(De)Constructing a Natural Supersymmetric Standard Model

(Or: SUSY models in light of the LHC?)

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arXiv: 1103.3708

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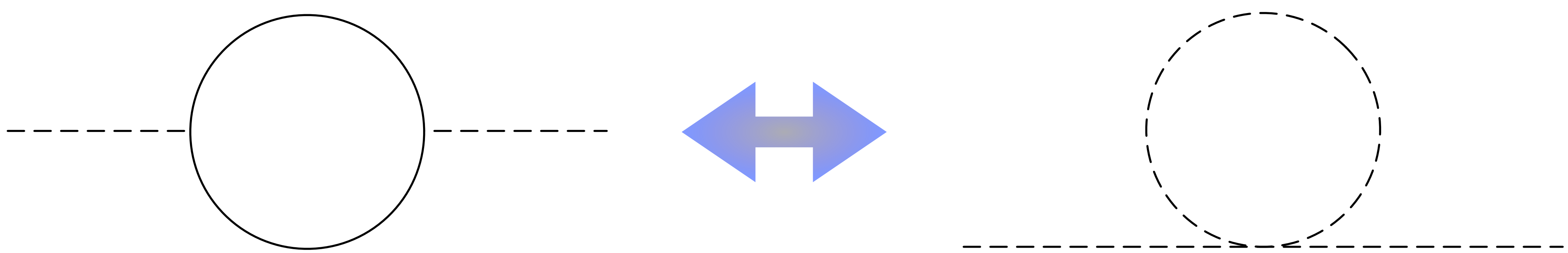
In progress

FNAL 10.06.11

SUSY as solution to the hierarchy problem

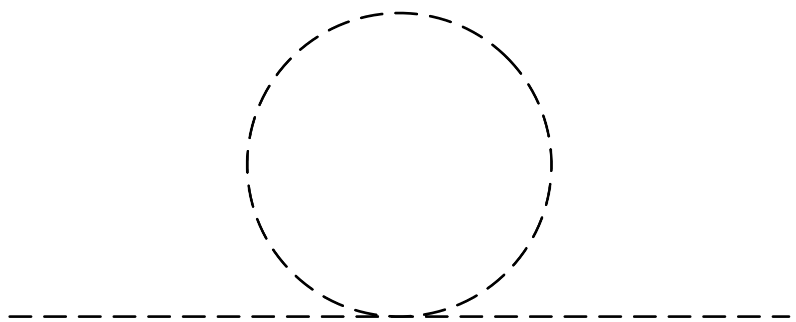
Supersymmetry is a well-motivated solution to the hierarchy problem -- perhaps the best theoretical framework available (calculable; most consistent with precision electroweak)



Quadratically divergent contributions to the Higgs mass cancelled by superpartners; superpartner masses act as a cutoff for the divergences.

How heavy can natural SUSY be?

Corrections to the Higgs (soft) mass are driven by the top/stop system, since the top yukawa is so large



$$\Delta m_{H_u}^2 \sim -12 \frac{y_t^2}{16\pi^2} m_{\tilde{t}}^2 \log \frac{\Lambda_{UV}}{\mu_{IR}}$$

But there is a close relation between the scale of EWSB and the Higgs soft mass

$$\frac{1}{2} m_Z^2 \simeq \mu^2 - m_{H_u}^2$$

Stop should not be heavier than ~ few hundred GeV if SUSY is a natural solution to the hierarchy problem

A separate tuning problem

Supersymmetry has its own problem with the Higgs mass, namely that in the MSSM the Higgs quartic comes strictly from SM D-terms, fixing the tree-level prediction at

$$m_h^2 \leq m_Z^2 \cos(2\beta)^2$$

whereas the LEP bound is $m_h > 114$ GeV

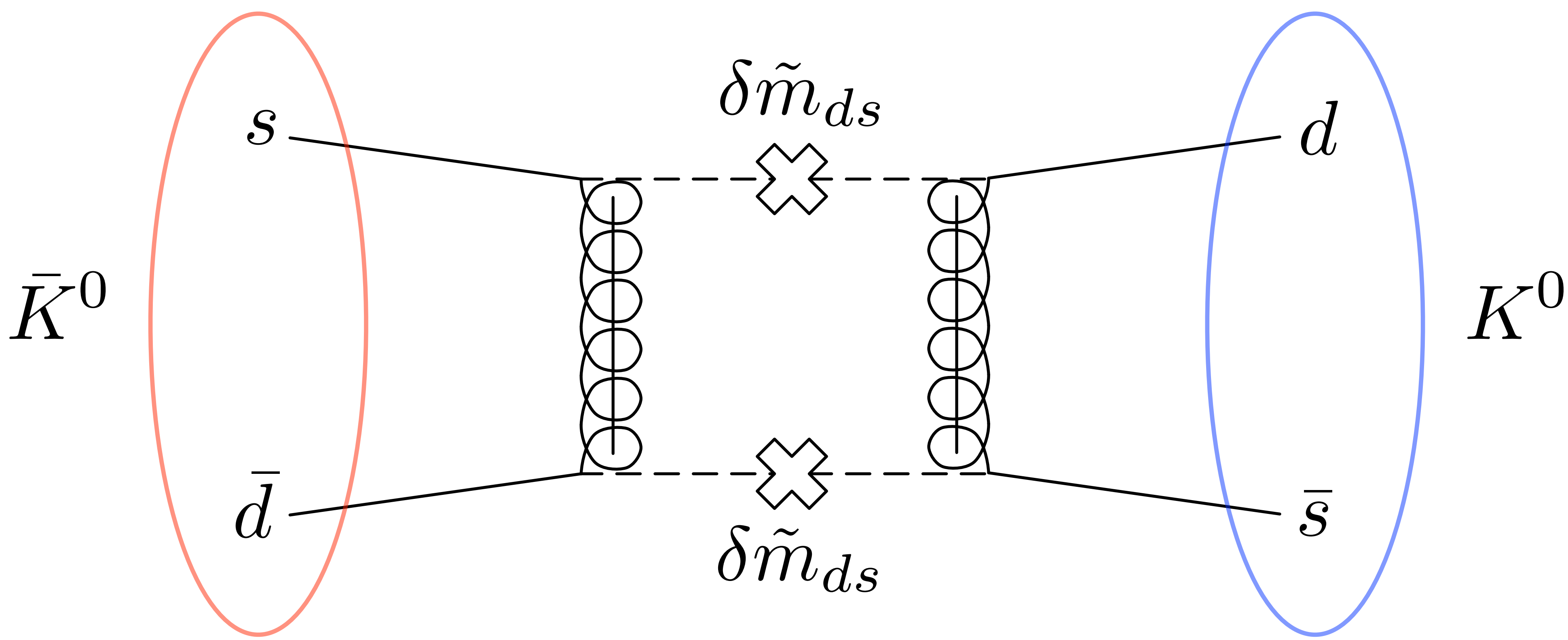
Of course, the MSSM prediction is raised by radiative corrections coming from the stop

$$m_h^2 \simeq m_Z^2 + \frac{3}{4\pi^2} y_t^4 v^2 \log \frac{m_{\tilde{t}}^2}{m_t^2}$$

Relying on these corrections alone to satisfy the LEP bound leads to tension with naturalness; “little hierarchy problem”

The trouble with sflavor

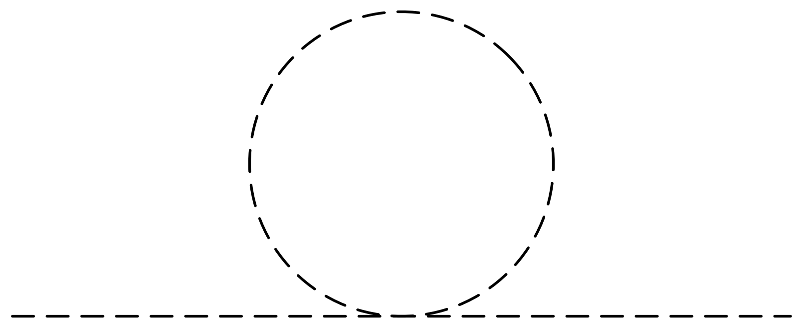
Any significant inter-generational mixing in the squark and slepton soft masses leads to prohibitive contributions to, e.g., flavor-changing neutral currents



Remedies include universality; alignment; or decoupling.
Universality is typically simplest & easiest to realize

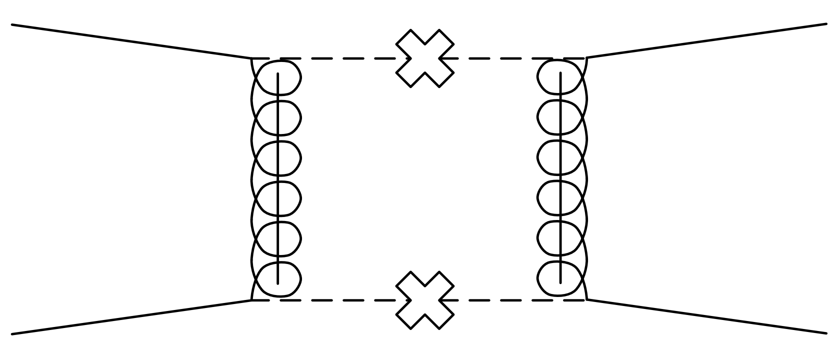
Supersymmetric desiderata (desideratini?)

Naturalness:



Need the stop to be light in order to avoid large radiative corrections to the Higgs mass; also need the Higgs above LEP bound

(Pre-LHC) Data:



Squark masses need to avoid generating large contributions to FCNCs -- the safest and most readily calculable way is with universality

Universal mediation mechanisms

These considerations incline us towards
flavor-blind forms of mediation

Gauge mediation

- Great for SUSY flavor, CP
- Moderately tuned spectrum
- (Big mu problem)
- (Decent dark matter)

Gaugino mediation

- Great for SUSY flavor, CP
- Highly tuned spectrum
- (Moderate mu problem)
- (Decent dark matter)

