

APM 426 / 1700  
Assignment 2

Prof. McCann

Due: Thursday Jan. 26

Practice problem: Schutz # 2.25

To be graded: Schutz # 2.26, 2.32 and

1. Assume A lies in the causal past of B, and B lies in the (causal) past of C.

a) Prove a triangle inequality for the interval:  $\sqrt{-\Delta s_{AC}^2} \geq \sqrt{-\Delta s_{AB}^2} + \sqrt{-\Delta s_{BC}^2}$ .

b) Deduce a sharp upper bound on the amount that a particle can age as it moves along any path from A to C.

c) Along which path is this realized and why?

d) Explain the twin paradox in light of (a)-(c). The twin paradox refers to the following puzzle: Diana and Artemis are separated at birth. Diana is placed on board a spaceship which races away from earth at a high fraction of the speed of light for 7 years, turns around and races back at the same velocity for another 7 years. Diana arrives home having aged 14 years. If Artemis had a powerful enough telescope, she could have watched Diana's clock running slow while it ticks off the 14 years, during which Artemis herself grew to be an old woman of 65. But the situation seems symmetric. Taking Diana's frame of reference, Artemis has been racing away from her for seven years and then racing back for another seven. Due to time dilation, Artemis should return younger than Diana. However after their reunion both observers are at rest in the same time and place, so must be able to agree on which one is older. Who is it?