PRECISE PREDICTIONS ON HIGGS DECAYS TO BOTTOM QUARKS AND GLUONS

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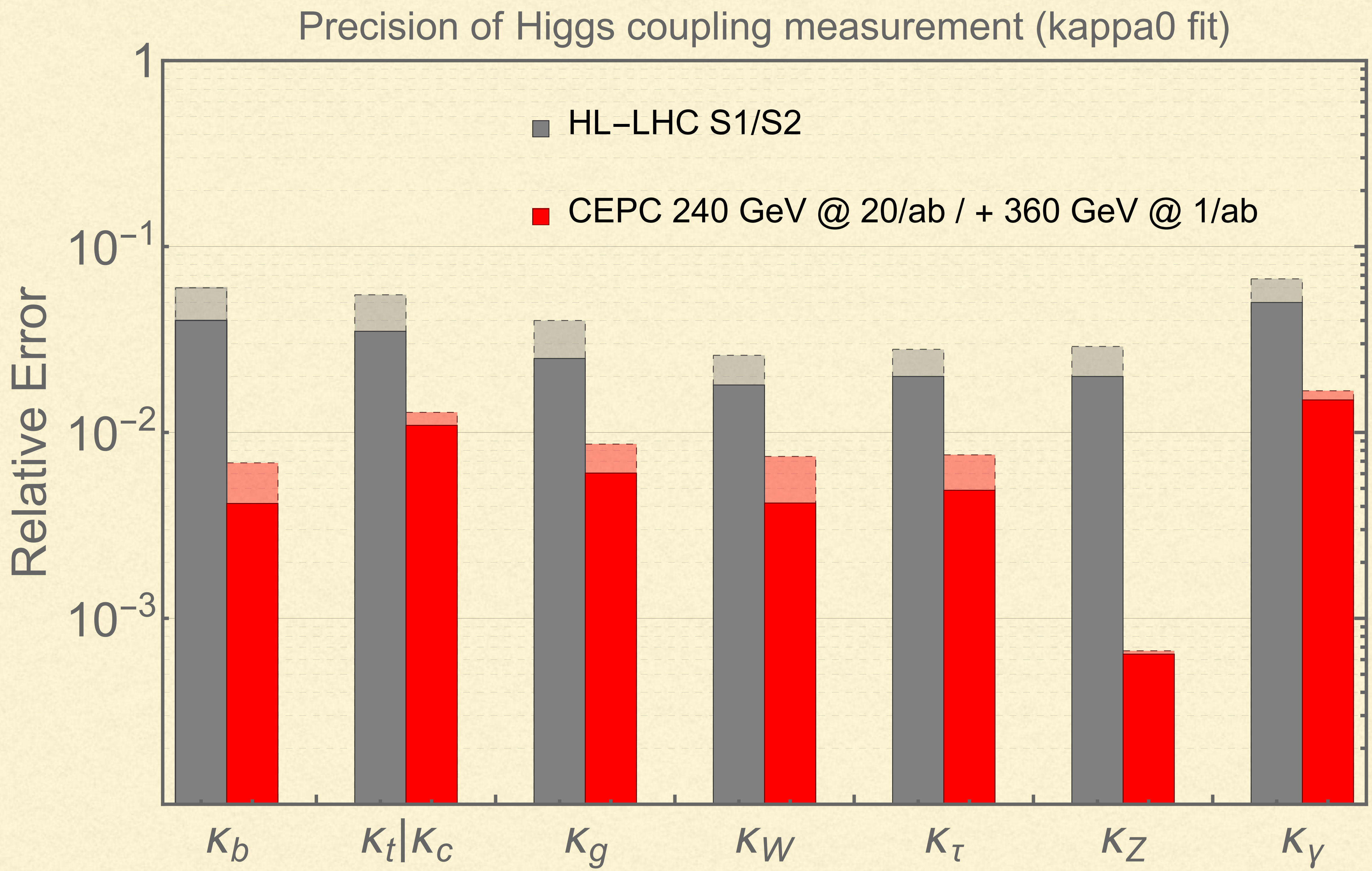
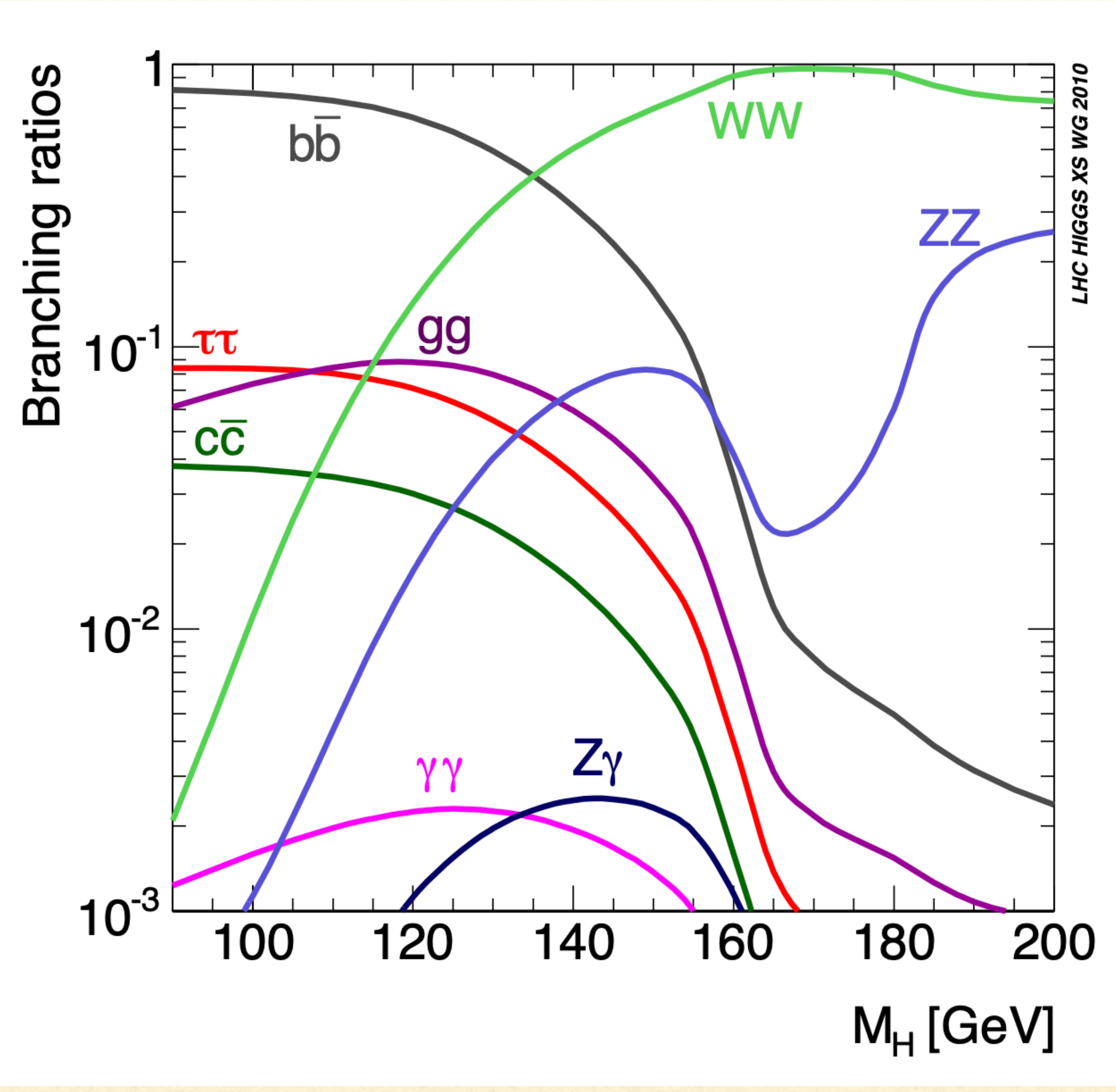
arXiv: 2310.20514, 2411.07493, 2503.22169
with Xing Wang, Yefan Wang, Da-Jiang Zhang