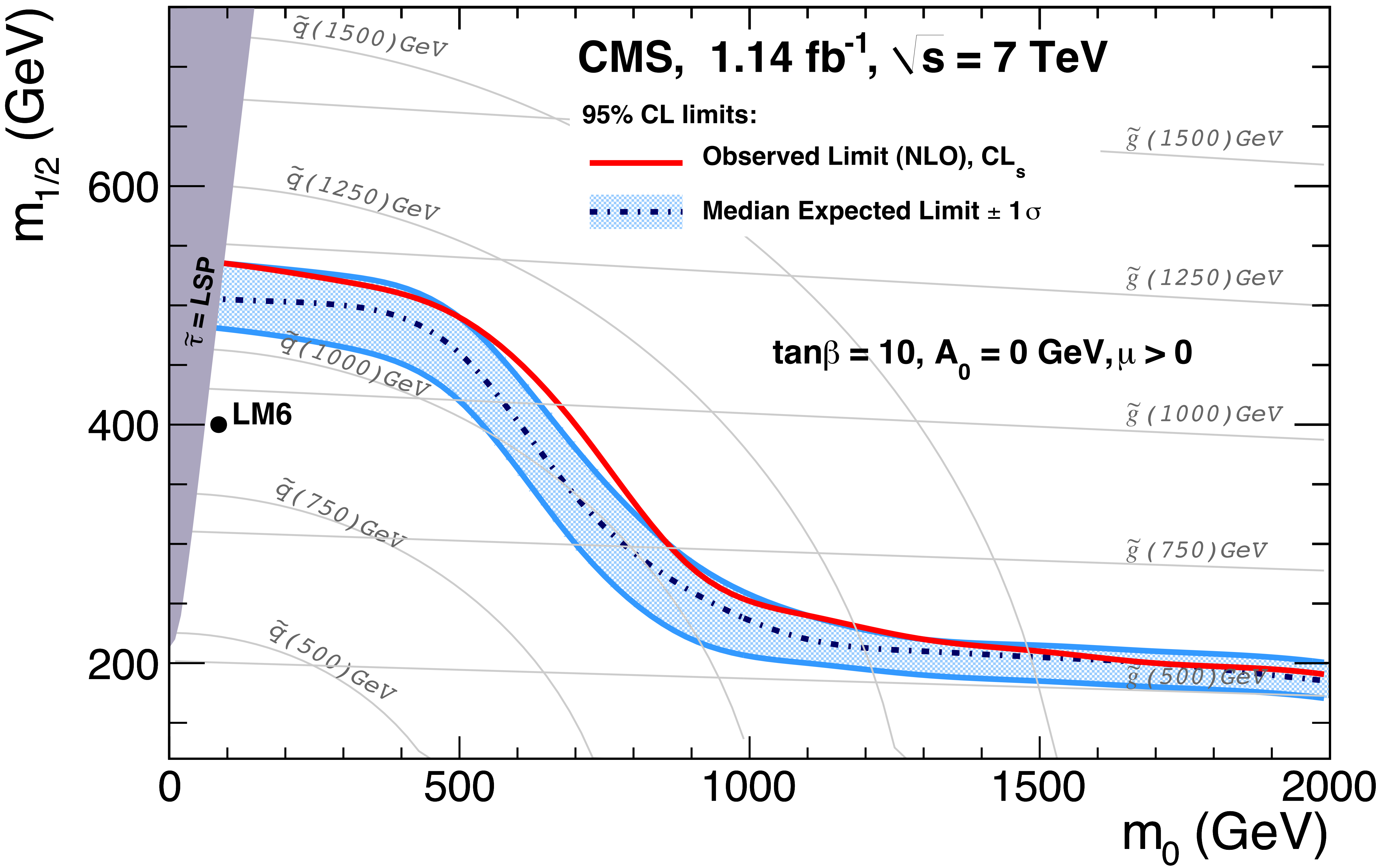
(Gravity mediation: FCNCs challenging; need a detailed model
Anomaly mediation: look for a sign fix...)

We've worked very hard to decouple SUSY from flavor

But these possible SUSY theories are all presently confronted by a minor inconvenience, namely....

...data

[Aspen ATLAS SUSY talk]



[from CMS-SUS-11-003, search for SUSY w/ 2+ jets & MET]

Bed time for SUSY?

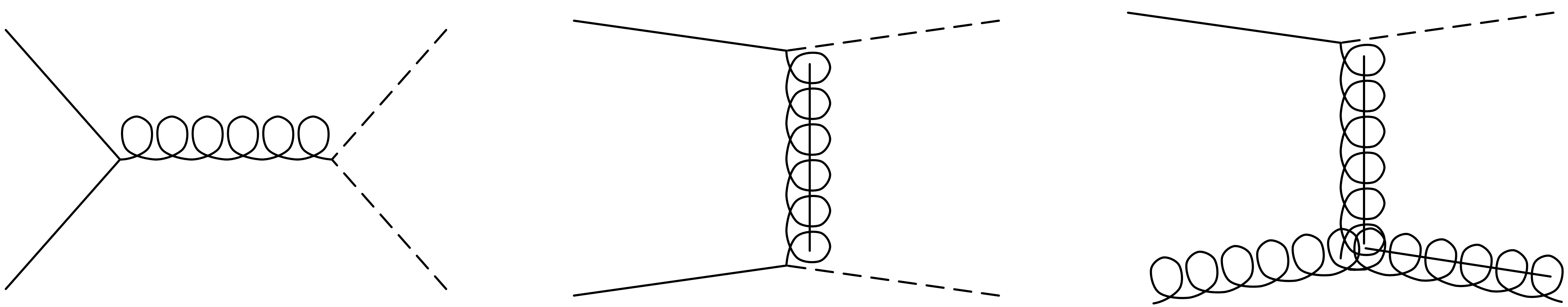
- Naturalness requires the stop mass well below a TeV, but the first inverse femtobarn of LHC data puts SUSY theories with universal masses above 1 TeV
- Naturalness in the MSSM is already challenged by the LEP bound on the Higgs mass; relying on radiative corrections from the stop leads to a significant tuning*
- If SUSY is profoundly tuned, does it make any sense to favor it over other tuned possible solutions to the hierarchy problem (technicolor, RS, etc.)?
- *Even apart from questions of naturalness*, is there any remaining hope of seeing light colored sparticles at the LHC?

*Amusingly, the first 1/fb data hasn't substantially increased the tuning problem in the MSSM -- living off stop loops already required ~TeV colored sparticles

What's driving current LHC SUSY limits?

Current limits are driven by squark pair production and squark-gluino associated production

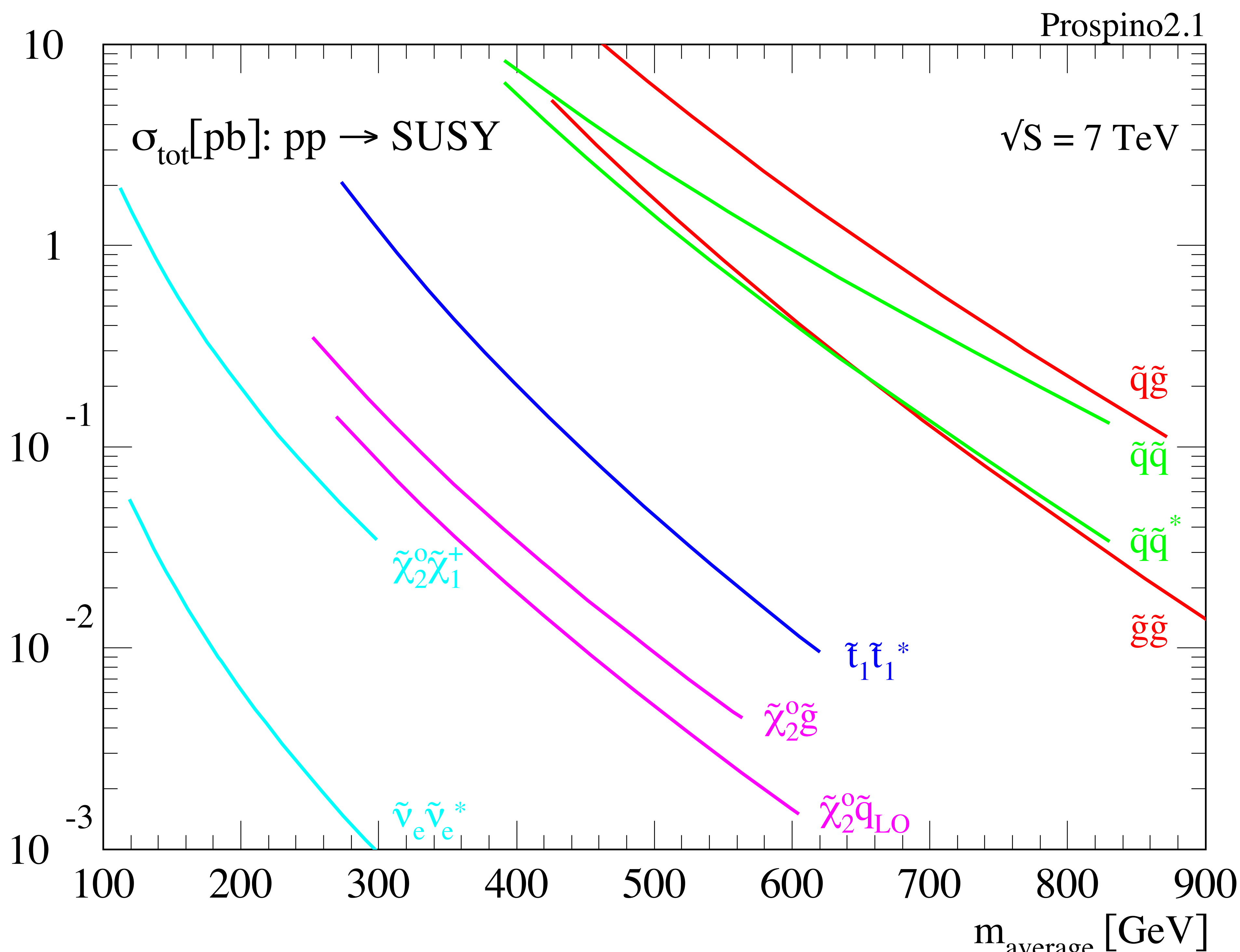
(diagrams not intended to be exhaustive)



