Higgs and *Sparticle* mass predictions from the String Landscape

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May 20th, 2021

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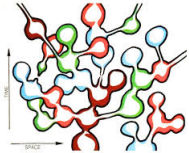
Anthropics + Landscape

- The Λ_{cc} problem: Why $\Lambda_{cc} \sim 10^{-120} M_P^2 \ll M_P^2$?



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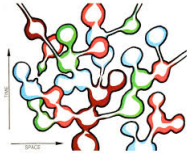

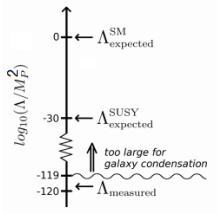

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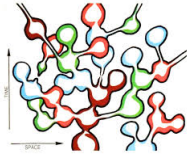

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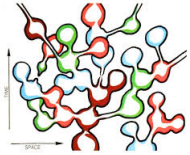
- Much larger a value of Λ_{cc}) no galaxy formation) non-livable PU.



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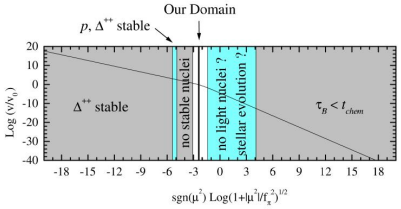

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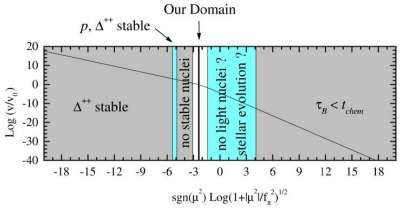

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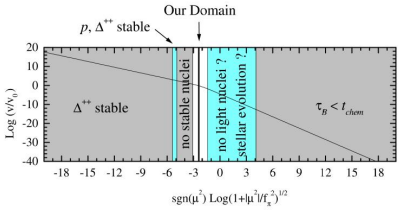

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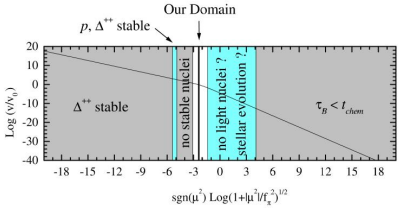

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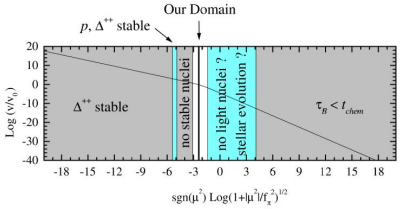
- For landscape, the condition is $(m_Z^{PU})^2$=2 and m_Z^{PU} 6= $m_Z^{OU} = 91{:}2$ GeV.



SUSY Breaking Scale

- For a fertile patch of the landscape with MSSM as low energy EFT, the distribution of PU vacua is given by m_{hidden}^2

$$dN_{vac}(m_{hidden}^2; m_{weak}; \Lambda_{cc}) = f_{SUSY} : f_{EWSB} : f_{cc} : dm_{hidden}^2$$

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- It was advocated by Douglas, Susskind and Arkani-Hamed *et al.* that SUSY breaking scales should follow a power-law distribution

$$f_{SUSY} \quad m^2_{hidden} \qquad m^2_{hidden}{}^{2n_F+n_D} \quad 1$$

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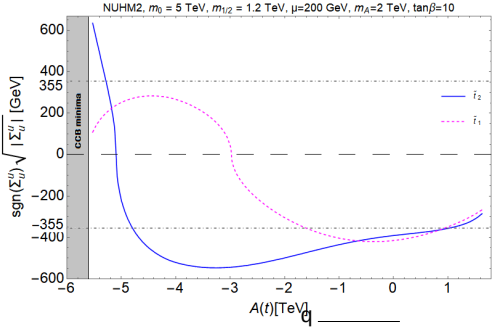
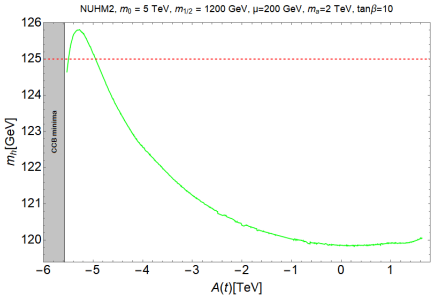
- The EWFT distribution f_{EWSB} is taken as

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

which ! large A_t ! m_h 125 GeV, proper EWSB and m^{PU}_{weak} $4m^{OU}_{weak}$.

