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DIMINISHED UPPER BOUNDS ON THE UNIFICATION MASS SCALES FOR HEAVY HIGGS BOSON MASSES

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We consider dominant three-, four- and ve-loop contributions to λ, the quartic scalar coupling-constant's β-function in the Standard Model. We nd that these terms accelerate the evolution of λ to nonperturbative values, thereby lowering the uni cation bound for which scalar-couplings are still perburbative. We also nd that these higher order contributions imply a substantial lowering of λ itself before the anticipated onset of nonperturbative physics in the Higgs sector.

The dominant running coupling constants of the standard model evolve with , the renormalization scale, according to two-loop renormalization group equations

$$\frac{d}{d} = \frac{1}{16^{2}}\left\{4^{2} + 12\ h \quad 36h^{4533}_{344}{}^{81}_{6264}{}^{6}_{4}{}^{4}_{4}{}^{2}_{100}g^{4533}_{13}{}^{35}_{6264}{}^{5}_{5}{}^{6}_{6}{}^{6}_{5}{}^{35}_{6}{}^{1} \quad {}^{35}_{6264}{}^{5}_{3113}\right.$$

$$+ \frac{27}{10}gg + \frac{27}{4}g \quad \frac{}{(16^{2})^{2}}\left\{-\frac{26}{3} \quad 24^{2}h\ 3\ h\right.$$

48 3047eTj /R35 9.96264 Tf 8.636 Tf 6.02212 2.88 Td (2)Tj /R13 9.9699 4.2 Td

$$+ 180h\ 80\ h\ g\ 192h +$$

Y < 0:084 (< 13:3). Hence $_{\max}$ = 13:3 is an $upper\ bound$ on the value of for which perturbative Higgs sector physics may still be possible, in that four- and ve-loop terms in (8) are equal. The evolution of the coupling constant should also be inclusive of the three-, four- and ve-loop terms of Eq. (8), as in the middle curve, since such terms are comparable when $_{\max}$ = 13:3. When we augment Eq. (1) with these three- ve loop terms in Eq. (8), and impose the additional requirement that the upper bound on for perturbative