Landscape Higgs boson and sparticle mass predictions from a logarithmic soft term distribution

Howard Baer^{1,*}, Vernon Barger^{2,†}, Shadman Salam^{1,‡} and Dibyashree Sengupta^{3,§}

¹*Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma, Norman, Oklahoma 73019, USA*

²*Department of Physics, University of Wisconsin, Madison, Wisconsin 53706, USA*

³*Department of Physics, National Taiwan University, Taipei 10617, Taiwan, China*

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Recent work on calculating string theory landscape statistical predictions for the Higgs boson and sparticle mass spectrum from an assumed power-law soft term distribution yields an expectation for $m_h \simeq 125$ GeV with sparticles (save light Higgsinos) somewhat beyond the reach of the high-luminosity LHC. A recent examination of the statistics of supersymmetry breaking in IIB string models with stabilized moduli suggests a power law for models based on Kachru-Kalosh-Linde-Trivedi stabilization and uplifting, while models based on the large-volume scenario instead yield an expected logarithmic soft term distribution. We evaluate statistical distributions for the Higgs boson and sparticle masses from the landscape with a log soft term distribution and find the Higgs mass still peaks around ~ 125 GeV with sparticles beyond the LHC reach, albeit with somewhat softer distributions than those arising from a power law.

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I. INTRODUCTION

The cosmological constant problem—how can it be that the numerical value of Λ_{cc} is more than 120 orders of magnitude less than its expected theoretical value [1]—finds a compelling resolution within the landscape of string vacua [2] coupled to anthropic reasoning [3]. The idea is that, with, say, $\sim 10^{500}$ string vacua states [4,5], each leading to different $4-d$ laws of physics and with a rather uniform distribution of Λ_{cc} ranging from m_P^2 to values well below $10^{-120} m_P^2$, it may not be surprising to find ourselves living within a pocket universe (within the eternally inflating multiverse) with such a small Λ_{cc} since if its value was much larger, then the expansion rate would be so great that galaxy (structure) formation would not occur [6]. Such anthropic reasoning works if we posit, in addition, that our pocket universe is but one within a fertile/friendly patch wherein the Standard Model (SM) is

the low energy effective field theory (EFT) and only one of a few fundamental parameters (such as Λ_{cc}) scans within the patch [7].

Possibly related to the cosmological constant problem is the riddle as to why—within the SM—the magnitude of the weak scale $m_{\text{weak}} \sim m_{W,Z,h} \sim 100$ GeV is so much lower than the Planck or grand unified theory scale. Even if tree level SM parameters are dialed so that $m_{\text{weak}} \sim 100$ GeV, quadratically divergent quantum corrections to m_h ought to drag their mass up to the highest energy scales admissible within the model. The latter situation is fixed [8,9] by supersymmetrizing the SM into the softly broken minimal supersymmetric Standard Model or MSSM [10,11]. While weak-scale supersymmetry (SUSY) stabilizes the weak scale, it still does not explain its magnitude.

An explanation for the magnitude of the weak scale can also be found within the string landscape wherein something like the MSSM forms the low energy $4-d$ EFT. In this case, one again assumes a fertile patch of vacua wherein just the soft SUSY breaking terms scan between different pocket universes [12]. Then, the pocket-universe value for the weak scale is determined by the values of the soft SUSY breaking terms and the superpotential μ term. While the former are expected to scan, the latter value is presumably determined by whatever solution to the SUSY μ problem is invoked in nature [13]. Then, the pocket-universe value of the weak scale is given (in terms of the Z mass) by

*baer@ou.edu

†barger@pheno.wisc.edu

‡shadman.salam@ou.edu

§Dibyashree.Sengupta-1@ou.edu

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$$\frac{(m_Z^{\text{PU}})^2}{2} = \frac{m_{H_d}^2 + \Sigma_d^d - (m_{H_u}^2 + \Sigma_u^u) \tan^2 \beta}{\tan^2 \beta - 1} - \mu^2$$

$$\simeq -m_{H_u}^2 - \Sigma_u^u - \mu^2. \quad (1)$$

Here, $m_{H_u}^2$ and $m_{H_d}^2$ are the Higgs field soft squared masses, and the Σ_d^d and Σ_u^u contain over 40 loop corrections to the weak scale (expressions can be found in the Appendix to Ref. [14]). Agrawal *et al.* [15,16] have calculated that if the pocket-universe (PU) value $m_{\text{weak}}^{\text{PU}}$ is much bigger or smaller than its measured value in our Universe (OU), then complex nuclei and hence atoms as we know them would not form. The existence of atoms seems necessary for life as we know it; this is known as the *atomic principle*, in analogy with the structure principle used for anthropic reasoning in the case of the cosmological constant. Thus, a value of $m_{\text{weak}}^{\text{PU}}$ to within a factor of 2–5 of its value in our Universe would form the anthropic requirement for life as we know it in a fertile patch of vacua with a MSSM-like low energy EFT.

