

PHY 490 - Minkowski Diagram Exercise

A relativistic train of rest length 240 meters travels at $0.6c$ through a tunnel which has rest length 360 meters. In the figure below the world lines for the tunnel openings are drawn as line 1 and 2 and the world line of the front of the train is the third dotted line. Let S_{tunnel} be the tunnel with coordinates (x, t) and let S_{train} be the train coordinates (x', t') . We set the origin as the event B_0 , the back of the train location just as the front end enters opening 1.

a. Label the following events on the spacetime diagram:

- F1: The front of the train enters door 1.
- F2: The front of the train passes door 2.
- B1: The back of the train enters the tunnel.
- B2: The back of the train leaves the tunnel.

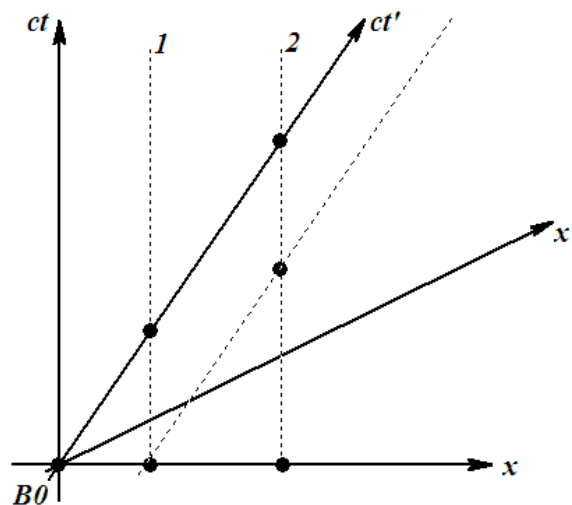
b. Determine the coordinates of the following for the given frame: Use units with $c = 1$.

i. The coordinates (x, t) of F2 in S_{tunnel}

ii. B1's coordinates in the *train* frame of reference

iii. Use the Lorentz equations to find the coordinates of B1 in S_{tunnel} . Is B1 before or after F2 in this frame? _____

iv. Use the Lorentz equations to find the coordinates of F2 in S_{train} . Is B1 before or after F2 in this frame? _____



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Below is boost paper for $\beta = v/c = 0.6$. Pick an appropriate scale to reproduce the previous diagram for this problem. Make measurements on this diagram to confirm the answer obtained in the above exercise. Label all events and spacetime intervals clearly.

