Paradoxes in Special Relativity Assignment

SPH4U

Please answer all questions on a separate sheet of paper. You may look up the answers to these questions, but please credit your sources.

1. **The Ladder Paradox**: A ladder is too long to fit in a garage when it is at rest in the reference frame with respect to the garage. If the ladder is moving at relativistic speeds with respect to the garage, from the garage's point of view, the ladder is length contracted and the ladder will fit. However, from the ladder's point of view, the garage is length contracted and the ladder will not fit. Briefly explain how this paradox can be resolved.

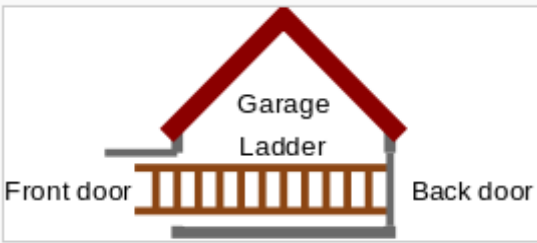


Figure 1: An overview of the garage and the ladder at rest

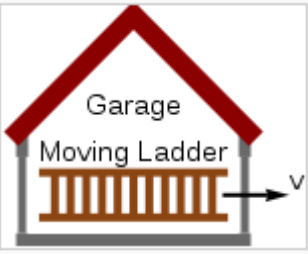


Figure 2: In the garage frame, the ladder undergoes length contraction and will therefore fit into the garage.

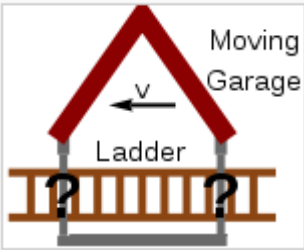
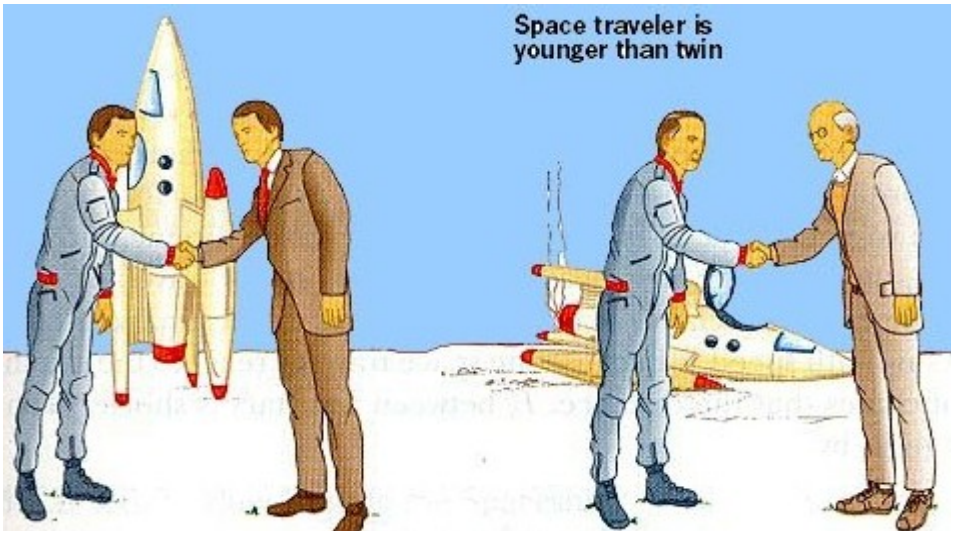


Figure 3: In the ladder frame, the garage undergoes length contraction and seems too small to contain the ladder.

(Note that this paradox has many variations. Sometimes the ladder is a pole, sometimes the garage is a barn, etc.)

2. A twin takes a round trip into space on a rocket that travels at relativistic speeds. From the Earth-bound twin's point of view, the space-travelling twin's clock is running slower and the space-travelling twin is younger than his twin when he returns. However, from the space-travelling twin's point of view, clocks on Earth run slower and his Earth-bound twin should be younger when he returns. Briefly explain how this paradox can be resolved.



3. Identify and describe one other well-known paradox in special relativity (Bell's spaceship paradox, the Sagnac Effect, etc.) and explain how it is resolved.