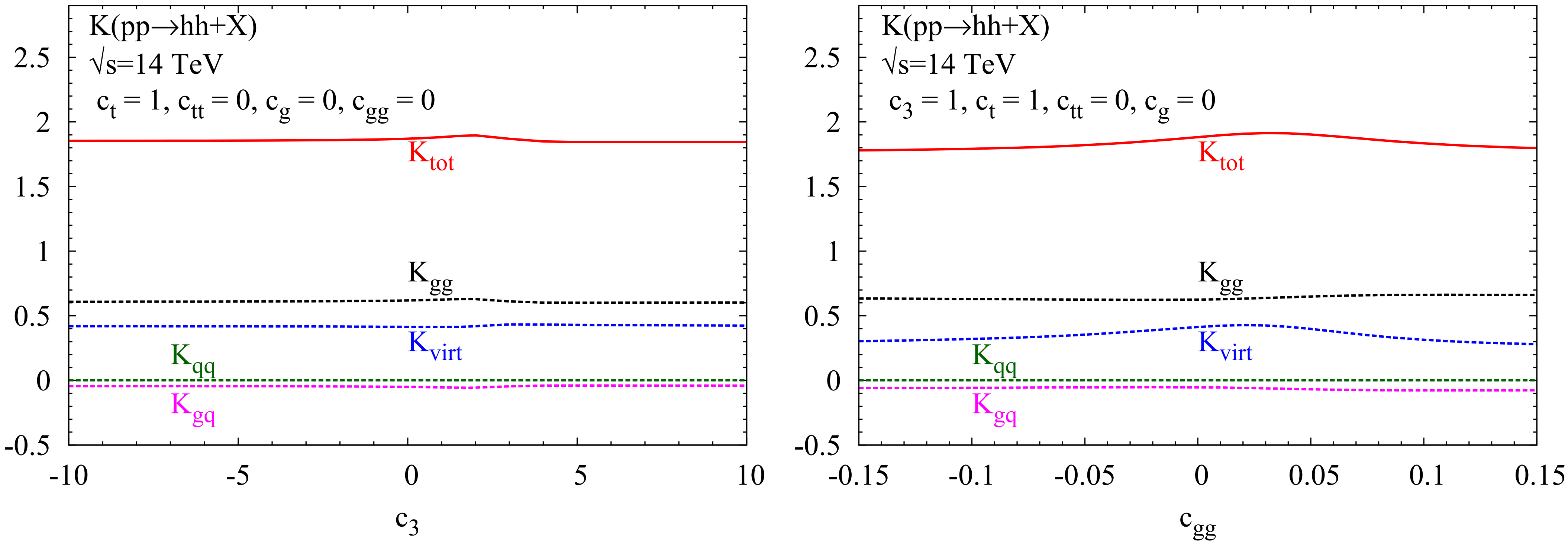
VARYING THE HIGGS SELF – COUPLING AS PART OF ELECTROWEAK CORRECTIONS

Michael Spira (PSI)