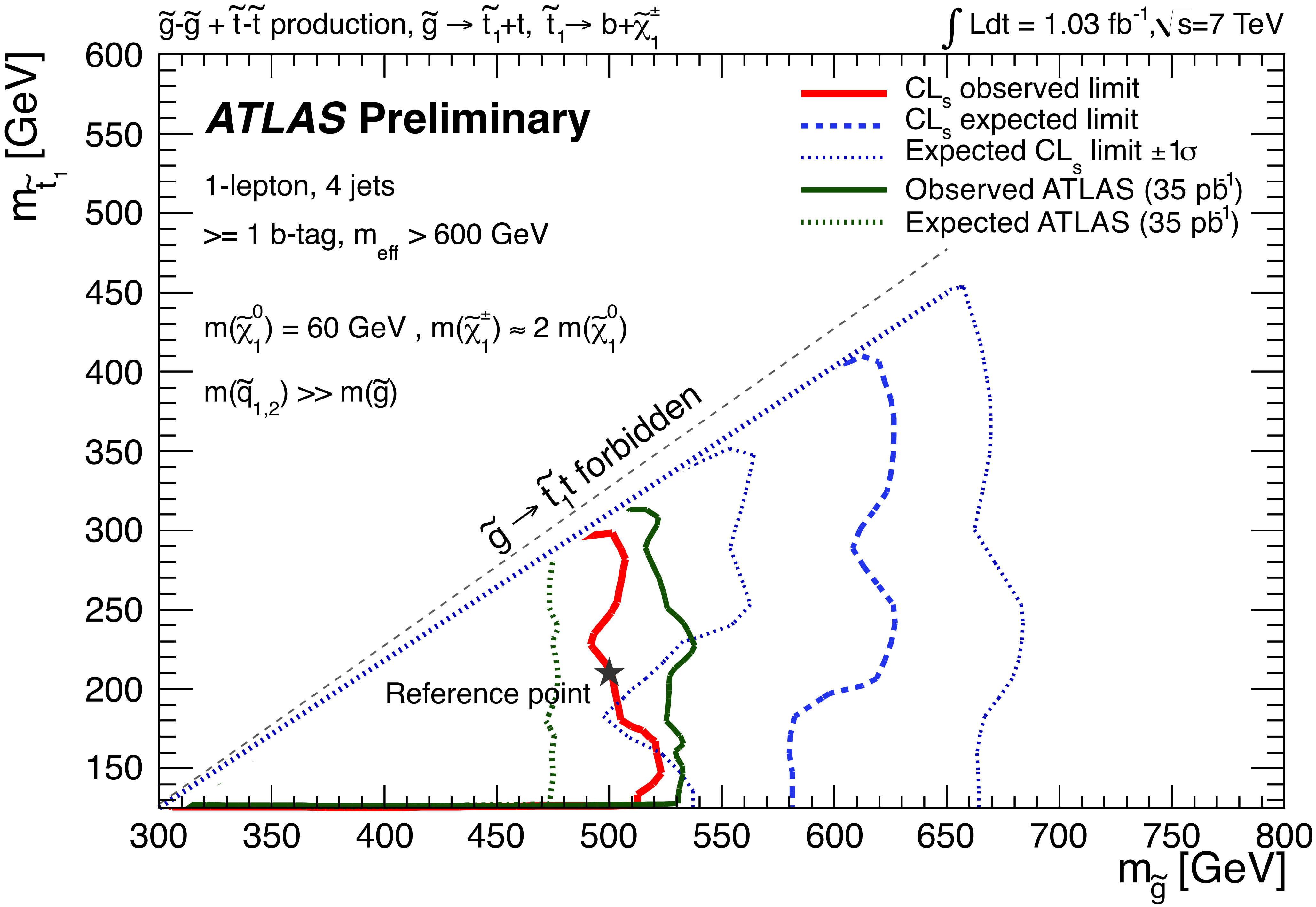
These processes are dominated by *first-generation* squarks

SUSY is natural and consistent if we decouple first-generation squarks while keeping third-generation squarks light

How much better do we do?



How sharp are the limits w/out the 1st generation?



[from ATLAS-CONF-2011-130, search for SUSY w/ b-jets, MET, & 1 lepton]

The challenge to theorists

- Are there well-motivated models that predict light stops (keeping SUSY natural) with heavier first- and second-generation squarks (explaining why we haven't yet seen sharp signs of SUSY)?

- Are there any such models that have sharp low-energy predictions beyond the desired spectrum? [Many ways that don't: extra heavy U(1) w/ high-scale D-terms; MFV contributions to RG flow at the GUT scale; single-sector; yada yada]

- Since these models necessarily require SUSY breaking to know about flavor, can we be certain they're consistent with bounds on FCNCs?

- Can we solve any other mysteries of the Standard Model while we're at it? SM flavor? The LEP bound on the Higgs mass?

Picking up the gauntlet

Motivated by data from the LHC and by SUSY flavor,
I'd like to advocate a simple picture that:

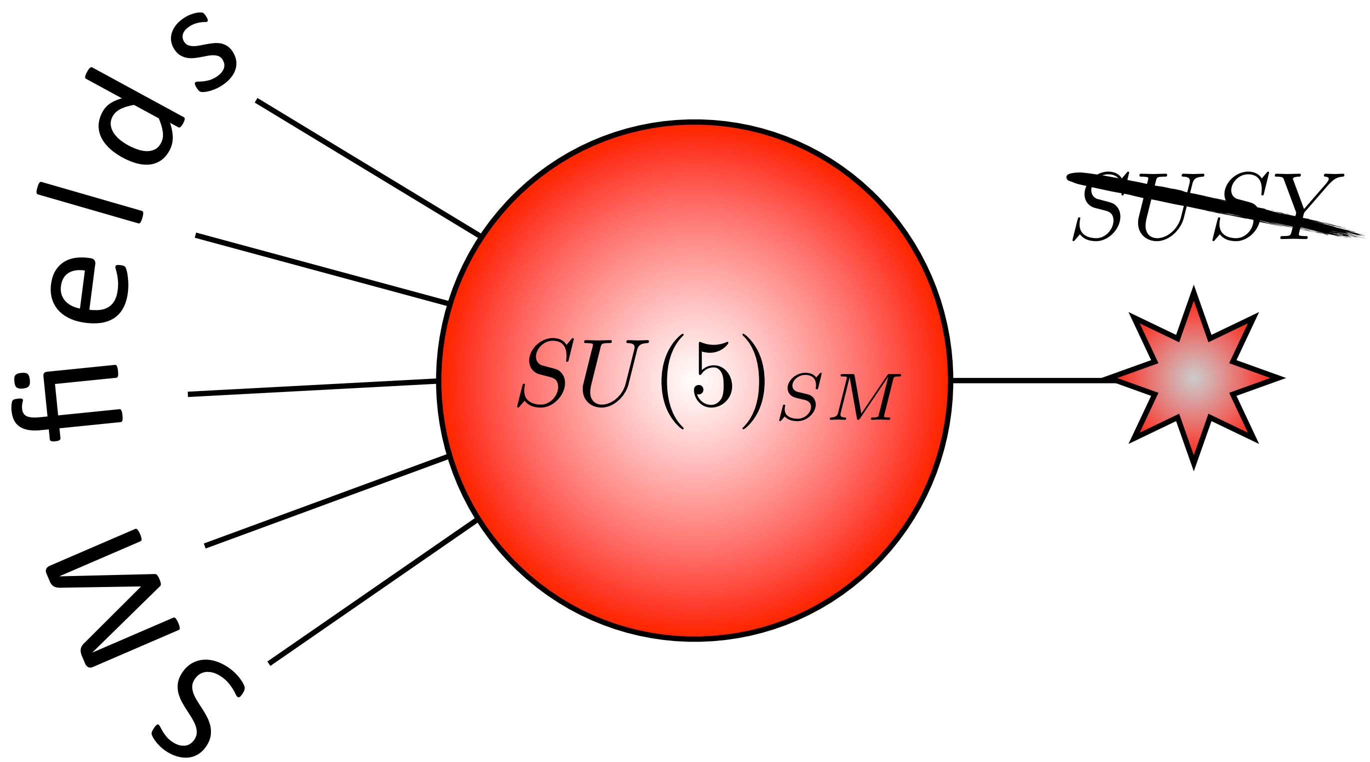
- Has light stops and heavy 1st- & 2nd-generation scalars
- Naturally evades SUSY flavor problems
- Explains the broad features of SM flavor
- Naturally satisfies the LEP bound on the Higgs mass
- Preserves (in a sense) gauge coupling unification
- May have additional states in (far) LHC reach

Hopefully I'll convince you that this doesn't require epicycles of ugly model-building, but (literally) just a simple shift.

