$$\Gamma_{int,a} = \frac{1}{n_a}\int_{\bar{p}} \frac{1}{2E_a}\int_{\bar{q}} \frac{1}{2E_b}\int_{\bar{p}'} \frac{1}{2E_{a'}}\int_{\bar{q}'} \frac{1}{2E_{b'}} (2\pi)^4 \delta(E_a + E_b - E_{a'} - E_{b'}) \sqrt{-\det g}\, \delta^{(3)}(p_i + q_i - p_i' - q_i')\, f_a(p)\, f_b(q)\, |T|^2$$

$$\Gamma_{int,a} = \frac{|T|^2}{n_a}\int_{\bar{p}} \frac{a}{2p}\int_{\bar{q}} \frac{1}{2m_b}\int_{\bar{p}'} \frac{a}{2p'}\int_{\bar{q}'} \frac{1}{2m_b} (2\pi)^4 \delta(E_a + E_b - E_{a'} - E_{b'}) \sqrt{-\det g}\, \delta^{(3)}(p_i + q_i - p_i' - q_i')\, e^{-\frac{p}{akT}} f_b(q)$$

DONDE SE USÓ $E_b = E_{b'} = m_b$

$$\Gamma_{int,a} \propto \frac{|T|^2}{m_b^2 n_a} \frac{(2\pi)^4}{(\sqrt{-\det g})^3} \int \frac{d^3p\, a}{2p} \int \frac{d^3q}{2} \int \frac{d^3p'\, a}{2p'} \int \frac{d^3q'}{2}\, e^{-p/akT} f_b(q)\, \delta(E_a + E_b - E_{a'} - E_{b'})\, \delta^{(3)}(p_i + q_i - p_i' - q_i')$$

$$q' = p + q - p'$$

$$\Gamma_{int,a} \propto \frac{a^2 |T|^2}{m_b^2 n_a} \frac{(2\pi)^4}{(\sqrt{-\det g})^3} \int \frac{d^3p}{p} \int d^3q \int \frac{d^3p'}{p'}\, e^{-p/akT} f_b(q)\, \delta(E_a(p) + E_b(q) - E_{a'}(p') - E(p+q-p'))$$

but $E_b = E_{b'} \Rightarrow \delta(E_a + E_b - E_{a'} - E_{b'}) = \delta(E_a - E_{a'}) = \delta\left(\frac{p}{a} - \frac{p'}{a}\right)$ con lo cual

$$\Gamma_{int,a} \propto \frac{a^2 |T|^2}{m_b^2 n_a} \int \frac{d^3p}{p} \underbrace{\int d^3q\, f_b(q)}_{n_b} \int \frac{d^3p'}{p'}\, e^{-p/akT}\, \delta(p/a - p'/a)$$

$$\Gamma_{int,a} \propto \frac{a^2 |T|^2 n_b}{m_b^2 n_a} \int \frac{d^3p}{p}\, e^{-p/akT} \int \frac{4\pi\, p'^{\cancel{2}}\, dp'}{\cancel{p'}}\, \delta(p/a - p'/a)$$

$$\Gamma_{int,a} \propto \frac{a^2 |T|^2 n_b}{m_b^2 n_a} \int \frac{d^3p}{p}\, e^{-p/akT}\, 4\pi \underbrace{\int dp'\, p'\, \delta(p/a - p'/a)}_{p} \propto \frac{a^2 |T|^2 n_b}{m_b^2 n_a} \underbrace{\int \frac{d^3p\, \overset{f_a(p)}{\overset{\parallel}{e^{-\frac{p}{akT}}}}\, \cancel{p}}{\cancel{p}}}_{n_a}$$

$$\Gamma_{int,a} \propto \frac{a^2 |T|^2 n_b \cancel{n_a}}{m_b^2 \cancel{n_a}} \quad \text{donde} \quad |T|^2 \propto \sigma_T \quad \therefore \quad \boxed{\Gamma_{int,a} \propto n_b \sigma_T}$$