

## Erratum

# Erratum to “Threshold corrections to baryon number violating operators in supersymmetric $SU(5)$ GUTs” [Nucl. Phys. B 898 (2015) 1–29]

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We have found an error in the third line of an equation (3.10). The corrected formula for Eq. (3.10) is given as

$$\begin{aligned} \frac{16\pi^2}{2g_5^2} \overline{\Sigma}_X(p^2) = & \left[ \frac{1}{2}(N_5 + N_{\overline{5}}) + \frac{3}{2}(N_{10} + N_{\overline{10}}) \right] B(p^2, 0, 0) + \frac{25}{6} B(p^2, M_{\Sigma}^2, M_X^2) \\ & + \frac{5}{6} B(p^2, M_{\Sigma_{24}}^2, M_X^2) + B(p^2, M_{M_{HC}}^2, 0) \\ & + \frac{5}{12} M_X^2 \left[ 3A(p^2, M_X^2, 0) + 10A(p^2, M_X^2, M_{\Sigma}^2) \right. \\ & \left. + 2A(p^2, M_X^2, M_{\Sigma_{24}}^2) \right] \\ & - 5C_2(G) \frac{p^2}{4} A(p^2, M_X^2, 0) - \frac{1}{2} C_2(G) B(p^2, M_X^2, 0) \\ & + (p^2\text{-independent terms}), \end{aligned} \quad (3.10)$$

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since an equation (A.26) is replaced by

$$\begin{aligned} \mathcal{K}_{v_\Sigma X} = & -10g_5^2 v_\Sigma \left\{ \Sigma_{(3,2)} \left[ GX - WX + \frac{5}{\sqrt{60}} BX \right] \right. \\ & \left. + \Sigma_{(3^*,2)} \left[ GX^\dagger - WX^\dagger + \frac{5}{\sqrt{60}} BX^\dagger \right] \right\} + \text{h.c.} \end{aligned} \quad (\text{A.26})$$

We used these formulae for numerical evaluations. Besides, we have also found an additional error in numerical calculations, which we underestimated the vacuum polarization from gauge multiplets. The numerical values Eqs. (4.9) and (4.11) should be respectively replaced by

$$\lambda_1|_{\text{vac.}} = \lambda_2|_{\text{vac.}} = \frac{\Sigma(0)}{M_X^2 + \Sigma(0)} = -3.68 \times 10^{-2}, \quad (\text{4.9})$$

$$\lambda_1(M_{\text{GUT}}) = -2.66 \times 10^{-2}, \quad \lambda_2(M_{\text{GUT}}) = -2.53 \times 10^{-2}. \quad (\text{4.11})$$

The numerical results Eqs. (4.13) and (4.15), which are defined in Eq. (4.12) and describe the short range renormalization factors of Wilson coefficients, should be replaced by

$$A_S^{(1)} = 2.025, \quad A_S^{(2)} = 2.118, \quad (\text{4.13})$$

for the case of  $M_\Sigma = M_{\Sigma_{24}}$ , and

$$A_S^{(1)} = 2.014, \quad A_S^{(2)} = 2.107, \quad (\text{4.15})$$

for the case of  $M_\Sigma = 5M_{\Sigma_{24}}$ . As a result, in the minimal SUSY  $SU(5)$  GUT, we found the corrected numerical values for  $R$  defined in Eq. (4.14) as  $R = 1.052$  for the case of  $M_\Sigma = M_{\Sigma_{24}}$ , and  $R = 1.041$  for the case of  $M_\Sigma = 5M_{\Sigma_{24}}$ .

Figs. 6–8 should be replaced by the following figures.

