PHYSQ 208, Devoir 3 - mardi 2 octobre 2018

42. Prove that for a timelike interval, two events can never be considered to occur simultaneously.

44. Given two events, (x_1, t_1) and (x_2, t_2), use a spacetime diagram to find the speed of a frame of reference in which the two events occur simultaneously. What values may Δs^2 have in this case?

60. A particle initially has a speed of $0.5c$. At what speed does its momentum increase by (a) 1%, (b) 10%, (c) 100%?

66. The Tevatron accelerator at the Fermi National Accelerator Laboratory (Fermilab) outside Chicago boosts protons to 1 TeV (1000 GeV) in five stages (the numbers given in parentheses represent the total kinetic energy at the end of each stage): Cockcroft-Walton (750 keV), Linac (400 MeV), Booster (8 GeV), Main ring or injector (150 GeV), and finally the Tevatron itself (1 TeV). What is the speed of the proton at the end of each stage?

[Prenez la masse du proton égale à 938 MeV/c^2.]

84. The reaction $^2\text{H} + {}^2\text{H} \rightarrow n + {}^3\text{He}$ (where n is a neutron) is one of the reactions useful for producing energy through nuclear fusion. (a) Assume the deuterium nuclei (^{2}H) are at rest and use the atomic mass units of the masses in Appendix 8 to calculate the mass-energy imbalance in this reaction. (Note: You can use atomic masses for this calculation, because the electron masses cancel out.) This amount of energy is given up when this nuclear reaction occurs. (b) What percentage of the initial rest energy is given up?

[Prenez $m(^2\text{H}) = 2.014102$ u, $m_n = 1.008665$ u et $m(^3\text{He}) = 3.016029$ u]