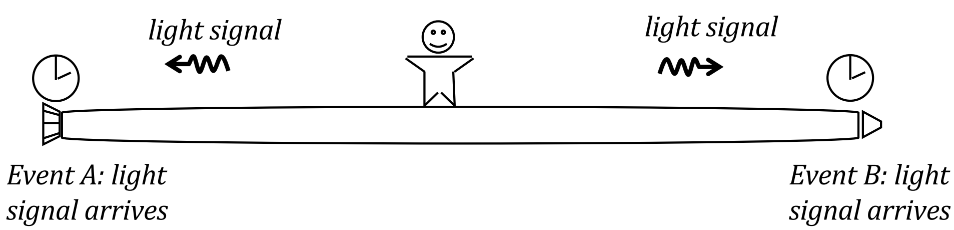
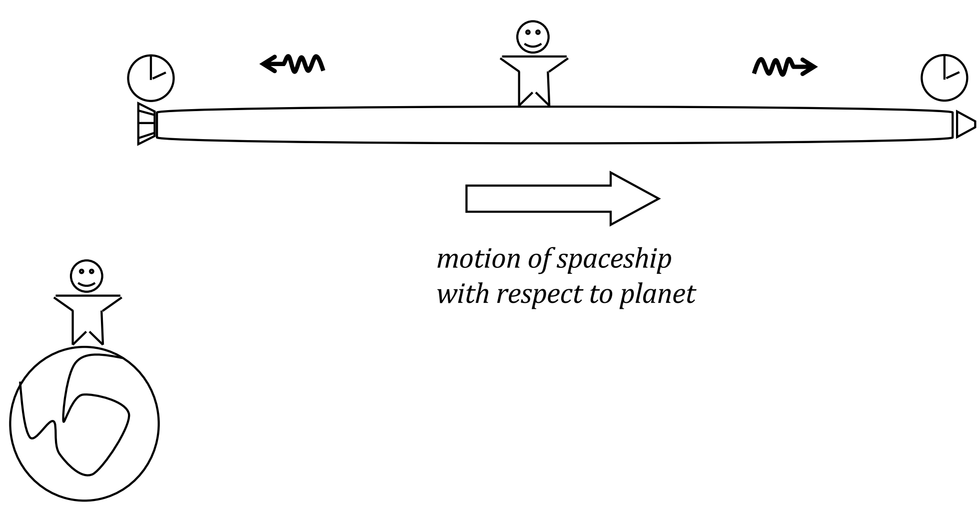
Assignment #2

1. Suppose the length of each arm of a Michelson interferometer is $10m$, and let $v/c = 10^{-4}$.
   (a) What is the maximum difference in times of travel for two light signals traveling along the arms?
   (b) What is the corresponding maximum difference in path lengths for the two light signals? (*i.e.*, How far does light travel during the time calculated in (a)?)
   (c) If the light signals have wavelengths of $5 \times 10^{-7}m$, how many fringe shifts should we expect to observe?

2. An observer is at the midpoint of a spaceship. At the same instant she sends light signals to both front and rear of the spaceship. Event A is the arrival of the signal at the rear; event B is the arrival of the signal at the front.
   (a) Are the two events A and B simultaneous according to the spaceship observer?
   (b) Imagine there are two clocks located at the front and the rear of the spaceship and the arrival of the signals is used to reset each clock to the same time. Are the clocks now properly synchronized according to the spaceship observer?



   (c) The spaceship is moving rapidly in the direction of its length past a planet. An observer on the planet watches the signaling procedure described above. Does the planet observer judge events A and B to be simultaneous? If not, which happens first?
   (d) Does the planet observer judge the two clocks to be set in proper synchrony? If not, which is set ahead of the other?



3. A light signal flashes back and forth between the two ends of the same spaceship. If the light postulate is to hold for the spaceship observer, then the spaceship observer must see light travel at the same speed in all directions. That is, according to the spaceship observer, the signal must take the same time to travel from front to back as from back to front. Assume this transit time is one minute. Then the arrival times of the light signal must be registered as 12:00, 12:02, 12:04, ..., *etc*., at the rear of the ship and 12:01, 12:03, 12:05, ..., *etc*., at the front.

   (a) Assume the light postulate also holds for the planet observer. Will the planet observer see the transit time for the forward trip of the light signal to be the same as the transit time for the backward trip? If not, which is longer?

   (b) How can the planet observer reconcile the answer to 2a) with the readings on the clocks of the moving spaceship that record the transit times for the light signal? (<u>*Hint*</u>: Recall questions 2b and 2d.)