$gg \to HH$ $\quad \Delta\sigma/\sigma \approx -\Delta c_3/c_3$

- dim6 $\to$ large impact on cxn, small impact on K-factor,

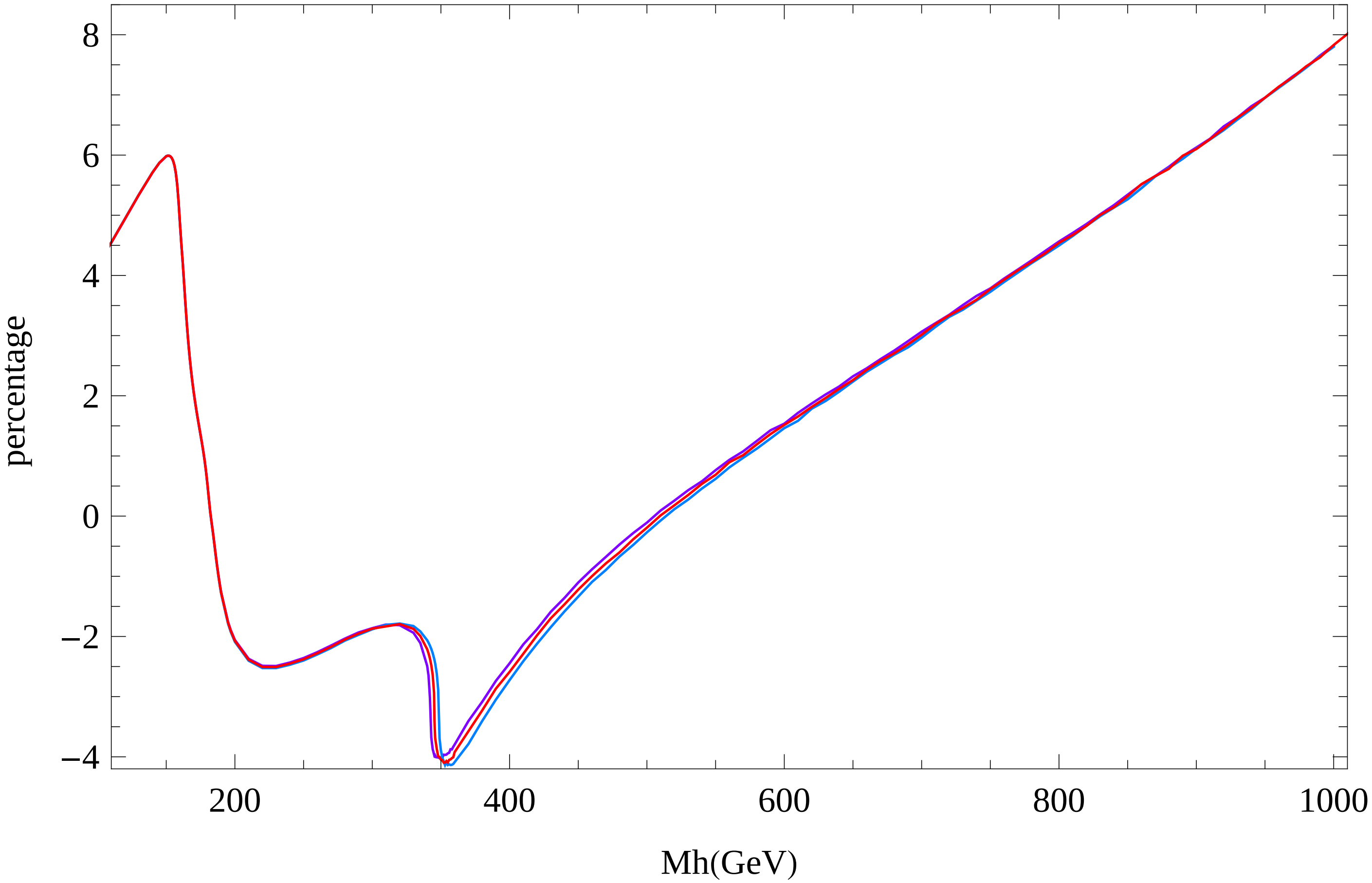
$$\mathcal{L}_{eff} = -m_t \bar{t} t \left(c_t \frac{h}{v} + c_{tt} \frac{h^2}{2v^2} \right) - c_3 \frac{1}{6} \left(\frac{3M_h^2}{v} \right) h^3 + \frac{\alpha_s}{\pi} G^{a\,\mu\nu} G^a_{\mu\nu} \left(c_g \frac{h}{v} + c_{gg} \frac{h^2}{2v^2} \right)$$



Gröber, Mühlleitner, S., Streicher

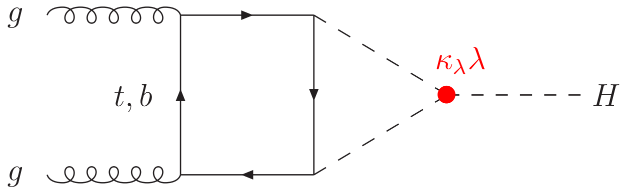
- missing: dim6 chromomagn. operator $c_{tg} \frac{g_s m_t}{2v^3} (v+H) G^a_{\mu\nu} \left[\overline{t_L} \sigma^{\mu\nu} T^a t_R + h.c. \right]$
- disentanglement: distributions boosted $\leftrightarrow$ threshold
- electroweak corrections unknown $\to$ problem?

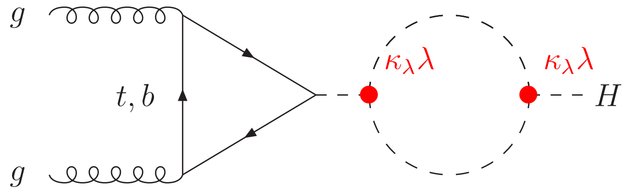
$gg \longrightarrow H$



Actis, Passarino, Sturm, Uccirati

full NLO electroweak corrections

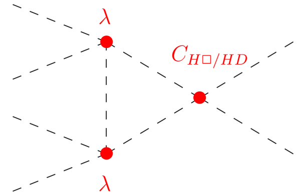


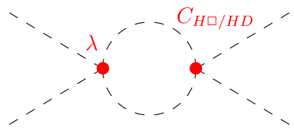


$$\kappa_\lambda = 1 - 2C_H \frac{v^2}{M_H^2}$$

- finite partial correction due to purely scalar interaction
- RGEs: $t = \log \mu^2/\mu_0^2$ $\quad C_H (H^\dagger H)^6 + C_{H\Box}(H^\dagger H)\Box(H^\dagger H) + C_{HD}|H^\dagger D_\mu H|^2$

