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Description of `decsusy3l.m`

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In the Mathematica file `decsusy3l.m` one can find the results for the decoupling constants listed in the following table:

`Mathematica` expression	relation

`ZetaAlphas[5,"exact"]`
`ZetaAlphas[5,"h1"]`
`ZetaAlphas[5,"h2"]`
`ZetaAlphas[5,"h3"]`
	$\alpha_s^{(5)}(\mu_{\rm dec}) = \zeta_{\alpha_s}(\mu_{\rm dec})\alpha_s^{\rm SQCD}(\mu_{\rm dec})$

`ZetaAlphas[6,"exact"]` `ZetaAlphas[6,"h1"]`	$\alpha_s^{(6)}(\mu_{\rm dec}) = \zeta_{\alpha_s}(\mu_{\rm dec})\alpha_s^{\rm SQCD}(\mu_{\rm dec})$

`ZetaAlphasForC1[5,"h1"]`
`ZetaAlphasForC1[5,"h2"]`
`ZetaAlphasForC1[5,"h3"]`
	$C_1(\mu_{\rm ren}) = D_h \ln \zeta_{\alpha_s}(\mu_{\rm ren} = \mu_{\rm dec})$

- `"exact"` refers to the exact expressions with no assumptions on the relations between the mass parameters.
- `"h1"`, `"h2"` and `"h3"` refer to the hierarchies defined in Section 2 of Ref. [1].
- `ZetaAlphas` should be used for numerical values for the decoupling constants.
- `ZetaAlphasForC1` should only be used to derive C_1 up to three loops using the LET. It contains the relevant dependence on $m_{\tilde{q}_1}$ and $m_{\tilde{q}_2}$ through mass differences, as well as on the generic mass $m_{\tilde{q}}$ itself. In this limit $D_{\tilde{q}}$ (see Ref. [1]) reads:

$$D_{\tilde{q}} = V_{11}^{\tilde{q}} \frac{\partial}{\partial m_{\tilde{q}_1}^2} + V_{22}^{\tilde{q}} \frac{\partial}{\partial m_{\tilde{q}_2}^2} + \frac{V_{11}^{\tilde{q}} + V_{22}^{\tilde{q}}}{2} \frac{\partial}{\partial m_{\tilde{q}}^2} \,. \tag{1}$$

  The masses $m_{\tilde{q}_1}$, $m_{\tilde{q}_2}$ and $m_{\tilde{q}}$ have to be treated as independent variables. After the derivatives are taken one has to set $m_{\tilde{q}_1} = m_{\tilde{q}_2} = m_{\tilde{q}}$ and $\theta_q = 0$. [Note that there is still a dependence on ϵ (where $D = 4 - 2\epsilon$) and the mass of the ε scalar if this identification is not done.]

In the expressions listed in the above table the following variables are used:

symbol	meaning	symbol	numerical value/meaning
`apifull`	$\alpha_s^{\rm SQCD}/\pi$	`tr`	$\frac{1}{2}$
`MB1`	m_R	`cf`	$\frac{4}{3}$
`MB2`	m_{R_2}	`ca`	3
`mst1`	$m_{\tilde{t}_1}$	`na`	8
`mst2`	$m_{\tilde{t}_2}$	`d33`	$\frac{5}{6}$
`msq`	$m_{\tilde{q}}$	`nq`	5
`mgl`	$m_{\tilde{g}}$	`nt`	1
`mt`	m_t		
`mudec`	$\mu_{\rm dec}$	`lm‘M’`	$\ln \frac{\mu_{\rm dec}^2}{\texttt{‘M’}^2}$
`Sthetat`	$\sin\theta_t$	`Dm2‘X’‘Y’`	$\texttt{m‘X’}^2 - \texttt{m‘Y’}^2$
`Cthetat`	$\cos\theta_t$	`Dm1‘X’‘Y’`	$\texttt{m‘X’} - \texttt{m‘Y’}$

In case m_{R_2} is present, m_R is interpreted as m_{R_1}.

The following combinations of mass differences appear in `ZetaAlphas`:
`Dm2B1gl, Dm2B1sq, Dm2B1st1, Dm2B1st2, Dm2B2st1, Dm2B2t`

For `ZetaAlphasForC1` the reference masses are fixed to $m_R = m_{\tilde{t}_1}$ (h1), $m_R = m_{\tilde{g}}$ (h2) and $m_{R_1} = m_{\tilde{g}}$ and $m_{R_2} = m_t$ (h3). These expressions furthermore contain the colour invariants of $SU(N_C)$ and are expressed in terms of the following mass differences:
`Dm1glst1, Dm2st1st2, Dm2sqst1, Dm2sq1st1, Dm2sq2st1,`
`Dm2st1t, Dm2glst2, Dm2sqgl, Dm2sq1gl, Dm2sq2gl`

For further details on the meaning and definition of the parameters we refer to Ref. [1].

References

[1] A. Kurz, N. Zerf, and M. Steinhauser "Decoupling constant for α_s and the effective gluon-Higgs coupling to three loops in supersymmetric QCD," SFB/CPP-12-30, TTP12-22, LPN12-068.