SM input parameters

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guideline for discussion

warning: contains RH's and MG's personal opinions

- Lepton masses
  → no controversy
- M_W, M_Z : complex mass scheme
- Γ_W, Γ_Z : physical parameters vs. theory input

α_s

PDG: $\alpha_s(M_Z) = 0.1185(6)$

PDFs: ..., 0.117, 0.118, 0.119, ...

→ use $\alpha_s(M_Z) = 0.118 \pm 0.001$

note: this is a reference value for $\alpha_s(\mu)$, μ arbitrary

⇒ if central scale $\mu_0 \neq M_Z$,

evaluate $\alpha_s(\mu_0)$ from $\alpha_s(M_Z)$ through 4-loop RGE

m_b

1) Yukawa coupling: $R = R(y_b)$

$y_b = y_b(\mu) \sim m_b(\mu)$

$\mu \sim$ typical scale μ_0 (e.g. $\mu_0 = M_H$)

(a) $\Rightarrow$ required input: $m_b(\mu_0)$ (best value)

but: not directly available

instead: $m_b(m_b)$ and $\gamma^m \Rightarrow m_b(\mu_0)$

$\Rightarrow$ use best prediction for $m_b(m_b)$ and γ^m

(b) $R(y_b(\mu_0))$ available to N^nLO

→ scale uncertainty ?

vary $\mu_0/k < \mu < k\mu_0$ (e.g. $k=2$)

- explicitely in R
- through RGE with γ^m at n-loop

2) "kinematical" m_b (in prop's and phase space)

→ use m_b^{OS} ?

defined perturbatively (confinement!),

but:

$$m_b^{OS} = (4.16 + 0.40 + 0.20 + 0.15 + 0.14)\,\text{GeV}$$

0- 1- 2- 3- 4- loop !

⇒ m_b^{OS} is not a good parameter!

→ take into account in parametric uncertainty!

3) m_b in PDFs:

- weak dependence, except for b-PDFs

$\Rightarrow$ value $m_b^{\overline{\text{MS}}} = 4.75$ GeV does not constitute a serious constraint (in most cases)

- $m_c(3\,\mathrm{GeV})$: theory uncertainty too large?
- m_b, m_c : correlation with α_s ?
- $m_b(\mu)$ vs. m_b^{OS} : EW corrections