Douglas has proposed a program for the statistical determination of the soft SUSY breaking terms, and hence, the expected Higgs boson and sparticle mass spectrum, from sampling the array of soft terms expected within our fertile patch [17]. The distribution of $4-d$ supergravity vacua with hidden sector SUSY breaking scale m_{hidden}^2 is expected to be a product of three distributions

$$dN_{\text{vac}}(m_{\text{hidden}}^2, m_{\text{weak}}, \Lambda_{cc}) = f_{\text{SUSY}} \cdot f_{\text{EWSB}} \cdot f_{cc} \cdot dm_{\text{hidden}}^2, \quad (2)$$

where the hidden sector SUSY breaking scale $m_{\text{hidden}}^4 = \sum_i |F_i|^2 + \frac{1}{2} \sum_\alpha D_\alpha^2$ is a mass scale associated with the hidden sector (and usually in supergravity-mediated models, it is assumed $m_{\text{hidden}} \sim 10^{12}$ GeV such that the gravitino gets a mass $m_{3/2} \sim m_{\text{hidden}}^2/m_P$). Consequently, in gravity mediation, the visible sector soft terms are of magnitude $m_{\text{soft}} \sim m_{3/2}$ [18–20].

As noted by Susskind [21] and Douglas and co-worker [22], the scanning of the cosmological constant is effectively independent of the determination of the SUSY breaking scale so that $f_{cc} \sim \Lambda_{cc}/m_{\text{string}}^4$. Thus, the cosmological constant decouples from the statistical determination of the SUSY breaking scale.

One proposal for f_{SUSY} arises from examining flux vacua in IIB string theory [17,21,23]. Since nothing in string theory prefers one SUSY breaking vacuum expectation value over another, all values should be comparably probable. Then, the SUSY breaking F_i and D_α terms are likely to be uniformly distributed—in the former case as complex numbers, while in the latter case as real numbers. Then, one expects the following distribution of supersymmetry breaking scales

$$f_{\text{SUSY}}(m_{\text{hidden}}^2) \sim (m_{\text{hidden}}^2)^{2n_F+n_D-1}, \quad (3)$$

where n_F is the number of F -breaking fields and n_D is the number of D -breaking fields in the hidden sector. Even for the case of just a single F -breaking term, one expects a *linear* statistical draw toward large soft terms: $f_{\text{SUSY}} \sim m_{\text{soft}}^n$ where $n = 2n_F + n_D - 1$, and in this case, where $n_F = 1$ and $n_D = 0$, then $n = 1$. For SUSY breaking contributions from multiple hidden sectors, as typically expected in string theory, n can be much larger, with a consequent stronger pull toward large soft breaking terms.

An initial guess for f_{EWSB} , the (anthropic) electroweak symmetry breaking factor, was $m_{\text{weak}}^2/m_{\text{soft}}^2$, which would penalize soft terms that were much bigger than the weak scale. However, it was pointed out in Refs. [24,25] that this ansatz fails in a variety of circumstances:

- (i) If the trilinear soft breaking parameter A_t gets too big, then the $m_{t_R}^2$ soft term can be driven negative resulting in charge or color breaking (CCB) vacua. Such vacua states would likely be hostile to life as we know it and would have to be vetoed instead of merely penalized.
- (ii) If soft terms such as $m_{H_u}^2$ are too big, then they will not be driven negative at the weak scale and electroweak (EW) symmetry will not even break; such vacua should also be vetoed.
- (iii) For some soft terms, the larger their high scale value, the *smaller* (more natural) is their associated contribution to the weak scale. This occurs for $m_{H_u}^2$, where if it is too small, it is driven deeply negative to (negative) multi-TeV squared values. Then, one would expect $m_{\text{weak}}^{\text{PU}}$ to also be in the multi-TeV range absent any (improbable) fine-tuning. Also, the larger the A_t parameter, the smaller the $\Sigma_u^u(\tilde{t}_{1,2})$ contributions are to the weak scale (due to cancellations) [26,27]. Also, large first/second generation soft terms $m_0^2(1,2)$ in the tens of TeV range can drive $m_{t_{L,R}}^2$ to small weak-scale values via two-loop renormalization group (RG) effects; this would also result in smaller $\Sigma_u^u(\tilde{t}_{1,2})$ contributions to the weak scale.