First, some moose. Moose 1: gauge mediation

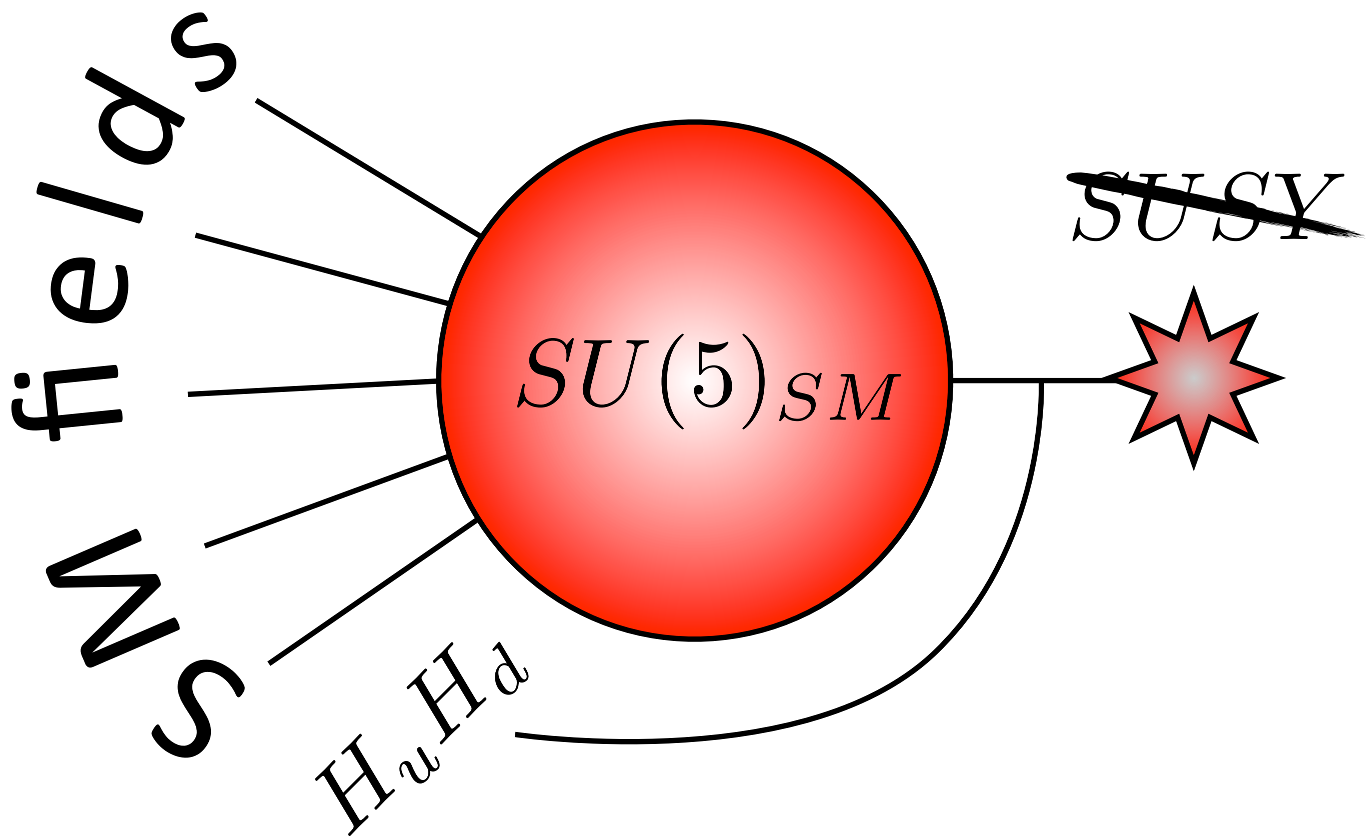
The moose picture of gauge mediation

First, some moose. Moose 1: gauge mediation



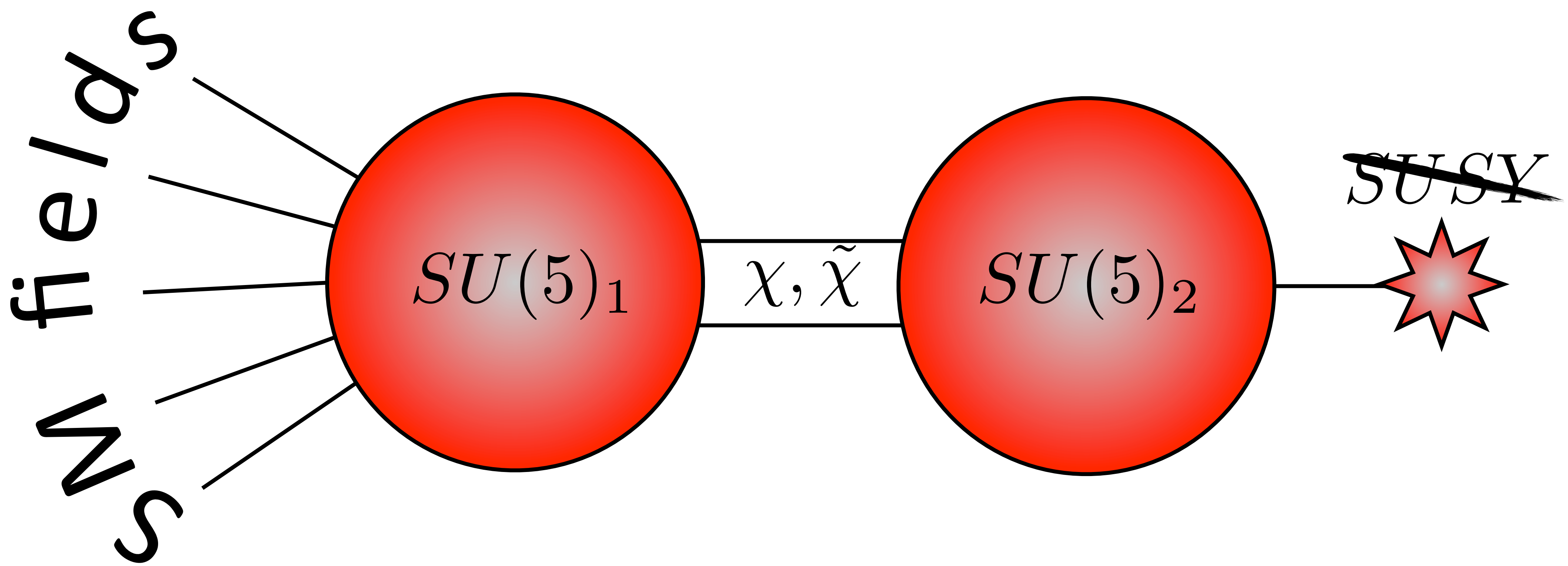
The moose picture of gauge mediation

First, some moose. Moose 1: gauge mediation



The moose picture of gauge mediation

Moose 2: gaugino mediation



$$\langle \chi \rangle \rightarrow \quad SU(5)_1 \times SU(5)_2 \rightarrow SU(5)_{SM}$$

$SU(5)_1$ scalar masses suppressed by $\left(\frac{\langle \chi \rangle}{M} \right)^2$

[Kaplan, Kribs, Schmaltz; Chacko, Luty, Nelson, Ponton]

[Arkani-Hamed, Cohen, Georgi] [Csaki, Erlich, Grojean, Kribs; Cheng, Kaplan, Schmaltz, Skiba]

Mechanics of (deconstructed) gaugino mediation

Superpotential or scalar potential induces vevs for link fields

$$W_\chi = A(\chi\tilde{\chi} - f^2)$$

Link field vev breaks gauge groups to diagonal

$$\langle\chi\rangle : \;\; G_{SM}^{(1)} \times G_{SM}^{(2)} \rightarrow SU(3)_c \times SU(2)_L \times U(1)_Y$$

SM gauge couplings from matching: $\dfrac{1}{g_i^2} = \dfrac{1}{g_{(1)i}^2} + \dfrac{1}{g_{(2)i}^2}$

$$g_i = g_{(1)i} \cos\theta_i = g_{(2)i} \sin\theta_i$$

Features of deconstruction

Heavy gauge bosons from Higgsing:

$$M_i \sim \langle \chi \rangle \sqrt{g^2_{(1)i} + g^2_{(2)i}}$$

(There is a full set of heavy SU(3)xSU(2)xU(1) gauge bosons)

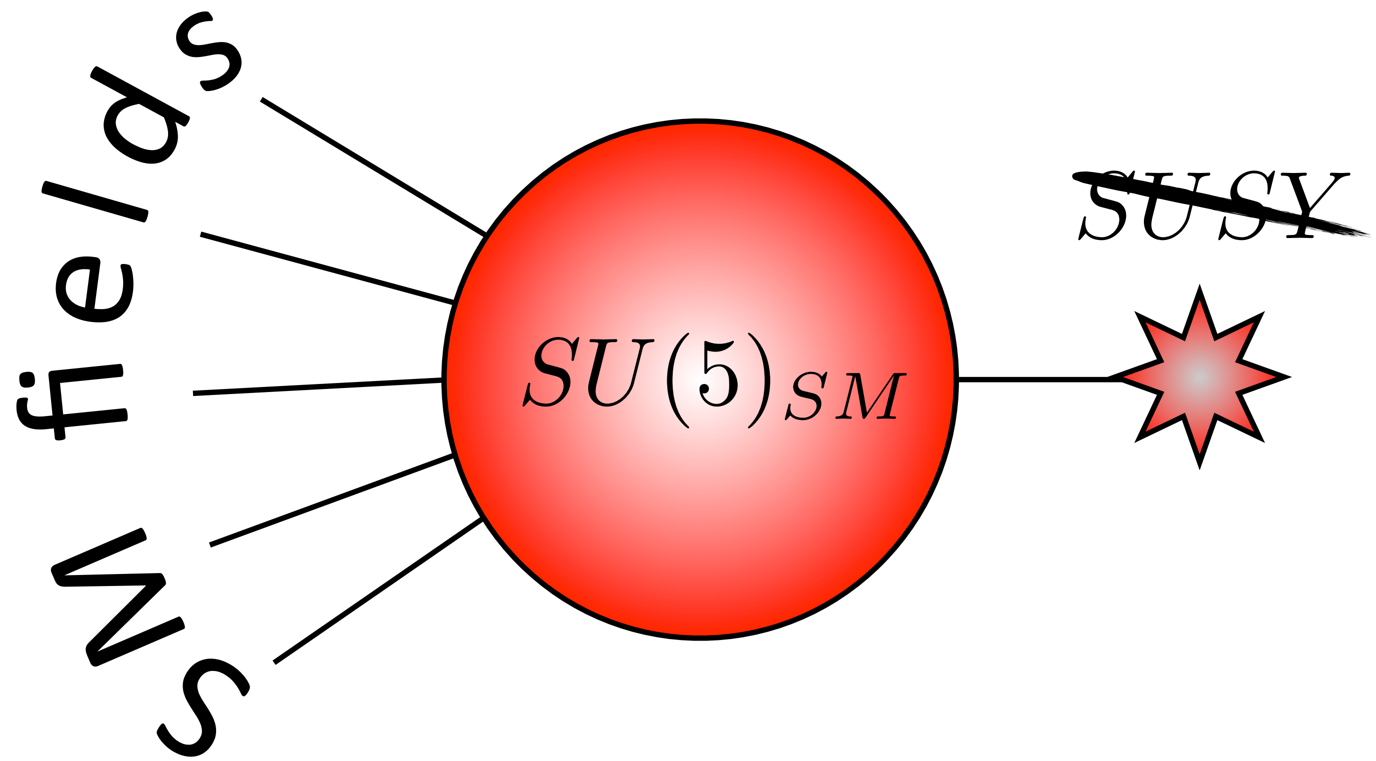
SM gauginos massive at tree level:

$$m_{\lambda_i} \simeq \sin\theta_i^2 \; m_{\lambda_{(2)i}}$$

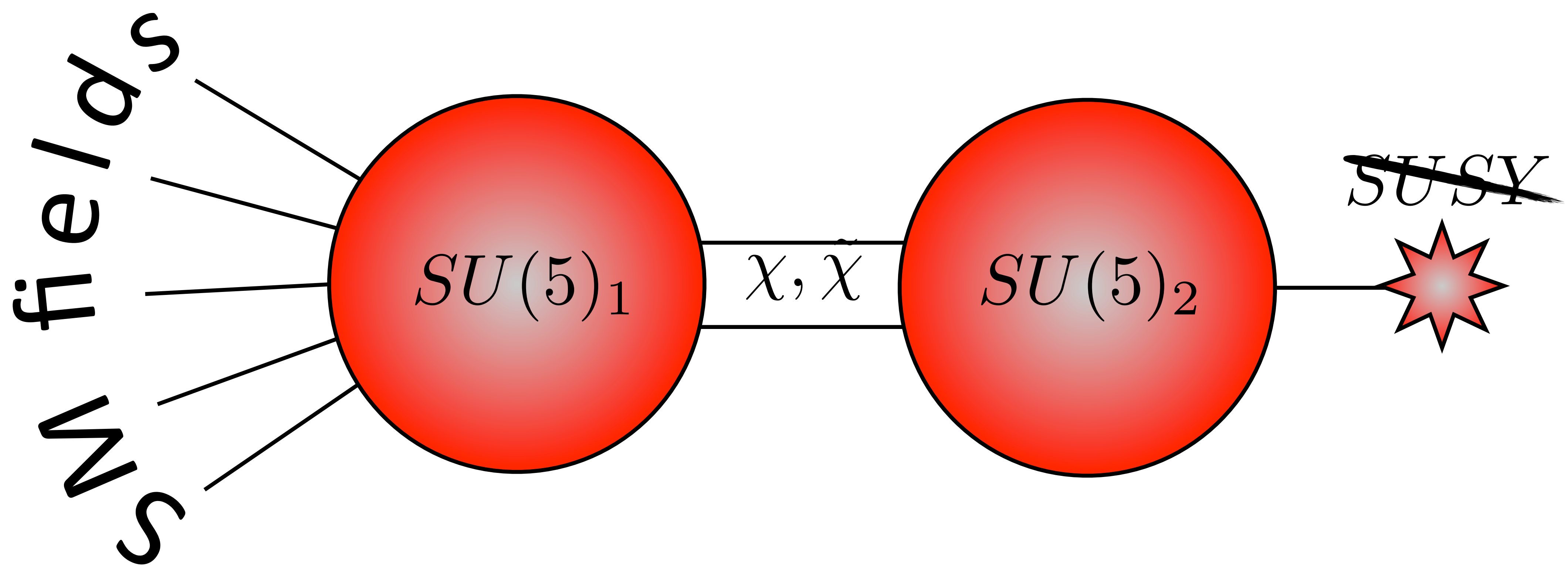
(There is an extra set of gauginos at the scale of Higgsing)

MSSM scalar masses are a combination of vev-suppressed 2-loop + unsuppressed 3,4-loop.

