Re-examine invariant mass: M→a b

$$\mathrm{M}^2 = \left(\sqrt{m_a^2 + a_x^2 + a_y^2 + a_z^2} + \sqrt{m_b^2 + b_x^2 + b_y^2 + b_z^2}\right)^2 - \left(a_\mathrm{x} + b_\mathrm{x}\right)^2 - \left(a_\mathrm{y} + b_\mathrm{y}\right)^2 - \left(a_\mathrm{z} + b_\mathrm{z}\right)^2$$

$$= \left(E_a + E_b\right)^2 - \left(a_\mathrm{x} + b_\mathrm{x}\right)^2 - \left(a_\mathrm{y} + b_\mathrm{y}\right)^2 - \left(a_\mathrm{z} + b_\mathrm{z}\right)^2$$

$$= m_a^2 + m_b^2 + 2\left(E_a E_b - a_x b_\mathrm{x} - a_\mathrm{y} b_\mathrm{y} - a_\mathrm{z} b_\mathrm{z}\right)$$

$$= m_a^2 + m_b^2 + 2\left(e_a e_b \cosh(\Delta\eta) - a_x b_x - a_y b_y\right)$$

where $e_a = \sqrt{m_a^2 + a_x^2 + a_y^2}$

$e_b = \sqrt{m_b^2 + a_b^2 + a_b^2}$

and $\eta_a = \frac{1}{2}\ln\left(\left(E_a + a_z\right)/\left(E_a - a_z\right)\right)$

$\eta_b = \frac{1}{2}\ln\left(\left(E_b + b_z\right)/\left(E_b - b_z\right)\right)$

$\Delta\eta = \eta_a - \eta_b$