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Astron-84

Written Assignment Week 3

1. In this instance, symmetry was not preserved. The two doors closing, which to the farmer and his children appeared to be simultaneous, did not have to appear to be simultaneous to the pole vaulter. This is due to the relativity of simultaneity – events which are simultaneous to one observer do not have to be simultaneous to another. Thus, the measurement from the pole vaulter’s frame of reference saw the ladder as being stationary and the barn as moving towards him, contracted by (1 – v^2/c^2)^½, and so the ladder could not fit within the barn all at once. According to the pole vaulter, when the front end of the ladder entered the barn, the front door was shut and opened, and when the back end of the ladder just entered the barn, the back door was shut and opened. These events were not simultaneous to him.
2. Through Lorentz contraction, Lp = L\*sqrt(1 – v^2/c^2), and so if L = 2L\*sqrt(1 – v^2/c^2), then 1/4 = 1 – v^2/c^2, c^2/4 = c^2 – v^2, and so v > sqrt( (3/4)c^2).
3. According to the pole vaulter, who was running at v’ = sqrt(3)c/2, the length of the barn contracts by a factor of ½, leading to a length of ½L. then the front door shut and opened as soon as the front part of the ladder encountered the door. As the pole first enters, then t = 0. As the front of the pole leaves, then t = L/2v’, and the back of the pole enters at t = Lp/v’ = 2L/v’. Thus, the front gate closes and opens instantaneously at t = L/2v’ and the back gate opens at t = 2L/v’.