	240 GeV, 20 ab^{-1}		360 GeV, 1 ab^{-1}		
	ZH	**vvH**	ZH	**vvH**	**eeH**
inclusive	**0.26%**		**1.40%**	\	\
H→bb	**0.14%**	**1.59%**	**0.90%**	**1.10%**	**4.30%**
H→cc	**2.02%**		**8.80%**	**16%**	**20%**
H→gg	**0.81%**		**3.40%**	**4.50%**	**12%**
H→WW	**0.53%**		**2.80%**	**4.40%**	**6.50%**
H→ZZ	**4.17%**		**20%**	**21%**	
$H \to \tau\tau$	**0.42%**		**2.10%**	**4.20%**	**7.50%**
$H \to \gamma\gamma$	**3.02%**		**11%**	**16%**	
$H \to \mu\mu$	**6.36%**		**41%**	**57%**	
$H \to Z\gamma$	**8.50%**		**35%**		
$\mathrm{Br}_{upper}(H \to inv.)$	**0.07%**				
Γ_H	**1.65%**		**1.10%**		

"Physics potential of the CEPC", 2205.08553

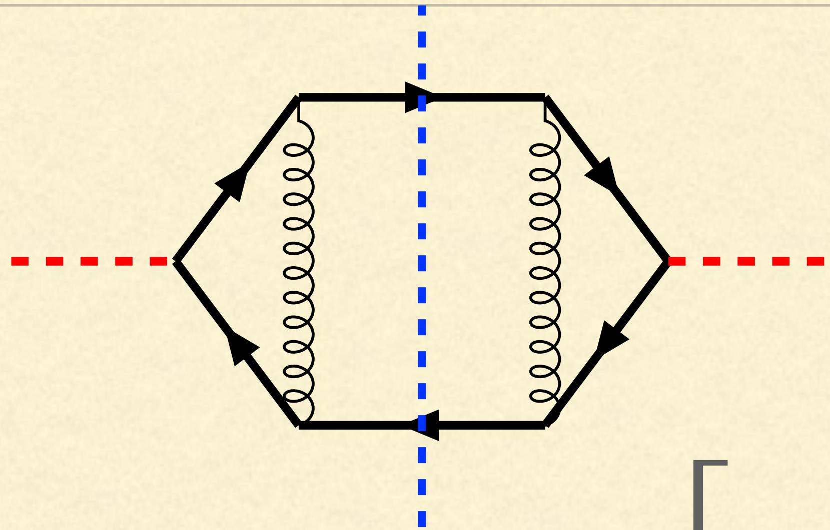


"Physics potential of the CEPC", 2205.08553



"Handbook of LHC Higgs cross sections", 1101.0593

HIGGS DECAYS TO $b\bar{b} + X$



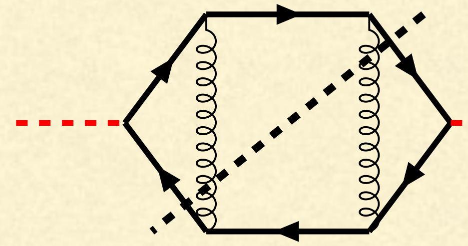
The decay rate is proportional to y_b^2.

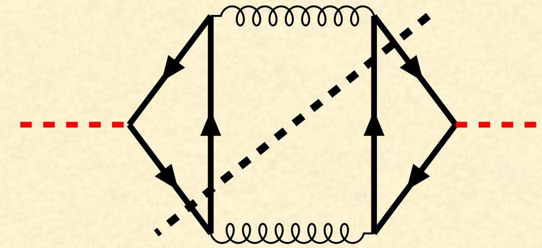
$$\Gamma(H \to b\bar{b}) = \Gamma_{\text{LO}} \left[1 + \frac{\alpha_s(\mu)}{\pi} X_1^{y_b y_b} + \left(\frac{\alpha_s(\mu)}{\pi} \right)^2 (X_2^{y_b y_b} + X_2^{y_b y_t}) \right]$$

$$\Gamma_{\text{LO}} = \frac{N_c}{16\pi} \bar{y}_b^2 m_H \left(1 - \frac{4}{z} \right)^{3/2}, \quad z \equiv \frac{m_H^2}{m_b^2}$$

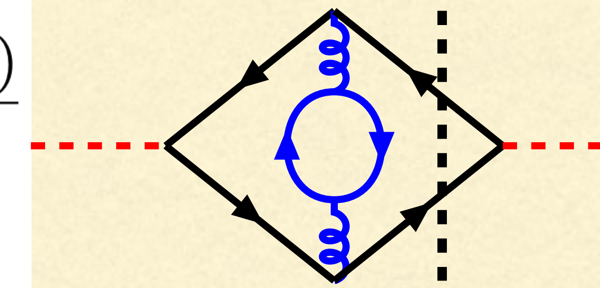
$$X_1^{y_b y_b} = 2 \log \left(\frac{\mu^2}{m_H^2} \right) + \frac{17}{3} + \frac{12 \log(z) + 10}{z} + \mathcal{O}(z^{-2})$$

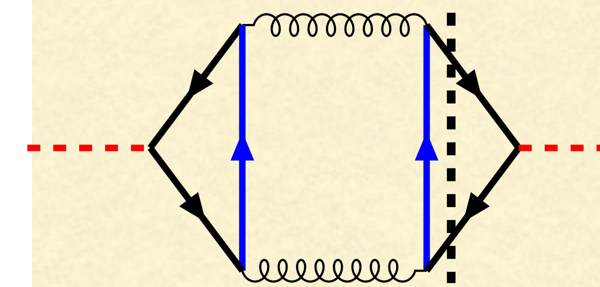
$$X_2^{y_b y_b} = \tilde{X}_{2,b\bar{b}}^{y_b y_b} + X_{2,b\bar{b}b\bar{b}}^{y_b y_b}$$





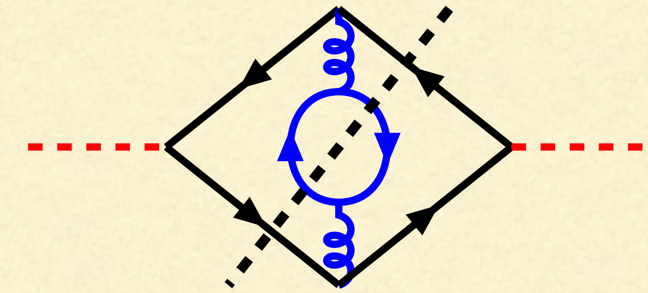
$$\begin{aligned}
\tilde{X}_{2,b\bar{b}}^{y_b y_b}|_{z\to\infty} = &-\frac{\log^3(z)}{27} + \frac{19\log^2(z)}{54} + \frac{2\zeta(3)\log(z)}{9} + \frac{\pi^2\log(z)}{54} \\
&- \frac{503\log(z)}{324} + \frac{55-2n_l}{12}\log^2\left(\frac{\mu^2}{m_H^2}\right) + \frac{307-11n_l}{9}\log\left(\frac{\mu^2}{m_H^2}\right) + \frac{2(3n_l-86)\zeta(3)}{9} \\
&+ \frac{(3n_l-98)\pi^2}{54} - \frac{19\pi^4}{1620} + \frac{2\log(2)\pi^2}{9} + \frac{98681-3510n_l}{1296} \\
&+ \frac{1}{z}\left(-\frac{5\log^4(z)}{36} + \frac{\log^3(z)}{18} + \frac{\pi^2\log^2(z)}{18} - \frac{(2n_l-9)\log^2(z)}{2} - \frac{7\pi^2\log(z)}{54} \right. \\
&- (2n_l-55)\log(z)\log\left(\frac{\mu^2}{m_H^2}\right) - \frac{(117n_l-3625)\log(z)}{27} - 4\zeta(3)\log(z) \\
&- \frac{71\pi^4}{540} + \frac{4\pi^2\log(2)}{3} - \frac{5(2n_l-55)}{6}\log\left(\frac{\mu^2}{m_H^2}\right) + \frac{430\zeta(3)}{9} - \frac{(9n_l-175)\pi^2}{9} \\
&\left. + \frac{36829-1548n_l}{324}\right) + \mathcal{O}(z^{-2}), \qquad (5.
\end{aligned}$$