The third moose

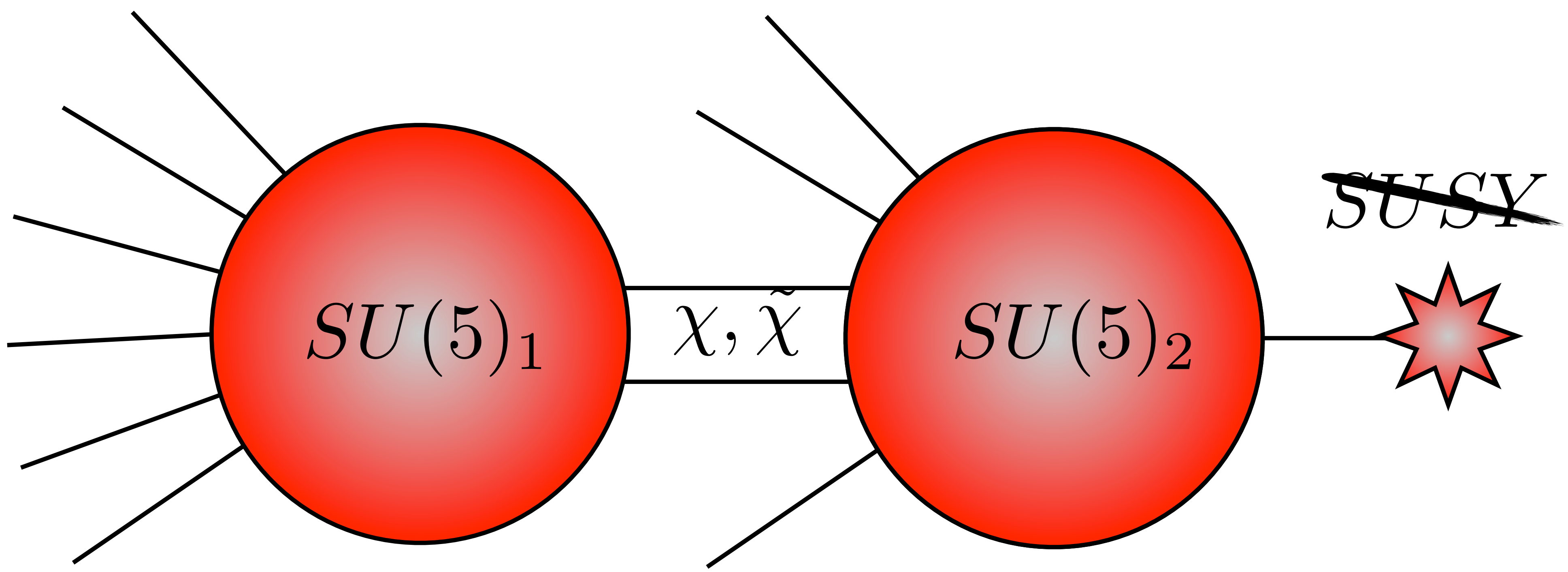


The third moose



The third moose

Charge SM states under both gauge symmetries



Automatically gives a theory of SM + SUSY flavor

If the scales are low, solves a host of other problems

Distribution of fields motivated by flavor + anomaly cancellation

Two interesting limits...

(1) Unsuppressed gaugino masses

(leading order F/M)

$$m_\lambda \sim \tilde{m}_1 \sim \tilde{m}_2$$

(2) Suppressed gaugino masses

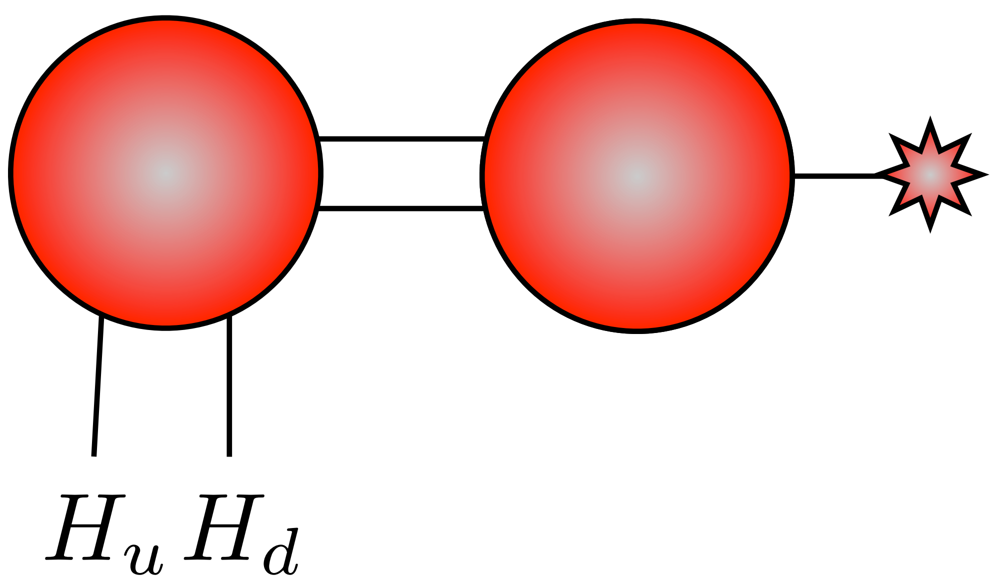
(leading order F^3/M^5)

$$m_\lambda \sim \tilde{m}_1 \ll \tilde{m}_2$$

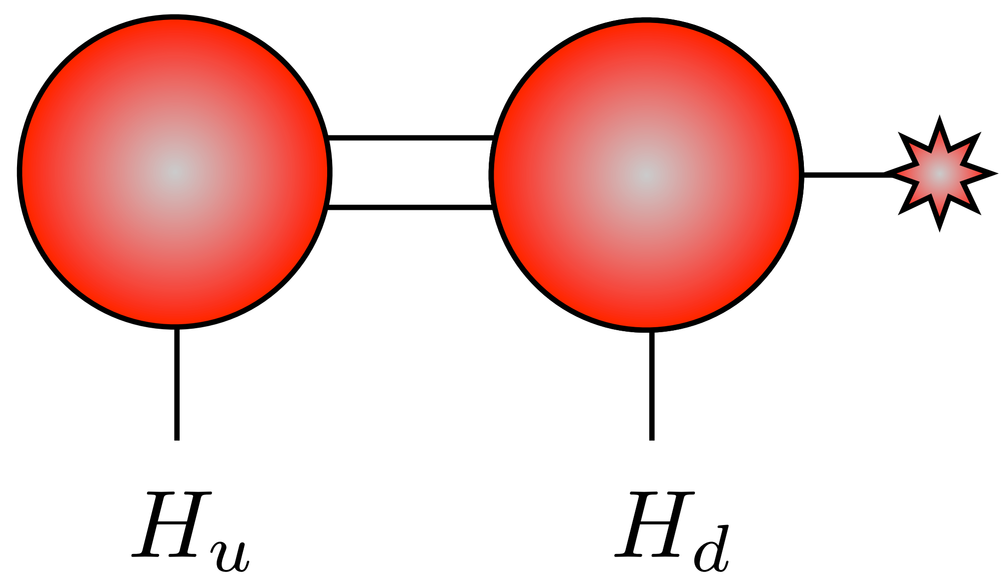
(Typical in, e.g. dynamical SUSY breaking)

...and two interesting cases

Vector Higgs



Chiral Higgs

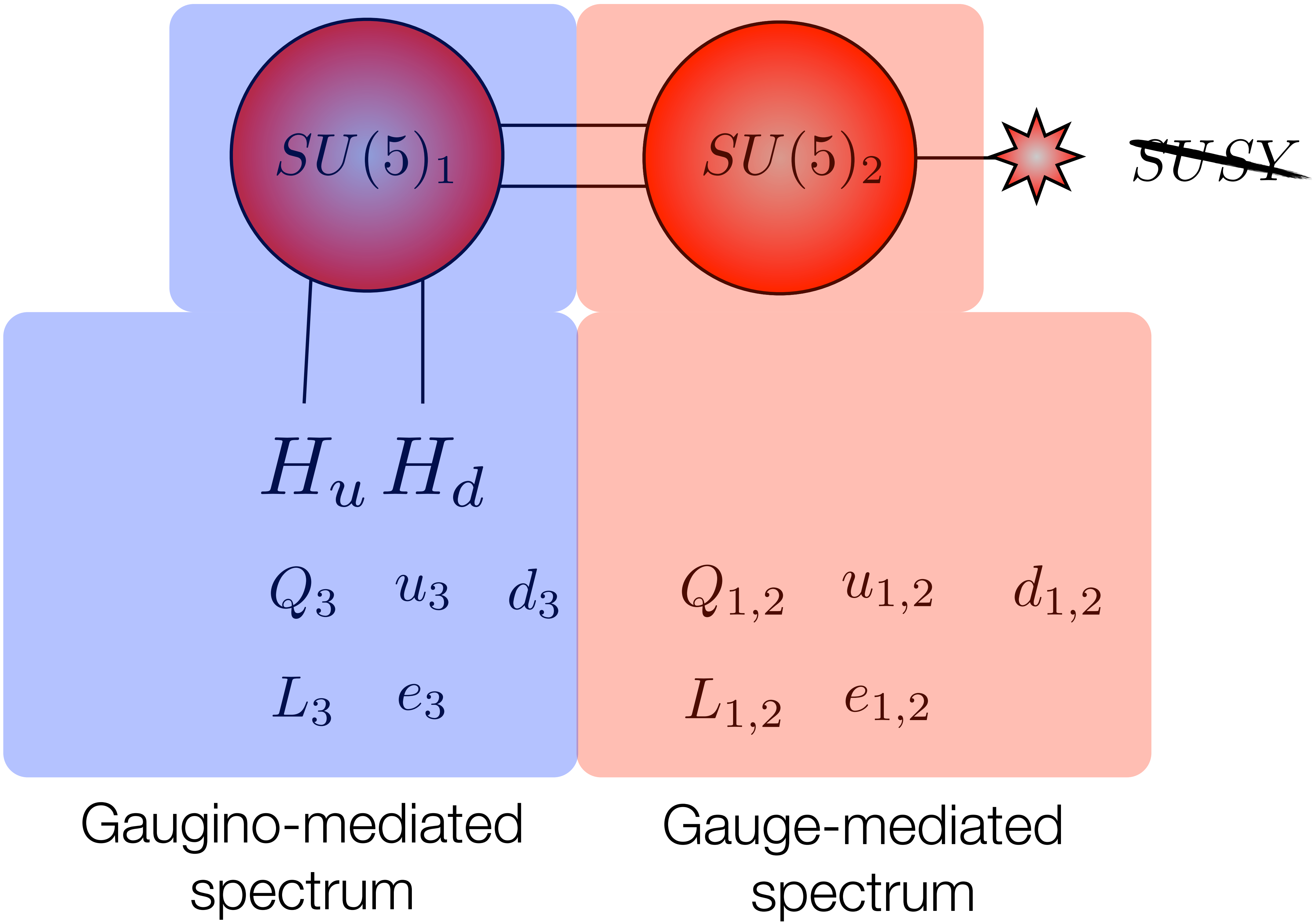


(N.B. -- somewhat reminiscent of orbifold GUT models of flavor; SUSY breaking shares some features of flavorful supersymmetry)

[Hall, March-Russell, Okui, Tucker-Smith]

[Nomura, Papucci, Stolarski]

A flavorful model with a vector Higgs



A model of flavor and mu

Gives a model of SM flavor from gauge invariance:

