Total energy, $E = 2(mc^2)$

$$E = \gamma_p mc^2$$

$$\gamma_p = \frac{E}{mc^2} = 2$$

$$\gamma_p = \frac{1}{\sqrt{1 - u^2/c^2}}$$

So

$$\frac{u}{c} = \sqrt{1 - \frac{1}{\gamma_p^2}} = 0.866$$

Or, $\underline{u = 0.866c}$