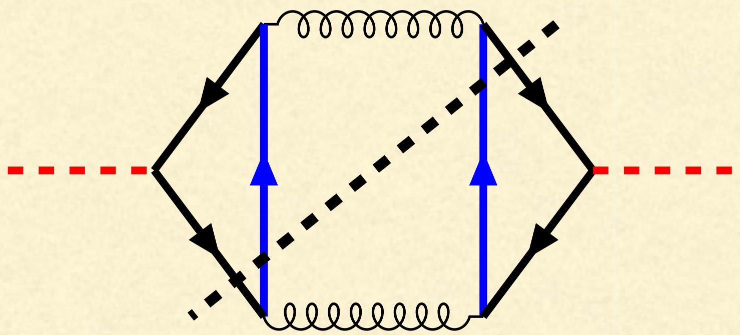




It is divergent in the massless limit!

$$X^{y_b y_b}_{2,b\bar{b}b\bar{b}}|_{z\to\infty} = \frac{\log^3(z)}{27} - \frac{19\log^2(z)}{54} - \frac{2\zeta(3)\log(z)}{9} - \frac{\pi^2\log(z)}{54} + \frac{503\log(z)}{324} + \frac{19\pi^4}{1620} - \frac{2\log(2)\pi^2}{9} + \frac{5\zeta(3)}{18} + \frac{31\pi^2}{108} - \frac{2491}{648} + \frac{1}{z}\left(\frac{\log^4(z)}{18} - \frac{\log^3(z)}{18} - \frac{2\pi^2\log^2(z)}{9} + \frac{7\pi^2\log(z)}{54} - \frac{\log^2(z)}{3} + 4\zeta(3)\log(z) + \frac{211\log(z)}{54} + \frac{13\pi^4}{270} - \frac{7\zeta(3)}{9} + \frac{19\pi^2}{18} - \frac{8353}{324}\right) + \mathcal{O}(z^{-2})\,.$$

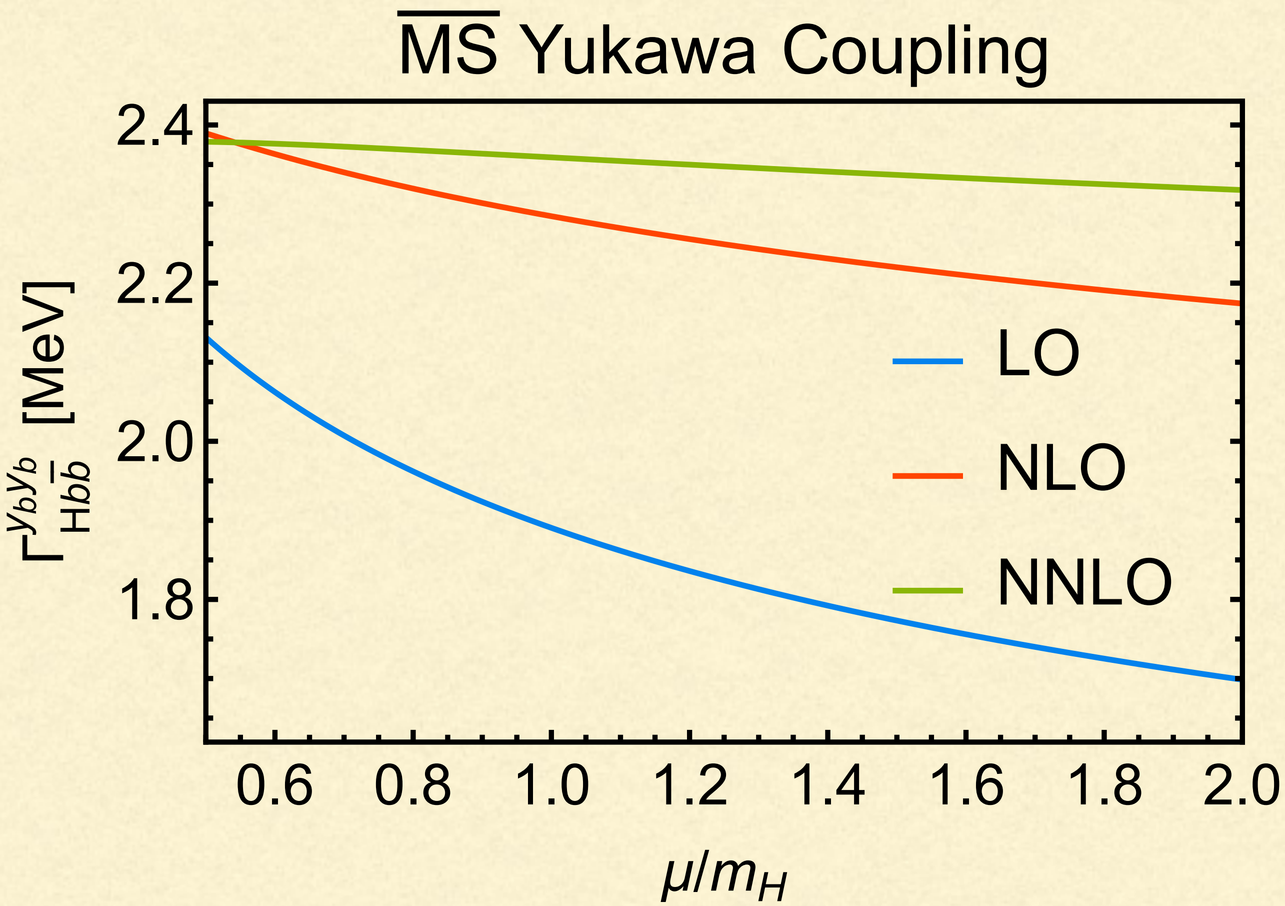




$$X^{y_b y_b}_{2}|_{z\to\infty\,(m_b^2\to 0)} = \frac{55-2n_l}{12}\log^2\left(\frac{\mu^2}{m_H^2}\right) + \frac{307-11n_l}{9}\log\left(\frac{\mu^2}{m_H^2}\right) + \frac{(4n_l-113)\zeta(3)}{6} + \frac{(2n_l-55)\pi^2}{36} + \frac{10411-390n_l}{144} + \frac{1}{z}\left(-\frac{\log^4(z)}{12} - \frac{\pi^2\log^2(z)}{6} - \frac{(6n_l-25)\log^2(z)}{6} - \frac{(26n_l-829)\log(z)}{6} - (2n_l-55)\log(z)\log\left(\frac{\mu^2}{m_H^2}\right) - \frac{5(2n_l-55)}{6}\log\left(\frac{\mu^2}{m_H^2}\right) - \frac{\pi^4}{12} + \frac{4\pi^2\log(2)}{3} + 47\zeta(3) - \frac{(2n_l-41)\pi^2}{2} + \frac{791-43n_l}{9}\right) + \mathcal{O}(z^{-2})\,. \quad (5.12)$$

