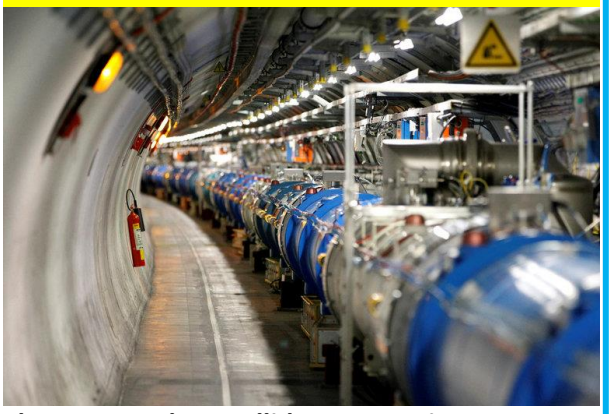
RELATAVISTIC ENERGY AT 0.99999999 c

Unit 10 & 11 Dr. John P. Cise, Prof. of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu & NYTimes , 8/6/16, Dennis Overbye

---

The Particle That Wasn't



The Large Hadron Collider at CERN in 2014.

INTRODUCTION: Total relativistic energy ($m c^2$) = $[m_o/(1 - V^2/c^2)]\ c^2$ Where m_o = rest mass of proton = 1.67 X 10^{-27} kg.. In the large hadron collider the speed of protons achieved (as stated in the article V = 0.99 C) is actually V = 0.99999999 C. The speed of light C = 3 X 10^8 m/s.

QUESTIONS: (a) Compute the relativistic energy of a proton moving at V = 0.99999999 C? The solution will come out in units of Joules. (b) Convert answer (a) in Joules to electron volts(ev)?

HINTS: Carry out computation to eight significant figures, especially when squaring V at 0.99999999 C. Also, when converting Joules to electron volts (ev) use 1.60217622 X 10^{-19} Joules/ev. Terra ev = 10^{12}

ANSWERS: (a) 106.27 X 10^{-8} J, (b) 6.63 X 10^{12} ev = 6.63 Tev (terra ev)
Comment: Article below states the protons have total energy 6.5 Tev

A great "might have been" for the universe, or at least for the people who study **it, disappeared Friday.**

Last December, two teams of physicists working at CERN's Large Hadron Colliderreported that (((*they might have seen traces of what could be a new fundamental constituent of nature*))), an elementary particle that is not part of the Standard Model that has ruled particle physics for the last half-century. A bump on a graph signaling excess pairs of gamma rays was **most likely a statistical fluke**, they said. But physicists have been holding their breath ever since. Looking for the Higgs Particle was the longest, most costly manhunt in science for an elusive particle that was said to be key to the workings of the universe. By Jeffery DelViscio, Catherine Spangler and Soo-Jeong Kang on Publish DateMarch 4, 2013. Photo by Denis Balibouse/Reuters.Watch in Times Video »

The non-result has further deepened an already deep mystery about the famous Higgs boson, which explains why other particles have mass, and whose discovery resulted in showers of champagne and Nobel Prizes four years ago.

The Higgs, one of the heaviest elementary particles known, weighs about 125 billion electron volts, in the units of mass and energy favored by particle physicists

The Large Hadron Collider is expected to run for another 20 years. So, these could still be exciting times.

The CERN collider was built at a cost of some $10 billion, to speed protons around an 18-mile underground track at more than **(((99 percent of the speed of light,(actually V = 0.99999999 c))))** and smash them together with a combined energy of 14 trillion electron volts, in search of new particles and forces of nature. The more energy they can pour into these collisions, microscopic samples of primordial fire, by virtue of Einstein's equivalence of mass and energy, the more massive particles can come out of them. Since last spring, after a two-year shutdown, CERN physicists have been running their collider at nearly its full energy, 13 trillion electron volts, or 13 TeV. This is due to two protons having a head on collision traveling at **V = 0.99999999 c (c = speed of light = 3.0 X 10^8 m./s.). Thus each proton has about 6.5 Tev (10^{12}).**

FURTHER COMMENT: total relativistic energy = rest mass energy + classic kinetic energy

$$m C^2 = m_o C^2 + K$$

$$[1/(1 - V^2/C^2)^{1/2}]\ m_o C^2 = m_o C^2 + K$$

So, when moving close to the speed of light C, the kinetic energy is not just ½ m v^2 , but much much more….

$$K = m C^2 - m_o V^2 \quad \text{where} \quad m = m_o/(1 - V^2/C^2)^{1/2}$$