Answer on Question #42934, Physics, Relativity

Task:

Before it leaves Earth you observe the length of another spacecraft to be 200 m. After take-off, the craft travels past Earth (to wave good bye!) while moving at a velocity of 95% of the speed of light. You are assigned the task of re-measuring its length as it travels past.

a) Explain, at a fundamental level (i.e. with the principles of relativity in mind), how must you perform this measurement?

b) What value will you obtain? (ANS: 62m)

Solution:

The length of the object is moving in any inertial reference frame is less than the system associated with the body.

Body length depends on the speed of the body. If l_0 - the length of the spacecraft in a system in which the spacecraft is at rest and l - length of the spacecraft in the moving frame of reference , we have the following formula for the length:

$$l = l_0\sqrt{1-\frac{v^2}{c^2}}.$$

Reduction occurs only with the measurement of the body along the direction of motion. Two other dimensions remain unchanged.

b) What value will you obtain? (ANS: 62m)

$$l_0 = 200m; v = 0.95\cdot c \Rightarrow l = 200\sqrt{1-\frac{(0.95\cdot c)^2}{c^2}} = 200\sqrt{1-0.95^2} \approx 62.44m$$

Answer: $l = 62.44m$.