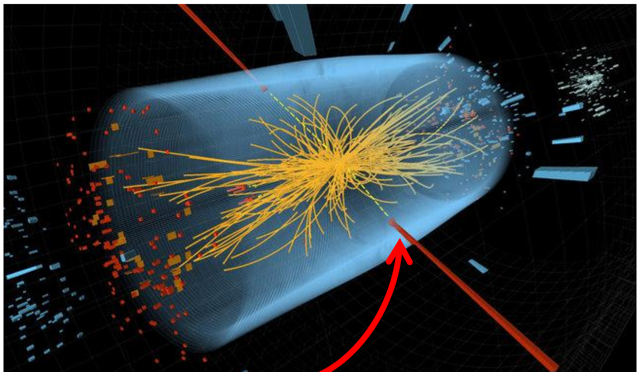
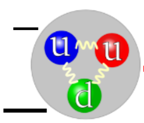
ENERGY

Unit 10 & 11 Dr. John P. Cise,Professor of Physics, Austin Community College, 1212 Rio Grande St.,Austin, Tx. 78701 jpcise@austincc.edu & NYTimes Dec. 13, 2011 by Dennis Overbye. Send Dr. Cise an e-mail on how used.

Physicists will have to keep holding their breath a while longer.



An illustration of photons, provided by the Compact Muon Solenoid team of researchers.



Proton moving at v = 0.999999991 c
In Large Hadron Collider(LHC)
$c = 3.0 \times 10^8$ m/s
Protons are made up of 2 up quarks and 1 down quark. Up quarks have +2/3 charge and down quarks have -1/3 charge. Thus, the total charge of proton is 2(2/3)-1/3 = 1+ charge

INTRODUCTION: Protons have a rest mass(m) of 1.672176×10^{-27} kg., Speed of light $c = 3 \times 10^8$ m/s, 1.602×10^{-19} J/ev , relativistic kinetic energy = $KE = mc^2/(1 - v^2/c^2)^{1/2} - mc^2$

QUESTION: Show that protons moving at 0.999999991 c have ~ 7 Tev as stated below?

HINT: 7 tev = 7×10^{12} ev

Two teams of scientists sifting debris from high-energy proton collisions in the Large Hadron Collider at CERN, the European Organization for Nuclear Research outside Geneva, said Tuesday that they had recorded tantalizing hints — but only hints — of a long-sought subatomic particle known as the Higgs boson, whose existence is a key to explaining why there is mass in the universe. By next summer, they said, they will have enough data to say finally whether the elusive particle really exists. If it does, its mass must lie within the range of 115 billion to 127 billion electron volts, according to the new measurements. The putative particle would weigh in at about 126 billion electron volts, about 126 times heavier than a proton and 250,000 times heavier than an electron, reported one army of 3,000 physicists, known as Atlas, for the name of their particle detector. In 1967 Dr. Weinberg(Prof. of Physics, U of Texas at Austin) made the Higgs boson a centerpiece of an effort to unify two of the four forces of nature, electromagnetism and the nuclear "weak" force, and explain why the carriers of electromagnetism — photons — are massless but the carriers of the weak force — the W and Z bosons — are about 100 times as massive as protons. Unfortunately, the model does not say how heavy the Higgs boson itself — the quantum personification of this field — should be. And so physicists have had to search for it the old-fashioned train-wreck way, by smashing subatomic particles together to see what materializes. **The Large Hadron Collider accelerates protons to energies of 7 trillion electron volts** around an 18-mile underground racetrack and then crashes them together. If these crashes have indeed put the Higgs on the horizon of discovery, the news comes in the nick of time. Over the course of the last few years, searches at the CERN collider and the now-defunct Tevatron at the Fermi National Accelerator Laboratory in Batavia, Ill., have come to the verge of ruling the Higgs out. Perhaps it won't come to that. Reached in Austin, Dr. Weinberg, who shared the Nobel for coming up with the theory of electroweak unification with Sheldon Glashow, of Boston University, and Abdus Salam, of Pakistan, said: "It's always a little weird when something that comes out of the mathematics in theoretical work turns out to exist in the real world. You asked me earlier if it's exciting. Sure is."