Yukawa couplings suppressed by $1 \quad , \quad \left(\frac{v}{M_*}\right) \quad , \quad \left(\frac{v}{M_*}\right)^2$

(a sort of “nonabelian” Froggatt-Nielsen)

Also solves the mu problem:

Forbid leading supersymmetric mu term w/ PQ symmetry; leading mu term from

$$W \sim \frac{\chi\tilde{\chi}H_u H_d}{M_*} \longrightarrow \mu_{eff} \sim \frac{v^2}{M_*}$$

(SUSic, so B mu generated radiatively)

A model of flavor

$$\chi_h \sim (3, 1, -\frac{1}{3}) \times (\bar{3}, 1, \frac{1}{3}) \qquad \chi_l \sim (1, 2, \frac{1}{2}) \times (1, 2, -\frac{1}{2})$$

Yukawas are now irrelevant operators, e.g.

$$\Delta W \sim \frac{H_u \tilde{\chi}_l Q_2 \bar{u}_2}{M_*} + \frac{H_d \chi_l Q_2 \bar{d}_2}{M_*}$$

$$\epsilon_l \equiv \frac{\langle \chi_l \rangle}{M_*} = \frac{\langle \tilde{\chi}_l \rangle}{M_*}, \qquad \epsilon_h \equiv \frac{\langle \chi_h \rangle}{M_*} = \frac{\langle \tilde{\chi}_h \rangle}{M_*}$$

$$Y_u \sim \sin\beta \begin{pmatrix} \epsilon_l & \epsilon_l & \epsilon_h \epsilon_l \\ \epsilon_l & \epsilon_l & \epsilon_h \epsilon_l \\ \epsilon_h^2 & \epsilon_h^2 & 1 \end{pmatrix}, \qquad Y_d \sim \cos\beta \begin{pmatrix} \epsilon_l & \epsilon_l & \epsilon_h \epsilon_l \\ \epsilon_l & \epsilon_l & \epsilon_h \epsilon_l \\ \epsilon_h & \epsilon_h & 1 \end{pmatrix}$$

Flavor predictions

Fermion masses

$$m_{u,c} \propto \sin\beta\ \epsilon_l v \qquad m_t \propto \sin\beta\ v$$

$$m_{d,s} \propto \cos\beta\ \epsilon_l v \qquad m_b \propto \cos\beta\ v$$

CKM matrix

$$V_{CKM} \sim \begin{pmatrix} 1 & 1 & \epsilon_h\epsilon_l \\ 1 & 1 & \epsilon_h\epsilon_l \\ \epsilon_h\epsilon_l & \epsilon_h\epsilon_l & 1 \end{pmatrix}$$

(Two gauge groups means only two hierarchies, two small CKM angles)

(Easy enough to build a 3-site model, but FCNCs constraining)

$$\epsilon_l \sim \frac{m_c}{m_t} \sim \frac{m_s}{m_b} \longrightarrow \epsilon_l \sim \epsilon_h \lesssim \mathcal{O}(10^{-2})$$

Scales

Correct predictions for μ, flavor hierarchy require

$$\langle \chi_I \rangle \lesssim 10 \text{ TeV}, \qquad M_* \lesssim 10^3 \text{ TeV}$$

Natural scales if $\qquad M_* \sim M_{\text{mess}}$

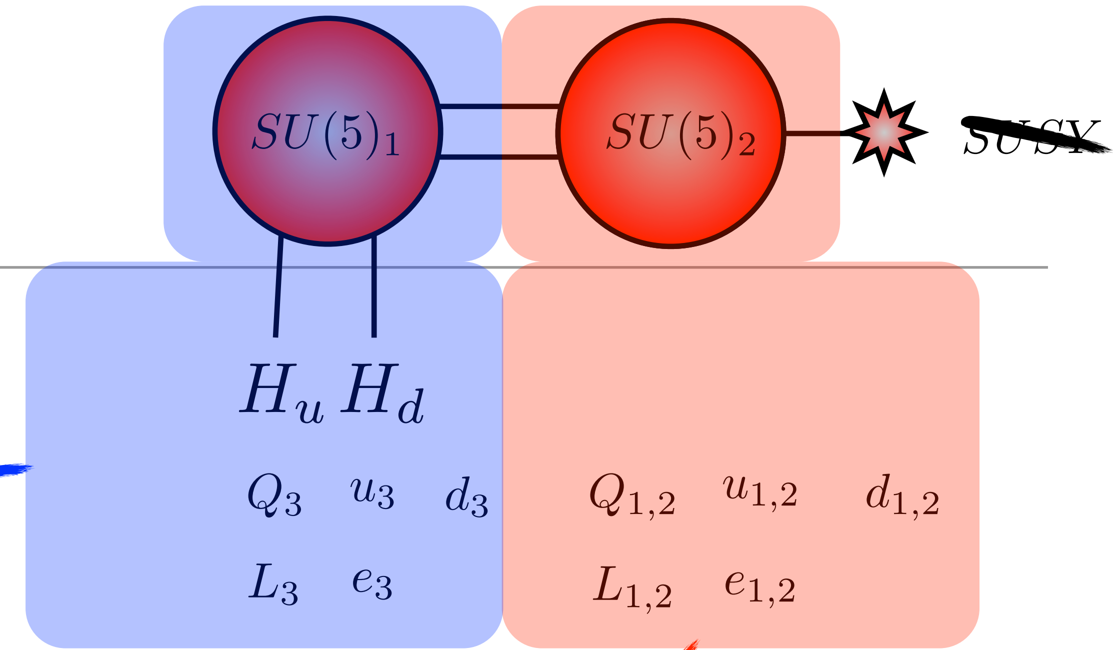
(low-scale gauge mediation!)

Requires low-scale gauge, gaugino mediation

(Could go to higher scales if we give up mu)

The low higgsing scale also may put additional states (gauge bosons, fermions) within (far) LHC reach

SUSY spectrum



$$m^2_{\tilde{g}M} \sim \left(\frac{\alpha}{4\pi}\right)^2 \left(\frac{v}{M}\right)^2 \left(\frac{F}{M}\right)^2$$

$$m^2_{GM} \sim \left(\frac{\alpha}{4\pi}\right)^2 \left(\frac{F}{M}\right)^2$$

Precise spectrum depends on whether or not gauginos are suppressed

Unsuppressed ⟶ Moderate deviations from gauge mediation

Suppressed ⟶ 1st & 2nd gen scalars heavy and decouple

[Dimopoulos, Guidice; Cohen, Kaplan, Nelson]

How much do we split the spectrum?

A variety of effects connect soft masses between the two sites at one loop, so that

$$\tilde{m}_1 \simeq \frac{1}{4\pi}\tilde{m}_2$$

Typical separation is ~one order of magnitude

So, e.g., the stops, sbottoms, and staus can lie around 500 GeV, while the scalars of the first two generations are ~5 TeV or heavier

This completely decouples the scalars of the first two generations from current LHC production

Sflavor?

Despite being flavorful SUSY breaking, triply protected against prohibitive FCNCs

Soft masses diagonal in gauge eigenbasis;
in fermion mass eigenbasis they are rotated to

$$m^2_{\tilde{Q}} \sim \begin{pmatrix} m^2_{GM} & 0 & \epsilon_h \epsilon_l m^2_{GM} \\ 0 & m^2_{GM} & \epsilon_h \epsilon_l m^2_{GM} \\ \epsilon_l \epsilon_h m^2_{GM} & \epsilon_l \epsilon_h m^2_{GM} & m^2_{\tilde{g}M} \end{pmatrix}$$

U(2) symmetry in gens.1 & 2 saves K - K mixing

Combined alignment + decoupling sufficient for remaining FCNCs; largest contribution (though safe) is to B-B mixing

EWSB?

For such low-scale SUSY breaking, might worry that there's not enough room for the H_u mass to run negative (typically we need several decades of RG running in the MSSM)

Surprisingly, m_{Hu}^2 negative at two loops!

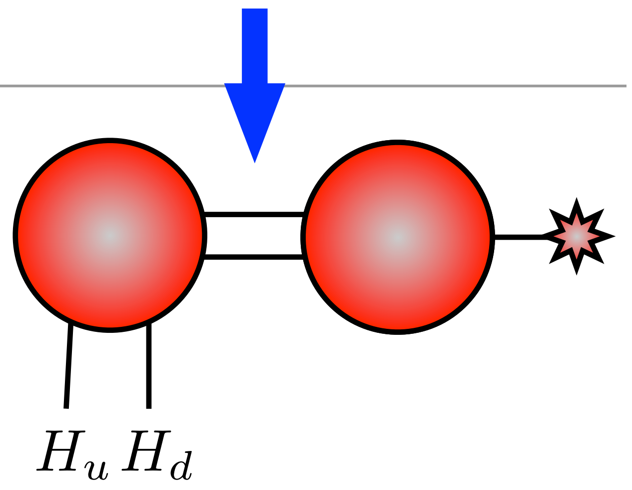
$$\delta m_{H_u}^2 \sim -\frac{g_3^2\lambda_t^2}{16\pi^4} m_3^2 \left[\log^2\frac{M_3^2}{m_3^2} + \frac{c_3^2}{s_3^2}\log\frac{M_3^2}{m_3^2} - 2 + 2\log\frac{m_3^2}{m_{\tilde{t}}^2}\left(\log\frac{M_3^2}{m_3^2} - 1 + \frac{1}{2}\frac{c_3^2}{s_3^2}\right)\right]$$
$$-\frac{g_3^2\lambda_t^2}{16\pi^4} m_\chi^2 \left[\frac{s_3^2}{c_3^2}\left(\log\frac{M_3^2}{m_{\tilde{t}}^2} + 1\right)\right]$$

[De Simone, Fan, Schmaltz, Skiba]

So no problems with electroweak symmetry breaking...

...and no little hierarchy problem

Non-supersymmetric, non-decoupling
D-term from heavy gauge bosons:



$$\delta V = \frac{g^2\Delta}{8}\left|H_u^\dagger\sigma^a H_u + H_d^\dagger\sigma^a H_d\right|^2 + \frac{3{g'}^2\Delta'}{40}\left|H_u^\dagger H_u - H_d^\dagger H_d\right|^2$$

where $$\Delta = \frac{g_1^2}{g_2^2}\frac{2\tilde{m}_\chi^2}{M^2 + 2\tilde{m}_\chi^2}$$

Shifts tree-level bound on Higgs mass $$m_h^2 \leq m_z^2 + \frac{g^2\Delta + {g'}^2\Delta'}{2}v^2$$

Corrections can easily shift tree-level Higgs mass 10-20 GeV

New light states?

- Predicts a variety of states at and around the higgsing scale: heavy SU(3)xSU(2) xU(1) gauge bosons; heavy gaugino partners; heavy link field fermions (scalars lifted further by soft masses). Some of these may be as light as 1-3 TeV; production rates for colored states may put them within LHC reach

- Direct production aside, primary constraints come from precision electroweak (limits heavy SU(2)xU(1) gauge bosons > 2 TeV) and tree-level FCNCs (limits SU (3) gauge bosons > 1.8 TeV).

