— WRITING SAMPLE —
(trades reporting)
Stephen X. Arthur, technical writer 2005
www.transcanfilm.com/stephenarthur

NEWS BRIEF

Measuring the Lamb Shift with muonium

A man-made atom reveals the fabric of the universe.

The theory of quantum electrodynamics unites the two fundamental theories of relativity and quantum mechanics to explain electromagnetism, one of the four forces of nature. Recently, an experiment in Vancouver at the Tri-University Meson Facility (TRIUMF) confirmed one of that theory's most amazing predictions—that empty space is not, in fact, empty.

Imagine that the universe is composed entirely of fields, like the familiar magnetic field, one field for each type of elementary particle, or quanta. The quanta themselves can be thought of as ripples on the sea of these fields. Because of the fundamentally chancy nature of quantum mechanics, pairs of quanta, such as an electron and an anti-electron (positron), may spontaneously appear out of nothing, disappearing an instant later—a brief ripple in the vacuum. Seemingly empty space may be teeming with these "virtual quanta."

These virtual quanta should be "felt" within the empty spaces of atoms, causing a measurable difference—called a Lamb Shift—in the energy of electron orbits. Until now, however, it's been too hard to measure the Lamb Shift accurately, even in the simplest atom, hydrogen.

To solve this problem, physicists at TRIUMF have created a new type of atom, *muonium*, composed of an electron orbiting a positive muon instead of a proton. A muon, like an electron only heavier, is a point—it has no size, and so calculations and measurements can be made with precision.

To perform the experiment, the powerful proton beam of the TRIUMF cyclotron hits a target, creating short-lived pions, which spontaneously decay into sizeless muons and neutrinos. The positive muons can then be shot into another target where they pick up electrons. There, for a fraction of a second, muonium atoms are created. Using a radio-frequency technique, the Lamb Shift is precisely measured in these artificial atoms. So far, the measurements match closely the value predicted by quantum electrodynamics, and support the idea of an "unstable vacuum."

This theory of the vacuum met with resistance until Carlo Rubia built the anti-matter collider that applied energy to the vacuum to "bump out" new quanta that had been predicted but never before detected—the heralded W and Z gluons responsible for the weak nuclear force.

This idea also suggests a tongue-in-cheek answer to the question of how the universe itself may have been created out of nothing. "Nothing" is unstable, so if you wait long enough... you're bound to get something.