

$$K = H_u^\dagger e^{g_1 V_1} H_u + H_d^\dagger e^{g_1 V_1} H_d + \frac{2M_{v'}^2}{(g_1^2 + g_2^2)} \text{Tr} \left[e^{g_2 V_2} e^{g_1 V_1} \right]$$