161 (3):

This is: $$T = E_a = (\gamma - 1) mc^2 \quad -(1)$$

for all particles.

Energy Conservation

This leads to the same result:

$$m_2 = \frac{E}{c^2}\left(\omega'' + \omega' - \omega\right) - (2)$$

Momentum Conservation

It leads to:

$$\frac{1}{\omega''^2}\left(\omega''^2 - x_2^2\right)\left(\omega''^2 + x_2^2\right) = \frac{1}{\omega^2}\left(\omega^2 - x_1^2\right)\left(\omega^2 + x_1^2\right) + \frac{1}{\omega'^2}\left(\omega'^2 - x_1^2\right)\left(\omega'^2 + x_1^2\right)$$
$$- \frac{2}{\omega\omega'}\left(\omega^2 - x_1^2\right)^{1/2}\left(\omega'^2 - x_1^2\right)\left(\omega + x_1\right)\left(\omega' + x_1\right)\cos\theta \quad -(3)$$

and eq. (2).

Eqs. (2) and (3) can be solved in principle, but are very complicated.