Addendum: Towards a UV completion of chameleons in string theory

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Note that in KKLT, the scale appearing in ρ is not the 4d Planck scale, as written in eq. (4.1), but rather the 10d string scale $M_s = (2\pi\sqrt{\alpha'})^{-1}$, so $\sigma = M_s^4 r^4 / g_s = M^4 r^4 / (2\sqrt{\phi} g_s)$, where M is the 10d Planck scale. Since the experimental constraints require large extra dimensions r , this makes a big difference. M is of course fixed, and M_{Pl} is given by experiment, so the difference between the two definitions can be absorbed by rescaling the prefactor a appearing in the nonperturbative superpotential in eq. (4.3) by a large number, in which case we keep eq. (4.1) as it is.

We continued to refer to such a model as KKLT, though obtaining a of order 1 as we assumed, as opposed to very small, is problematic for KKLT. Specifically, including this rescaling, KKLT have $a = 2\pi(M_s/M_{Pl})^4$ for Euclidean D3-brane instantons, and $a = 2\pi/N_c(M_s/M_{Pl})^4$ for gluino condensation on D7-branes, modifying the expressions written below eq. (4.3). The experimental constraint on R^k in eq. (5.11) implied a KK scale of $10^{11} GeV$ in eq. (6.2). This in turn implies that the 10d Planck scale is $M \simeq 10^{13} GeV$, and $M_s^4/M_{Pl}^4 \sim 10^{-23}$, so we would need an a which is 10^{23} times larger than natural. The same comment applies for the examples with $a < 0$ from refs. [65,66,67] cited in footnotes 4 and 5. It is possible to modify the model to work with M rather than M_{Pl} , but we will save this for future work.