To ameliorate these issues, the form

$$f_{\text{EWSB}} = \Theta(30 - \Delta_{\text{EW}}) \quad (4)$$

was adopted, which requires all contributions to the weak scale to be within a factor 4 of the measured value of the weak scale in our Universe $m_{\text{weak}}^{\text{OU}}$. In addition, EW symmetry must be properly broken with no CCB minima.

The statistical calculation of generating soft terms according to f_{SUSY} (as might be expected in a scan of our fertile patch of the landscape) along with the anthropic selection Eq. (4) that electroweak symmetry breaking (EWSB) is properly broken with $m_{\text{weak}}^{\text{PU}} \lesssim 4m_{\text{weak}}^{\text{OU}}$, has

led to some very compelling success. The statistical pull on soft SUSY breaking terms to large values pulls the sparticle mass predictions beyond present day limits from the LHC: For instance, statistically we would expect for $n = 1$ or 2 that $m_{\tilde{g}} \sim 4 \pm 2$ TeV, which explains why the LHC has not seen gluinos so far. But sparticles cannot be pulled so high that $m_{\text{weak}}^{\text{PU}}$ gets too big, lest we violate the atomic principle. The fact that A_t gets pulled to large values (but stopping short of CCB vacua) leads to maximal mixing in the top-squark sector, which also lifts m_h to a statistical peak around $m_h \simeq 125$ GeV. Thus, from the string landscape with a power-law draw to large soft terms, we expect $m_h \simeq 125$ GeV, while sparticles are typically beyond the present LHC reach. This methodology has been applied to the two- and three-extra-parameter nonuniversal Higgs gravity-mediation models [28–33] NUHM2 and NUHM3 in Ref. [25] and to mirage mediation in Ref. [34].

An alternative form for f_{SUSY} is instead motivated by dynamical SUSY breaking (DSB) where instead of perturbative breaking, one expects SUSY breaking from nonperturbative effects [8]. These might include, for instance, SUSY breaking via gaugino condensation when some hidden sector gauge group becomes strongly interacting. In such a case, the hidden sector SUSY breaking scale is expected to be $m_{\text{hidden}}^2 \sim m_P^2 e^{-8\pi^2/b_0 g^2}$ where g is the hidden sector gauge coupling, and $b_0 \sim 1$ enters the hidden sector beta function. A strong motivation for DSB is that it provides some mechanism to generate an exponential hierarchy between the SUSY breaking scale and the fundamental scale m_P in the theory. A plot of hidden sector SUSY breaking mass scale vs g_{hidden} is shown in Fig. 1. In the context of the landscape, if the hidden gauge coupling g_{hidden}^2 is uniformly distributed within various pocket universes [22], then the SUSY breaking scale will be logarithmically distributed across the decades of values. Then, we might expect as well a slowly rising (log) distribution of soft terms. A log or log times a power-law distribution of soft terms has been advanced by Dine

FIG. 1. Expected SUSY breaking scale m_{hidden} vs hidden sector coupling g from dynamical SUSY breaking.

et al. in a series of papers [35–38]. Such a log distribution may also be expected in nonperturbative SUSY breaking due to instanton effects [39].

The logarithmic landscape draw on soft terms has also emerged from considerations of Kähler moduli stabilization in Ref. [40]. In previous work, Kähler moduli effects were thought to be subleading, but in Ref. [40], the stabilization of Kähler moduli in the Kachru-Kalosh-Linde-Trivedi (KKLT) [41], large-volume scenario (LVS) [42], and perturbative moduli stabilization [43] (PS) schemes was examined. For these cases, it was found that KKLT and PS led to a power-law draw for soft terms, while LVS stabilization led to a log draw. Given these motivations, in the present paper we calculate the statistical distributions of Higgs boson and sparticle masses in the NUHM3 gravity-mediation model assuming a log draw on soft terms.

II. RESULTS

In this section, we will present the results of our calculations of the string landscape probability distributions for the Higgs boson and sparticle masses under the assumption of $f_{\text{SUSY}} = \log(m_{\text{soft}})$ along with Eq. (4) for f_{EWSB} . Our results will be presented within the gravity-mediated three-extra-parameter nonuniversal Higgs model NUHM3 with parameter space given by

$$m_0(1, 2), m_0(3), m_{1/2}, A_0, \tan \beta, \mu, m_A \quad (\text{NUHM3}). \quad (5)$$

We adopt the ISAJET [44] code for the calculation of the Higgs boson and superparticle mass spectrum [45] based on two-loop renormalization group equation (RGE) running [46] along with sparticle and Higgs masses calculated at the RG-improved one-loop level [47].

