[mex222] Relativistic mass

Two particles with equal masses m as measured when at rest are undergoing an inelastic collison as shown in the lab frame S. From the conservation of total momentum in frame S,

$$m(v)\mathbf{v} + m(0)0 = M(\bar{v})\bar{\mathbf{v}}, \quad v = 2\bar{v}/(1+\bar{v}^2/c^2),$$

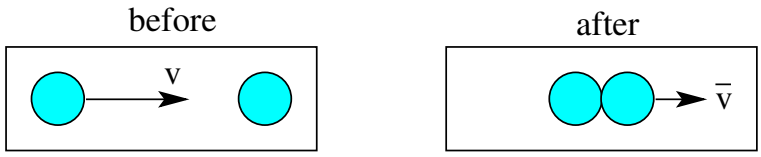
and the conservation of transverse total momentum in frame S' that moves with relative velocity $\mathbf{u}$ perpendicular to $\mathbf{v}$ (as shown in [mex221]),

$$m(v')\mathbf{u} + m(u)\mathbf{u} = M(\bar{v}')\mathbf{u}, \quad v' = \sqrt{v^2+u^2(1-v^2/c^2)}, \quad \bar{v}' = \sqrt{\bar{v}^2+u^2(1-\bar{v}^2/c^2)},$$

derive the expression

$$m(v) = \frac{m_0}{\sqrt{1-v^2/c^2}},$$

for the relativistic mass, where $m_0 = m(0)$ is called the rest mass.



Solution: