Physics failure could mean success

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It might sound like a bit of a surprise, but a handful of scientists participating in the $4-billion international experiment to discover the Higgs boson, the Holy Grail of particle physics, hope the effort fails. The Large Hadron Collider (LHC) under construction at the European Centre for Nuclear Research (CERN) in Switzerland becomes operational in 2007 and will be the world's most powerful particle accelerator. If the Higgs boson exists, it will be detected at the LHC, says Dr. James Pinfold, a University of Alberta physics professor who is leading an international team of scientists in a separate experiment at CERN.

At present, the Higgs boson, a particle that would explain why objects have mass, exists only according to the so-called Standard Model, a theory of particle physics that purports to explain everything we see around us.

But some physicists believe the LHC will disprove the Standard Model, providing evidence supporting a theory known as super symmetry, or SUSY, which predicts the existence of five different types of Higgs bosons.

"We expect to see the Standard Model Higgs boson and/or some new physics. If we don't see the Higgs boson, then the Standard Model is wrong. Either way, the LHC guarantees a discovery," said Pinfold. "We are really building this to see all kinds of new physics. The last mystery of the Standard Model must be revealed or else the Standard Model is overthrown."

Pinfold himself suspects the Standard Model is wrong and is a leading member of the ATLAS (A Toroidal LHC Apparatus) collaboration that hopes to discover the evidence for a deeper underlying theory. He is also heading up another international experiment at the LHC to help prove the point. Pinfold and his team are searching for an elusive, almost mythical, particle called a magnetic monopole.

A monopole is a particle with a single magnetic charge. It has either a north or a south pole but not both.

"It is probably of more import than the Higgs particle," said Pinfold. "If it were found it would be even more revolutionary than the discovery of the Higgs particle."

A monopole would have "amazing properties," said Pinfold, not the least of which is the ability to be accelerated to extremely high energies in very short distances, making large particle acceleration rings at facilities like LHC, and Fermilab, in the U.S., obsolete. "You could go one kilometer and achieve10 times the energy of CERN."

Pinfold’s experiment, known as MOEDAL (monopole and exotic object detector at the large hadron), is remarkably simple and inexpensive. Canadian universities are contributing $400 million to the LHC's ATLAS detector unit, while MOEDAL's cost is a paltry $200,000.

“The experiment 'parasites' off the LHC-b experiment – one of the big four LHC experiments – in that it will utilize the same collision point,” Pinfold said. In the experiment, Pinfold and his team will place a specially designed plastic ball around the intersection where particles collide at the LHC. If monopoles form as a result of the collisions, they will pass through the ball, leaving unique scars as evidence of their existence. There will be no doubt about what particles left their mark.

Because of its unique properties, the monopole would ionize 4,700 times more than other particles, and leave a distinct trail. "It would be kind of hard to miss it," he said. "There is no known particle that can mimic it. It will be very clear."

Other researchers have come up with tantalizing results when searching for the monopole. During the early 1980s, researchers at Stanford University detected a charge which they felt could only be explained by a passing monopole; a couple of years later the same finding was made by researchers at Imperial College University in the UK. Several modern theories, the Standard Model excluded, suggest different types of monopoles must exist. One explanation for their rarity is inflation of the universe. As the universe expands, the theories suggest, monopole density becomes very much smaller and thus monopoles would be more difficult to find.

If a monopole is detected, it would open new, uncharted territory in physics. Monopoles as described in the Grand Unified Theory (GUT), for example, would alter our understanding of particle physics forever. They would also be capable of something no one today believes possible: causing the decay of a proton. At present, protons are believed immutable – their estimated lifetime is greater than 10 to the power of 31 (10,000,000,000,000,000,000,000,000,000,000) years – older than the universe itself.

"A GUT monopole would cause all kinds of disruptions to atoms, transmute them and cause protons to decay," Pinfold said. "The discovery of a monopole would be a revolution which wouldn't only affect high level physics, but would even affect basic physics and our good old Physics 101 textbooks."

Source: University of Alberta (By Richard Cairney)