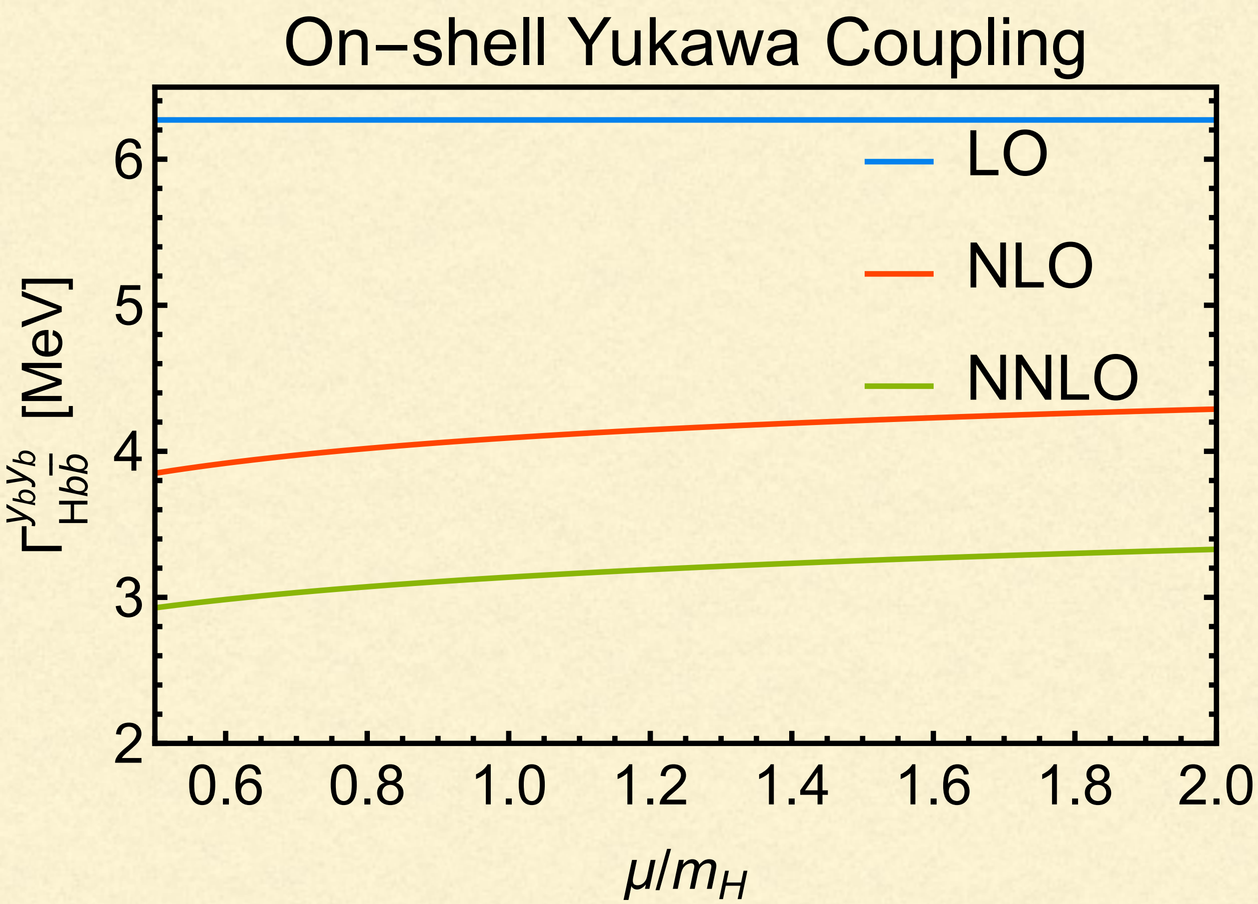
The large logarithms at subleading power: $\log^4(z) = 1688$

$\overline{m_b}(m_H) = 2.78$ GeV



LO unc. ~23%
NLO unc.~9%
NNLO unc.~3%
NLO/LO=1.12-1.28
NNLO/NLO=0-1.07

$m_b = 5.07$ GeV



NLO unc.~11%
NNLO unc.~13%
NLO/LO=0.65
NNLO/NLO=0.78

width	LO	NLO	NNLO(y_b^2)	NNLO($y_b y_t$)	NNNLO(y_b^2)	NNNNLO(y_b^2)
$\overline{\text{MS}}$	$1.891^{+0.241}_{-0.192}$	$2.285^{+0.105}_{-0.110}$	$2.359^{+0.020}_{-0.041}$	$2.376^{+0.026}_{-0.046}$	$2.379^{+0.005}_{-0.015}$	$2.377^{+0.006}_{-0.006}$
on-shell	6.269	$4.092^{+0.197}_{-0.242}$	$3.138^{+0.191}_{-0.210}$	$3.193^{+0.181}_{-0.197}$	$2.804^{+0.112}_{-0.096}$	$2.649^{+0.065}_{-0.049}$

Larin et al, hep-ph/9506465

Chetyrkin hep-ph/9608318,

Baikov et al, hep-ph/0511063,

Herzog et al, 1707.01044

The results in MS scheme become stable quickly.
Scale unc. ~0.3%.

In onshell scheme, N3LO/NNLO=0.88, N4LO/N3LO=0.95.
Scale unc.~2%.

$$\mathscr{L}_{\text{eff}} = -\frac{H}{v}\left(C_1\mathcal{O}_1^R + C_2\mathcal{O}_2^R\right) + \mathscr{L}_{\text{QCD}}$$

$$\mathcal{O}_1 = (G^0_{a,\mu\nu})^2, \quad \mathcal{O}_2 = m_b^0\bar{b}^0 b^0$$

$$C_1 = -\left(\frac{\alpha_s}{\pi}\right)\frac{1}{12} - \left(\frac{\alpha_s}{\pi}\right)^2\frac{11}{48} - \left(\frac{\alpha_s}{\pi}\right)^3\left[\frac{2777}{3456} + \frac{19}{192}L_t - n_f\left(\frac{67}{1152} - \frac{1}{36}L_t\right)\right] + \mathcal{O}(\alpha_s^4),$$

$$C_2 = 1 + \left(\frac{\alpha_s}{\pi}\right)^2\left[\frac{5}{18} - \frac{1}{3}L_t\right] + \left(\frac{\alpha_s}{\pi}\right)^3\left[-\frac{841}{1296} + \frac{5}{3}\zeta(3) - \frac{79}{36}L_t - \frac{11}{12}L_t^2 + n_f\left(\frac{53}{216} + \frac{1}{18}L_t^2\right)\right] + \mathcal{O}(\alpha_s^4),$$

The relative error of using this EFT is below 1%.
The correction to the total decay width is below 0.01%.

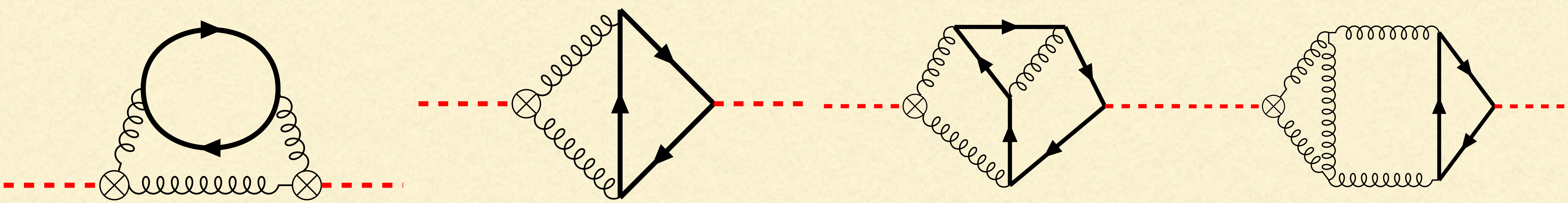
Primo et al, 1812.07811

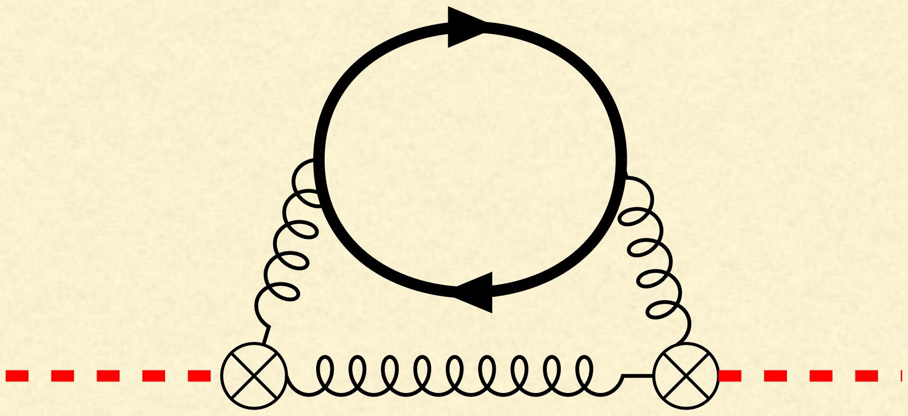
$$\Gamma_{H\to b\bar{b}} = \Gamma^{C_2C_2}_{H\to b\bar{b}} + \Gamma^{C_1C_2}_{H\to b\bar{b}} + \Gamma^{C_1C_1}_{H\to b\bar{b}}$$

$$\Gamma^{C_2C_2}_{H\to b\bar{b}} = C_2C_2\left[\Delta^{C_2C_2}_{0,b\bar{b}} + \left(\frac{\alpha_s}{\pi}\right)\Delta^{C_2C_2}_{1,b\bar{b}} + \left(\frac{\alpha_s}{\pi}\right)^2\Delta^{C_2C_2}_{2,b\bar{b}} + \left(\frac{\alpha_s}{\pi}\right)^3\Delta^{C_2C_2}_{3,b\bar{b}} + \mathcal{O}(\alpha_s^4)\right]$$

$$\Gamma^{C_1C_2}_{H\to b\bar{b}} = C_1C_2\left[\left(\frac{\alpha_s}{\pi}\right)\Delta^{C_1C_2}_{1,b\bar{b}} + \left(\frac{\alpha_s}{\pi}\right)^2\Delta^{C_1C_2}_{2,b\bar{b}} + \mathcal{O}(\alpha_s^3)\right],$$

