's largest particle “smasher,” located near Geneva, Switzerland. One experiment at LHC will be LHCb, the Large Hadron Collider beauty project, designed to make precise measurements of CP violation and study rare particle decays.

Another facility where these transitions could be studied is the Super B Factory, a proposed experiment at KEK, the High Energy Accelerator Research Organization in Tsukuba, Japan. KEK houses two high-energy particle accelerators; the Super B project (recently renamed KEKB) may end up as an upgrade to the existing facility rather than new construction. Regardless, according to Ciuchini and his co-authors, such a facility, whether new or an upgrade, “would play a very important role” in probing new physics via bottom-to-strange transitions.

Another “super B” experiment that may be built is a joint Europe-U.S. project called SuperB, which would be a new facility to be built, possibly, in Italy. SuperB is currently being considered by the INFN.

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