Answer on question #52486, Physics, Relativity

Question   An unstable particle at rest breaks up into two fragments of unequal mass. The mass of the lighter fragment is equal to $2.50 \cdot 10^{-28}$ kg and that of the heavier fragment is $1.67 \cdot 10^{-27}$ kg. If the lighter fragment has a speed of 0.893c after the breakup, what is the speed of the heavier fragment?

Solution   Relativistic momentum is

$$p = \frac{mv}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The momentums of fragments should be equal. Hence, momentum of heavier fragment m_2 is

$$p = \frac{m_1 0.893c}{\sqrt{1 - 0.893^2}} \approx 1.984 m_1 c$$

From this we can find velocity of heavier fragment v_2

$$p = \frac{m_2 v_2}{\sqrt{1 - \frac{v_2^2}{c^2}}}$$

$$p^2 (1 - \frac{v_2^2}{c^2}) = m_2^2 v_2^2$$

$$v_2^2 (m_2^2 + p^2/c^2) = p^2$$

$$v_2 = \sqrt{\frac{p^2}{(m_2^2 + p^2/c^2)}} = \frac{1.984 m_1 c}{\sqrt{m_2^2 + 1.984^2 m_1^2}} \approx 0.285c$$

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