To compare our results against similar calculations which were presented in Ref. [25] but using $f_{\text{SUSY}} = m_{\text{soft}}^n$, we will scan over the same parameter space:

- (i) $m_0(1, 2): 0.1\text{--}60$ TeV,
- (ii) $m_0(3): 0.1\text{--}20$ TeV,
- (iii) $m_{1/2}: 0.5\text{--}10$ TeV,
- (iv) $A_0: -50\text{--}0$ TeV,
- (v) $m_A: 0.3\text{--}10$ TeV,

with $\mu = 150$ GeV while $\tan \beta: 3\text{--}60$ is scanned uniformly. The goal here is to choose upper limits to our scan parameters which will lie beyond the upper limits imposed by the anthropic selection from f_{EWFT} . Lower limits are motivated by current LHC search limits. Our final results will hardly depend on the chosen value of μ so long as μ is within a factor of a few of $m_{W,Z,h} \sim 100$ GeV.

Our first results are shown in Fig. 2, where we show probability distributions of input parameters. Our present $f_{\text{SUSY}} = \log(m_{\text{soft}})$ distributions are shown as shaded histograms. These are then compared to previous scans with $f_{\text{SUSY}} = m_{\text{soft}}^n$ for $n = 0$ (typical uniform scan) and the simplest power-law scan with $n = 1$. In Fig. 2(a), we show

FIG. 2. Probability distributions for NUHM3 soft terms (a) $m_0(1,2)$, (b) $m_0(3)$, (c) $m_{1/2}$, and (d) A_0 from a log distribution of soft terms in the string landscape with $\mu = 150$ GeV. For comparison, we also show probability distributions for $n = 0$ and 1.

the distribution vs first/second generation soft terms $m_0(1,2)$. While the $n = 0$ result (green histogram) peaks at the few TeV range, and the $n = 1$ result (red histogram) peaks around 15–20 TeV, we see that the new log result is significantly harder than the uniform scan but slightly softer than $n = 1$. Here, the peak probability value for $m_0(1,2)$ lies in the 10–20 TeV range with a tail extending to 40 TeV. Such large values of $m_0(1,2)$ should still be enough to provide the mixed decoupling/quasidegeneracy landscape solution to the SUSY flavor/ CP problems as outlined in Ref. [48]. In Fig. 2(b), we show the distribution vs third generation soft mass $m_0(3)$. Here, the log distribution peaks around 4 TeV, which is again intermediate between the $n = 0$ and $n = 1$ histograms. For Fig. 2(c), which shows the distribution in unified gaugino mass $m_{1/2}$, we see the log distribution peaks around 1 TeV with a tail extending to ~ 2.5 TeV. For comparison, the $n = 0$ scan peaks at very low $m_{1/2}$, while the $n = 1$ histogram peaks near $m_{1/2} \sim 1.5$ TeV. Finally, we show in Fig. 2 (d) the distribution in $-A_0$. While the uniform scan favors small $|A_0|$, leading to small stop mixing and lower m_h , the log scan is substantially harder with a double peak structure: one at small $|A_0|$ leading to small stop mixing and another around $A_0 \sim -7$ TeV with large mixing. The large $-A_0$ bump occurs due to previously noted *cancellations* in

the weak-scale radiative corrections $\Sigma_u^u(\tilde{t}_{1,2})$ when $|A_0|$ becomes maximal just stopping short of inducing CCB minima in the scalar potential [26,27].

In Fig. 4, we show various probability distributions for quantities associated with the Higgs/Higgsino sector, including the light Higgs mass dP/dm_h in Fig. 4(a). From the frame, we see that with a log distribution of soft terms, the distribution in m_h has a two-peak structure: a dominant

FIG. 3. Scatter plot of models with appropriate EWSB and $m_Z^{\text{PU}} < 4m_Z^{\text{OU}}$ in the m_h vs A_0 plane with $\mu = 150$ GeV.

