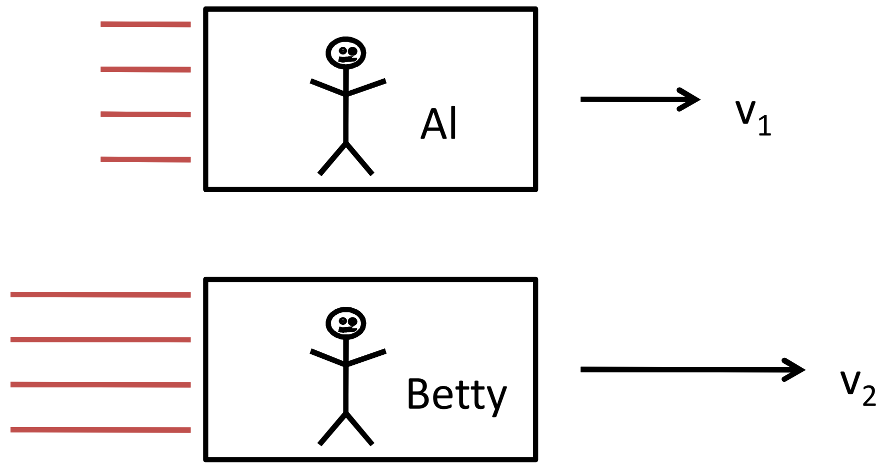
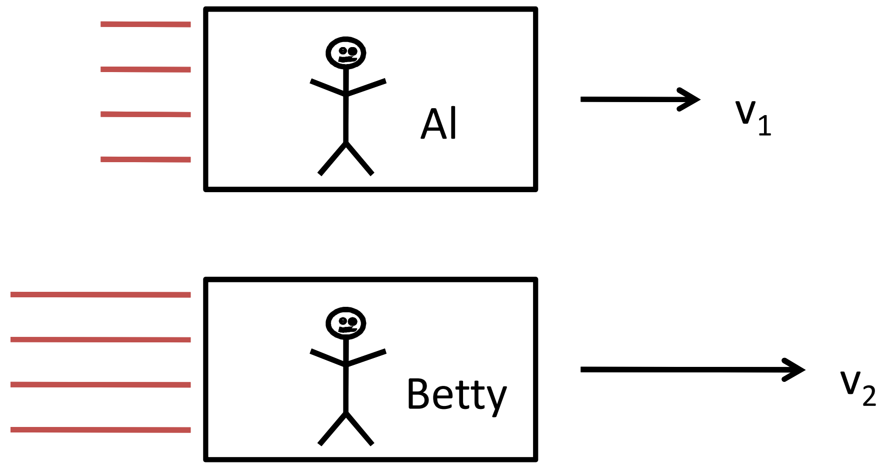


Al and Betty are hurtling through space on windowless spacecraft. Is there an experiment each of them can perform within their ships that would indicate that Betty is travelling faster (i.e. it would give a larger result for Betty than for Al)?

A) Yes
B) No

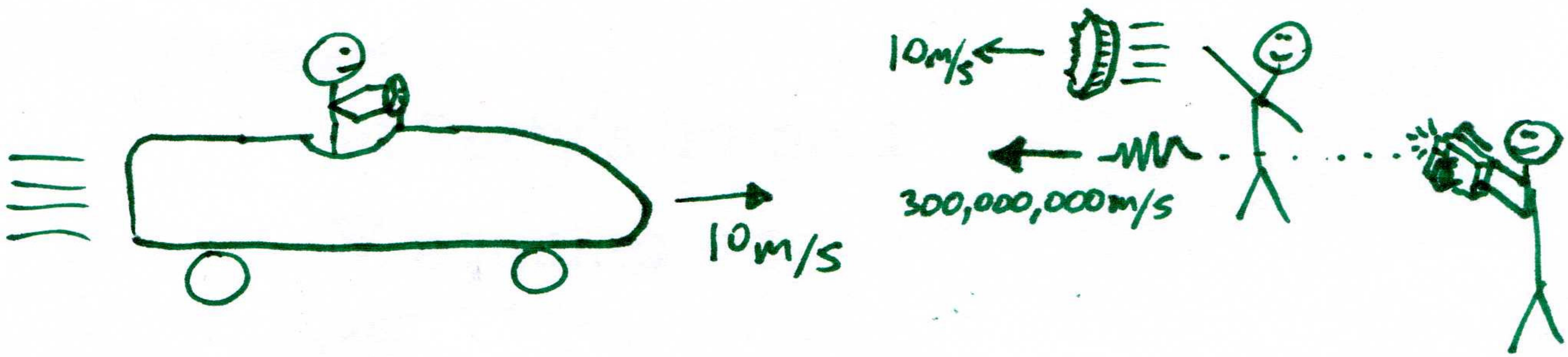
Be prepared to explain your answer.



Al and Betty are hurtling through space on windowless spacecraft. Is there an experiment each of them can perform within their ships that would indicate that Betty is travelling faster (i.e. it would give a larger result for Betty than for Al)?

