Flavored Gauge Mediation

YS, Szabo

Abdullah, Galon, YS, Shirman

no supersymmetry at the LHC

? because it`s simply not there

? because the spectrum is different from what we imagined

- one prevalent assumption:

Minimal Flavor Violation (MFV)

suppresses flavor violating processes

but overkill

things to bear in mind (theory and exp):

we don`t understand the SM Yukawa couplings

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kinematic edges and flavor subtraction

Galon YS

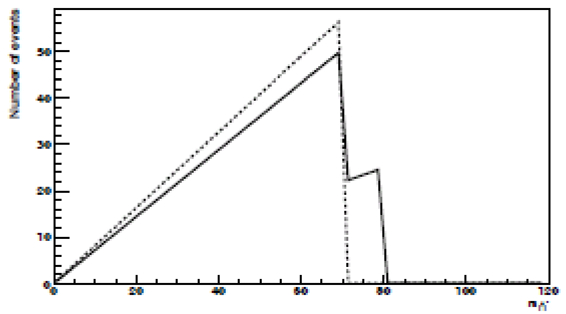

Fig. 1. The l^+l^- invariant mass distribution ($l = e, \mu$) for degenerate sleptons (dashed) and for sleptons of different masses (solid).

use flavor-added distributions instead

- no supersymmetry at the LHC
- but Higgs seems to be there
- uncomfortably heavy for SUSY

  in particular for GMSB

  [which doesn`t have A-terms]

e.g. Draper Meade Reece Shih

Gauge Mediated Supersymmetry Breaking

- beautiful, nothing swept under $M_{\mathbf{Planck}}$ carpet

  (but see where following beauty led us with susy..)

- many variations considered recently

  (General Gauge Mediation)

- but: **FLAVOR**

but is GMSB **automatically** FLAVOR-blind ?

(depends on your definition of automatic..)

Minimal GMSB : messengers 5 + 5bar :

$$D \;+\; \bar{D}$$

$$H_D \qquad H_U$$

but is GMSB automatically FLAVOR-blind ?

minimal GMSB : messengers 5 + 5bar :

$$D \; + \bar{D}$$
$$H_D \quad H_U$$

in principle:

$$W = H_U qu + H_D qd + H_D le$$
$$+ \bar{D}qu \; + \; Dqd \; + \; Dle$$

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Minimal GMSB : messengers 5 + 5bar : $D + \bar{D}$

$H_D \quad H_U$

in principle: $W = H_U qu + H_D qd + H_D le$

$+ \bar{D}qu + Dqd + Dle$

messenger-matter couplings

$$W = Y_U H_U qu + Y_D H_D qd + Y_L H_D le$$

$$+ \lambda_U \bar{D} qu \; + \lambda_D \, Dqd \; + \; \lambda_L Dle$$

Chacko-Ponton (MFV)

new GENERATION dependent contributions to soft masses from messenger loops

usually **forbid** messenger-matter couplings by **imposing** a discrete symmetry (messenger parity) overkill:

- we are ignorant about Yukawas:

  we are at least as ignorant about the new couplings

- non-trivial Yukawas hint at some *flavor theory*

same *flavor theory* would necessarily control the new couplings simplest example: if $H_D \; D$

same properties under flavor theory

$$\longrightarrow \qquad (\lambda_D)_{ij} \approx (Y_D)_{ij}$$

nearly MFV: mass splittings similar to MFV

flavor constraints obeyed ✓

simplest example: if H_D D

same properties under flavor theory

→ $$(\lambda_D)_{ij} \approx (Y_D)_{ij}$$

nearly MFV: mass splittings similar to MFV

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[can still have interesting effects at LHC: **mixings**] more generally: H_D D

have different properties under flavor theory

→ λ_D Y_D different matrices

but can sometimes be consistent with

flavor constraints

simple realization: flavor symmetries

flavor symmetry controls

a. fermion masses

b. messenger-matter couplings

can give rise to

interesting squark spectra

interesting slepton spectra ← **today**

want messengers to couple to susy-breaking

but not the Higgses

$\longrightarrow$ in each messenger pair: either

$$\lambda_U \bar{D} q u \quad \text{or} \quad \lambda_D D q d \ , \ \lambda_L D l e$$

if want both types of couplings: need more than one pair of messengers

sleptons

with U(1)xU(1) flavor symmetry

- suppose we want some new coupling to be large
- lepton Yukawas are small
- so need $$(\lambda_D)_{ij} > (Y_D)_{ij}$$
- recall: $$W \supset Y_L H_D le + \lambda_L Dle$$

$\longrightarrow$ need: flavor charge of D smaller than flavor charge of Higgs

{

taking flavor spurion: negative charge

so: smaller charges → less suppression
larger couplings

}

flavor charge of D smaller
than flavor charge of Higgs

↓

often: new couplings vanish for 3rd generation
sleptons
(holomorphic zeros)

since 3rd generation sleptons have smaller
charges to have large Yukawa

- naturally have large effects in 1st and 2nd generation
- interesting spectra

    selectron mass splittings a few-10 GeV

    large selectron-smuon mixings

to conclude:

- no need to assume MFV to handle flavor constraints: flavor structure of supersymmetry may be richer than what we imagined
- matter-messenger couplings: viable models with interesting spectra