Higgs and *Sparticle* mass predictions from the String Landscape

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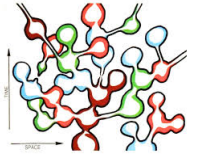
Anthropics + Landscape

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



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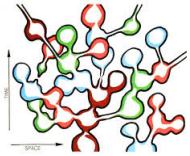

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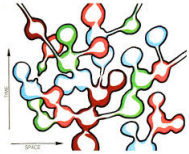

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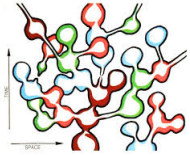
- Much larger a value of $\Lambda_{cc} \Rightarrow$ no galaxy formation $\Rightarrow$ non-livable PU.



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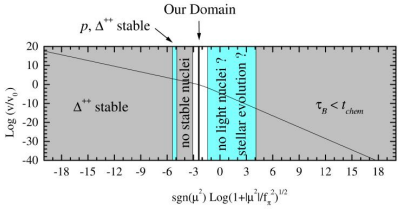

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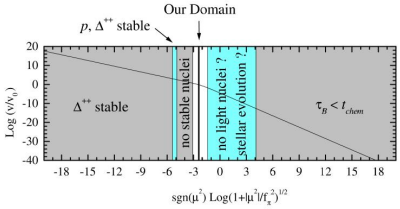

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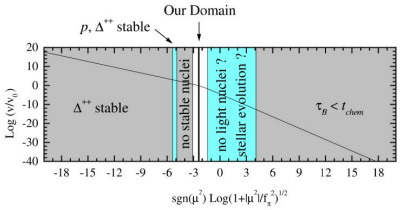

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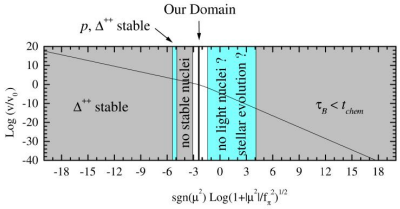

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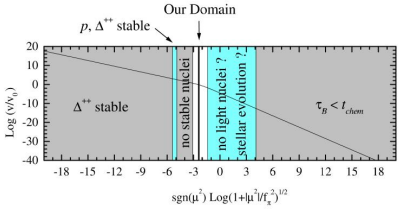
- For landscape, the condition is $\left(m_Z^{PU}\right)^2/2$ and $m_Z^{PU} \neq m_Z^{OU} = 91.2$ GeV.



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

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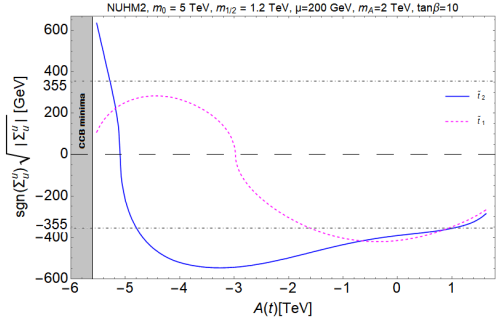
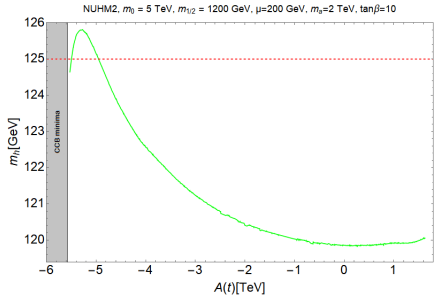
  with $n = 2n_F + n_D - 1$.
- The EWFT distribution f_{EWSB} is taken as

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

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

Consequence of Anthropics and Power law Distribution





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

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

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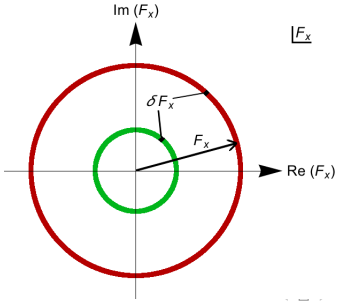
- The results are then compared to $f_{SUSY} = m^n_{soft}$ draw with $n = 0$ (uniform distribution) and $n = 1$ (text book example of a single F-breaking field distributed as a complex number in the landscape).