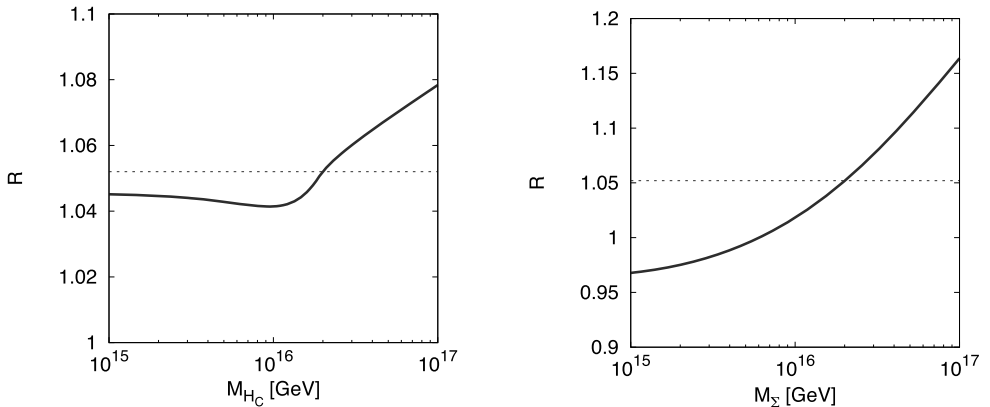


Fig. 6. GUT-scale particle mass dependence on renormalization factor of proton decay. Left panel shows  $M_{H_C}$  dependence for  $M_\Sigma = M_X = 2 \times 10^{16}$  GeV. Right panel shows  $M_\Sigma$  dependence for  $M_{H_C} = M_X = 2 \times 10^{16}$  GeV. Dotted line shows the degenerate mass case in each panels.

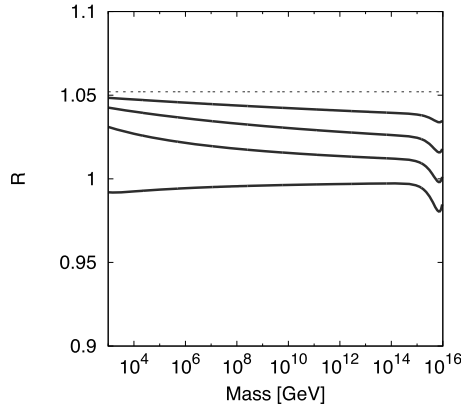


Fig. 7. Ratio of short-range renormalization effects with and without threshold effect in the minimal SUSY  $SU(5)$  GUT with light vector-like matters. We take  $n_5 = 1, \dots, 4$  in solid lines from top to bottom. The case of the minimal SUSY  $SU(5)$  with no light vector-like matter is shown in dotted line.

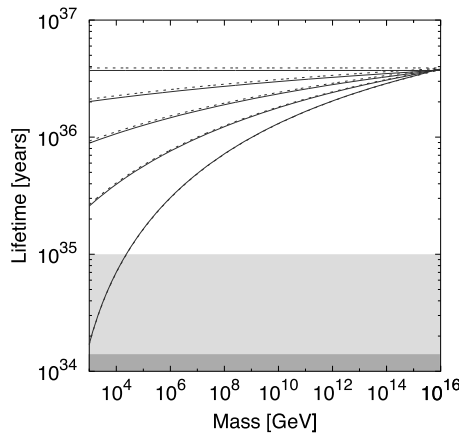


Fig. 8. Partial proton lifetime ( $p \rightarrow \pi^0 + e^+$ ) in vector-like extension scenario. In solid (dotted) lines, we take  $n_5 = 0, 1, \dots, 4$  with (without) threshold corrections at GUT scale. Deep gray (gray) region corresponds to experimental excluded region by Super-Kamiokande (the future sensitivity by the Hyper-Kamiokande).

Our conclusion is also changed as follows. In the minimal SUSY  $SU(5)$  GUT, the partial proton decay rate ( $p \rightarrow \pi^0 + e^+$ ) is enhanced about 5% due to the threshold corrections to the baryon-number violating dimension-six operators. From vector-like superfields, the additional contribution to the vacuum polarization of  $X$ -boson can be positive as long as the vector-like masses can be negligible. This additional contribution cancels with the contribution via the vacuum polarization  $\lambda_i|_{\text{vec.}}$  ( $i = 1, 2$ ) in the minimal SUSY  $SU(5)$ . Therefore, in the vector-like extension of the minimal SUSY  $SU(5)$  GUT, the effects of threshold corrections can become smaller when the number of vector-like superfields increases.