A) Yes
B) No

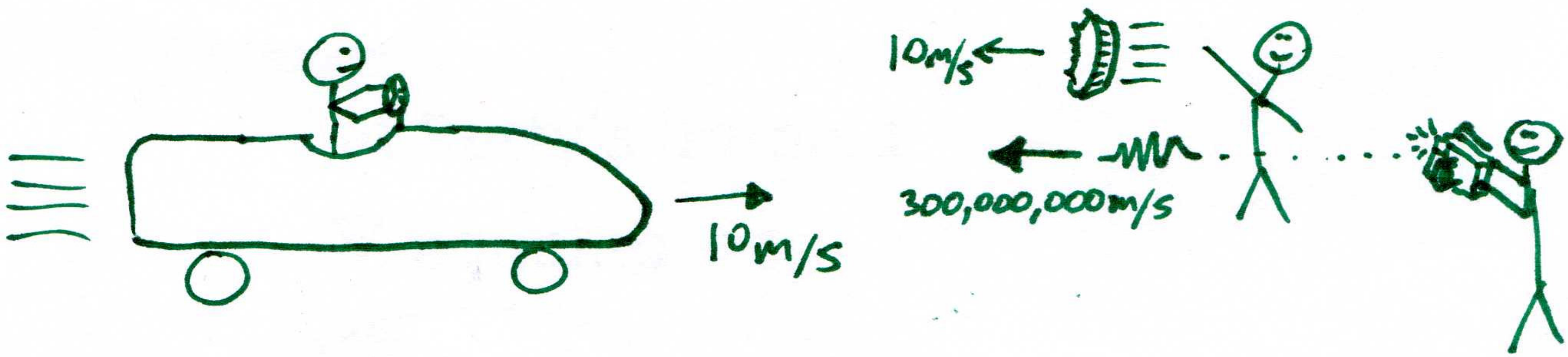
Any identical experiments performed by both Al and Betty must give the same result.



Justin Bieber is driving home from his concert at 10m/s. A "fan" on the sidewalk throws a pie in his direction, also at 10m/s while another fan takes a photo, with the flash sending light towards him at 300,000,000m/s (both as measured in the frame of reference of the road). According to Einstein, in Justin's frame of reference,

A) The pie hits Justin at 20m/s and the light hits Justin at 300,000,010 m/s
B) The pie hits Justin at 20m/s and the light hits Justin at 300,000,000 m/s
C) The pie hits Justin at 10m/s and the light hits Justin at 300,000,010 m/s
D) The pie hits Justin at 10m/s and the light hits Justin at 300,000,000 m/s

Choose the answer which is most nearly correct.



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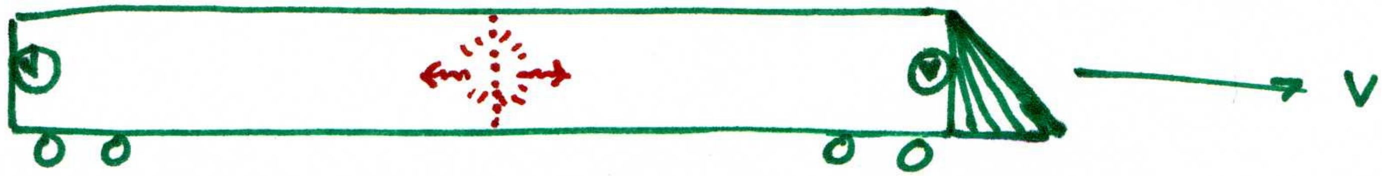
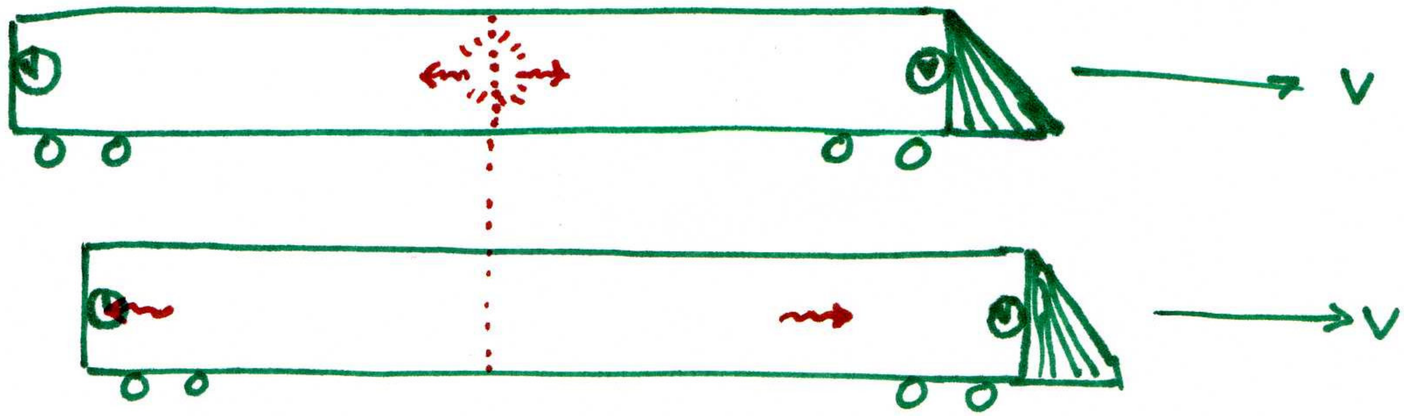
Choose the answer which is most nearly correct.



A light flashes exactly in the middle of a train moving along a track. Observers in the train measure the light to hit each end of the train at exactly noon. According to observers on the track:

A) Light hits the front of the train before the back of the train.
B) Light hits the back of the train before the front of the train.
C) Light hits the front and back at the same time.

Extra: Do we observe the clocks at either end of the train to read the same time? If not, which one appears to read an earlier time and how much do the times differ by?

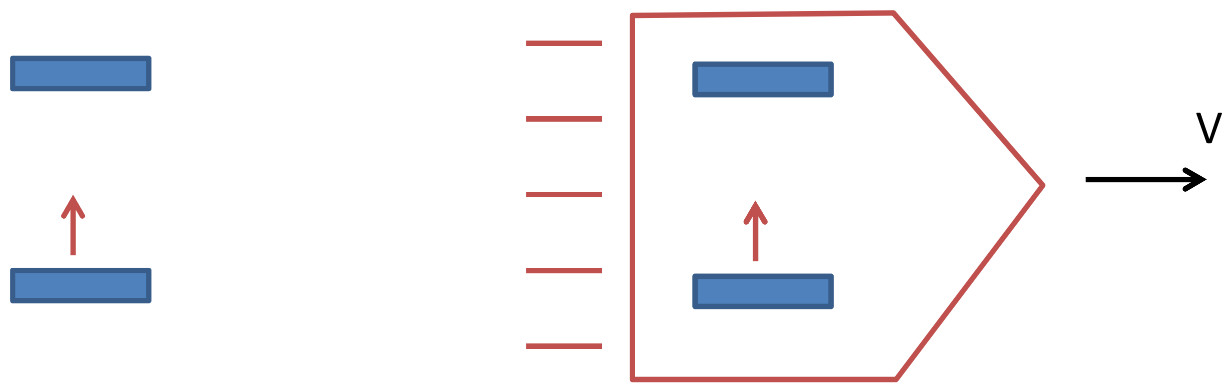


Answer:

D) Light hits the back of the train before the front of the train.

