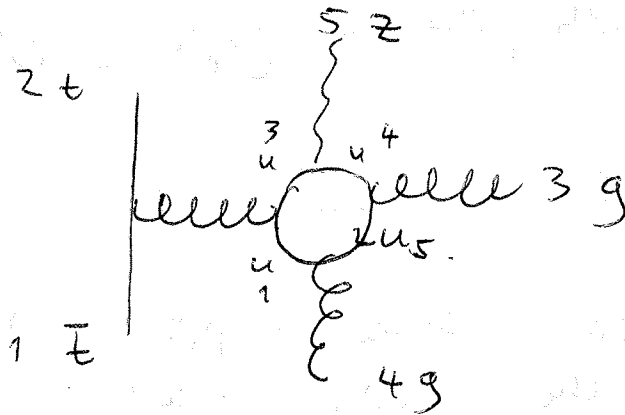


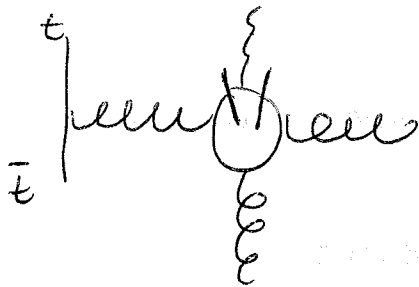
$gg \rightarrow t\bar{t}Z$  through a fermion loop.


RR 05/22/2013.

Diagram:



Consider double cut 34:

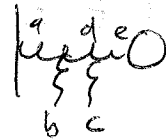


leads to trees:  $\mu n^2$  ;  +  $\text{ie } n_1 = 2$   
 $n_2 = n_3 = n_4 = 0$

This will reconstruct amplitudes like



These have color factor

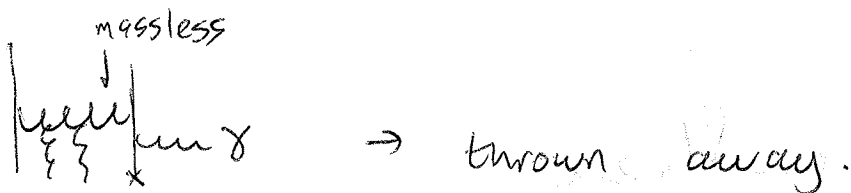


$$(T^a)_{i_1 i_2} f^{adb} f^{dec} (T^c)_{i_3 i_4} \delta_{i_3 i_4}.$$

$$= (T^a)_{i_1 i_2} f^{adb} f^{dec} \text{Tr}(T^c) = 0.$$

& therefore should not be included.

This problem only happens for MASSIVE, COLORLESS particles on the loop, since for a massless particle, ~~these~~ the gluon prop is <sup>massless</sup> ~~zero~~ & therefore thrown away at the level of helicities:



Hence, we have to throw these away when the particle is massive, for reasons of color rather than kinematics. They are color-zero, but the primitives / tree-level amplitudes don't know this!

A similar thing happens w. massive particles in the loop.