Riding the Train

You're on a long train back to Richmond from fall break. You're in the last car in the train and you get up to get a drink from the club car. The speed of the train is $\vec{v}_t$. Your speed walking up the middle of the train is $\vec{v}_p$. What is your velocity?

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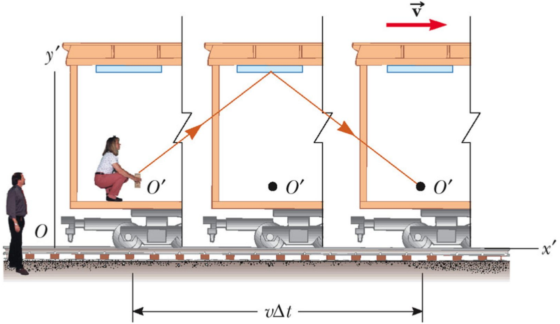
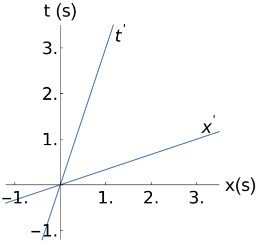


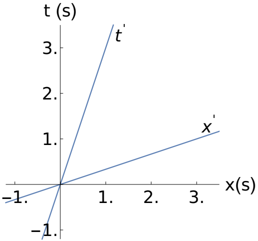
Galilean Transformations
$x' = x - vt$
$y' = y$
$z' = z$
$t' = t$
$v'_x = v_x - v_O$
$v'_y = v_y$
$v'_z = v_z$

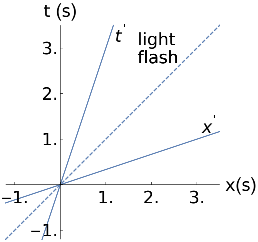
Star Trek!! 4

A large armada of Federation spaceships moves with a speed $0.95c$ away from the nearby Kronos system. A scout ship launched from the trailing ship in the armada moves at a speed $0.7c$ relative to its mother ship towards the front of the fleet. The scout ship's speed is measured relative to the fleet. What is the speed of the scout ship as measured on Kronos?

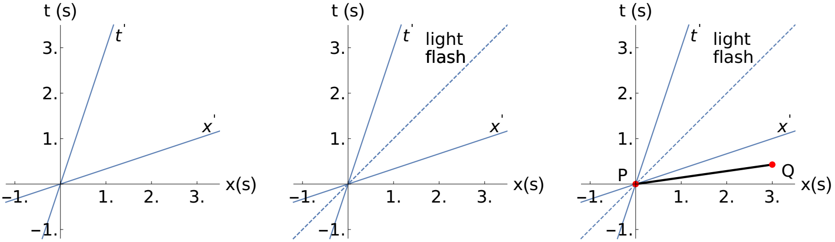

SPEED
LIMIT
C
670,616,629
MPH

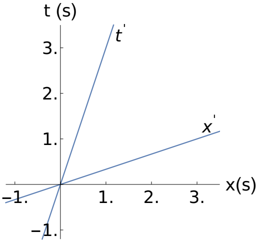

t (s)
t'
3.
2.
1.
x'
x(s)
−1.
1.
2.
3.
−1.


t (s)
t'
x'
x(s)
3.
2.
1.
–1.
1.
2.
3.
–1.

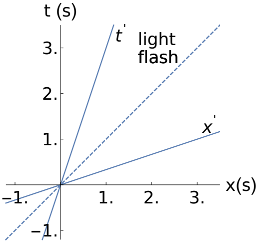

t (s)
t'
light
flash
x'
x(s)
3.
2.
1.
–1.
1.
2.
3.
–1.

Stop! In the name of Einstein!

