PHYSQ 208, Devoir 4 - mardi 9 octobre 2018

26. A mechanism on Earth used to shoot down geosynchronous satellites that house laser-based weapons is finally perfected and propels golf balls at $0.94c$. (Geosynchronous satellites are placed 3.58×10^4 km above the surface of the Earth.) (a) What is the distance from the Earth to the satellite, as measured by a detector placed inside the golf ball? (b) How much time will it take the golf ball to make the journey to the satellite in the Earth's frame? How much time will it take in the golf ball's frame?

98. The International Space Federation constructs a new spaceship that can travel at a speed of $0.995c$. Mary, the astronaut, boards the spaceship to travel to Barnard's star, which is the second nearest star to our solar system after Alpha Centauri and is 5.98 lightyears away. After reaching Barnard's star, the spaceship travels slowly around the star system for three years doing research before returning back to Earth. (a) How much time does her journey take? (b) How much older is her twin Frank than Mary when she returns?

81. The Large Hadron Collider at Europe's CERN facility is designed to produce 7.0 TeV (that is, 7.0×10^{12} eV) protons. Calculate the speed, momentum, and total energy of the protons.

82. What is the kinetic energy of (a) an electron having a momentum of 40 GeV/c? (b) a proton having a momentum of 40 GeV/c?

96. A high-speed K^0 meson is traveling at a speed of $0.90c$ when it decays into a π^+ and a π^- meson. What are the greatest and least speeds that the mesons may have?