According to observers on the track, when the light hits the back of the train, the front of the train is further from the place where the light flashed, so the light cannot have reached it yet.

In the second picture, the back clock reads noon, but the front clock reads earlier than noon, since the light hasn't hit it yet.
Earlier by $v L/c^2$ to be precise.

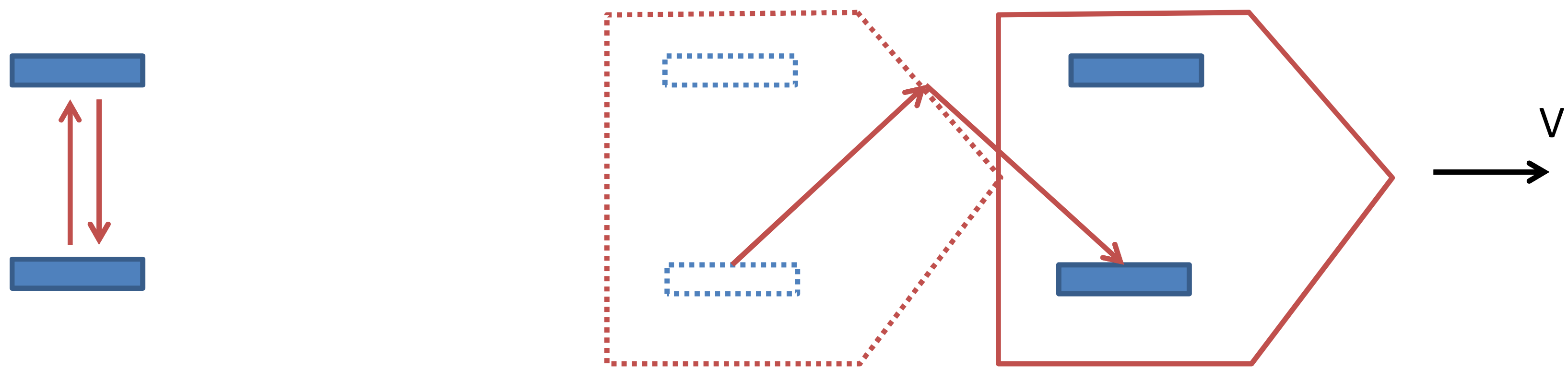


We observe a pulse of light move up and down once in two identical light clocks, one aboard a rocket and one at rest in our frame of reference. Compared to the length of the path taken by the light in the stationary clock, we will measure that

A) The path taken by the light in the moving clock is longer.
B) The path taken by the light in the moving clock is shorter.
C) The path taken by the light in the moving clock is the same.

Extra: What can we say about the observed time for the light to go up and down in the two clocks?

In terms of v and the height L of the clocks, what is the ratio of the path lengths?



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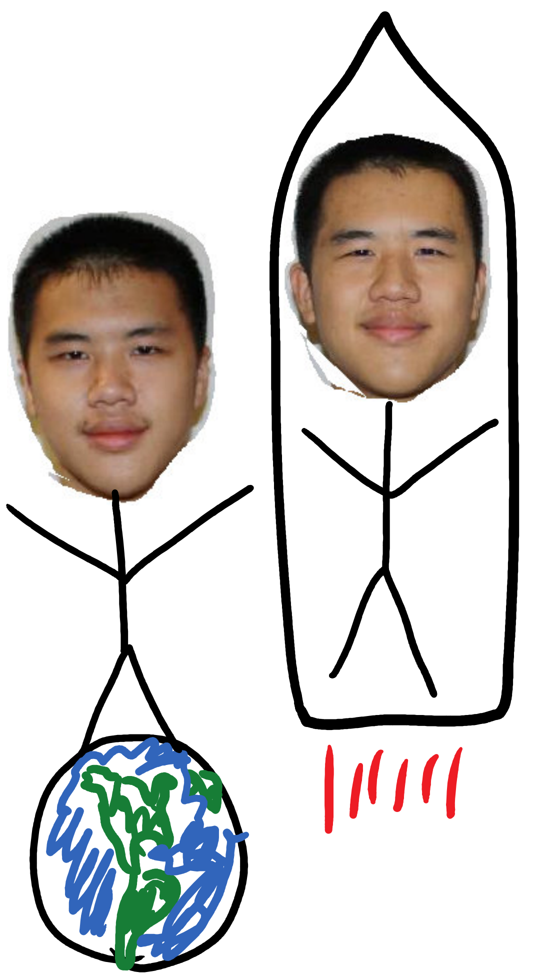

