

**Assignment #4****Readings:**

- Moore - Chapter 8
- Moore - Chapter 9

**Supplemental**

- Boccio - Relativity 5 - P6
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**Summary:** This week we continue to use the Lorentz transformation equations and their representation on spacetime diagrams.

We will spend some time working with the velocity addition formula

Finally we will discuss the causal structure of spacetime and light cones and introduce 4-vectors.

**Everyone Problems:**

- M8-7 Trip to the Past
- M8-12 Velocity Transformation
- M9-5 Four-momentum to velocity and mass
- M9-7 Four-momentum to velocity and mass
- M9-9 Velocity and mass to four-momentum
- EP-11 Red or Green?

**Individual Problems:**

- M8-2 Relativistic Detective Work
- M8-8 Spacelike or Timelike
- M8-11 Velocity Transformation
- M8-13 Train Wreck
- M8-18 Velocity Transformation
- M9-6 Four-momentum to velocity and mass
- M9-8 Velocity and mass to four-momentum
- M9-10 Letter bomb
- EP-12 What is the frequency?

**Presentations:**

- (1) Timelike, spacelike and light cones
- (2) The Einstein velocity transformation
- (3) The headlight effect
- (4) Properties of 4-vectors; 4-momentum

**Seminar Break:****Extra Problems:****EP-11 Red or Green?**

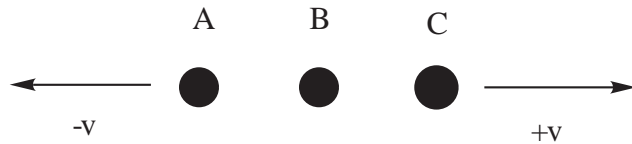
There is a spaceship shuttle service from the earth to Mars. Each spaceship is equipped with two identical lights, one at the front and one at the rear. The spaceships normally travel at a speed  $v_0$ , relative to the earth, such that the headlight of a spaceship approaching the earth appears to be 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  $\nu_0$ ?

(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-12 What is the frequency?**

Three identical radio transmitters A, B, and C, each transmitting at the frequency  $\nu_0$  in its own rest frame, are in motion as shown below:



(a) What is the frequency of B's signal as received by C?

(b) What is the frequency of A's signal as received by C?