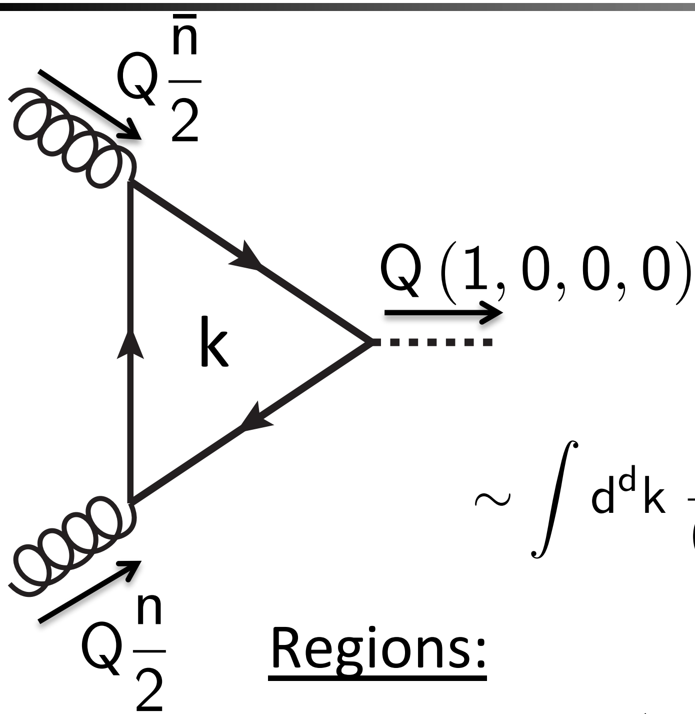
Resummation of m_b effects in $gg \rightarrow H$

Maximilian Stahlhofen

DESY

In collaboration with Stefan Liebler and Frank Tackmann

Resummation of m_b effects in $gg \to H$



Scales: $Q = m_H$, m_b $\quad \boxed{\lambda = \frac{m_b}{m_H}}$

$$\propto \frac{m_b y_b}{m_H^2}\left[\ln^2\left(\frac{-m_H^2}{m_b^2}\right) - 4 + \mathcal{O}(\lambda)\right]$$

$$\sim \int d^d k \, \frac{\mathrm{Tr}[\ldots] \;\; |k^- - k^+|^{-\eta}\, \nu^\eta}{(k^2 - m_b^2)(-k^+ Q + k^2 - m_b^2)(k^- Q + k^2 - m_b^2)}$$

Regions:

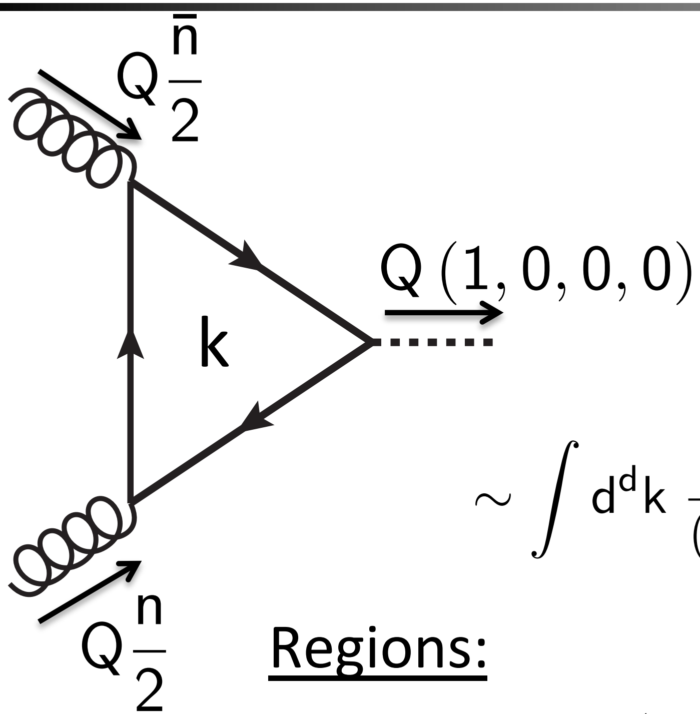
hard: $k \sim (1,1,1)$ $\rightarrow$ $\frac{1}{\epsilon^2} - \frac{\ln\left(\frac{-m_H^2}{\mu^2}\right)}{\epsilon}$

n-coll: $k \sim (\lambda^2, 1, \lambda)$ $\searrow$

nbar-coll: $k \sim (1, \lambda^2, \lambda)$ $\nearrow$ $\quad -\frac{1}{\epsilon\,\eta} + \frac{\ln\left(\frac{m_b^2}{\mu^2}\right)}{\eta} + \frac{\ln\left(\frac{m_H}{\nu}\right)}{\epsilon}$

soft: $k \sim (\lambda, \lambda, \lambda)$ $\rightarrow$ $-\frac{1}{\epsilon^2} + \frac{2}{\epsilon\,\eta} - \frac{2\ln\left(\frac{m_b^2}{\mu^2}\right)}{\eta} + \frac{2\ln\left(\frac{\nu}{\mu}\right)}{\epsilon}$