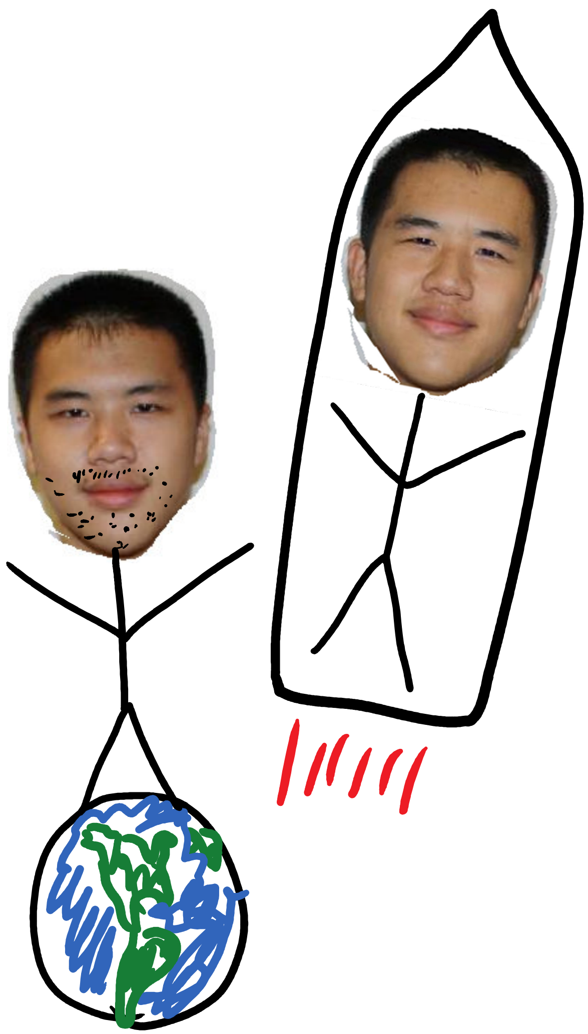

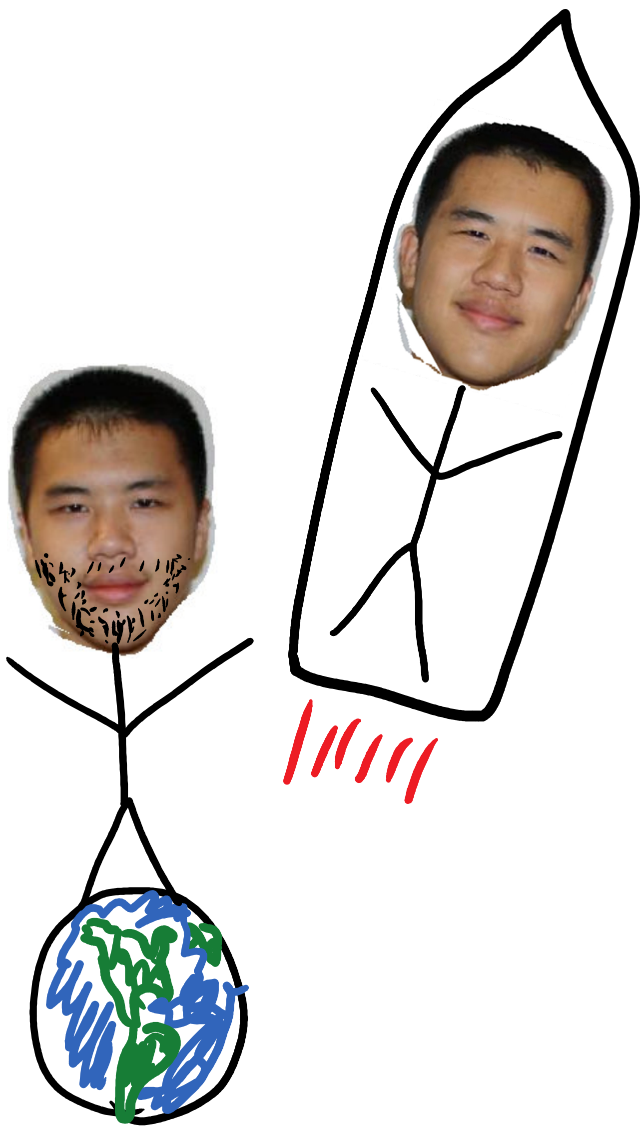

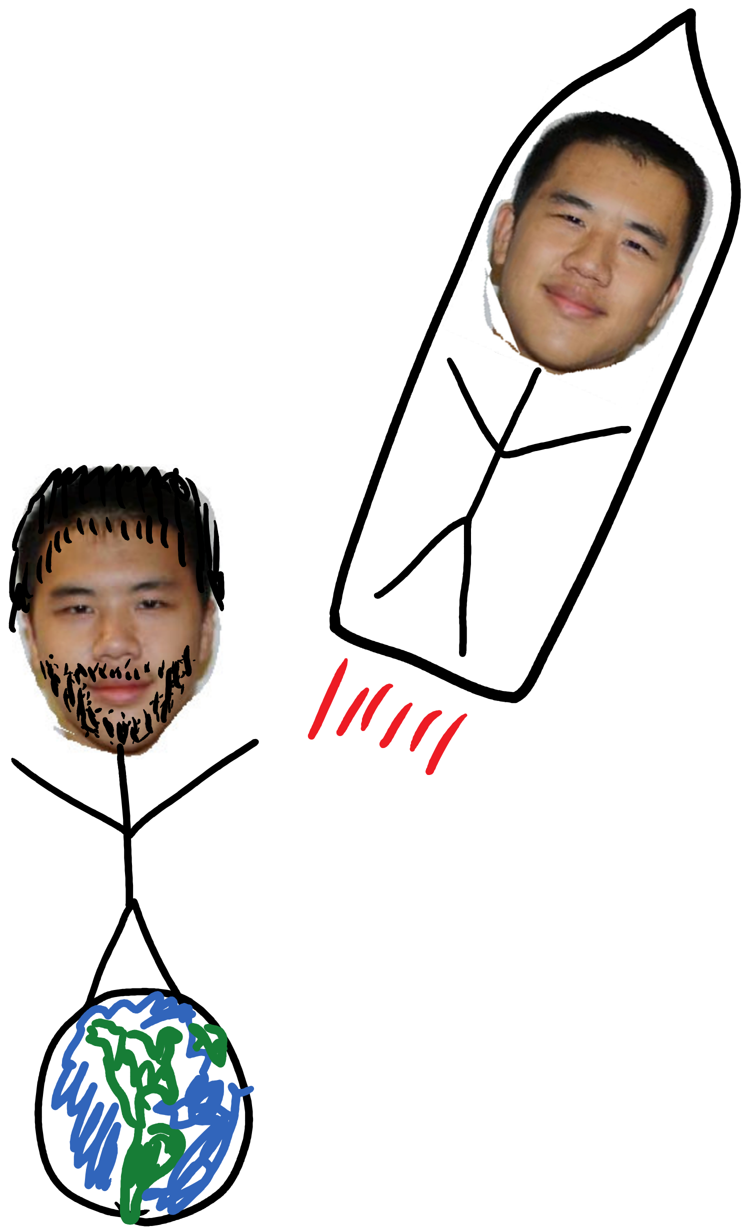

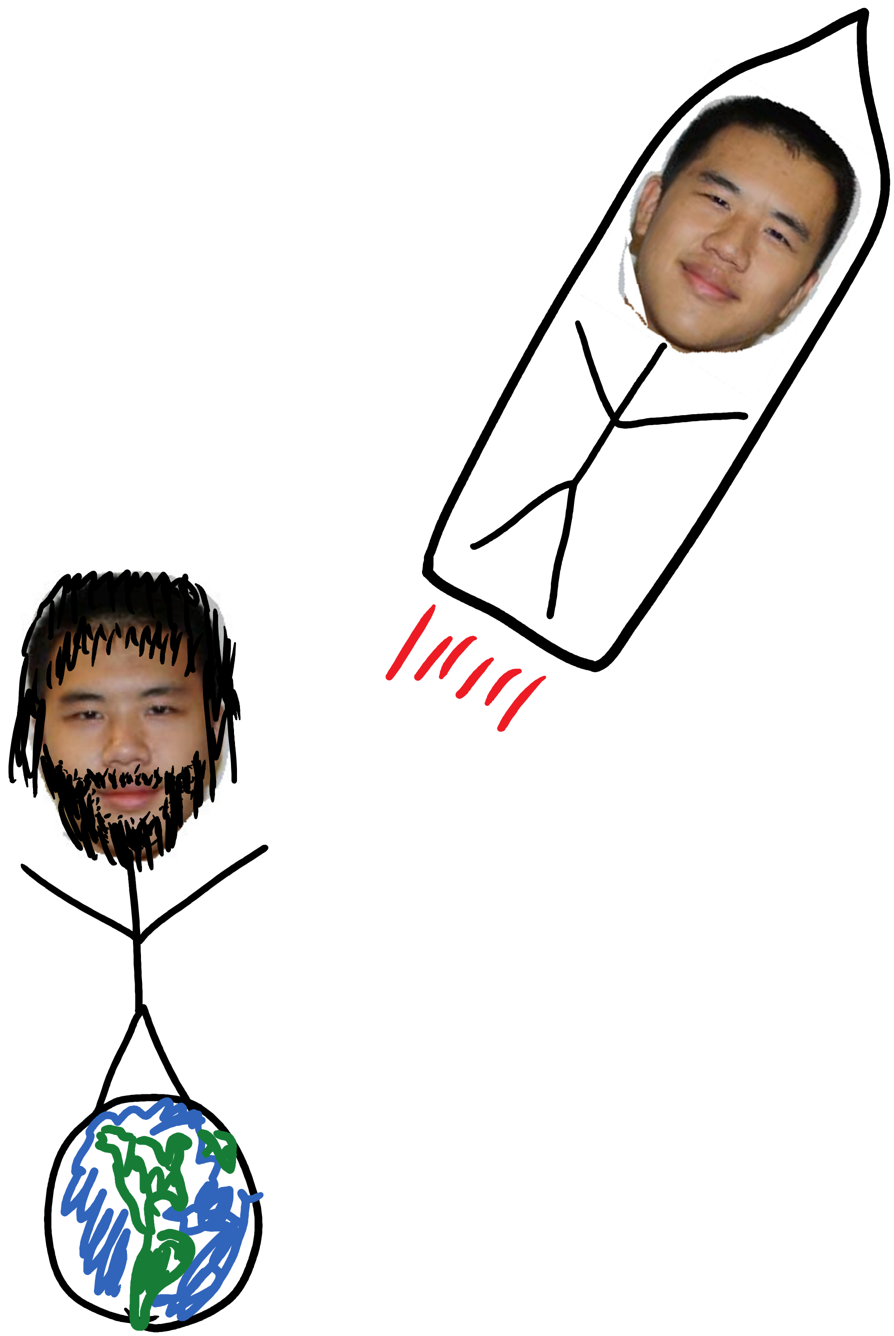

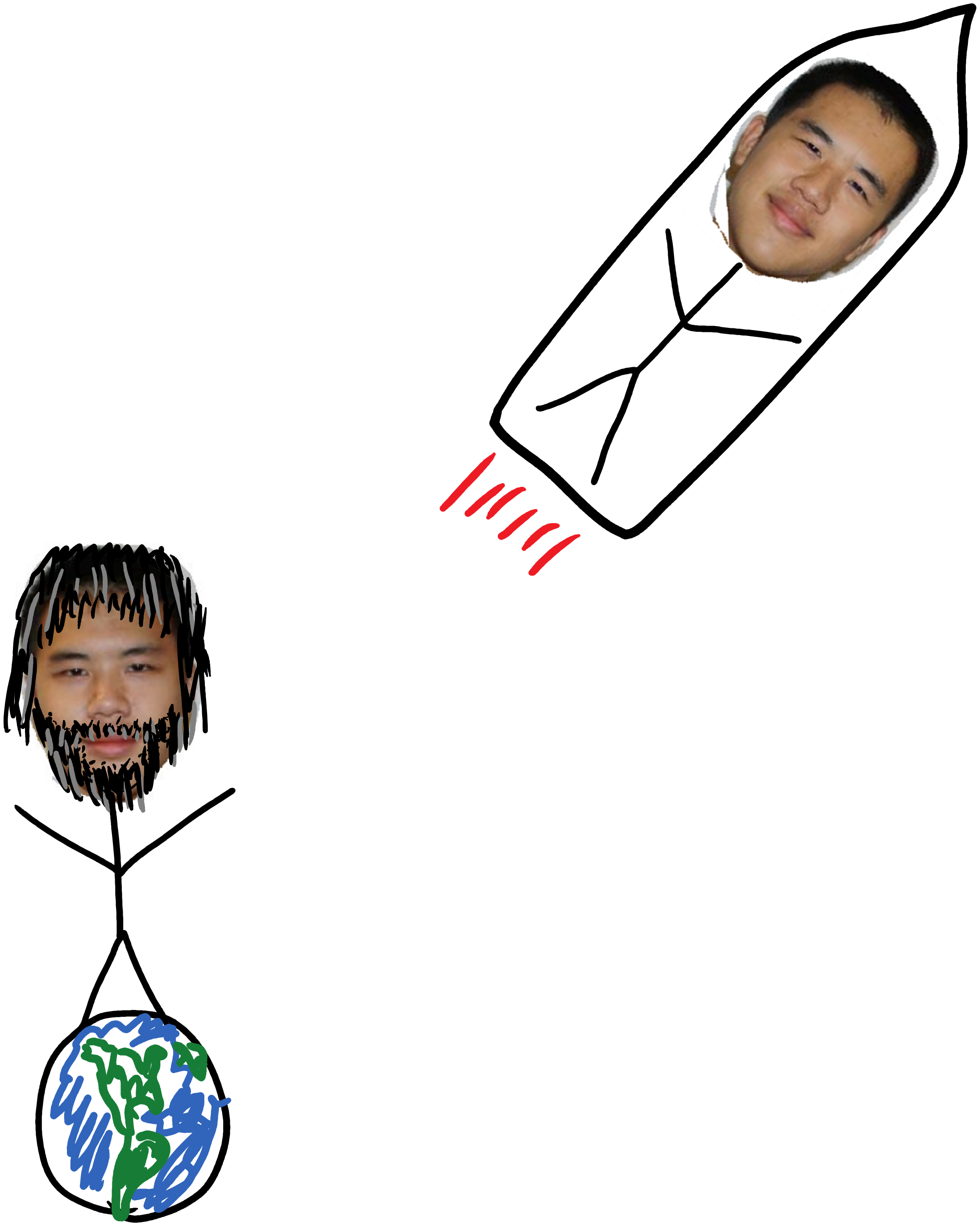

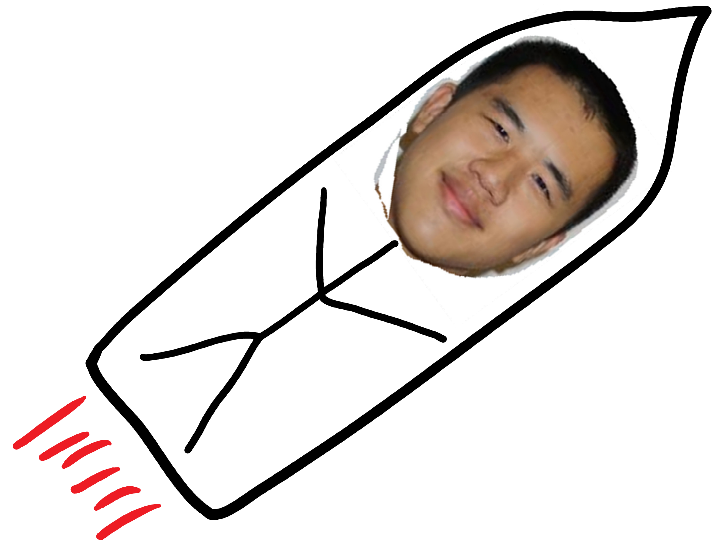

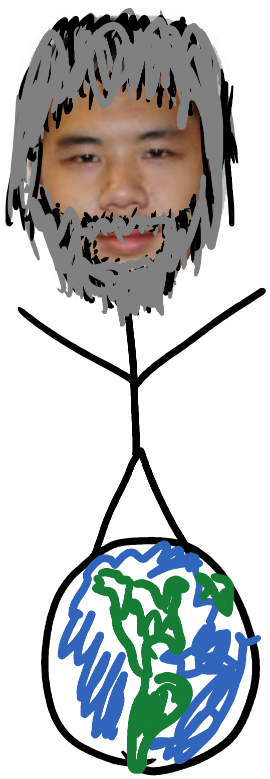

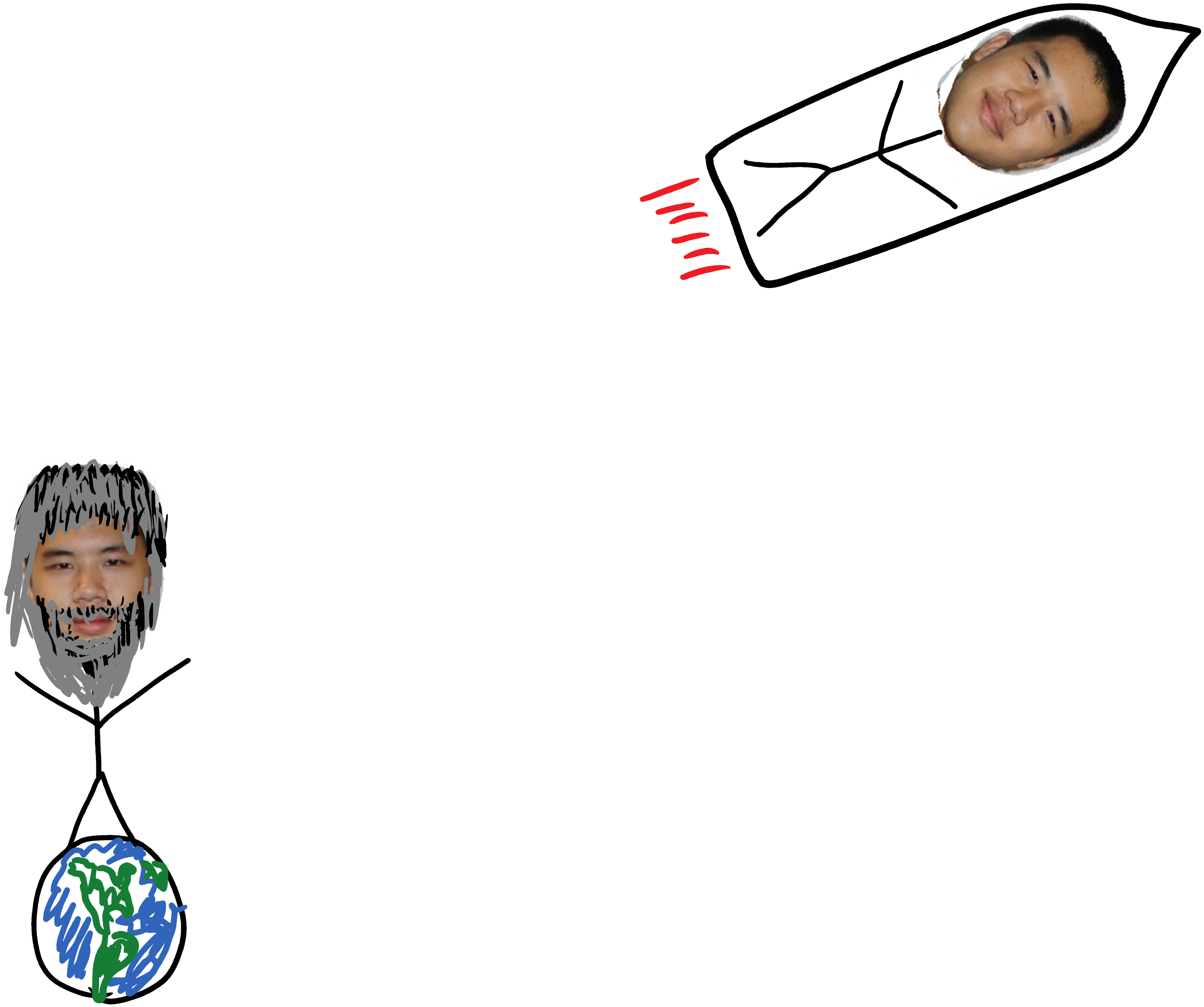

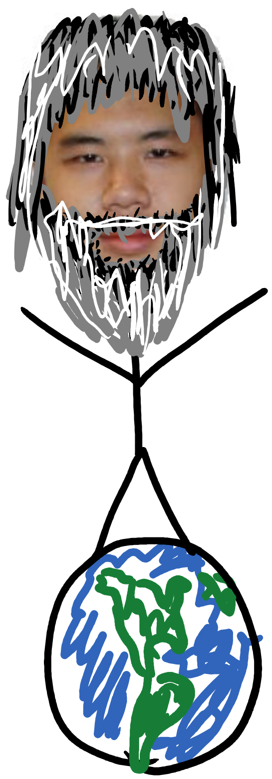


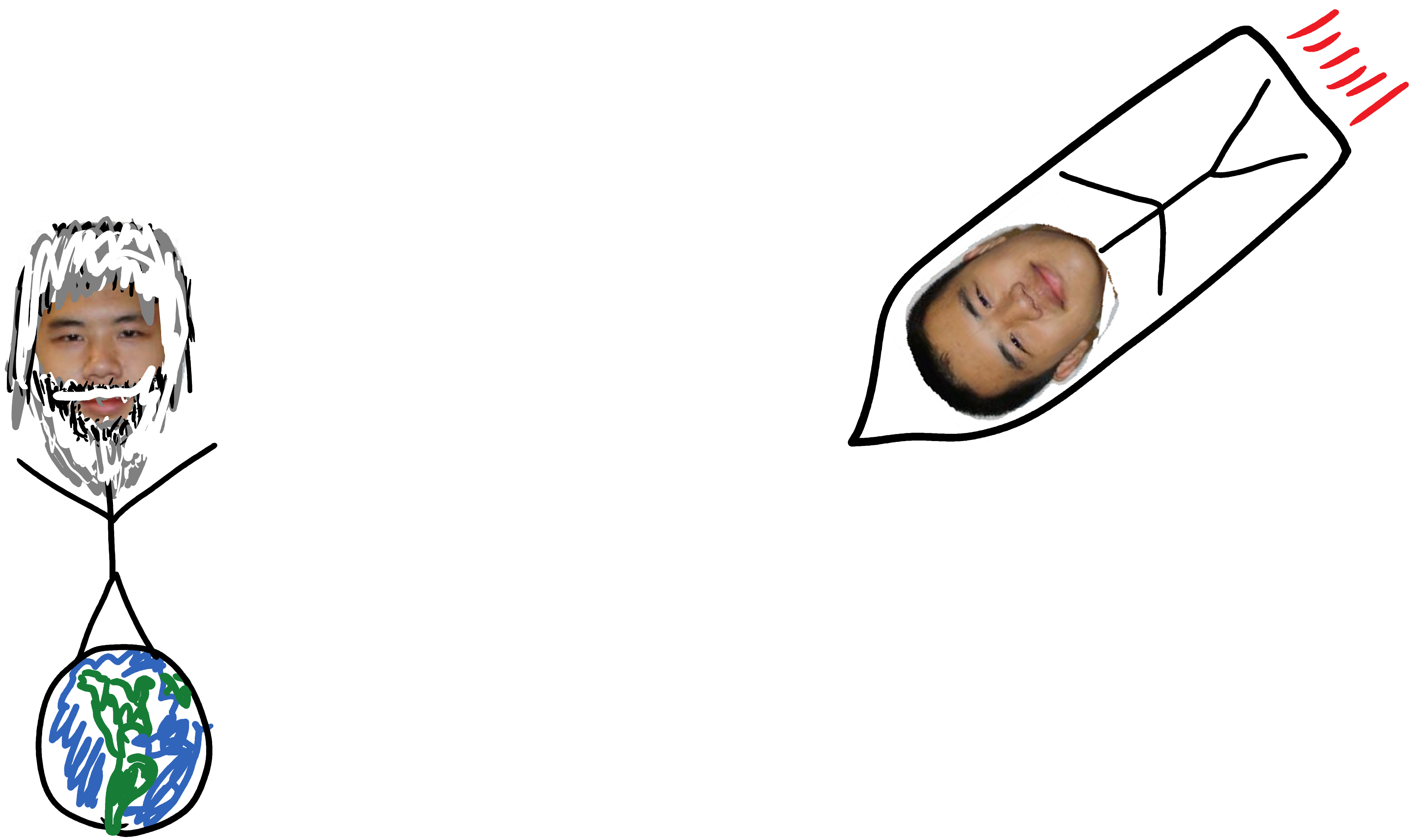