$$
\begin{aligned}
\frac{\partial \lambda}{\partial t} &= (SM) + \frac{M_H^2}{32\pi^2}\left\{12C_H - 32\lambda^2 C_{H\Box} + 12\lambda C_{HD} + \cdots\right\} \\
\frac{\partial C_H}{\partial t} &= \frac{1}{32\pi^2}\left\{108\lambda C_H - 160\lambda^2 C_{H\Box} + 48\lambda^2 C_{HD} + \cdots\right\} \\
\frac{\partial C_{H\Box}}{\partial t} &= \frac{24\lambda}{32\pi^2} C_{H\Box} \\
\frac{\partial C_{HD}}{\partial t} &= \frac{12\lambda}{32\pi^2} C_{HD}
\end{aligned}
$$

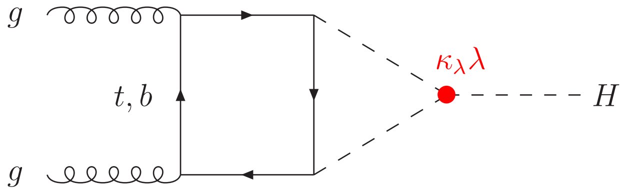


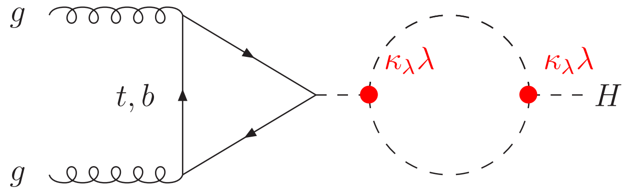


$$v = \left[1 + \frac{3}{8} C_H \frac{v^2}{\lambda}\right] v_{SM} \qquad M_H^2 = 2\lambda v^2 \left[1 - \frac{3}{2} C_H \frac{v^2}{\lambda} + 2c_{kin}\right]$$

$$c_{kin} = \left[C_{H\Box} - \frac{1}{4} C_{HD}\right] v^2 \qquad H^0 = \frac{(1 + c_{kin})h + v}{\sqrt{2}}$$

Jenkins, Manohar, Trott





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$$\frac{\partial \lambda}{\partial t} = (SM) + \frac{M_H^2}{32\pi^2}\left\{12 C_H - 32\lambda^2 C_{H\Box} + 12\lambda C_{HD} + \cdots\right\}$$

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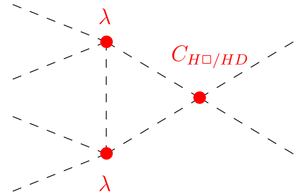
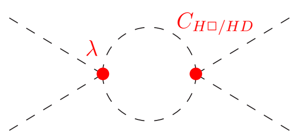
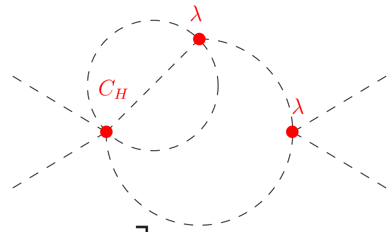
$$\frac{\partial C_{H\Box}}{\partial t} = \frac{24\lambda}{32\pi^2} C_{H\Box} + \mathcal{O}\left(\frac{\lambda^2 C_H}{(16\pi^2)^3}\right)$$

$$\frac{\partial C_{HD}}{\partial t} = \frac{12\lambda}{32\pi^2} C_{HD} + \mathcal{O}\left(\frac{\lambda^2 C_H}{(16\pi^2)^3}\right)$$







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Jenkins, Manohar, Trott

- disentanglement? (analogous for VBF, VH, $t\bar{t}H$, $\Gamma_{\gamma\gamma,gg,VV,f\bar{f}}$)

- issue: direct $\leftrightarrow$ indirect contribution

- direct contribution: explicit access to ind. couplings via distributions $\Rightarrow$ exclusive calculations

- indirect contribution: indicator of direction, not unique

- both contribute to global fit $\Rightarrow$ both relevant

- complete calculations required [linear dim6 $\leftrightarrow$ non-linear (derivatives)]

- variation of single Wilson coefficient: consistency test (not more!)

- no known theory with *only* Higgs self-interactions modified [not to be confused with Higgs self-interactions providing *largest* deviation from SM]