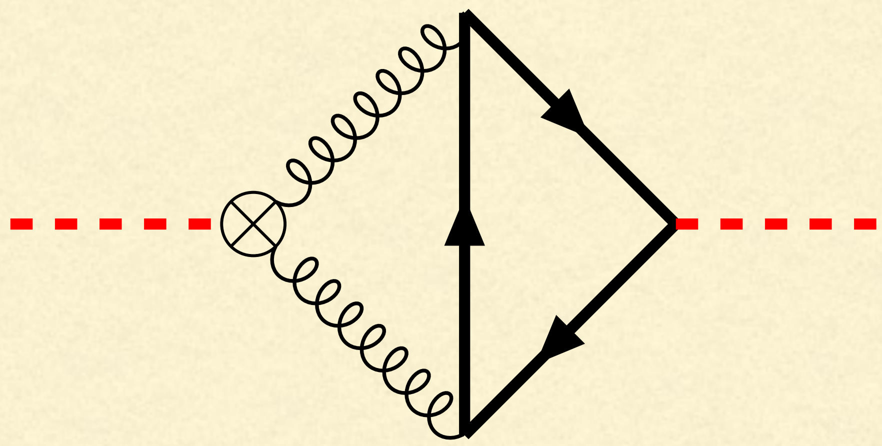
$$\Gamma^{C_1C_1}_{H\to b\bar{b}} = C_1C_1\left[\left(\frac{\alpha_s}{\pi}\right)\Delta^{C_1C_1}_{1,b\bar{b}} + \mathcal{O}(\alpha_s^2)\right],$$





$$\Delta^{C_1C_1}_{1,b\bar{b}}|_{z\to\infty} = \frac{m_H^3}{\pi v^2} C_A C_F \left[\frac{1}{6}\log(z) - \frac{7}{12} + \frac{3}{z}\right] + \mathcal{O}(z^{-2})$$

It is power enhanced and divergent in $m_b \to 0$ limit.
The extraction of yb is highly non-trivial after considering such contributions.



$$\Delta^{C_1C_2}_{1,b\bar{b}}|_{z\to\infty} = \frac{m_H m_b \overline{m_b}(\mu)}{\pi v^2} C_A C_F \left[-\frac{1}{8}\log^2(z) - \frac{3}{4}\log\left(\frac{\mu^2}{m_H^2}\right) + \frac{\pi^2}{8} - \frac{19}{8} + \frac{1}{2}\frac{\log^2(z)}{z} + 2\frac{\log(z)}{z} + \frac{9}{2z}\log\left(\frac{\mu^2}{m_H^2}\right) - \frac{\pi^2}{2z} + \frac{15}{2z}\right] + \mathcal{O}(z^{-2}),$$

The double logarithm dominates.

It is induced by soft massive quarks, different from traditional Sudakov double logarithms.

$$-\frac{m_H m_b \overline{m_b}(\mu)}{8\pi v^2} C_A C_F \log^2(z) \times \frac{1}{24}(C_A - C_F)\log^2(z).$$

$$
\begin{aligned}
\Gamma_{H\to b\bar{b}} = \frac{3 m_H \overline{m_b}^2}{8 v^2 \pi} \Bigg\{ 1 + \left(\frac{\alpha_s}{\pi}\right) \frac{17}{3} \\
&+ \left(\frac{\alpha_s}{\pi}\right)^2 \left[\frac{1}{9}\log^2(\overline{z}) - \frac{2}{3}\log(x) - \frac{97\zeta(3)}{6} - \frac{17\pi^2}{12} + \frac{9235}{144}\right] \\
&+ \left(\frac{\alpha_s}{\pi}\right)^3 \left[\frac{5}{648}\log^4(\overline{z}) + \frac{59}{324}\log^3(\overline{z}) - \frac{31\pi^2}{324}\log^2(\overline{z}) + \frac{989}{648}\log^2(\overline{z}) \right.\\
&+ \frac{32\zeta(3)}{27}\log(\overline{z}) - \frac{41\pi^2}{324}\log(\overline{z}) + \frac{137}{216}\log(\overline{z}) - \frac{23}{18}\log^2(x) - \frac{49}{6}\log(x) \\
&\left. + \frac{1945\zeta(5)}{36} - \frac{13\pi^4}{3240} - \frac{81239\zeta(3)}{216} - \frac{81239\zeta(3)}{216} - \frac{22291\pi^2}{648} + \frac{37434709}{46656}\right] \Bigg\} \\
&+ \frac{m_H^3}{v^2\pi}\left(\frac{\alpha_s}{\pi}\right)^3 \left[\frac{\log(\overline{z})}{216} - \frac{7}{432}\right] + \mathcal{O}(\overline{z}^{-1}) + \mathcal{O}(x) + \mathcal{O}(\alpha_s^4)
\end{aligned}
$$

	[MeV]	$\mu = \frac{1}{2}m_H$	$\mu = m_H$	$\mu = 2m_H$
$\mathcal{O}(\alpha_s^0)$	$\Gamma_{Hb\bar{b}}^{C_2C_2}$	2.1314	1.8905	1.6985
$\mathcal{O}(\alpha_s^1)$	$\Gamma_{Hb\bar{b}}^{C_2C_2}$	0.25813	0.39409	0.47563
$\mathcal{O}(\alpha_s^2)$	$\Gamma_{Hb\bar{b}}^{C_2C_2}$	-0.0043084	0.076819	0.143670
	$\Gamma_{Hb\bar{b}}^{C_1C_2}$	0.027078	0.024746	0.022608
$\mathcal{O}(\alpha_s^3)$	$\Gamma_{Hb\bar{b}}^{C_2C_2}$	-0.015360	0.0048336	0.038198
	$\Gamma_{Hb\bar{b}}^{C_1C_2}$	0.010314	0.013585	0.015170
	$\Gamma_{Hb\bar{b}}^{C_1C_1}$	0.0088676	0.0064617	0.0048595

MS scheme

NLO/LO=20%

NNLO/NLO=4%

1% correction!