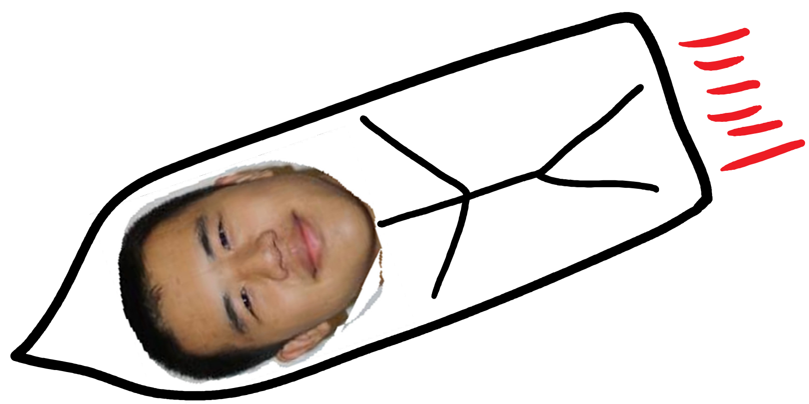

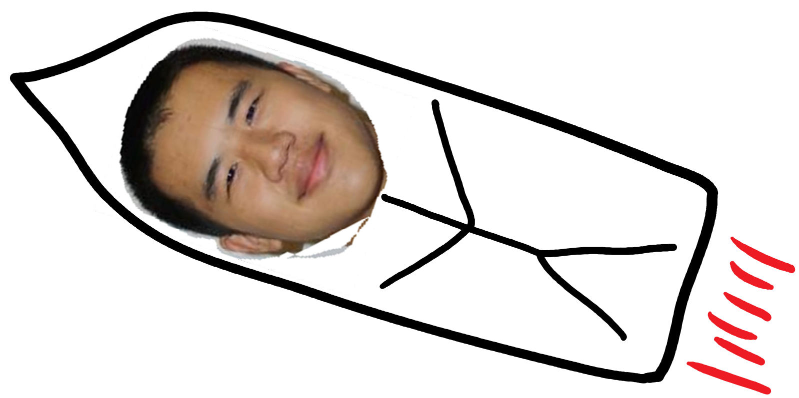

An unstable particle (e.g. a radioactive nucleus) has a half-life of 10^{-8}s when it is at rest. If we produce a beam of these particles travelling at 4/5 times the speed of light, how far on average will the particles travel before decaying?

A) About 1.4m

B) About 2.4m

C) About 4m

