$$\vec{p} = m\vec{v}$$

$$\vec{p} = \gamma m\vec{v}$$

$$p = \gamma m v$$

$$\frac{p}{m} = \gamma v$$

$$Q \equiv \frac{p}{m}$$

$$\gamma v = Q$$

$$\gamma^2 v^2 = Q^2$$

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

$$v^2 = (1 - v^2/c^2) Q^2$$

$$v^2 = Q^2 - v^2 \left(\frac{Q^2}{c^2}\right)$$

$$v^2 + v^2 \left(\frac{Q^2}{c^2}\right) = Q^2$$

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

$$v^2 = \frac{Q^2}{1 + \frac{Q^2}{c^2}}$$

$$v = \sqrt{\frac{(p/m)^2}{\left(1 + \frac{(p/m)^2}{c^2}\right)}}$$

$$p \simeq \gamma mc$$

$$\begin{aligned} p &\simeq \gamma mc \\ E &= \gamma mc^2 \end{aligned}$$

$$\begin{aligned} pc &\simeq \gamma mc^2 = E \\ p &\simeq \frac{E}{c} \end{aligned}$$

$$\begin{aligned} \mathrm{E} &= (\text{rest energy}) + (\text{kinetic energy}) \\ &= (1)mc^2 \quad + \quad (\gamma - 1)mc^2 \end{aligned}$$

$$p = \frac{E}{c}$$

$$E = h\nu = h\frac{c}{\lambda}$$