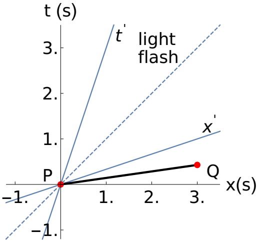




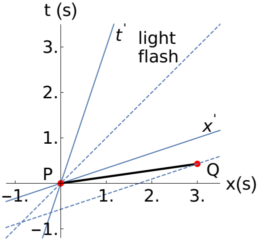
t (s)
t'
x'
x(s)



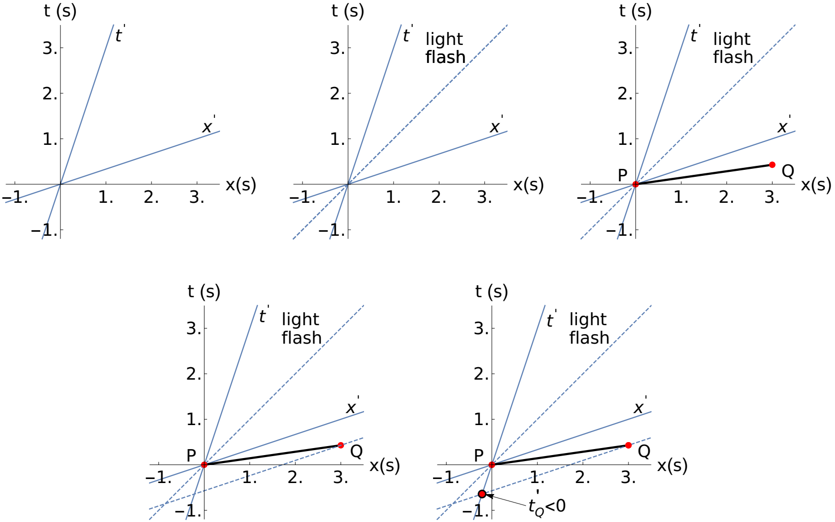
t (s)
t'
light flash
x'
x(s)



t (s)
t'
light flash
x'
P
Q
x(s)

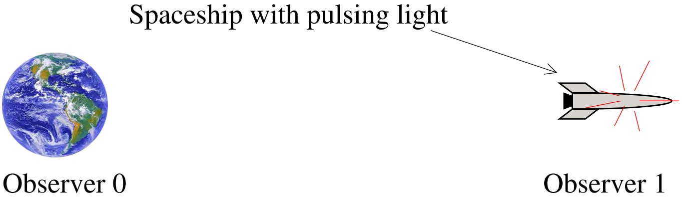


t (s)
t'
light flash
x'
P
Q
x(s)


t (s)
t'
light
flash
x'
P
Q
x(s)
3.
2.
1.
–1.
1.
2.
3.
$t'_Q<0$

The Universal Speed Limit (Part 1)

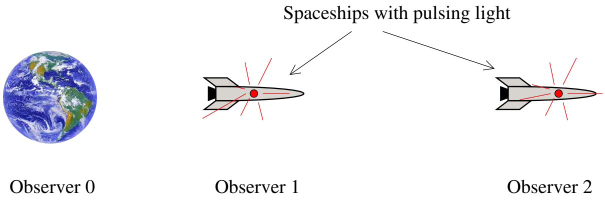
A spaceship (Observer 1 in the figure) is moving away from an Earth-bound observer (0) at a high speed v_0 as measured by Observer 0. It emits a periodic light pulse the observer on the Earth (0) detects. The time between pulses measured by Observer 1 is Δt_1. The time between pulses measured by Observer 0 is Δt_0. How is Δt_0 related to Δt_1?



Two spaceships (1 and 2 in the figure) are moving away from an Earth-bound observer (0) at different speeds. The fast, lead ship (2) emits a periodic light pulse the observer on the second, slow ship (1) receives and immediately relays to Earth (0). The speeds and time intervals are defined below.

v_0: speed of 1 from 0	Δt_0: time interval on 0
v_1: speed of 2 from 1	Δt_1: time interval on 1
	Δt_2: time interval on 2
v_2: speed of 2 from 0	

1. How is Δt_0 related to Δt_1?
2. How is Δt_1 related to Δt_2?
3. How is Δt_0 related to Δt_2?
4. What is v_2 in terms of v_0 and v_1?



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