La lagrangiana luego de la transformación conforme es:

$$\mathcal{L} = -2\xi M\kappa^2\phi\left[\frac{3}{2}\mathcal{T}_f + \mathcal{T}_H + 2(\mathcal{L}_Y - V_H)\right] \tag{1}$$

Para el decaimiento a $\bar{f}f$ tenemos la contribución de la parte cinética de la lagrangiana de Dirac y el término de masa

$$\mathcal{L}_{f\bar{f}\phi} = -\xi M\kappa^2\phi(-3\mathcal{T}_f + 4\mathcal{L}_Y) \tag{2}$$

$$\mathcal{L}_{f\bar{f}\phi} = -\xi M\kappa^2\phi(-3i\bar{f}\not{\partial}f + 4m_f\bar{f}f)$$

Entonces el vértice es:

$$i\xi M\kappa^2(3i\not{p} - 4m_f) \tag{3}$$

Como el vértice contiene siempre un fermión y un anti fermión podemos usar $\not{p}u_s(p) = mu_s$ y entonces el vértice queda así:

$$i\xi M\kappa^2 m_f(3i - 4) \tag{4}$$

Para el decaimiento a $q\bar{q}g$ el vértice es

$$-3i\kappa^2\xi M g_s t^a\gamma^\mu \tag{5}$$

Y la amplitud

$$iM_{if} = \bar{u}_s c_i^\dagger[-3i\kappa^2\xi M g_s t^a\gamma^\mu]v_{s'}c_j\epsilon_\mu^* a_a^* \tag{6}$$

$$= -3i\kappa^2\xi M g_s[\bar{u}_s\gamma^\mu v_{s'}](c_i^\dagger t^a c_j)\epsilon_\mu^* a_a^*$$

$$\mid M_{if}\mid^2 = 9\kappa^4\xi^2M^2g_s^2[\bar{u}_s\gamma^\mu v_{s'}]^2(c_i^\dagger\frac{\lambda^a}{2}c_j)(c_j^\dagger\frac{\lambda^b}{2}c_i)(\epsilon_\mu^*\epsilon_\nu)(a_a^*a_b)$$

Suma de espín y polarizaciones

$$\mid M_{if}\mid^2 = \frac{9}{4}\kappa^4\xi^2M^2g_s^2Tr[(\not{p}_1 + m)\gamma^\mu(\not{p}_2 - m)\gamma^\nu]Tr[\lambda^a\lambda^b](-g_{\mu\nu})(a_a^*a_b) \tag{7}$$

$$Tr[\lambda^a\lambda^b]a_a^*a_b = 2\delta^{ab}a_a^*a_b = 2a^*\cdot a = 16$$

$$-g_{\mu\nu}Tr[(\not{p}_1 + m)\gamma^\mu(\not{p}_2 - m)\gamma^\nu] = -g_{\mu\nu}Tr[\not{p}_1\gamma^\mu\not{p}_2\gamma^\nu - m^2\gamma^\mu\gamma^\nu] = -4g_{\mu\nu}(p_1^\mu p_2^\nu + p_2^\mu p_1^\nu - (p_1\cdot p_2)g^{\mu\nu} - m^2g^{\mu\nu})$$

$$= 8(p_1\cdot p_2 + 2m^2)$$

Entonces

$$\mid M_{if}\mid^2 = 9*4*8\kappa^4\xi^2M^2g_s^2(p_1\cdot p_2 + 2m^2) \tag{8}$$