Applied Modern Physics

Introduction - Basics
AAU, AAiT
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Events, Clocks, and Observers - 1

- **Priming the brain:**
  - Consider an event that has recently occurred in your life (whether significant or mundane), or any event that occurs.
    - What are the ways we differentiate that event from some other event?
    - What does it mean to say that someone "observed" or "recorded" an event?
      - That is, what criteria must be satisfied by someone to be a good observer and/or recorder?

- **Specifying an event in four dimensions**

- **Recording the time of an event**

- **The "photo clock principle"**

- **The meaning of "to observe an event"**

Events, Clocks, and Observers - 2

- **Synchronizing a lattice/grid of clocks**

- **The practical context of synchronization**

- **Two ways to synchronize the clocks**

Spacetime Diagrams

- **Example 1 (four flashes)**

- **Example 2 (different example with four flashes)**

- **Example 3 (another example with four flashes)**

- **Example 4 (another example with four flashes)**

- **Velocity on a spacetime diagram (four examples)**

- **Slope and velocity**

- **The "animation principle"**

Frames of Reference

- **Priming the brain:**
  - Consider three long moving sidewalks (or conveyor belts), side by side by side. Assume that they are not turned on at first (i.e., they are not moving). You are standing on the second sidewalk (the one in the middle), facing toward one end that you see far in the distance. As you glance behind you, you see the other end far in the distance behind you. Two of your friends are standing next to you, A on the left sidewalk and B on the right sidewalk. There are markings at 1-meter intervals on each sidewalk that indicate distances. You and your friends are standing on the "0" mark on each of your sidewalks. As you look toward the far end of each sidewalk in front of you, you see the markings "1 m," "2 m," "3 m," and so on. As you glance behind you, you see the markings "-1 m," "-2 m," "-3 m," and so on. Each of you has a remote control device that allows you to turn on your moving sidewalk and adjust the speed. Now think about these situations:

- 1. Your friend on the left **(A)** turns on her sidewalk and sets it for a speed of **2 meters per second backward**, while your friend on the right **(B)** turns on his sidewalk at the same instant and sets if for a speed of **3 meters per second forward**. You leave your sidewalk turned off.
  - If you write down their positions at 1-second intervals for 5 seconds, **based on the markings on your sidewalk, what do you record?** (That is, assuming you start your timer at the moment A and B go in motion, where are they at 1 second, 2 seconds, 3 seconds, 4 seconds, and 5 seconds, according to your markings?)

Frames of Reference

- **Priming the brain:**

- 2. You reset the sidewalks so that you and your friends are side by side and motionless again. This time **you** turn on your sidewalk and set it for a speed of **2 meters per second forward**, while **your friends** leave their sidewalks **turned off**. If each of your friends writes down your position at 1-second intervals for 5 seconds, **based on the markings on each of their sidewalks, what do they record?** (That is, where are you at 1 second, 2 seconds, 3 seconds, 4 seconds, and 5 seconds, according to their markings?) **At 5 seconds**, what is the **position of your friends** according to the **markings on your sidewalk**? **At 5 seconds**, what is **your position** according to the **markings on your sidewalk**?

- 3. Consider situation #1 again, but this time from the perspective of A. What does **A record for your position** at 1 second, 2 seconds, 3 seconds, 4 seconds, and 5 seconds, according to **the markings on her sidewalk**? (Remember that A is positioned on her "0" mark the whole time.) And what does A record for B's positions at those times, according to the markings on her sidewalk? Based on these results, how fast does A see you moving away from her, and how fast does she see B moving away from her?

Frames of Reference

- **Priming the brain:**

- 4. Imagine that the moving sidewalks were somehow set up in outer space (with you, A, and B wearing spacesuits), and there was nothing else around, and the sidewalks worked so smoothly that it was impossible to tell when your sidewalk was on or off. When you observed A moving away from you, would you be able to tell for sure whether it was her that was moving, or you? What would you need to figure this out?