

The Structure of Spacetime

Physics II: Modern Physics

College of the Atlantic

1. Some events are shown in Fig. 1. For each pair of events, classify the spacetime interval as timelike, lightlike, or spacelike.

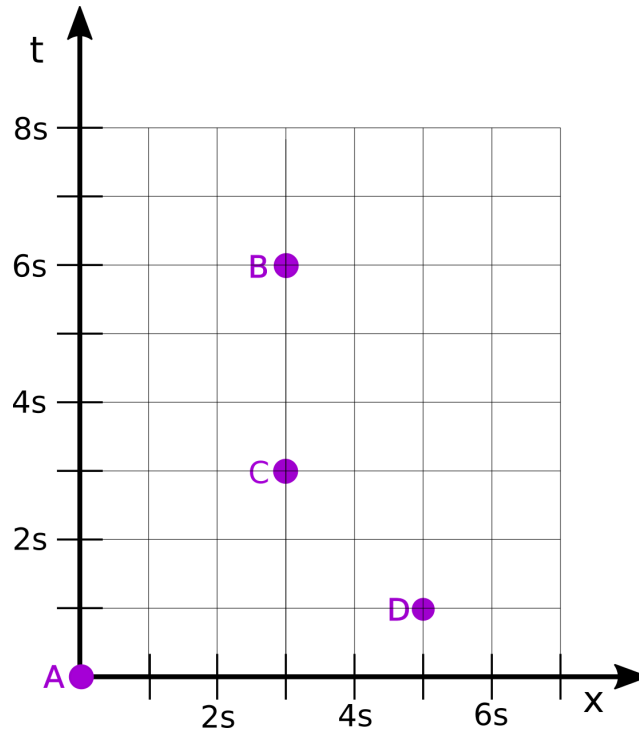


Figure 1: A spacetime diagram and some events



Figure 2: Dave Dresden, on Neptune, experiencing a pang of sadness.

2. Dave Dresden is on Neptune, four light hours from earth. At exactly 2:00am he suddenly experiences intense pangs of sadness (see Fig. 1). At exactly 5:00am you wake up with a pain in your abdomen. The times for the two events are measured by inertial clocks in a frame at rest with respect to the sun.
 - (a) Could Dave's pangs of sadness have caused your pain?
 - (b) The spacetime interval between the two events is timeline, spacelike, or lightlike?
 - (c) From your point of view, Dave's pangs of sadness are in the past, in the future, or elsewhere?

3. In the spacetime diagram in Fig. 3, Anastajia is at rest in the unprimed frame, and Beowulf is at rest in the primed frame. The purple line is the worldline of a space bat.
- (a) How fast is Beowulf traveling with respect to Anastajia?
 - (b) Approximately what is the bat's speed in Beowulf's (primed) frame?
 - (c) Approximately what is the bat's speed in Ana's (unprimed) frame?

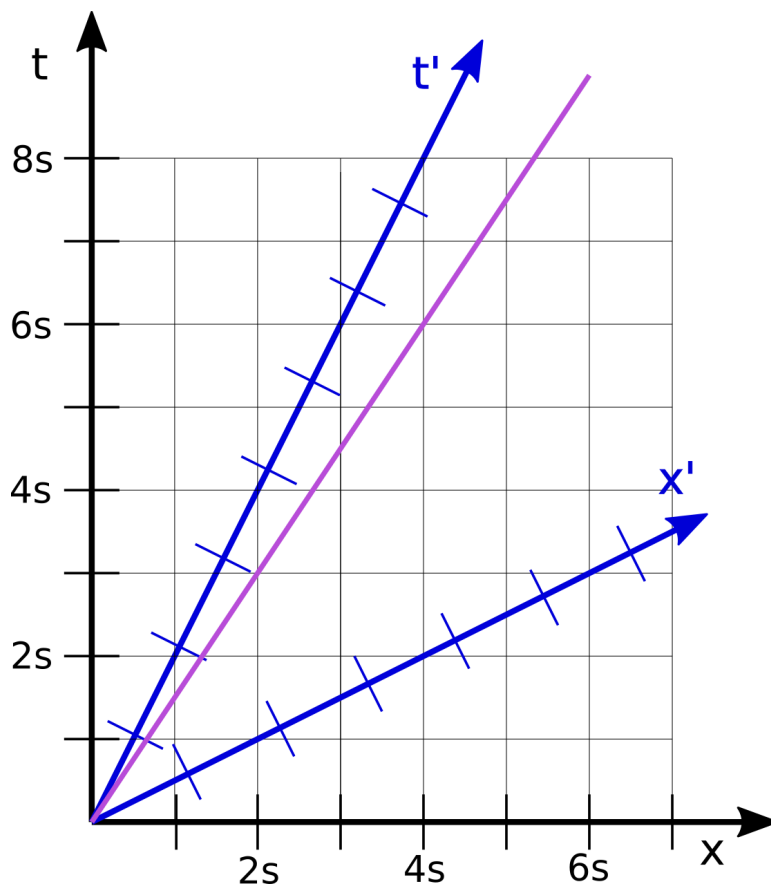


Figure 3: A spacetime diagram.

4. Anastajia is at rest, and Beowulf is traveling at constant velocity of 0.5 with respect to Anastajia.
- (a) Beowulf observes a spaceship traveling at a speed of 0.8. How fast is the spaceship traveling in Ana's reference frame?
 - (b) Ana observes a spaceship traveling at a speed of 0.7. How fast is the spaceship traveling in Beowulf's frame?