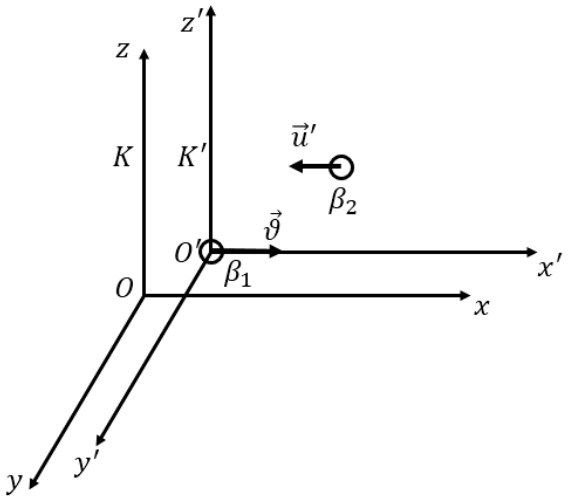
Two β-particles move in opposite directions with velocities of 0.5c in the laboratory frame. Calculate the velocity of one β-particle in the moving frame attached to the other β-particle.

Solution.



Let's denote: K is the laboratory frame, K' is the frame attached to the β-particle moving in the x direction.

Than $u = -0.5c$ is the velocity of β-particle moving in the opposite to x direction with respect to K frame, $\vartheta = 0.5c$ is the velocity of the β-particle moving in the x direction with respect to K frame, and thus ϑ is the velocity of the moving frame K'.

To find the velocity of the particle β_2 with respect to K' frame, let's use Lorentz velocity transformation:

$$u' = \frac{u - \vartheta}{1 - \frac{u\vartheta}{c^2}}$$

$$u' = \frac{-0.5c - 0.5c}{1 - \frac{(-0.5c \cdot 0.5c)}{c^2}} = -\frac{c}{1 + 0.25} = -0.8c$$

Answer: -0.8c