Physics 6/6P The Character of Physical Law Fall 2005

Assignment 5

Special and General Relativity

Readings

Kogut ---------- Chapter 6: Relativistic Dynamics

Ellis/Williams - Chapter 3.7-3.8: Relativistic Dynamics

Appendix B3: 4-Vectors

Boccio --------- High Energy Notes

Problem Assignments

Everyone Problem Assignments(hand in at start of seminar)

Kogut 6.14 Light sails

Kogut 6.20 Particles stick together

Kogut 6.24 Proton-antiproton collision

Ellis B9 4-momentum

EP 8 Red or Green?

EP 10 Proton-Proton Collision

Individual Problem Assignments

Ellis 3.25 Create a new particle _____

Ellis 3.28 Properties of the Sun _____

Ellis B8 4-momentum _____

Ellis B11 Momentum and energy together _____

Ellis B12 4-momenta _____

Ellis B14 Threshold energy _____

Kogut 6.1 How long? _____

Kogut 6.5 Transform the energy _____

Kogut 6.17 K-meson decay _____

Kogut 6.23 Pion decay _____

Kogut 6.28 K-meson decay _____

Kogut 6.30 Threshold energy _____

Kogut 6.31 Positron annihilation _____

EP 9 Center of Mass Frame _____

EP 11 In the other rest frame ... _____

EP-8 Red or Green?

There is a spaceship shuttle service from the earth to Mars. Each spaceship is equipped with two identical lights, one at the front and one at the rear. The spaceships normally travel at a speed v_0, relative to the earth, such that the headlight of a spaceship approaching the earth appears to be green ($\lambda = 5 \times 10^{-7} m$) and the taillight of a departing spaceship appears to be red ($\lambda = 6 \times 10^{-7} m$).

(a) What is the value of v_0?

(b) One spaceship accelerates to overtake the spaceship ahead of it. At what speed must the overtaking spaceship travel (relative to the earth) so that the taillight($\lambda = 6 \times 10^{-7} m$) of the Mars-bound spaceship ahead of it looks like a headlight ($\lambda = 5 \times 10^{-7} m$)?

EP-9 In the laboratory frame a particle of rest mass m_0 and a speed v is moving towards a particle of rest mass m_0 that is at rest. What is the speed of the inertial frame in which the total momentum of the system is zero? This frame is called the **center of mass** or **zero momentum** frame.

EP-10 A proton with a kinetic energy of $10^{10} eV$ collides with a proton at rest. Find

(a) the velocity of the center of mass
(b) the total momentum and total energy in the laboratory frame
(c) the kinetic energy of the particles in center of mass frame

EP-11 Two particles of rest mass m_0 approach each other with equal and opposite velocity v in the laboratory frame. What is the **total energy** of one particle as measured in the rest frame of the other?