Consequence of Anthropics and Power law Distribution





Large negative $A(t)$) smaller $\Sigma_u^u(\tilde{t}_{1;2})$ contributions to the weak scale ! bigger higgs mass.

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  $$f_{SUSY} = m_{soft}^{n}:$$
  2. Large Volume Scenario (LVS) (Perturbative & Non-perturbative) $\overset{leads\ to}{!}$ a logarithmic draw, i.e.
  $$f_{SUSY} = \log(m_{soft}):$$

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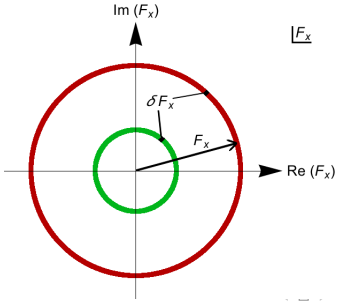
- The results are then compared to $f_{SUSY} = m^n_{soft}$ draw with $n = 0$ (uniform distribution) and $n = 1$ (text book example of a single F-breaking field distributed as a complex number in the landscape).



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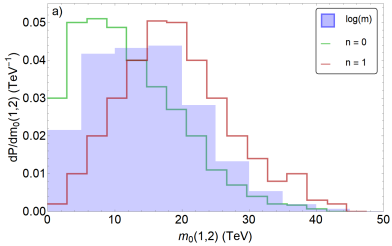
Results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log(m)
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dP/dm0(1,2) (TeV−1)
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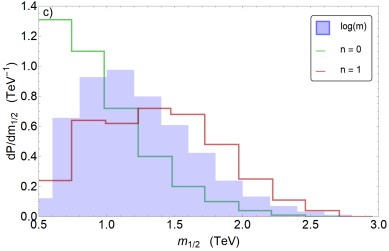
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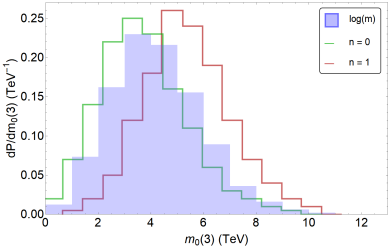
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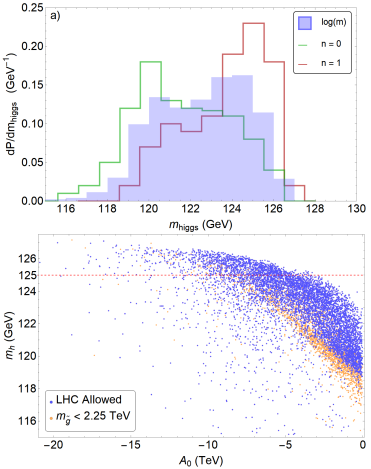

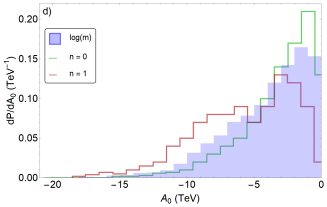

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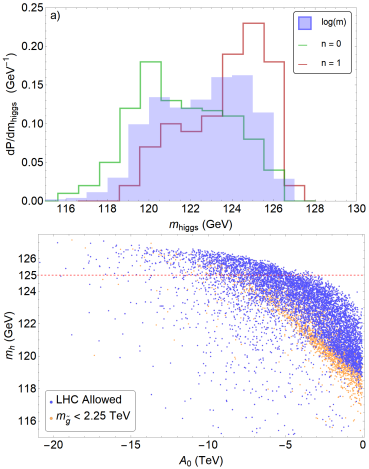

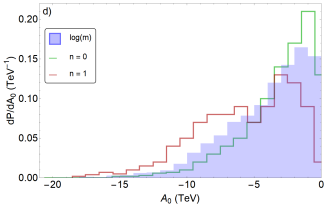

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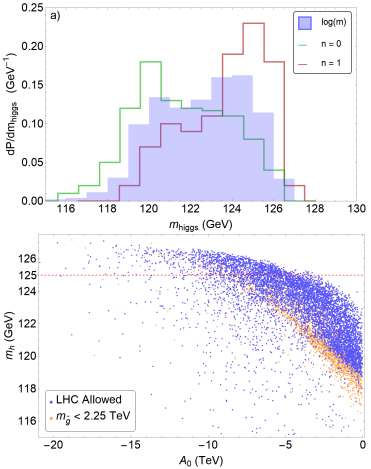