D) They won't decay once they are moving

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γ =5/3 for v = 4/5 c

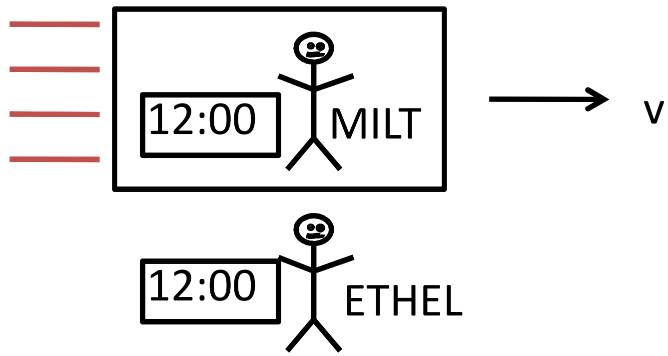
A) About 1.4m

observed lifetime is 5/3 times 10^{-8}s,
speed is 4/5 times 3×10^8 m/s,
so distance is 4m (lifetime times speed)

B) About 2.4m

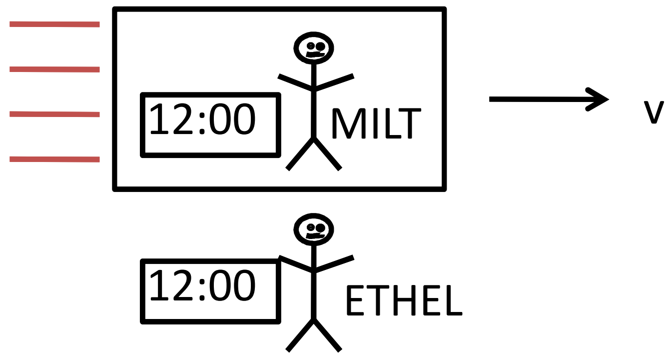
C) About 4m

D) They won't decay once they are moving



Ethel observes both her clock and Milt's clock to read 12:00 when he passes her in his glass rocket travelling at half the speed of light. What does Milt observe Ethel's clock to read when he passes her?

A) 12:00
B) An earlier time
C) A later time
D) Either B or C, but I'm not sure which



Ethel observes both her clock and Milt's clock to read 12:00 when he passes her in his glass rocket travelling at half the speed of light. What does Milt observe Ethel's clock to read when he passes her?

The two clocks passing each other is a single definite event (i.e. specific location, specific time). Both Milt and Ethel are present at this event, and if they are both looking at the same clocks, they will see the same thing!

A) 12:00
B) An earlier time
C) A later time
D) Either B or C, but I'm not sure which