Physics 3710 – Problem Set #4

David Peak
Utah State University, david.peak@usu.edu

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1. In this problem \((x, T)\) refers to the s-t coordinates (both measured in units of distance) of events according to an observer O. A rocket leaves Earth at \((0,0)\) (event A) and travels at constant speed to a distant star arriving at \((4,5)\) (event B). After a while a light signal is sent from the star at \((4,10)\) (event C) back to Earth, being received at event D. (a) Draw an s-t diagram of these events and the world lines connecting them. (b) What are the coordinates of event D? (c) Compare the elapsed time between A and D on Earth with the sum of proper times between A and B, B and C, and C and D.

2. Redo Problem 1, but now from the perspective of observer \(O'\) traveling relative to O with velocity +0.8 in the \(x\)-direction. Assume that both observers agree that A occurs at \((0,0)\).

3. According to one observer, event A is at \((2,7)\) and event B is at \((3,10)\). Calculate the proper time interval between these events. A second observer records event A as occurring at \((-6,9)\) and B at \((-25/3,38/3)\). Calculate the proper time interval between these two events and compare with the previous value.

4. \(O'\) travels relative to O with a constant (dimensionless) \(x\)-velocity +0.8. O records the velocity of a rocket to be +0.9 in the \(x\)-direction. What is the velocity of the rocket according to \(O'\)?

5. For the conditions in Problem 4, suppose O records the velocity of another rocket to be +0.8 in the \(y\)-direction. What is the velocity of the rocket according to \(O'\)?