Answer on Question #60712, Physics / Other

Two spacecrafts A and B approach the moon from opposite directions with speeds of 2.2×10^8 ms^{-1} and 2.5×10^8 ms^{-1}, respectively, as measured by an observer on the moon. Calculate the speed of A with which it approaches the moon as observed by an observer in B.

Solution:

The Lorentz velocity transformation:

$$u'_x = \frac{u_x - v}{1 - u_x v/c^2}$$

where u_x is the velocity of an object measured in the S frame, u'_x is the velocity of the object measured in the S' frame and v is the velocity of the S' frame along the x axis of S.

We take the S frame to be attached to the moon and the S' frame to be attached to spacecraft B moving with velocity v = -2.5×10^8 ms^{-1}along the x axis. Spacecraft A has velocity $u_x = 2.2 \times 10^8$ ms^{-1} in S.

It follows from first equation that spacecraft A has velocity

$$u'_x = \frac{2.2 \cdot 10^8 + 2.5 \cdot 10^8}{1 + 2.2 \cdot 10^8 \cdot 2.5 \cdot 10^8/(3 \cdot 10^8)^2} = 2.92 \cdot 10^8 \text{ m/s}$$

Answer: Spacecraft A moves with velocity $2.92 \cdot 10^8$ m/s as measured by an observer in spacecraft B.