- No strong indirect constraints on colored link fermion masses; may be significantly lighter than the gauge bosons

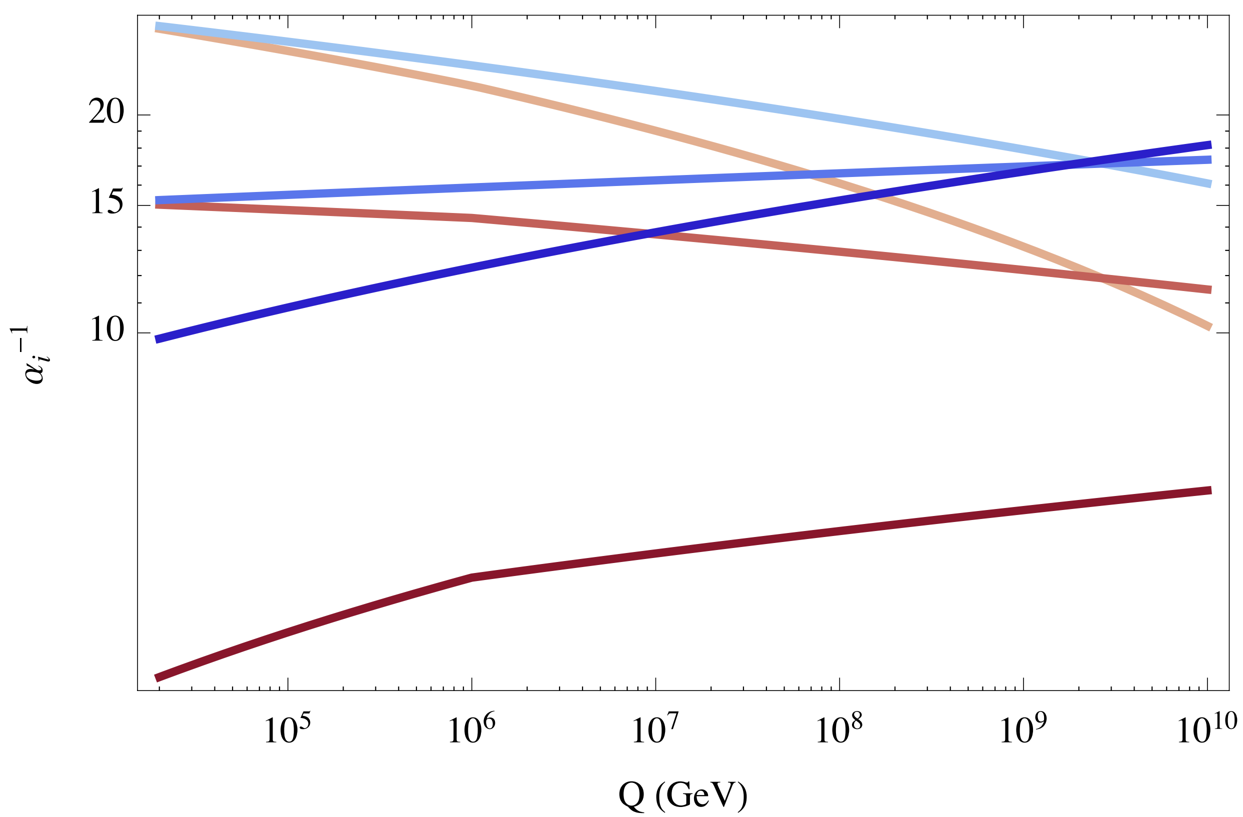
- Discovery of heavy SU(3) gauge bosons or heavy colored fermions in conjunction with a light third generation would be compelling indication for these models

Unification?

Might be concerned that this picture wholly surrenders unification.

Not quite; fairly easy to unify at least one gauge group

(typically $SU(5)_1$ due to extra SU(2) matter)



This *improves* certain unification predictions; b-tau unification preserved but no (poor) lower quark relations. Dimension-6 proton decay suppressed by small CKM angles.

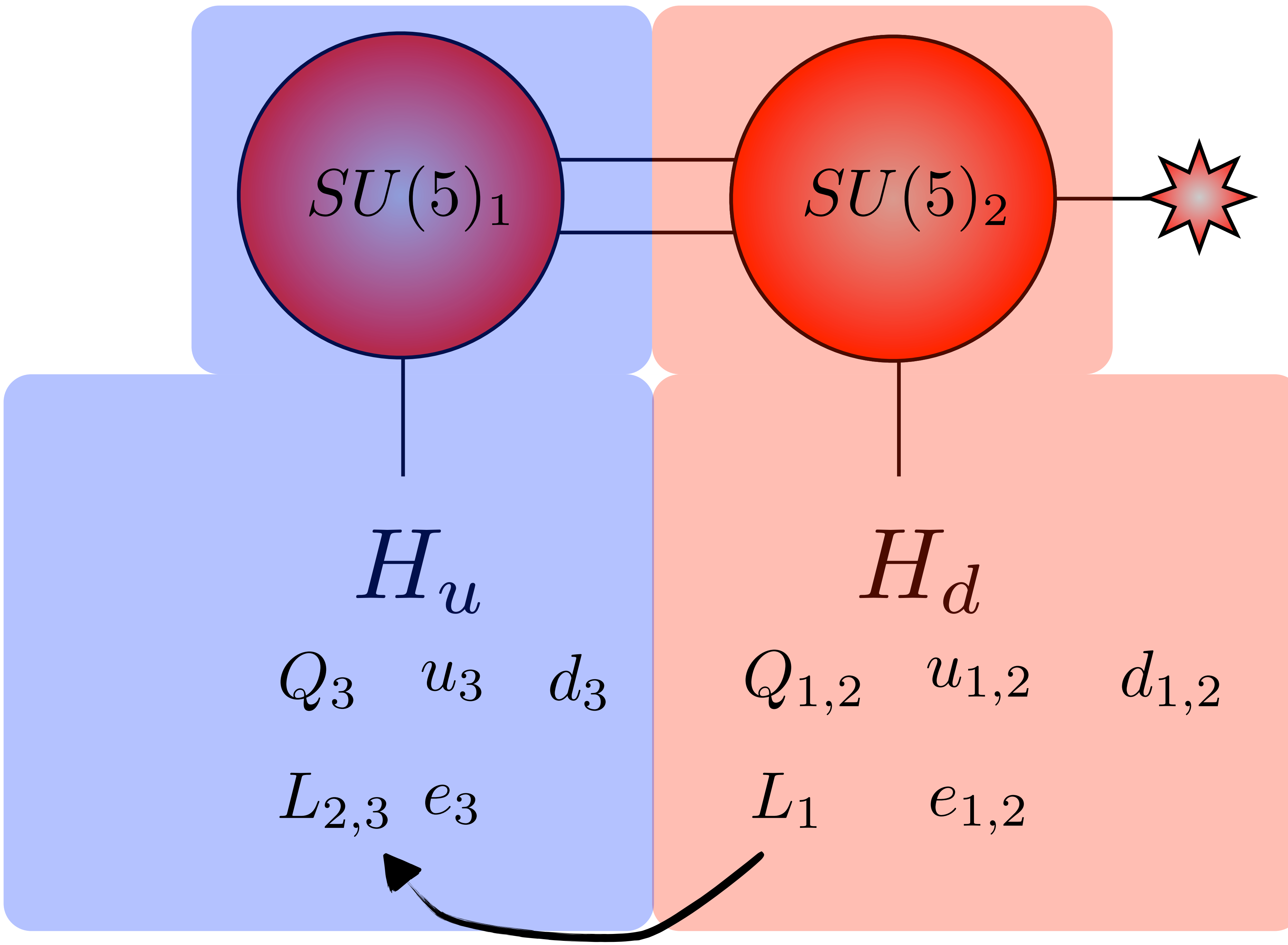
Leads to some form of accelerated unification; still need to account for dimension-5 proton decay (R-symmetry, discrete or continuous; missing partner; etc.)

Highlights of the vector model

- Broad features of SM flavor arise from dividing fermions
- Stops are light, 1st- and 2nd-gen squarks heavy; compatible with LHC limits
- Soft masses from gauge & gaugino mediation
- Flavorful soft spectrum, free of FCNCs
- D-term corrections lift the tree-level Higgs mass, solve little hierarchy problem
- Mu term generated supersymmetrically w/ no B mu problem
- Unification (in some sense!) is still preserved

Some variations

Consider instead a "chiral" Higgs model:



A novel solution to the mu problem

Supersymmetric μ term forbidden by gauge invariance;
leading possibility is now

$$W \sim \chi_l H_u H_d$$

For $\langle \chi \rangle \sim 10 \text{ TeV}$ this comes out too large;

Need 0.1-0.01 coefficient, much as the μ term in 5D gaugino mediation [Schmaltz, Skiba]

Unusual EWSB

Higgs soft masses are significantly split!

$$m_{H_d}^2 \gg \mu^2 \sim |m_{H_u}^2| \gg B\mu$$

Leads to decoupling of down-type Higgs

B mu generated radiatively; quite small:

$$B\mu \sim -\mu \left(\frac{3\alpha_2}{2\pi} m_{\tilde{w}} \log \frac{\chi_l}{m_{\tilde{w}}} + \frac{\alpha}{2\pi} m_{\tilde{b}} \log \frac{\chi_l}{m_{\tilde{b}}} \right)$$

$$B\mu \tan\beta \simeq m_{H_d}^2 \qquad \text{and} \qquad \mu^2 = -m_{H_u}^2 - \frac{M_Z^2}{2}$$

$$\longrightarrow \quad \tan\beta \sim \mathcal{O}(10^4)$$

Implications for flavor

The tree-level couplings yield Yukawa matrices...

$$Y_u = \begin{pmatrix} \epsilon_l & \epsilon_l & \epsilon_h^2 \\ \epsilon_l & \epsilon_l & \epsilon_h^2 \\ \epsilon_h^2 & \epsilon_h^2 & 1 \end{pmatrix} \qquad Y_d = \begin{pmatrix} 1 & 1 & \epsilon_h' \\ 1 & 1 & \epsilon_h' \\ \epsilon_l'\epsilon_h' & \epsilon_l'\epsilon_h' & \epsilon_l' \end{pmatrix}$$

...which are a disaster; O(1) off-diagonal CKM matrix (consequence of moving H_d)

