Higgs decay in two photons

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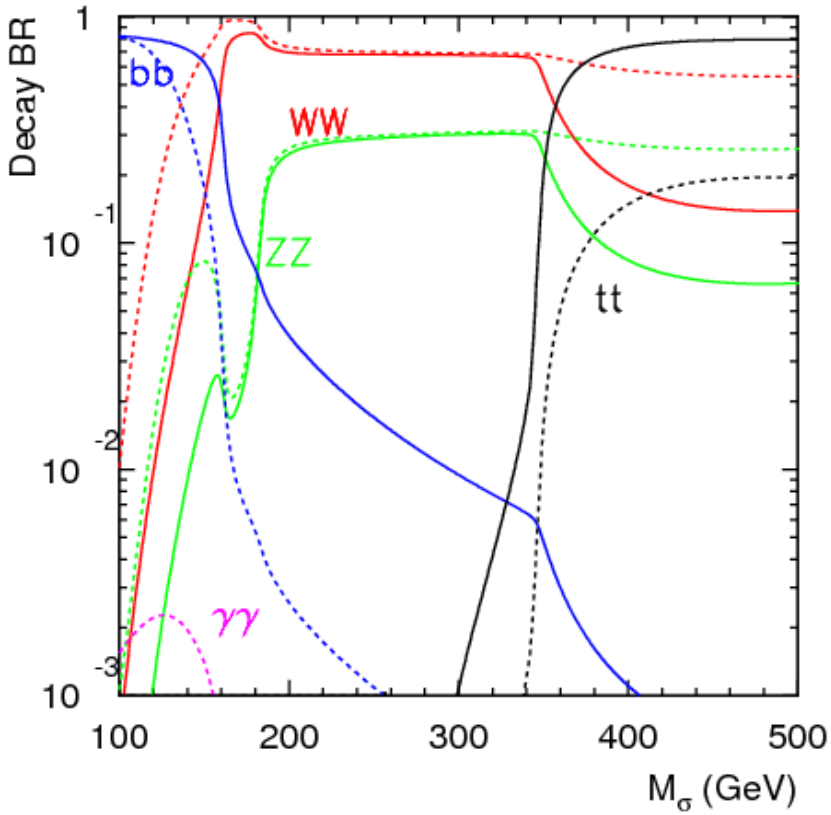
We want to explain the observed enhancement of the Higgs decay ratio in two photons.



We added at the SM Lagrangian one extra interaction term, involving a new massive vector field Z'_μ:

$$\mathcal{L}_{ZZ'A} = \alpha g^3 \epsilon^{\mu\nu\rho\sigma} Z_\mu Z'_\nu \left(\partial_\rho A_\sigma - \partial_\sigma A_\rho\right),$$