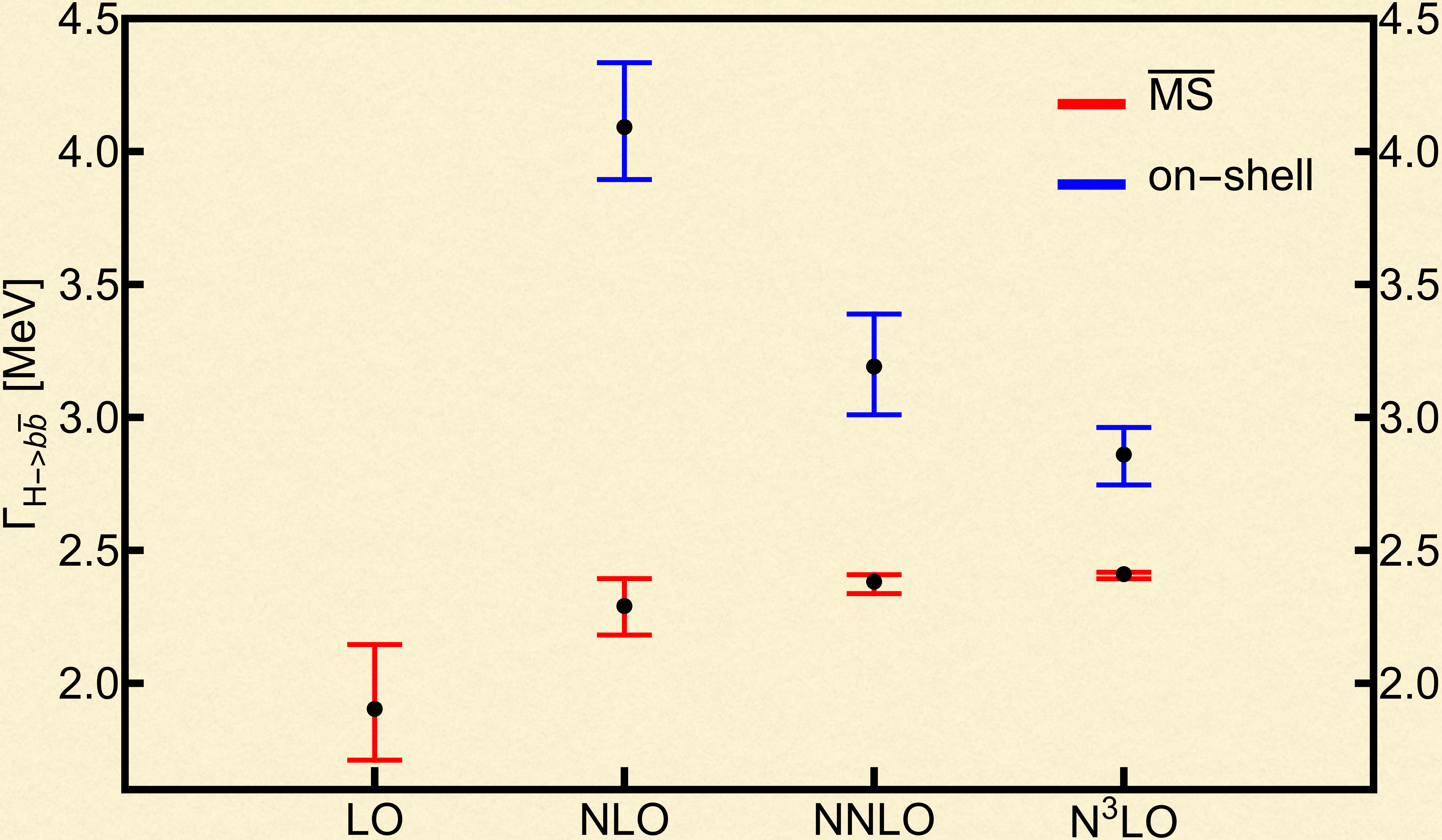
For C1C2, NNLO/NLO=55%

Fortunately, the C1C1 conbribution is not large.

	[MeV]	$\mu = \frac{1}{2}m_H$	$\mu = m_H$	$\mu = 2m_H$
$\Gamma_{H\to b\bar{b}}\,(\overline{\text{MS}})$	$\mathcal{O}(\alpha_s^0)$	2.1454	1.9036	1.7108
	$\mathcal{O}(\alpha_s^1)$	0.24806	0.38682	0.47051
	$\mathcal{O}(\alpha_s^2)$	0.014742	0.091773	0.15580
	$\mathcal{O}(\alpha_s^3)$	0.0092203	0.028117	0.055816
$\Gamma_{H\to b\bar{b}}\,(\text{OS})$	$\mathcal{O}(\alpha_s^0)$	6.2687	6.2687	6.2687
	$\mathcal{O}(\alpha_s^1)$	-2.4192	-2.1770	-1.9797
	$\mathcal{O}(\alpha_s^2)$	-0.85590	-0.90061	-0.91641
	$\mathcal{O}(\alpha_s^3)$	-0.23550	-0.33107	-0.39831

$$\Gamma_{H\to b\bar{b}}^{\text{N}^3\text{LO QCD}}\left(\overline{\text{MS}}\right) = 2.410^{+0.007}_{-0.017}\ \text{MeV}$$

$$\Gamma_{H\to b\bar{b}}^{\text{N}^3\text{LO QCD+NLO EW}}\left(\overline{\text{MS}}\right) = 2.382^{+0.007}_{-0.017}\ \text{MeV}$$



4.5
4.0
3.5
3.0
2.5
2.0
$\Gamma_{H\to b\bar{b}}$ [MeV]
$\overline{\text{MS}}$
on−shell
LO
NLO
NNLO
N^{3}LO

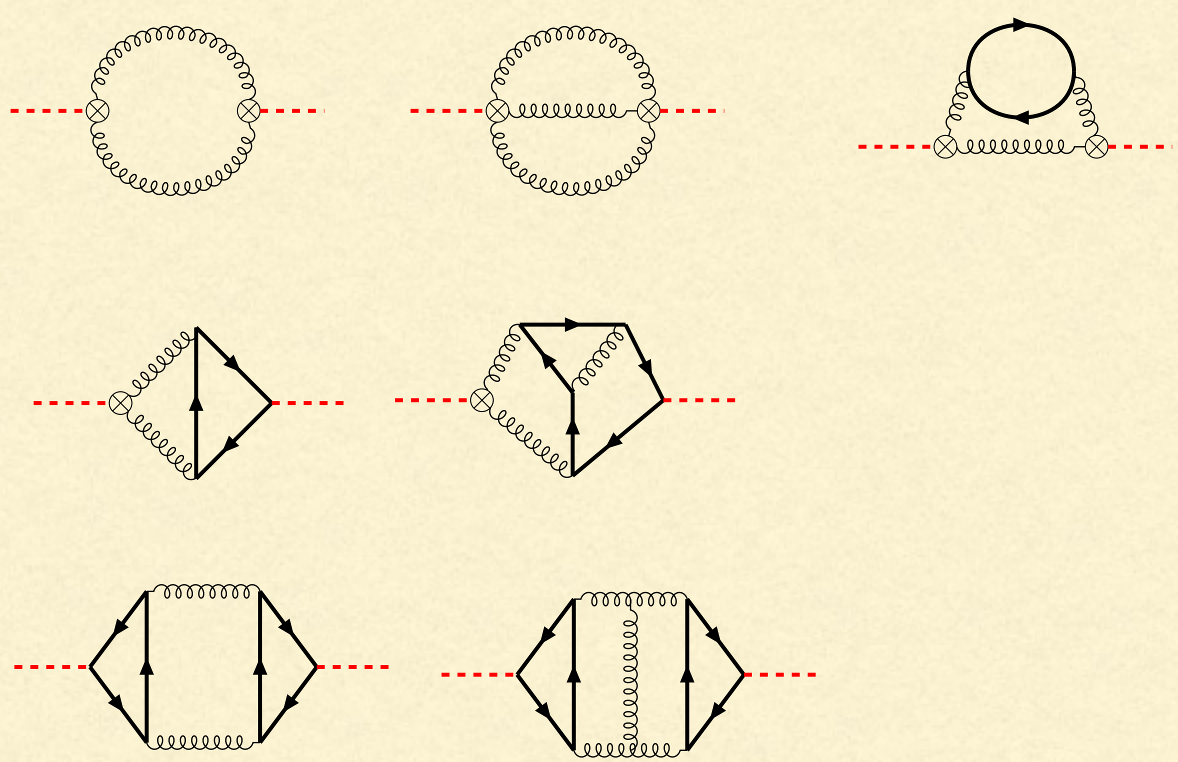
HIGGS DECAYS TO GLUONS

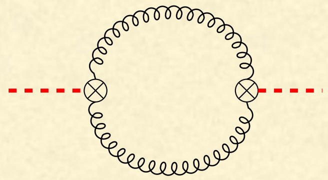
$$\Gamma_{H\to gg} = \Gamma^{C_1C_1}_{H\to gg} + \Gamma^{C_1C_2}_{H\to gg} + \Gamma^{C_2C_2}_{H\to gg}$$

$$\Gamma^{C_1C_1}_{H\to gg} = C_1C_1\left[\Delta^{C_1C_1}_{0,gg} + \left(\frac{\alpha_s}{\pi}\right)\Delta^{C_1C_1}_{1,gg} + \mathcal{O}(\alpha_s^2)\right],$$

