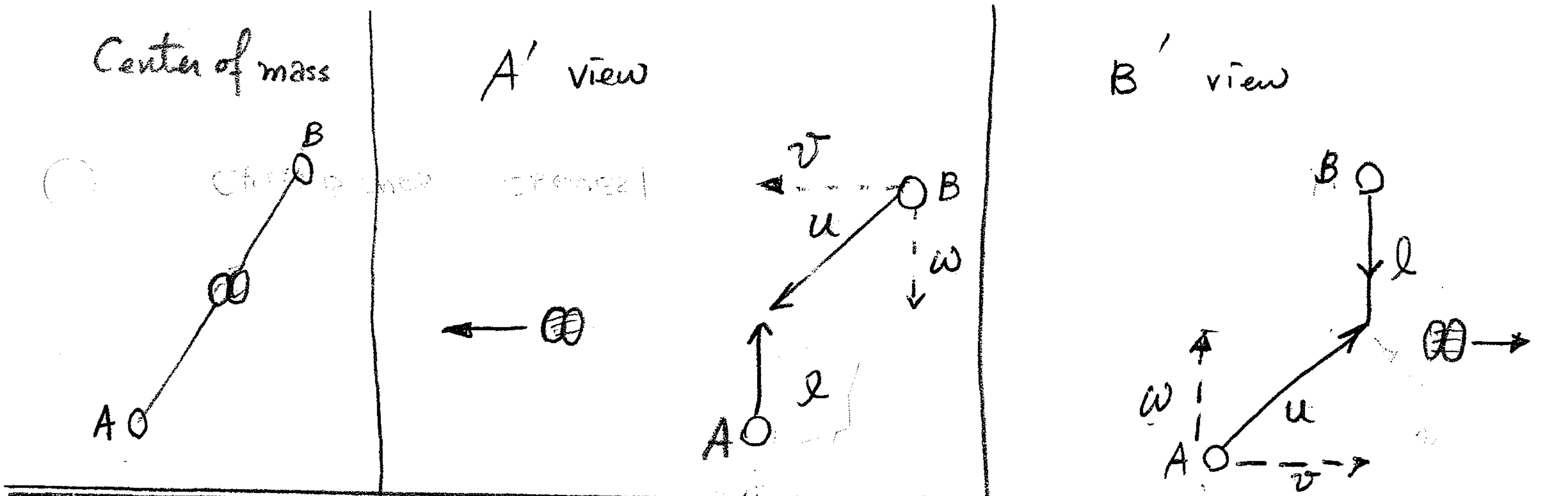


Conservation of momentum:

$$m_l\, l = m_u\, u_y$$

$$\omega = \sqrt{1-v^2/c^2}\; l$$

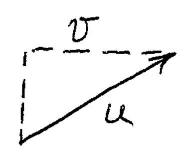
$$\begin{cases} \Delta y = \Delta y' \\ \Delta t = \Delta t'/\sqrt{1-v^2/c^2} \end{cases}$$

$$m_l\, l = m_u\, \omega$$

$$m_l = m_u \sqrt{1-v^2/c^2} \qquad \text{——— (1)}$$

This means the mass is a function of its velocity. Otherwise we cannot have conservation of momentum.

$$u^2 = v^2 + u_y^2 = v^2 + l^2(1 - v^2/c^2)$$



$$\frac{u^2}{c^2} = \frac{v^2}{c^2} + \frac{l^2}{c^2}\left(1 - \frac{v^2}{c^2}\right)$$

$$1 - u^2/c^2 = 1 - v^2/c^2 - l^2\left(1 - \frac{v^2}{c^2}\right) = \left(1 - l^2/c^2\right)\left(1 - v^2/c^2\right)$$

(1) becomes

$$\frac{m_l}{m_u} = \sqrt{1-v^2/c^2} = \frac{\sqrt{1-u^2/c^2}}{\sqrt{1-l^2/c^2}}$$

or $m_l\sqrt{1-l^2/c^2} = m_u\sqrt{1-u^2/c^2} = m$, or they have the same rest mass, as they are identical particles.

$$m_l = \frac{m}{\sqrt{1-l^2/c^2}} \quad \text{or} \quad m_u = \frac{m}{\sqrt{1-u^2/c^2}}.$$