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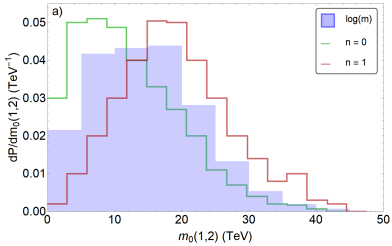
Results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dP/dm0(1,2) (TeV−1)
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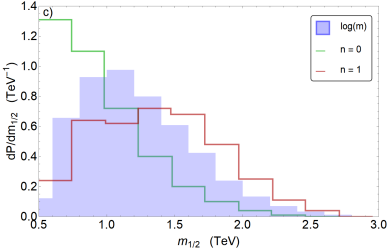
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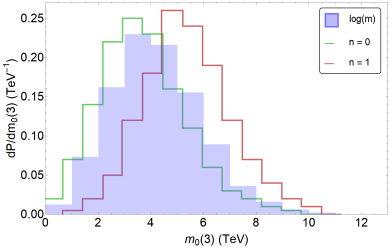
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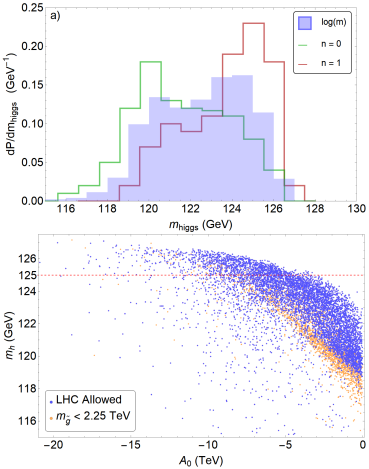

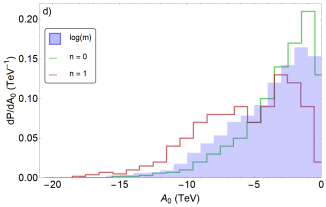

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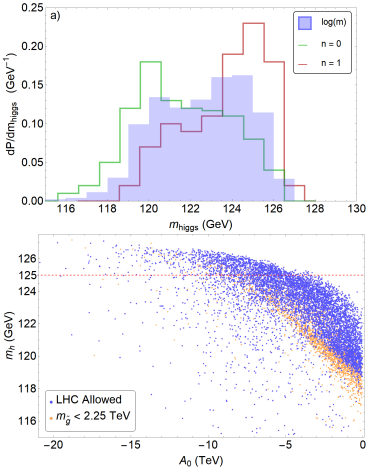

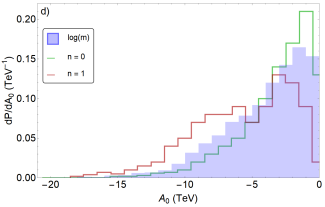

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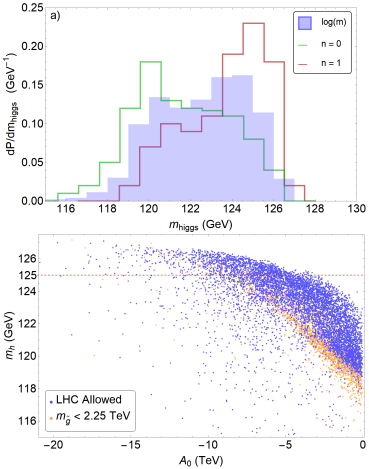

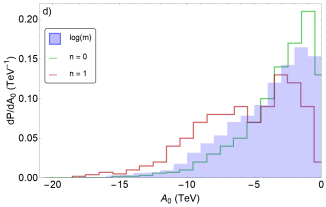

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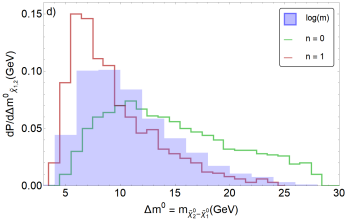
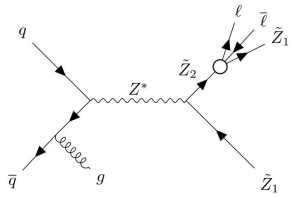
- This is a testable prediction of the string landscape: A SM-like higgs $m_h \sim 125$ GeV is reflective of large mixing in the stop sector.

