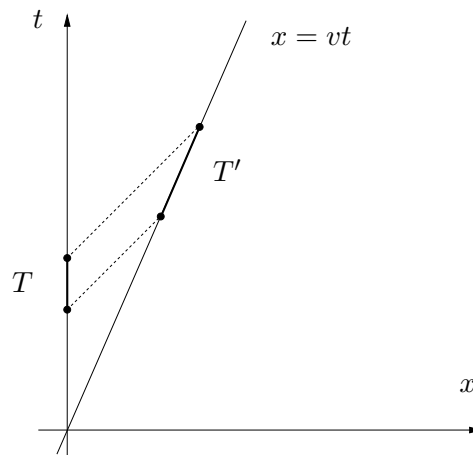


Geometric Mechanics

Homework 11

Due on December 7

- Twin paradox:** Twins Alice and Bob part on their 20th anniversary: while Alice stays on the Earth (which is approximately an inertial frame), Bob leaves at 80% of the speed of light towards Planet X, 8 light-years away from the Earth, which he therefore reaches 10 years later (as measured in the Earth's frame). After a short stay, Bob returns to the Earth, again at 80% of the speed of light. Consequently, Alice is 40 years old when they meet again.
 - How old is Bob at this meeting?
 - How do you explain the asymmetry in the twin's ages? Notice that, from Bob's point of view, he is the one who is stationary, while the the Earth moves away and back again!
 - Imagine that each twin has a very powerful telescope. What does each of them **see**? In particular, how much time elapses for each of them as they see their twin experiencing one year?



- Doppler effect:** Use the spacetime diagram in the figure to show that an observer moving with velocity v away from a source of light of period T measures the period to be

$$T' = T \sqrt{\frac{1+v}{1-v}}.$$