FIG. 4. Probability distributions for NUHM3 masses and parameters (a) m_h , (b) m_A , (c), $\tan \beta$, and (d) $m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^0}$ from a log distribution of soft terms in the string landscape with $\mu = 150$ GeV. For comparison, we also show probability distributions for $n = 0$ and 1.

peak around $m_h \sim 125$ GeV and a subdominant peak around $m_h \sim 120$ GeV. The dominant large m_h peak coincides with the large $|A_0|$ peak of Fig. 2(d), which leads to large stop mixing. As is well known, large stop mixing leads to large radiative corrections to m_h [49–51] and lifts m_h up into the ~ 125 GeV range. This is shown in a scatter plot of events with appropriate EWSB and $m_Z^{\text{PU}} < 4m_Z^{\text{OU}}$ in the m_h vs A_0 plane in Fig. 3. There we see explicitly that large $-A_0$ events correlate with large $m_h \simeq 125$ GeV, while lower values of $-A_0$ correspond to too low a value of m_h . This is a testable prediction of the string landscape picture: A value of $m_h \sim 125$ GeV is reflective of large stop mixing which can be untangled, for instance, at an e^+e^- collider operating with $\sqrt{s} > 2m_{\tilde{t}_1}$ [52]. Other stringy scenarios, such as G2 MSSM [53] or minisplit SUSY [54,55], obtain $m_h \sim 125$ GeV via very heavy (unnatural) top squarks but with rather small stop mixing. The low $m_h \sim 120$ GeV bump comes from small stop mixing with $-A_0 \lesssim 1$ TeV.

In Fig. 4(b), the distribution in dP/dm_A peaks around $m_A \sim 1.5$ –2 TeV with a long tail extending as high as 8 TeV. The upper limit on m_A arises from the $m_{H_d}^2/\tan^2 \beta$ contribution to the weak scale in Eq. (1). For $\tan \beta \sim 10$, $m_A \lesssim 3$ TeV, but for larger values of $\tan \beta$, $m_A \sim m_{H_d}$ can

become much bigger; see the $\tan \beta$ vs m_A scatter plot of solutions in Fig. 5. Such large values of $m_A \gg m_h$ (and consequently, m_H and $m_{H^\pm}$) predict that the Higgs sector looks decoupled, with h behaving largely as a SM-like Higgs boson. Thus, the landscape SUSY prediction is that precision Higgs measurements at the HL-LHC or an e^+e^-

FIG. 5. Scatter plot of models with appropriate EWSB and $m_Z^{\text{PU}} < 4m_Z^{\text{OU}}$ in the $\tan \beta$ vs m_A plane with $\mu = 150$ GeV. The orange dots have $m_h < 123$ GeV.

FIG. 6. Scatter plot of models with appropriate EWSB and $m_Z^{\text{PU}} < 4m_Z^{\text{OU}}$ in the Δm^0 vs m_h plane with $\mu = 150$ GeV. The orange dots have $m_h < 123$ GeV.

Higgs factory will see at best only small deviations from SM Higgs properties.

In Fig. 4(c), we see the distribution in $\tan\beta$, which is scanned uniformly since it is not a soft term. The expected value is for $\tan\beta \sim 10$ with a falling tail toward larger values. Large $\tan\beta$ yields large bottom-squark

$\Sigma_u^u(\tilde{b}_{1,2})$ and tau-lepton contributions to the weak scale and so is disfavored.

In Fig. 4(d), we show the light Higgsino mass gap $\Delta m^0 \equiv m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^0}$. This quantity is relevant to light Higgsino pair production at the LHC via the soft-opposite-sign-dilepton plus jet plus missing transverse energy channel [56–63]. The prediction here is for a mass gap $\Delta m^0 \sim 8$ –12 GeV but with a tail extending to 15–20 GeV. However, the large $\Delta m^0 > 14$ GeV tail corresponds to models with $m_h < 123$ GeV and $m_{\tilde{g}} \lesssim 2.25$ TeV as can be seen from the scatter plot of Δm^0 vs m_h in Fig. 6. In comparison, the $n = 0$ draw predicts much larger mass gaps, while $n = 1$ or 2 predicts gaps typically below 10 GeV. Such mass gaps can be easily measured to high precision at an e^+e^- collider operating with $\sqrt{s} > 2m(\text{Higgsino})$ [64,65].

