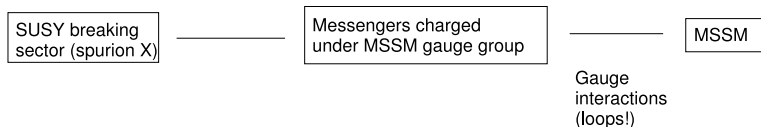


Generating A-terms at tree level

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Gauge mediation and A-terms



- Flavor blind mechanism to break SUSY.
- But... no large A-terms! They show up only at 2 loops.

Minimizing tuning and maximal mixing

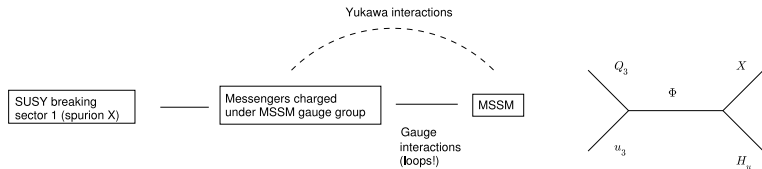
- Recall that for large $\tan(\beta)$ the one-loop higgs mass is

$$m_h^2 \approx m_Z^2 + \frac{3g^2 m_t^4}{8\pi^2 m_W^2} \left(\log \left(\frac{M_{SUSY}^2}{m_t^2} \right) + \frac{A_t^2}{M_{SUSY}^2} \left(1 - \frac{A_t^2}{12M_{SUSY}^2} \right) \right) \quad (1)$$

- To avoid large M_{SUSY} try to get *maximal mixing*, $A_t = \sqrt{6}M_{SUSY}$

→ We need large *a-terms!* (mixed stops)

The objective: find the implications of changing the picture



- Consider the following 1-messenger model.

$$W = \kappa Q_3 u_3 \tilde{\Phi}_{H_u} + X' \Phi_{H_u} \tilde{H}_u + M \Phi_{H_u} \tilde{\Phi}_{H_u} \quad , \quad X' = M_{X'} + F_{X'} \theta^2 \quad (2)$$

A simple example

- Integrating out $\Phi, \tilde{\Phi}$ we get

$$W_{\text{eff}} \propto \underbrace{\kappa \frac{X'}{M}}_{y_t, A_t} Q_3 u_3 H_u, \quad K_{\text{eff}} = \underbrace{\frac{X'^{\dagger} X'}{M^{\dagger} M}}_{m_{\text{soft}}^2} H_u^{\dagger} H_u + \dots \quad (3)$$

$$y_t \propto \kappa \frac{M_{X'}}{M}, \quad A_t \propto \kappa \frac{F_{X'}}{M}, \quad m_{\text{soft}}^2 = \frac{F_{X'}^2}{M^2} \quad (4)$$

$$\rightarrow \frac{m_{\text{soft}}^2}{A_t^2} \propto \frac{1}{\kappa^2} \quad (5)$$

- Tree level A-terms *and* soft masses m_{soft} generated at the same scale, $\frac{F_X}{M}$

$\rightarrow A/m_{H_u}$ problem (tuning problem!)

Can we solve the A/m_H problem?

- We made a comprehensive survey of models that generate A_t at tree level, and this feature is *very general* (MFV and NMFV models).
- Large $\kappa \rightarrow$ Landau pole. Sign of a strongly coupled theory in the UV (Seiberg dualize the theory).

Can we get the right Higgs mass without large tuning?

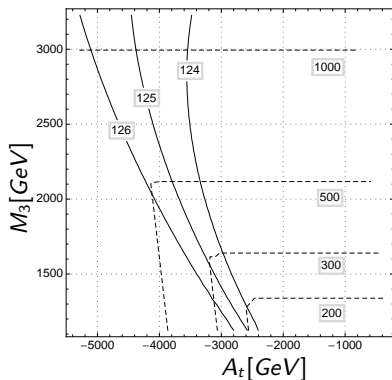


Figure : Contours of the Higgs mass and tuning.

Summary of features

- Tuning is reduced with respect to a non composite model.
- The size of the large top yukawa is explained from compositeness.
- $SU(5)$ unification can be achieved.
- Flavor constrains are not a problem.

What do you need to remember?

- We would like large A -terms to get the Higgs mass.
- Gauge mediation doesn't generate them.
- If we try to modify the GM picture we bump into the A/m_h problem (in a class of models).
- Some people in New Jersey thought about this and provided some solutions.

Work in progress

- Another module is needed for the introduction of a second, loop suppressed, susy breaking sector.
- Only explains a small part of the yukawa texture.

Backup: we need a new spurion

- X cannot be the gauge mediation SUSY breaking field if we want to avoid huge soft masses.
- We need a new, loop suppressed X' .
- But still we get $m_{soft} \sim A_t$

→ A/m_H problem still there (tuning problem!)