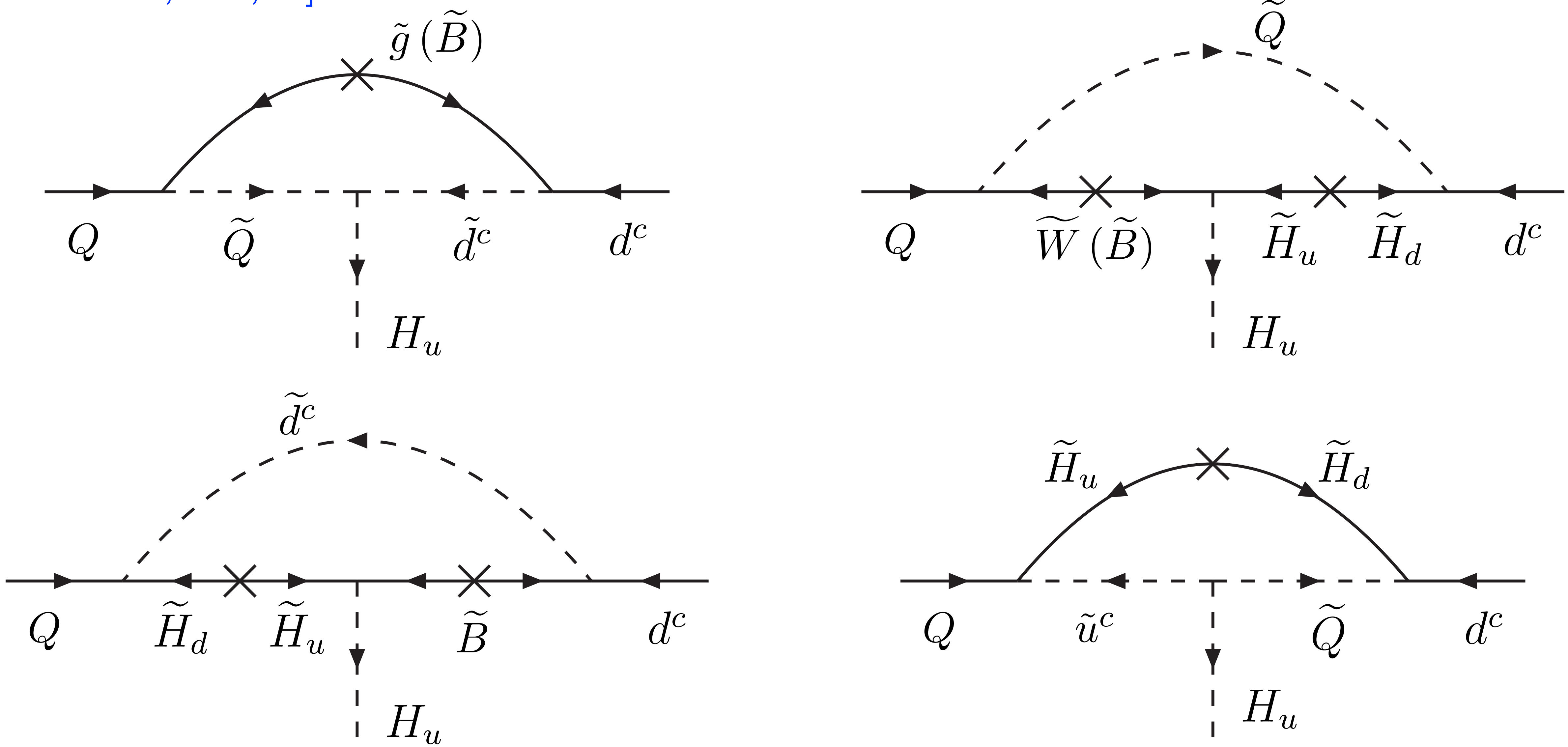
But you should already be suspicious; the down-type Yukawa coupling can’t give fermion masses at such large values of $\tan\beta$

Fermion masses are radiative...

Integrate out H_d; down-type masses come from H_u at one loop

$$\mathcal{L} \supset -\hat{y}_d \bar{d} H_u^\dagger Q - \hat{y}_l \bar{e} H_u^\dagger L + \text{h.c.}$$

[Dobrescu, Fox; ...]



Induced couplings proportional to tree-level couplings

Radiative miracles*

Radiative corrections induce new Yukawa terms

$$\hat{Y}_d \sim \frac{\alpha_3}{\pi} \begin{pmatrix} \delta & \delta & \epsilon_h' \delta \\ \delta & \delta & \epsilon_h' \delta \\ \epsilon_l' \epsilon_h' \delta & \epsilon_l' \epsilon_h' \delta & \epsilon_l' \end{pmatrix}$$

$$\delta = m_{\tilde{g}M}^2 / m_{GM}^2 \sim 10^{-4}$$

Ultimately the tree-level and loop-induced couplings are competitive for some entries

*had we considered unsuppressed gaugino masses, the CKM matrix would still have been unviable

A sfermionic theory of fermionic flavor

Fermion mass hierarchy induced by sfermion mass hierarchy

$$M_d = v \begin{pmatrix} c_\beta + \frac{\alpha_3}{\pi}\delta & c_\beta + \frac{\alpha_3}{\pi}\delta & \epsilon'_h(c_\beta + \frac{\alpha_3}{\pi}\delta) \\ c_\beta + \frac{\alpha_3}{\pi}\delta & c_\beta + \frac{\alpha_3}{\pi}\delta & \epsilon'_h(c_\beta + \frac{\alpha_3}{\pi}\delta) \\ \epsilon'_l\epsilon'_h(c_\beta + \frac{\alpha_3}{\pi}\delta) & \epsilon'_l\epsilon'_h(c_\beta + \frac{\alpha_3}{\pi}\delta) & \frac{\alpha_3}{\pi}\epsilon'_l \end{pmatrix}$$

(3,3) entry enhanced

CKM matrix is viable!

$$V_{CKM} = \begin{pmatrix} 1 & 1 & \epsilon^2 \\ 1 & 1 & \epsilon^2 \\ \epsilon^2 & \epsilon^2 & 1 \end{pmatrix}$$

But the bottom mass typically comes out light...

$$m_b \sim v \frac{2\alpha_3}{3\pi} \frac{\mu}{m_{\tilde{Q}_3}} \epsilon'_l$$

...with no little hierarchy problem

Similar non-decoupling D-terms in this theory

$$\delta V = \frac{g^4}{8} \frac{2\tilde{m}_\chi^2}{M^2 + 2\tilde{m}_\chi^2} \left(\frac{H_u^\dagger H_u}{\cos^2\theta} + \frac{H_d^\dagger H_d}{\sin^2\theta} \right)^2 + U(1)_Y$$

Easily raises the tree-level Higgs bound 10+ GeV

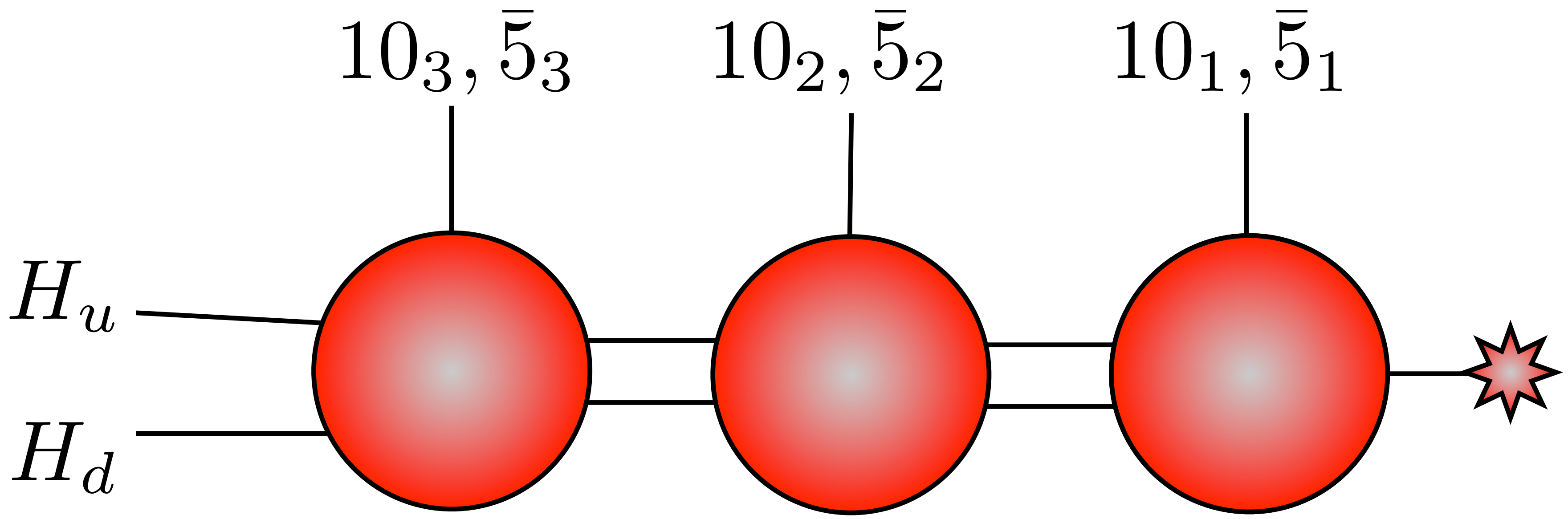
Again, no little hierarchy problem; tree-level prediction safe, and radiative corrections from stop are small

Highlights of the chiral model

- Broad features of SM flavor again arise from dividing fermions
- Fermionic flavor is partially radiative, feeding off soft masses
- Higgs sector is radically split, large tan beta
- Mu term generated supersymmetrically w/ no B mu problem (gauge invariance!)
- Soft masses from gauge & gaugino mediation
- Flavorful soft spectrum, free of FCNCs
- D-term corrections lift the tree-level Higgs mass, solve little hierarchy problem

A three-site model

The natural ambition is to describe *all* of fermionic flavor; this requires a three-site model



Excellent fit to fermion masses and mixings. K-K mixing becomes a relevant constraint; can be acceptable if 2nd gen. scalars are above 10 TeV and RH mixing angles are small

Otherwise preserves all the nice predictions of the 2-site model

(Why not an extra dimension?)

Connoisseurs of extra-dimensional model-building may be wondering why we're bothering with 4D deconstructions, since some features are shared w/ ED models. But in (RS) ED,

- Flavor typically comes from arbitrary adjustable parameters
- No natural U(2) sflavor symmetry, so FCNCs are problematic
- No analog of nondecoupling D-terms in ED models (a 1/N effect in RS or flat extra dimension)
- Many more problems with gauge coupling unification
- ....

Many of the attractive features of 4D models are inherently 4D!

A few LHC expectations

- Gravitino LSP (10 eV - 1 keV). Dark matter must be something else: axion, axino, ???
- Stau or neutralino NLSP; stau NLSP --> lots of taus
- Significant heavy flavor production, since third-generation squarks and sleptons are dominantly produced. If gluino is heavy, b-rich jets; if gluino is light enough, top decays lead to significant production of same-sign leptons. *These heavy flavor searches are already underway.*
- Higgs easily above LEP bound (114 - 140 GeV), but stop may be light
- Additional states that may lie within LHC reach (esp. colored fermions, gauge bosons)
- Anomalies in B meson flavor possibly within experimental reach

Conclusions

- The first year of LHC data has imperiled light SUSY with universal masses; this paradigm is beginning to look either unnatural or incorrect.
- Splitting SM matter between different gauge groups in the UV leads to a variety of flavorful, natural supersymmetric theories
- These models explain the broad features of SM flavor and naturally give a flavorful soft spectrum with a light stop and heavy 1st- & 2nd-generation squarks
- A flavorful SUSY model without prohibitive FCNCs! Also solves the mu problem and the little hierarchy problem.
- Fairly exciting LHC spectrum readily compatible with current bounds
- And, as I hope I've convinced you, these features are all a consequence of merely moving a few fields, rather than many epicycles of model-building.

Thank you!