# ASTR 3740 Relativity & Cosmology Spring 2017. Project 1. Fri Feb 3.

## Tachyons

The spacetime diagram shows an event A along Amy's worldline, and an event B along Bob's worldline.

1. Assume that the spacetime diagram is drawn from Amy's point of view, so that Amy is at rest in the coordinate system. Label Amy's worldline.

2. Draw and label a straight line from the event A to the event B. This is the worldline of a tachyon (from the Greek tachyos meaning fast), a hypothetical particle that moves faster than light, $v > 1$, emitted by Amy at A and received by Bob at B.

3. Draw and label a "now" line for Bob through event B, with the property that Bob's now line passes through Amy's worldline **before** Amy emitted the original tachyon.

4. Draw and label the worldline of a tachyon that is emitted by Bob at B, moves **forward** in time from Bob's point of view, and hits Amy's worldline **before** Amy emitted the first tachyon.

5. Draw and label Bob's worldline. Obviously, this has to be consistent with the now line that you drew for Bob.

6. Must Bob be moving towards or away from Amy? Does the tachyon that Amy sent out move forward or backward in time from Bob's point of view? Does the tachyon that Bob sent out move forward or backward in time from Amy's point of view?

7. Describe in words why the situation is problematical.

8. If Amy sends out her tachyon at speed $v$ (in units of the speed of light), what is the **smallest** velocity that Bob can move relative to Amy for the above situation to occur?

9. If it is possible for Amy to send out a particle with $v > 1$, do you think it should also be possible for Amy to send out a particle backward in time, with $v < -1$, from her point of view? Explain how she might do this, or not, as the case may be.

Please write your verbal answers on this sheet.

**Scribe's name:**

**Names of other members of the group:**