Results-Soft Dilepton Signal





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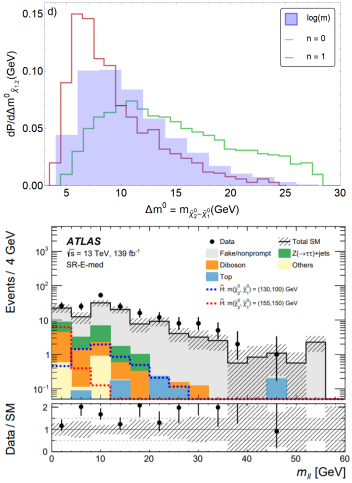

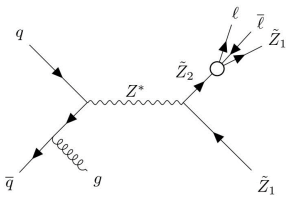

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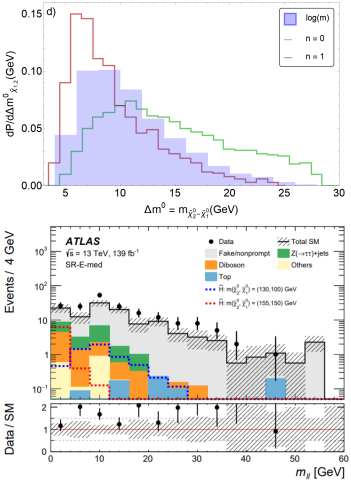

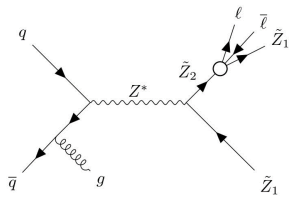

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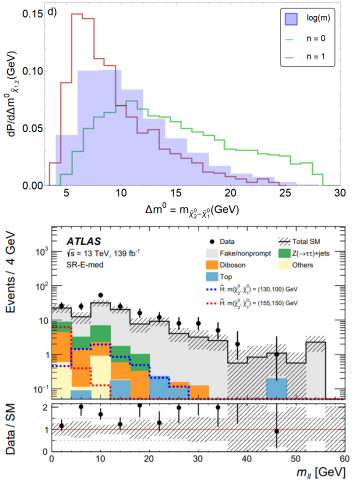

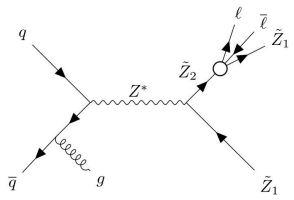

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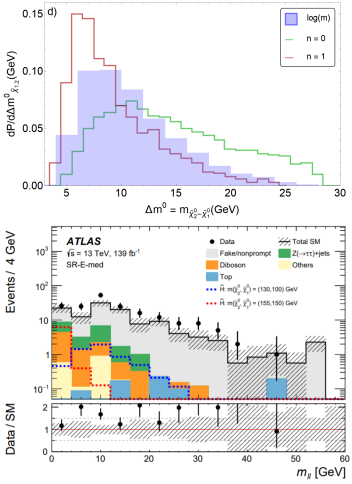
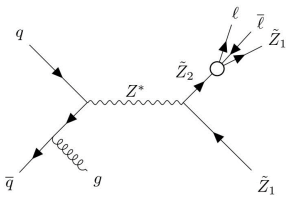
- The log-draw gives a broad peak structure $\sim 8 - 12$ GeV.