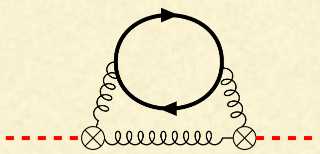
$$\Gamma^{C_1C_2}_{H\to gg} = C_1C_2\left[\left(\frac{\alpha_s}{\pi}\right)\Delta^{C_1C_2}_{1,gg} + \left(\frac{\alpha_s}{\pi}\right)^2\Delta^{C_1C_2}_{2,gg} + \mathcal{O}(\alpha_s^3)\right],$$

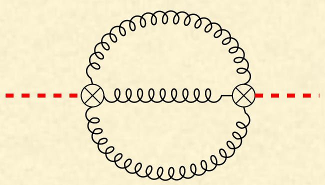
$$\Gamma^{C_2C_2}_{H\to gg} = C_2C_2\left[\left(\frac{\alpha_s}{\pi}\right)^2\Delta^{C_2C_2}_{2,gg} + \left(\frac{\alpha_s}{\pi}\right)^3\Delta^{C_2C_2}_{3,gg} + \mathcal{O}(\alpha_s^4)\right],$$



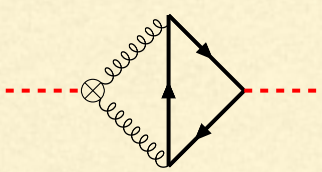


$$\Delta_{0,gg}^{C_1C_1} = \frac{C_A C_F m_H^3}{2\pi v^2}$$

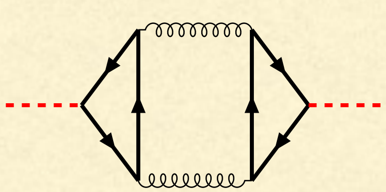




$$\Delta_{1,gg}^{C_1C_1} = \frac{m_H^3}{\pi v^2} C_A C_F \left(\left[-\frac{1}{6}\log(z) - \frac{1}{6}\log\left(\frac{\mu^2}{m_H^2}\right) \right] + C_A\left[\frac{11}{12}\log\left(\frac{\mu^2}{m_H^2}\right) + \frac{73}{24}\right] + n_l\left[-\frac{1}{6}\log\left(\frac{\mu^2}{m_H^2}\right) - \frac{7}{12}\right]\right)$$



$$\Delta_{1,gg}^{C_1C_2}|_{z\to\infty} = \frac{m_H m_b \overline{m_b}}{\pi v^2} C_A C_F \times \left[\frac{1}{8}\log^2(z) - \frac{\pi^2}{8} - \frac{1}{2} - \frac{1}{2}\frac{\log^2(z)}{z} - \frac{1}{2}\frac{\log(z)}{z} + \frac{\pi^2}{2z} + \mathcal{O}(z^{-2})\right]$$



$$\Delta_{2,gg}^{C_2C_2}|_{z\to\infty} = \frac{m_b^2\overline{m_b}^2}{\pi v^2 m_H} C_A \times \left[\frac{\left(\log^2(z) - 4\log(z) + \pi^2 + 4\right)\left(\log^2(z) + 4\log(z) + \pi^2 + 4\right)}{96} + \mathcal{O}(z^{-1})\right]$$

$$\Gamma_{H\to gg} = \frac{m_H^3}{v^2\pi}\left\{ \left(\frac{\alpha_s}{\pi}\right)^2 \frac{1}{72} + \left(\frac{\alpha_s}{\pi}\right)^3 \left[-\frac{1}{216}\log(\bar{z}) + \frac{229}{864}\right]\right\}$$
$$+ \frac{m_H \overline{m_b}^2}{v^2\pi}\left\{ \left(\frac{\alpha_s}{\pi}\right)^2 \left[-\frac{1}{24}\log^2(\bar{z}) + \frac{\pi^2}{24} + \frac{1}{6}\right]\right.$$
$$+ \left(\frac{\alpha_s}{\pi}\right)^3 \left[-\frac{5}{1728}\log^4(\bar{z}) - \frac{59}{864}\log^3(\bar{z}) + \frac{31\pi^2}{864}\log^2(\bar{z}) - \frac{989}{1728}\log^2(\bar{z})\right.$$
$$- \frac{4\zeta(3)}{9}\log(\bar{z}) + \frac{41\pi^2}{864}\log(\bar{z}) - \frac{137}{576}\log(\bar{z}) - \frac{137\pi^4}{8640} - \frac{29\zeta(3)}{36}$$
$$\left.\left. + \frac{1277\pi^2}{1728} + \frac{17275}{3456}\right] + \mathcal{O}(\bar{z}^{-1})\right\}$$

$$\Gamma_{H\to \mathrm{hadrons}} = \frac{m_H^3}{v^2\pi}\left\{ \left(\frac{\alpha_s}{\pi}\right)^2 \frac{1}{72} + \left(\frac{\alpha_s}{\pi}\right)^3 \frac{215}{864} + \mathcal{O}(\bar{z}^{-1})\right\}$$
$$+ \frac{3 m_H \overline{m_b}^2}{8 v^2\pi}\left\{ 1 + \left(\frac{\alpha_s}{\pi}\right)\frac{17}{3} + \left(\frac{\alpha_s}{\pi}\right)^2 \left[-\frac{2}{3}\log(x) - \frac{97\zeta(3)}{6} - \frac{47\pi^2}{36} + \frac{9299}{144}\right]\right.$$
$$+ \left(\frac{\alpha_s}{\pi}\right)^3 \left[-\frac{23}{18}\log^2(x) - \frac{49}{6}\log(x) + \frac{1945\zeta(5)}{36} - \frac{5\pi^4}{108} - \frac{81703\zeta(3)}{216}\right.$$
$$\left.\left. - \frac{10507\pi^2}{324} + \frac{38056609}{46656}\right] + \mathcal{O}(\bar{z}^{-1})\right\}$$

Agree with Davies et al, 1703.02988

	[MeV]	on-shell scheme $\mu = \frac{m_H}{2}$	on-shell scheme $\mu = m_H$	on-shell scheme $\mu = 2m_H$	$\overline{\text{MS}}$ scheme $\mu = \frac{m_H}{2}$	$\overline{\text{MS}}$ scheme $\mu = m_H$	$\overline{\text{MS}}$ scheme $\mu = 2m_H$
$\mathcal{O}(\alpha_s^2)$	$\Gamma^{C_2C_2}_{H\to gg}$	0.003208	0.002598	0.002148	0.0006336	0.0004269	0.0002994
	$\Gamma^{C_1C_2}_{H\to gg}$	-0.03018	-0.02444	-0.02021	-0.01601	-0.01200	-0.00925
	$\Gamma^{C_1C_1}_{H\to gg}$	0.2269	0.1837	0.1520	0.2269	0.1837	0.1520
$\mathcal{O}(\alpha_s^3)$	$\Gamma^{C_2C_2}_{H\to gg}$	-	-	-	-	-	-
	$\Gamma^{C_1C_2}_{H\to gg}$	-0.009250	-0.01140	-0.01208	-0.01088	-0.01054	-0.009632
	$\Gamma^{C_1C_1}_{H\to gg}$	0.1052	0.1117	0.1104	0.1019	0.1091	0.1082

