Decaimiento del Higgs a dos fotones en VHDMM

In[•]:=

```
Import["https://raw.githubusercontent.com/FeynCalc/feyncalc/master/install.m"];
InstallFeynCalc[]
```

Out[•]= $Aborted

In[•]:=

```
<< FeynCalc`;
```

FeynCalc 9.2.0. For help, use the documentation center, check out the wiki or write to the mailing list.

See also the supplied examples. If you use FeynCalc in your research, please cite

- V. Shtabovenko, R. Mertig and F. Orellana,
  Comput. Phys. Commun., 207C, 432–444, 2016, arXiv:1601.01167
- R. Mertig, M. Böhm, and A. Denner, Comput. Phys. Commun., 64, 345–359, 1991.

Definiciones

```
In[∘]:= dm[mu_] := DiracMatrix[mu]
dm[5] := DiracMatrix[5]
ds[p_] := DiracSlash[p]
mt[mu_, nu_] := MetricTensor[mu, nu]
fv[p_, mu_] := FourVector[p, mu]
epsilon[a_, b_, c_, d_] := LeviCivita[a, b, c, d]
id[n_] := IdentityMatrix[n]
sp[p_, q_] := ScalarProduct[p, q]
li[mu_] := LorentzIndex[mu]
prop[p_, m_] := ds[p] + m
PR := (1 + dm[5]) / 2
PL := (1 - dm[5]) / 2
ϵA[p_, mu_] := PolarizationVector[p, mu]
```

$$\text{propz}[p\_, mu\_, nu\_] := -I * \left(\text{MetricTensor}[mu, nu] - \frac{\text{fv}[p, mu] * \text{fv}[p, nu]}{MZ^2}\right) \Big/ \left(p^2 - MZ^2\right)$$

$$\text{propw}[p\_, mu\_, nu\_] := -I * \left(\text{MetricTensor}[mu, nu] - \frac{\text{fv}[p, mu] * \text{fv}[p, nu]}{MW^2}\right) \Big/ \left(p^2 - MW^2\right)$$

$$\text{propW}[p\_, mu\_, nu\_] := I * \left(-\text{mt}[mu, nu] + \frac{\text{fv}[p, mu] * \text{fv}[p, nu]}{MW^2}\right) *$$

```
  FeynAmpDenominator[PropagatorDenominator[p, MW]]
propf[p_, Mf_] := ⅈ * prop[p, Mf] * FeynAmpDenominator[PropagatorDenominator[p, Mf]]
```

$$\text{propV}[p\_, mu\_, nu\_] := I * \left(-\text{mt}[mu, nu] + \frac{\text{fv}[p, mu] * \text{fv}[p, nu]}{MVC^2}\right) *$$

```
  FeynAmpDenominator[PropagatorDenominator[p, MVC]]
```

Feynman Rules

Feynman Rules

```
In[•]:= (*SM*)

(*HWW*)
ΓHWW[mu_, nu_] := i * g * MW * mt[mu, nu]
(*AWW*)
ΓAWW[p1_, p2_, p3_, mu_, nu_, rho_] := -i * e * ((-fv[p1, rho] + fv[p2, rho]) * mt[mu, nu] +
    (-fv[p2, mu] + fv[p3, mu]) * mt[nu, rho] + (-fv[p3, nu] + fv[p1, nu]) * mt[mu, rho])
(*AAWW*)
ΓAAWW[mu_, nu_, rho_, sig_] := -i * e^2 *
   (2 mt[mu, nu] * mt[rho, sig] - mt[mu, rho] * mt[nu, sig] - mt[mu, sig] * mt[nu, rho])

(*ffH*)
ΓHff[Mf_] = -i * (e * Mf)/(2 MW * sw);
(*Aff*)
ΓAff[mu_, Q_] = -i * Q * e * dm[mu];

(*VHM*)

(*HVCVC*) (*ok*)
ΓHVCVC[mu_, nu_] := -2 * I * (MW * sw * λ2)/e mt[mu, nu]
(*AVCVC*)
ΓAVCVC[p1_, p2_, p3_, mu_, nu_, rho_] := -i * e * (fv[p2, rho] * mt[mu, nu] +
    (-fv[p2, mu] + fv[p3, mu]) * mt[nu, rho] + -fv[p3, nu] * mt[mu, rho])
(*AAWW*)
ΓAAVCVC[mu_, nu_, rho_, sig_] := -i * e^2 *
   (2 mt[mu, nu] * mt[rho, sig] - mt[mu, rho] * mt[nu, sig] - mt[mu, sig] * mt[nu, rho])
```

