

Minkowski Diagrams

Apparatus

large Minkowski diagram, contacted or laminated, markers for drawing on it

Action

The students should begin by identifying the two sets of axes as belonging to two different reference frames, S and S' .

The question contains the following information:

Frame S is stationary relative to the ground, and frame S' is a frame moving relative to the ground along with an alien spacecraft at velocity $v = 0.6c$. At time $t = t' = 0$ the spacecraft passes FBI agent Fox Mulder. Fox is at the origin of the x and x' axes. 6 nanoseconds later he turns on his mobile phone to make a call to his partner.

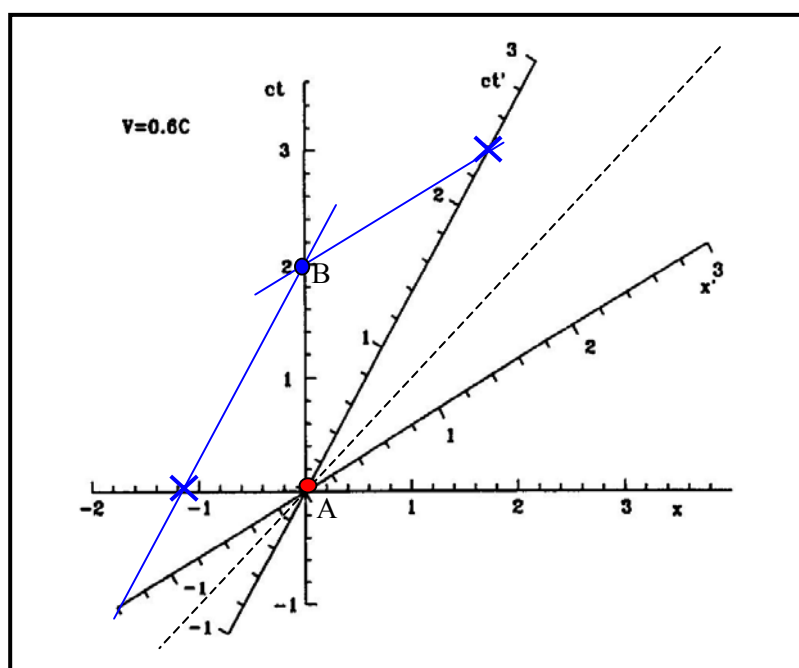
The students mark the coordinates for each of these two events on the Minkowski diagram. They then draw lines back to the axes to find the x , t and x' , t' , coordinates for each event.

The Physics

The axes of frame S are the x and ct axes. Event A on the diagram is the spacecraft passing Fox Mulder, and occurs $x = 0$, $t = 0$ in S , and $x' = 0$, $t' = 0$ in S' . Event B is Fox turning his phone on. This happens at $x = 0$, $t = 6 \text{ ns} = 2 \text{ ct}$ in the S frame.

In the S' frame this happens at $x' = -1.4$, $t' = 7.5 \text{ ns}$. These coordinates are found by drawing lines through the point (point B in this case) parallel to the S' axes and finding the intersections with the x' and ct' axes.

Note that the time axis is ct not t , so that in finding the time we need to divide by c .



Accompanying sheet

Minkowski Diagrams

The diagram has two sets of axis, one for each of two reference frames.

Frame S is stationary relative to the ground, frame S' is a frame moving relative to the ground along with an alien spacecraft at velocity $v = 0.6c$.

At time $t = t' = 0$ the spacecraft passes FBI agent Fox Mulder.

Fox is at the origin of the x and x' axes.

6 nanoseconds later he turns on his mobile phone to make a call to his partner.

Mark the coordinates for each of these two events on the Minkowski diagram.

Write down the x , t and x' , t' , coordinates for each event.