In Fig. 7, we show the predicted probability distributions for various strongly interacting sparticles which are relevant for LHC SUSY searches. In Fig. 7(a), we show the distribution $dP/dm_{\tilde{g}}$. The log distribution has a peak at $m_{\tilde{g}} \sim 2.5$ –3 TeV, somewhat beyond present LHC limits which require $m_{\tilde{g}} \gtrsim 2.2$ TeV. Only a small portion of log parameter space is excluded by the present LHC gluino

FIG. 7. Probability distributions for NUHM3 masses and parameters (a) $m_{\tilde{g}}$, (b) $m_{\tilde{u}_L}$, (c) $m_{\tilde{t}_1}$, and (d) $m_{\tilde{t}_2}$ from a log distribution of soft terms in the string landscape with $\mu = 150$ GeV. For comparison, we also show probability distributions for m_{soft}^n with $n = 0$ and 1.

TABLE I. Three models of moduli stabilization along with expected form of soft terms, expected soft term distribution in string IIB landscape, and references for the associated statistical distributions of Higgs boson and sparticle masses.

Model	KKLT [41]	LVS [42]	PS [43]
Soft terms	Mirage	Grav	Grav
Soft term distribution	m_{soft}^n	$\log(m_{\text{soft}})$	m_{soft}^n
Mass distributions	[34]	This paper	[25]

mass limit, so from the landscape point of view, it is not surprising that the LHC has not discovered SUSY. The distributions tails off to values of $m_{\tilde{g}} \sim 5\text{--}6$ TeV, such high values of $m_{\tilde{g}}$ would require at least an energy doubling upgrade of the LHC for detection [66,67]. In Fig. 7(b), we show an example of first/second generation squark masses: In this case, $m_{\tilde{u}_L}$. Here we see a peak value of $m_{\tilde{u}_L} \sim 15\text{--}20$ TeV with a tail extending to ~ 40 TeV. Such high first/second generation scalar masses are pulled upward until their two-loop RGE contributions to the top-squark sector cause those soft terms to run tachyonic resulting in CCB vacua.

In Fig. 7(c), we show $dP/dm_{\tilde{t}_1}$. For the log distribution, the peak is around $m_{\tilde{t}_1} \sim 1.5\text{--}2$ TeV. This compares to current LHC limits which require $m_{\tilde{t}_1} \gtrsim 1.1$ TeV. Thus, again we see that it is not surprising that top squarks have not been detected at the LHC from the string landscape point of view. In Fig. 7(d), we show the distribution $dP/dm_{\tilde{t}_2}$. This distribution peaks at $m_{\tilde{t}_2} \sim 3$ TeV and would likely require at least an energy doubling of the LHC in order to gain detection [66,67]. The log distribution is again intermediate between the $n = 0$ and $n = 1$ scan results.

III. CONCLUSIONS

In this paper, we were motivated by two major success stories for the string theory landscape: (i) its success in explaining the tiny value of the cosmological constant, and (ii) when applied to the statistics of SUSY breaking with a power-law draw to large soft terms and an anthropic bound on the pocket-universe value of the weak scale $m_{\text{weak}}^{\text{PU}}$, it predicts a value $m_h \simeq 125$ GeV with sparticles (other than hard-to-detect Higgsinos) lifted beyond present LHC

search limits. In this paper, we were motivated by an earlier suggestion by Dine based on DSB that soft terms would instead have a logarithmic statistical distribution. This case has also been recently advanced by Broeckel *et al.* [40] where they consider the effects of Kähler moduli stabilization to derive a log distribution for soft terms from models of LVS stabilization. Alternatively, they find a power-law soft term statistical distribution for the KKLT and PS models.

The three scenarios are listed in Table I along with the expected form of soft terms: either from gravity mediation or mirage mediation. Higgs boson and sparticle mass distributions have previously been presented in Ref. [25] for power-law draw and gravity mediation as expected in PS. In Ref. [34], the corresponding distributions have been presented for power-law draw but with mirage mediation. In this work, we completed the table by presenting expected Higgs boson and sparticle statistical mass distributions for a log draw with gravity mediation, as may be expected from the LVS stabilization within the string landscape.

Our results from Fig. 4 showed that the expectation for $m_h \simeq 125$ GeV still holds for a log draw, although the Higgs peak at 125 GeV is not as sharp as that found from $n = 1$ or 2 power-law draw. Also, sparticles (other than Higgsinos) are still expected to lie beyond LHC search limits, but again not as sharply as in the power-law case. Of course, if experiment confirms SUSY particles within the ranges shown here, one will be able to distinguish mirage from gravity mediation, for instance, by extracting running gaugino masses at an e^+e^- collider and checking at which scale they might unify [68]. But for the case of gravity mediation based on just a single data point of SUSY spectra, there will be no way to distinguish between the different stabilization mechanisms LVS or PS.

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