Resummation of m_b effects in $gg \to H$



Scales: $Q = m_H$, m_b $\boxed{\lambda = \frac{m_b}{m_H}}$

$$\propto \frac{m_b y_b}{m_H^2}\left[\ln^2\left(\frac{-m_H^2}{m_b^2}\right) - 4 + \mathcal{O}(\lambda)\right]$$

$$\sim \int d^dk \, \frac{\mathrm{Tr}[\ldots] \; |k^- - k^+|^{-\eta} \, \nu^\eta}{(k^2 - m_b^2)(-k^+Q + k^2 - m_b^2)(k^-Q + k^2 - m_b^2)}$$

Regions:

hard: $k \sim (1,1,1)$ $\rightarrow$ $\frac{1}{\epsilon^2} - \frac{\ln\left(\frac{-m_H^2}{\mu^2}\right)}{\epsilon}$

n-coll: $k \sim (\lambda^2, 1, \lambda)$ $\searrow$

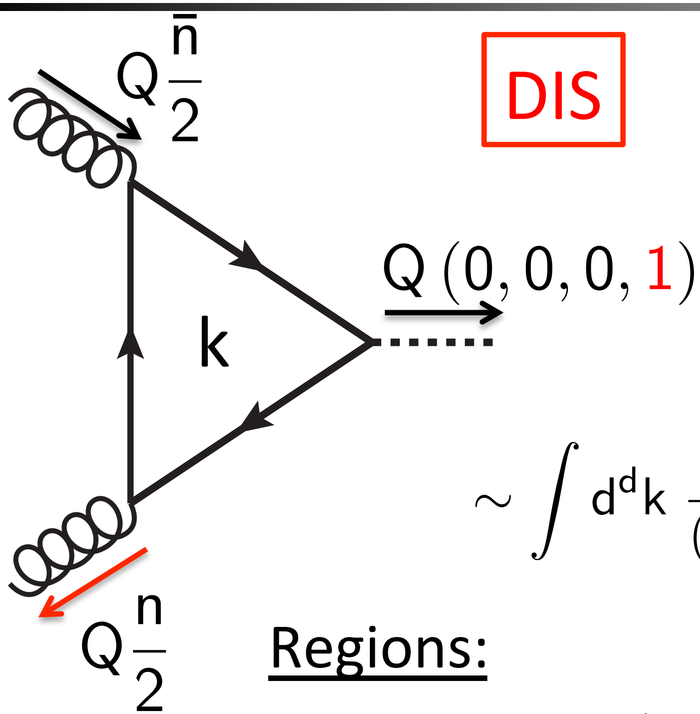
nbar-coll: $k \sim (1, \lambda^2, \lambda)$ $\nearrow$

$$-\frac{1}{\epsilon\,\eta} + \frac{\ln\left(\frac{m_b^2}{\mu^2}\right)}{\eta} + \frac{\ln\left(\frac{m_H}{\nu}\right)}{\epsilon}$$

soft: $k \sim (\lambda, \lambda, \lambda)$ $\rightarrow$ $-\frac{1}{\epsilon^2} + \frac{2}{\epsilon\,\eta} - \frac{2\ln\left(\frac{m_b^2}{\mu^2}\right)}{\eta} + \frac{2\ln\left(\frac{\nu}{\mu}\right)}{\epsilon}$

Glauber: $k \sim (\lambda^2, \lambda^2, \lambda)$ $\rightarrow$ $-\frac{i\,\pi}{\epsilon}$

Resummation of m_b effects in $gg \to H$



DIS

Scales: $Q = m_H$, m_b $\quad \boxed{\lambda = \frac{m_b}{m_H}}$

$$\propto \frac{m_b y_b}{m_H^2}\left[\ln^2\left(\frac{+m_H^2}{m_b^2}\right) - 4 + \mathcal{O}(\lambda)\right]$$

$$\sim \int d^d k \, \frac{\mathrm{Tr}[\ldots]\ \ |k^- - k^+|^{-\eta}\,\nu^\eta}{(k^2 - m_b^2)(+k^+ Q + k^2 - m_b^2)(k^- Q + k^2 - m_b^2)}$$

Regions:

hard: $k \sim (1,1,1) \quad \rightarrow \quad \frac{1}{\epsilon^2} - \frac{\ln\left(\frac{+m_H^2}{\mu^2}\right)}{\epsilon}$

n-coll: $k \sim (\lambda^2, 1, \lambda) \quad \searrow$

$$-\frac{1}{\epsilon\,\eta} + \frac{\ln\left(\frac{m_b^2}{\mu^2}\right)}{\eta} + \frac{\ln\left(\frac{m_H}{\nu}\right)}{\epsilon} \qquad \text{(C)}$$

nbar-coll: $k \sim (1, \lambda^2, \lambda) \quad \nearrow$

soft: $k \sim (\lambda, \lambda, \lambda) \quad \rightarrow \quad -\frac{1}{\epsilon^2} + \frac{2}{\epsilon\,\eta} - \frac{2\ln\left(\frac{m_b^2}{\mu^2}\right)}{\eta} + \frac{2\ln\left(\frac{\nu}{\mu}\right)}{\epsilon} \qquad \text{(S)}$

~~Glauber: $k \sim (\lambda^2, \lambda^2, \lambda) \quad \rightarrow \quad -\frac{i\pi}{\epsilon}$~~