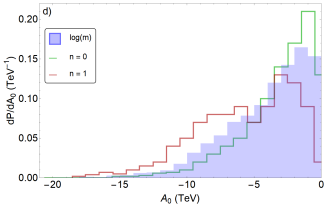

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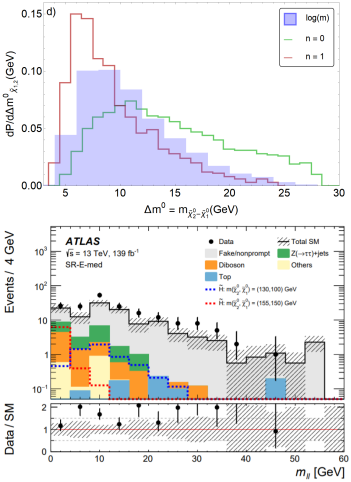
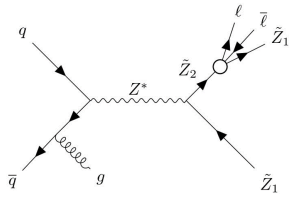
- This is a testable prediction of the string landscape: A SM-like higgs m_h 125 GeV is reflective of large mixing in the stop sector.

Results-Soft Dilepton Signal





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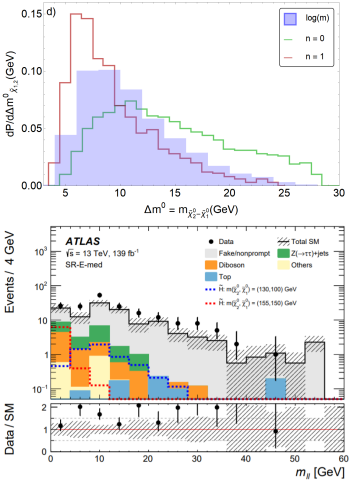

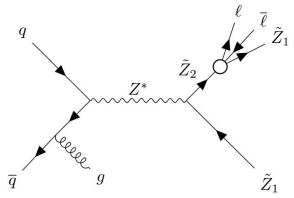

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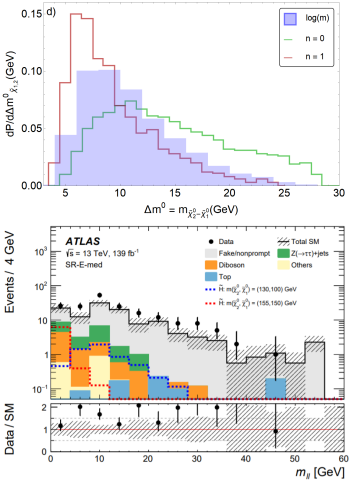

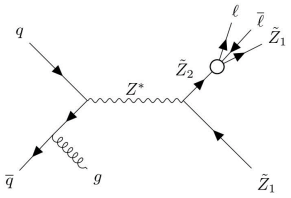

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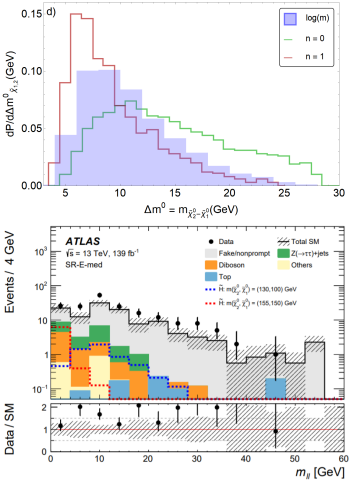

