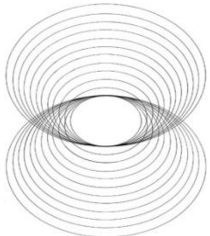
KINEMATICS

Unit 4 & 5, Dr. John P. Cise, Professor Of Physics, Austin Community College, 1212 Rio Grande St., Austin Tx. , 78701 jpcise@austincc.edu **& New York Times September 12, 2008 by Dr. Brian Greene**

THREE hundred feet below the outskirts of Geneva lies part of a ***17-mile-long tubular track(actually 26.659 km),*** circling its way across the French border and back again, whose interior is so pristine and whose nearly 10,000 surrounding magnets so frigid, that it's one of the emptiest and coldest regions of space in the solar system.



See the Large Hadron Collider in this youtube.com video:
http://www.youtube.com/watch?v=RXR-jkrsvg

The track is part of the Large Hadron Collider, a technological marvel built by physicists and engineers, and described alternatively as heralding the next revolution in our understanding of the universe or, less felicitously, as a doomsday machine that may destroy the planet.

After more than a decade of development and construction, involving thousands of scientists from dozens of countries at a cost of some $8 billion, the "on" switch for the collider was thrown this week. So what can we expect?

The collider's workings are straightforward: at full power, trillions of protons will be injected into the otherwise empty track ***and set racing in opposite directions at speeds exceeding 99.999999 percent of the speed of light — fast enough so* that every second *the protons will cycle the entire track more than 11,000*(actually 11.2455 X 10^3) times *and engage in more than half a billion head-on collisions.*** The raison d'être for creating this microscopic maelstrom derives from Einstein's famous formula, E = mc2, which declares that much like euros and dollars, energy ("E") and matter or mass ("m") are convertible currencies (with "c" — the speed of light — specifying the fixed conversion rate). By accelerating the protons to fantastically high speeds, their collisions provide a momentary reservoir of tremendous energy, which can then quickly convert to a broad spectrum of other particles. It is through such energy-matter conversion that physicists hope to create particles that would have been commonplace just after the big bang, but which for the most part have long since disintegrated.

Here's a brief roundup of the sort of long-lost particles the collisions might produce and the mysteries they may help unravel.

Higgs Particles

One of the mysteries that continues to stump physicists is ***the origin of mass***. We can measure with fantastic accuracy the mass of an electron, a quark and most every other particle***, but where does mass itself come from?***

More than 40 years ago, a number of researchers, including ***Peter Higgs, an English physicist, suggested an answer***: perhaps space is pervaded by a field, much like the electromagnetic fields generated by cellphones and radio broadcasts, that acts like invisible molasses. ***When we push something in the effort to make it move faster, the Higgs molasses would exert a drag force — and it's this resistance, as the Higgs theory goes, that we commonly call the object's mass.*** Scientists have incorporated this idea as a centerpiece of the so-called standard model — a refined mathematical edifice, viewed by many as the crowning achievement of particle physics, that since the 1970s has described the behavior of nature's basic constituents with unprecedented accuracy. The one component of the standard model that remains ***stubbornly unconfirmed is the very notion of the Higgs' "molasses" field.*** However, ***collisions at the Large Hadron Collider should be able to chip off little chunks of the ubiquitous Higgs field (if it exists), creating what are known as Higgs bosons or Higgs particles. If these particles are found, the standard model, more than a quarter-century after its articulation, will finally be complete.***

Question: With the data at the top of this article show that these protons do indeed travel "just" under the speed of light 3.0 X 10^8 m/s? Hint: Be sure to use the "actual" data and not the approximations given in the article. Answer: 2.997937845 X 10^2 m/s