Restrictions

Restrictions

```
In[•]:= onshell = {sp[k1, k1] → 0, sp[k2, k2] → 0, sp[k1, k2] -> MH^2/2};
R = p - k1;
q = p - k1 - k2;
```

Amplitudes

Amplitudes

1.– W's;

In[∘]:=
```
MW1 = 2 * Simplify[
    Contract[ΓHWW[alpha, a].propW[p, a, beta].ΓAWW[-k1, p, -R, mu, beta, rho].
       propW[R, rho, sig].ΓAWW[-k2, R, -q, nu, sig, gamma].
       propW[q, gamma, alpha]].ϵA[k1, mu].ϵA[k2, nu]];
MW12 = FullSimplify[MW1 /. onshell];
MW13 = Simplify[PaVeReduce[OneLoop[p, MW12]]];
MW14 = Series[MW13, {sp[k1, k1], 0, 1}, {sp[k2, k2], 0, 1}];
```

In[∘]:=
```
MW15 = Normal[MW14] /. {D → 4}
```

Out[∘]=

$$-\frac{1}{3\,\mathrm{MW}^3\,\overline{\mathrm{k1}}^2}\, i\, g\, \pi^2 \left(\overline{\mathrm{k1}}\cdot\overline{\mathrm{k2}}\right)\left(2\left(\overline{\mathrm{k1}}\cdot\overline{\varepsilon}(\mathrm{k1})\right)\left(\overline{\mathrm{k2}}\cdot\overline{\varepsilon}(\mathrm{k2})\right)\mathrm{A}_0\!\left(\mathrm{MW}^2\right) - 2\,\mathrm{MW}^2\left(\overline{\mathrm{k1}}\cdot\overline{\varepsilon}(\mathrm{k1})\right)\left(\overline{\mathrm{k2}}\cdot\overline{\varepsilon}(\mathrm{k2})\right)\mathrm{B}_0\!\left(0,\,\mathrm{MW}^2,\,\mathrm{MW}^2\right)\right) e^2 - \frac{i\, g\, \pi^2 \langle\!\langle 1 \rangle\!\rangle \left(\langle\!\langle 1 \rangle\!\rangle\right) e^2}{3\,\mathrm{MW}^3 \langle\!\langle 1 \rangle\!\rangle^2} + \langle\!\langle 1 \rangle\!\rangle + \frac{\langle\!\langle 1 \rangle\!\rangle}{96\,\langle\!\langle 1 \rangle\!\rangle} + \overline{\mathrm{k1}}^2 \left(\frac{1}{6\,\mathrm{MW}^3\,\overline{\mathrm{k2}}^2} i\, g\, \pi^2 \left(2\left(\overline{\mathrm{k2}}\cdot\overline{\varepsilon}(\mathrm{k1})\right)\left(\overline{\mathrm{k2}}\cdot\overline{\varepsilon}(\mathrm{k2})\right)\mathrm{A}_0\!\left(\mathrm{MW}^2\right) - 2\,\mathrm{MW}^2\left(\langle\!\langle 1 \rangle\!\rangle\right)\left(\langle\!\langle 1 \rangle\!\rangle\right)\mathrm{B}_0\!\left(0,\,\mathrm{MW}^2,\,\mathrm{MW}^2\right)\right) e^2 + \frac{i\, g\, \pi^2 \left(\langle\!\langle 1 \rangle\!\rangle\right) e^2}{96\,\mathrm{MW}^5} + \frac{i\, g\, \pi^2 \langle\!\langle 1 \rangle\!\rangle^2 \left(\langle\!\langle 6 \rangle\!\rangle + \langle\!\langle 1 \rangle\!\rangle\right) e^2}{96\,\mathrm{MW}^5}\right)$$

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