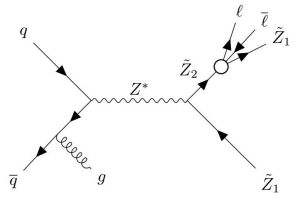

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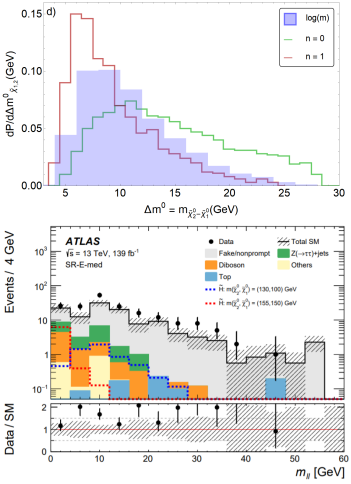
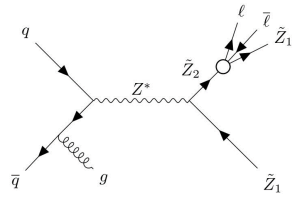
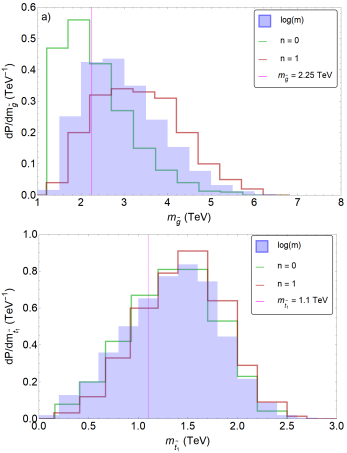




- m_Z^2=2 ' $m_{H_u}^2$ 2 $\Sigma_u^u(\tilde{t}_{1;2})$! is SUSY conserving) too big a value of ! too big m_{weak} unless one finetunes.
- String landscape favors (100 350GeV) m_{soft}) small ! **light higgsinos**.
- Small has a signature in the higgsino pair-production channel.
- The log-draw gives a broad peak structure 8 12 GeV.
- Current search results from ATLAS with 139fb^{-1} data ! slight excess in bins with m_{ll} 5 10 GeV.[3]

Results



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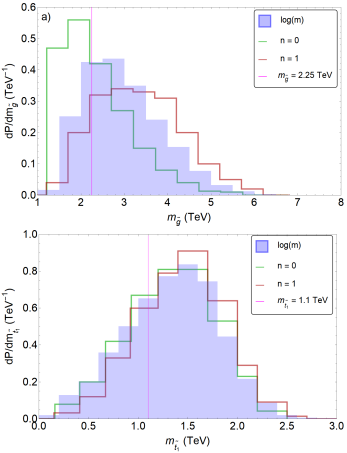

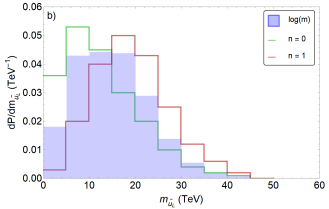

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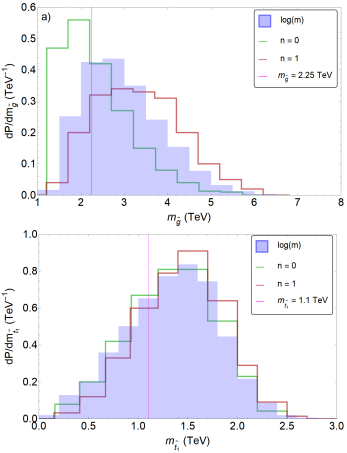

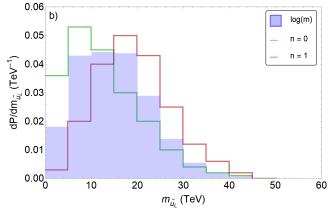

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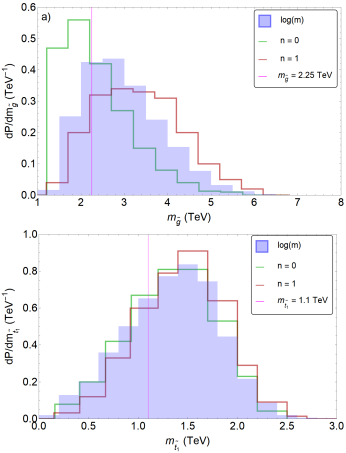

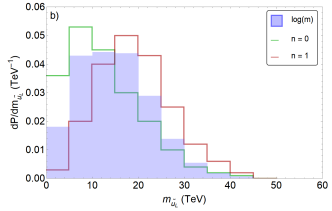

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- First and Second generation squarks yield peaks in the 10 40 TeV range ! decoupling solution to the SUSY flavor and CP problem.

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- Dark matter content: higgsino-like WIMP and *axion*.

References

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