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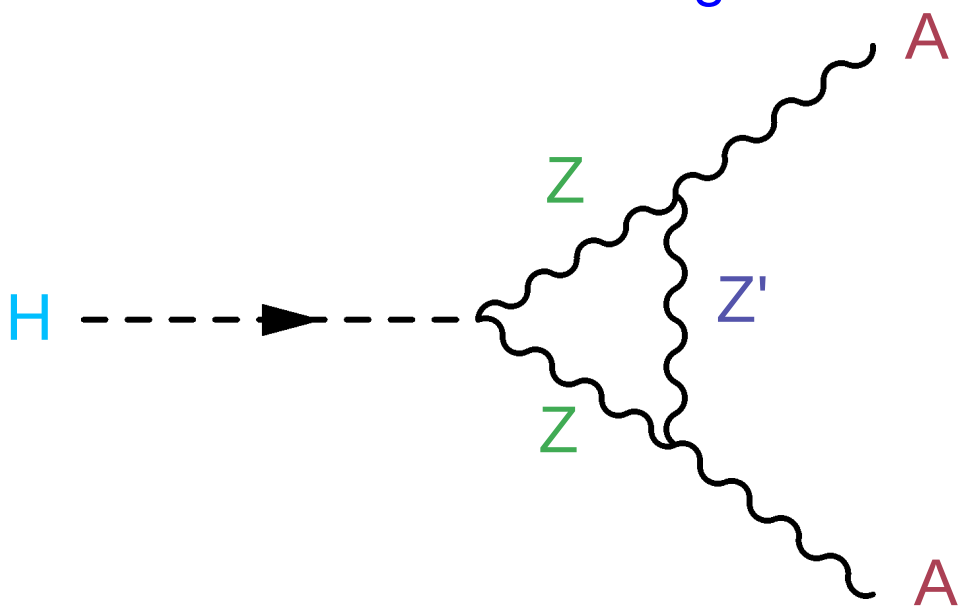
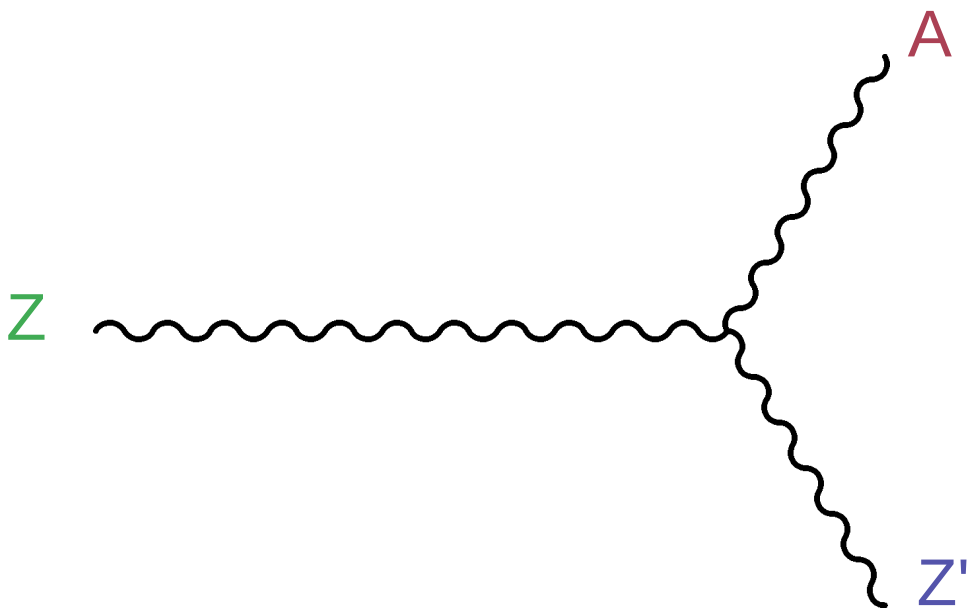
such that the diagram

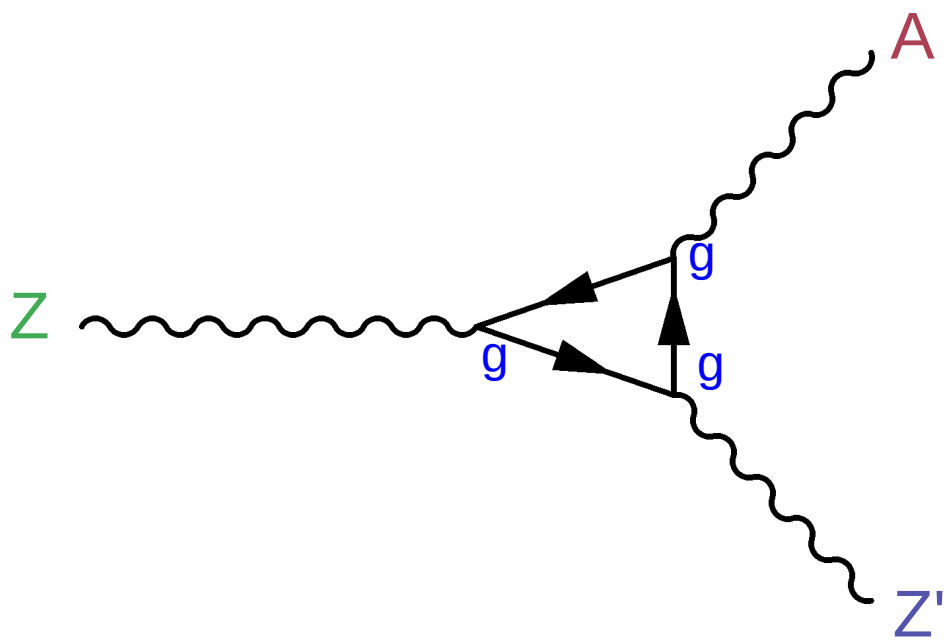


contributes to the $H \to \gamma\gamma$ process.

Attention : the coupling we added is anomalous and the diagram just written turns out to be UV quadratically divergent. Therfore we think of a microscopic theory with heavy chiral fermions such that the coupling



is given by the diagram



once one integrates out the heavy fermions, whose masses are obtained as a result of a certain Higgs mechanism.

The microscopic theory is finite, and so must be the macroscopic theory. Therefore one has to find other effective couplings that are allowed by the microscopic theory and that cancel the divergences in the $H \to \gamma\gamma$ computation.