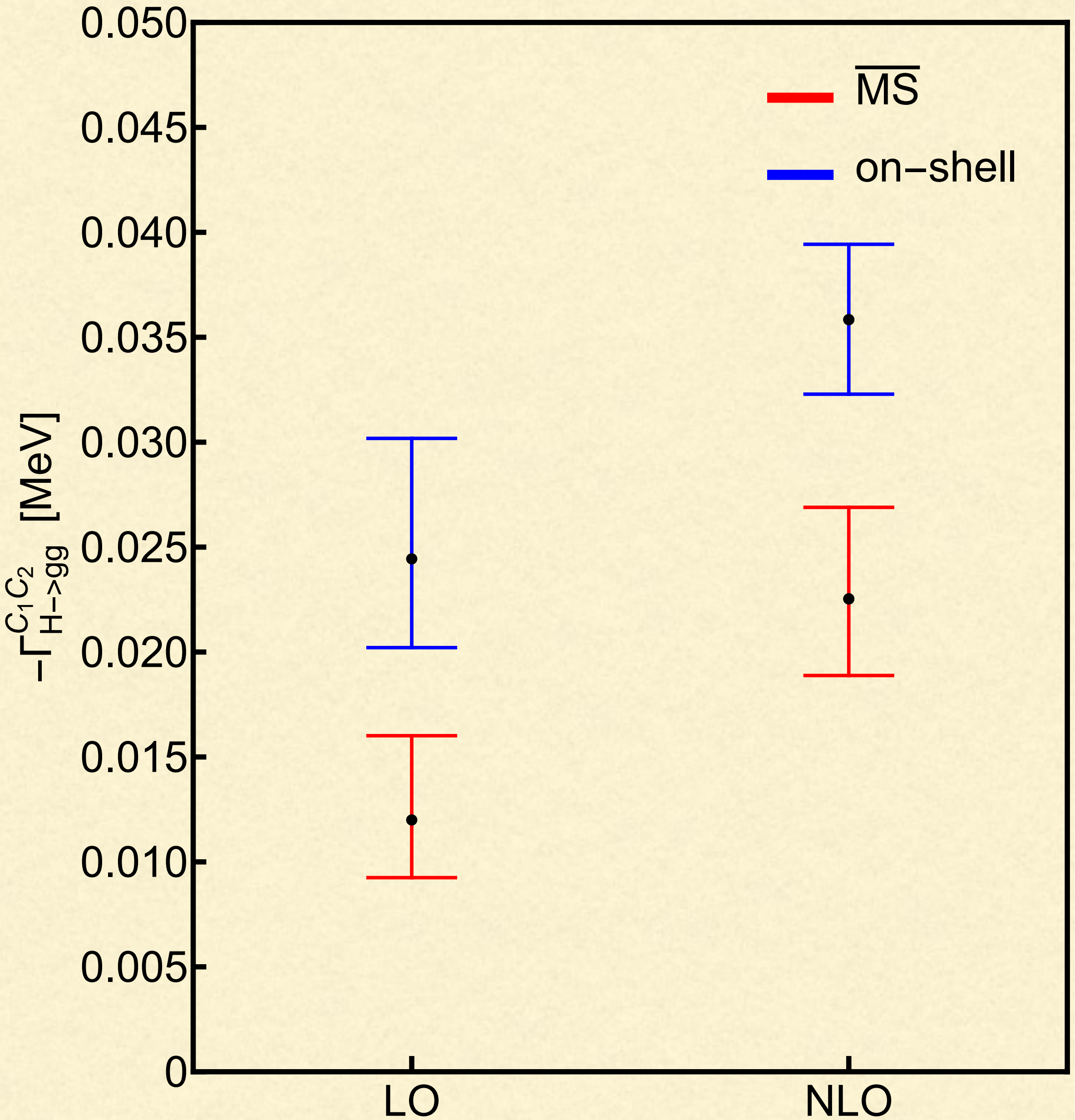
The C1C1 contributions are dominant.

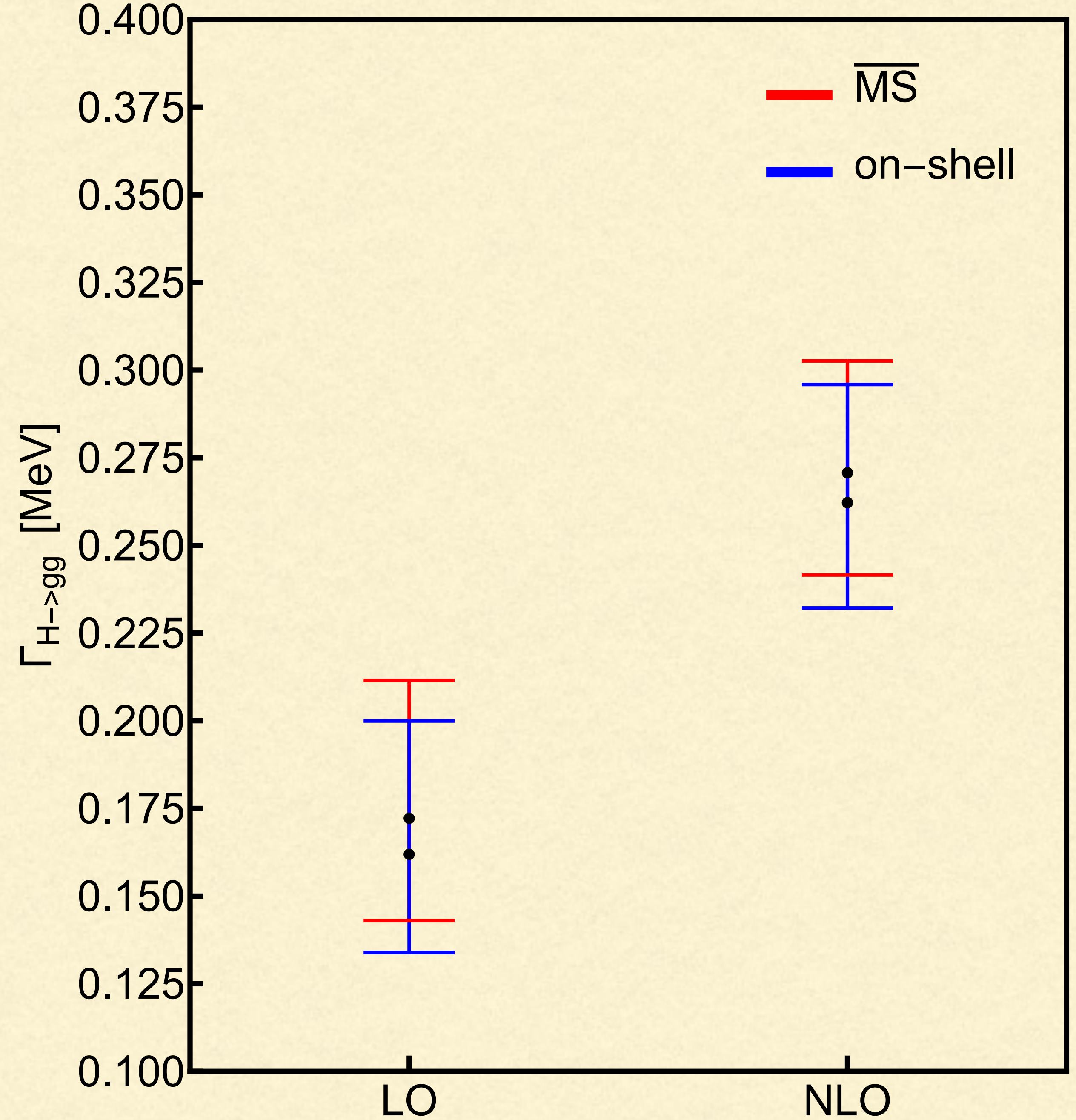
The C1C2 contributions are 13%, much larger than m_b^2/m_H^2.

The C2C2 contributions are only 1%.

The QCD correction in C1C1 is 61%.

The QCD correction in C1C2 is 47% (88%) in onshell (MS) scheme.





$$\Gamma^{\mathrm{NLO}}_{H\to gg}\ (\text{on-shell}) = 0.278^{+0.038}_{-0.033}\ \text{MeV}$$

$$\Gamma^{\mathrm{NLO}}_{H\to gg}\ (\overline{\mathrm{MS}}) = 0.289^{+0.034}_{-0.031}\ \text{MeV}$$

CONCLUSIONS

- Higgs decays to $b\bar{b}$ and gg can be measured with an accuracy better than 1%.
- Theoretical predictions are investigated with full dependence on the bottom quark mass.
- Large corrections are found due to the logarithms $\log(m_H^2/m_b^2)$.
- Extraction of the bottom quark Yukawa coupling is nontrivial after considering higher order corrections.

Thanks a lot for your attention!