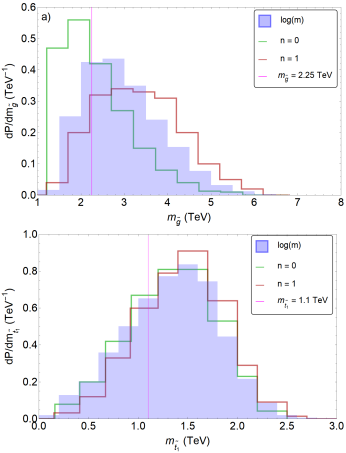
Results-Soft Dilepton Signal

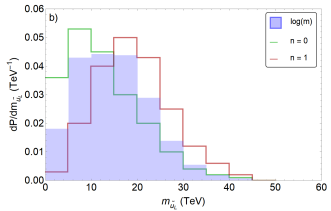




- $m_Z^2/2 \simeq -m_{H_u}^2 - \mu^2 - \Sigma_u^u(\tilde{t}_{1,2}) \rightarrow \mu$ is SUSY conserving $\Rightarrow$ too big a value of $\mu \rightarrow$ too big m_{weak} unless one finetunes.
- String landscape favors $\mu(\sim 100 - 350\text{GeV}) \ll m_{soft} \Rightarrow$ small $\mu \rightarrow$ **light higgsinos**.
- Small μ has a signature in the higgsino pair-production channel.
- The log-draw gives a broad peak structure $\sim 8 - 12$ GeV.
- Current search results from ATLAS with $139 fb^{-1}$ data $\rightarrow$ slight excess in bins with $m_{ll} \sim 5 - 10$ GeV.[3]

Results





- Log-draw and $n = 1$ draw both pull the gluino mass up to peaks roughly $2.5 - 3$ TeV and $3 - 6$ TeV.

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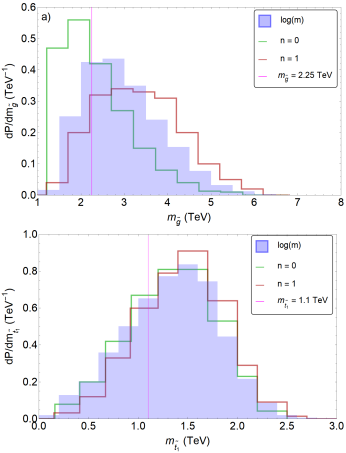

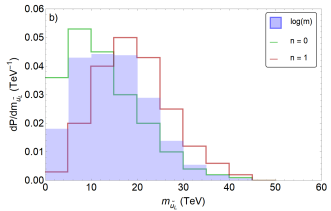

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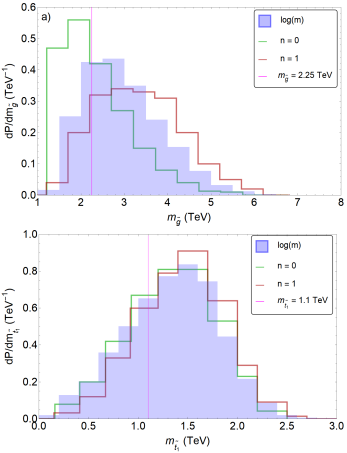

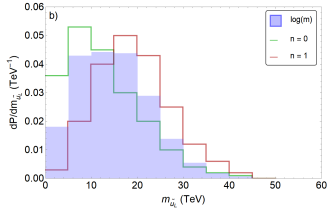

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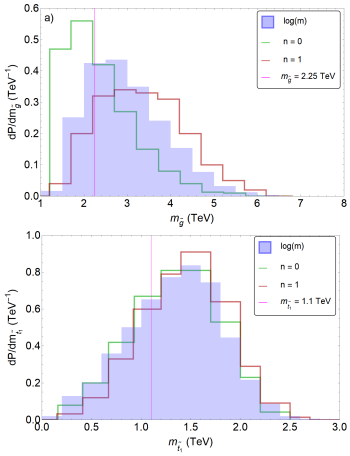

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- First and Second generation squarks yield peaks in the $10 - 40$ TeV range $\rightarrow$ decoupling solution to the SUSY flavor and CP problem.

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

References

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