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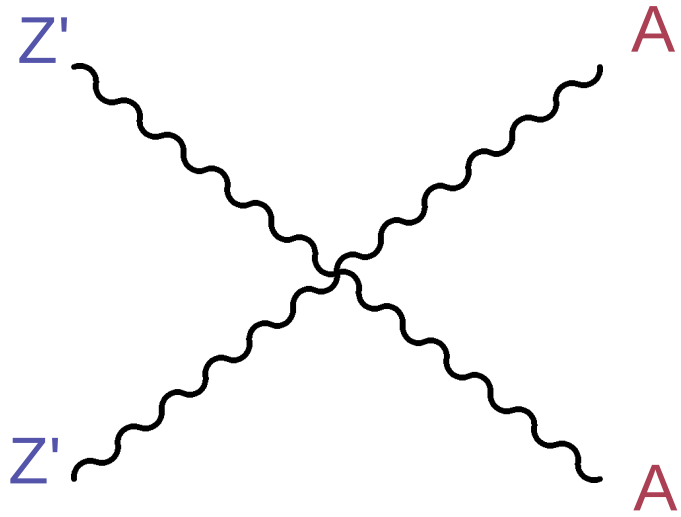
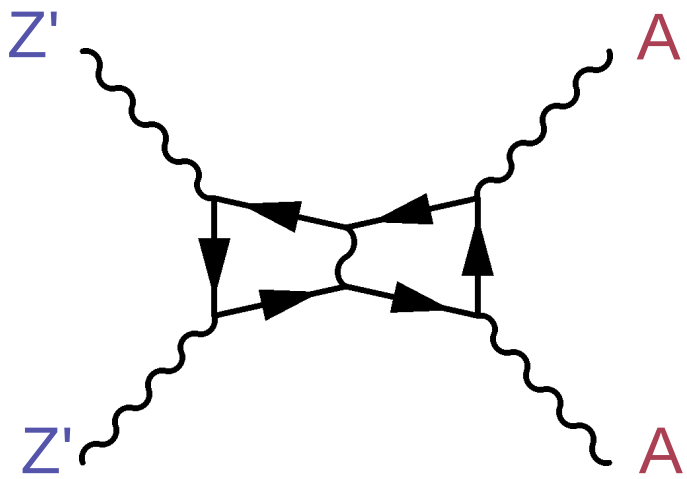
For instance we have an effective $Z'Z'AA$ vertex



coming from microscopic diagrams like



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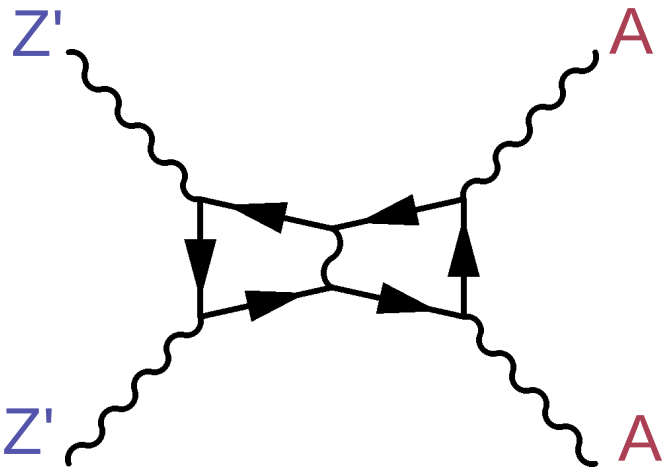
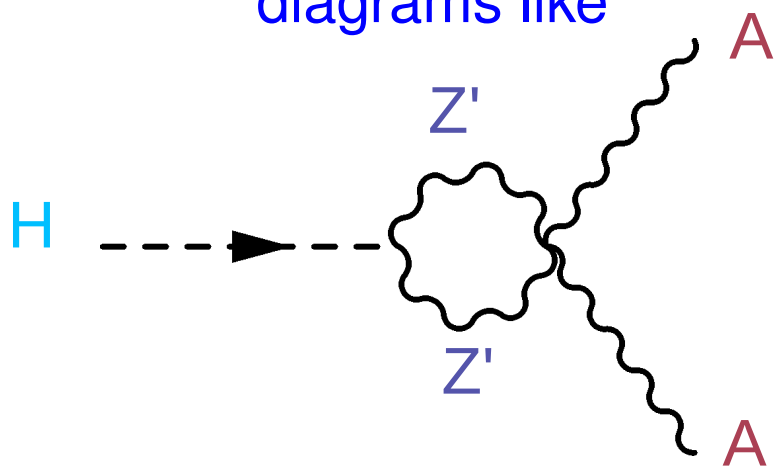


which add several terms to the effective lagrangian. In this way diagrams like



Can compete with the “triangle” diagram and cancel the divergences.