



Flavour Structure in Baryon-Violating RPV SUSY

- Different λ''_{ijk} RPV couplings cause LSP decays to different quarks:

$$\tilde{\chi}_1^0 \rightarrow q_1 q_2 q_3$$

- Identifying the dominant λ'' gives insight into flavour physics!



*Cambridge SUSY
Working Group*

- Use vertexing and non-isolated muons to statistically separate c - and b - from light quark jets.

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R-Parity Violation

$$R_p = (-1)^{3B+L+2S}$$

+1 for SM particles

-1 for SUSY particles

- Consequences of RPV
 - Decay of Lightest SUSY Particle (LSP)
 - Large couplings \Rightarrow single sparticle production.

- $\lambda_{ijk} L^i L^j E^k \Rightarrow \tilde{\nu}_1^0 \rightarrow \text{leptons}$
- $\lambda'_{ijk} L^i Q^j D^k \Rightarrow \tilde{\nu}_1^0 \rightarrow l \text{ or } \mathbf{u} + \text{jets}$
- $\lambda''_{ijk} U^i D^j D^k \Rightarrow \tilde{\nu}_1^0 \rightarrow qqq$

- Hardest at LHC is λ'' - no leptons, many jets!



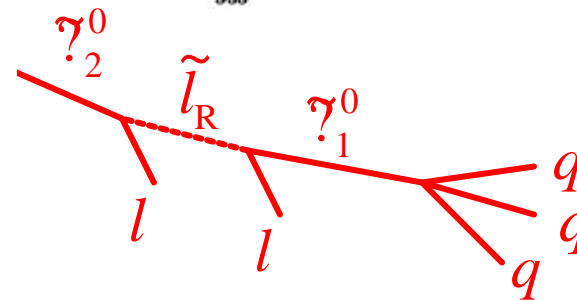
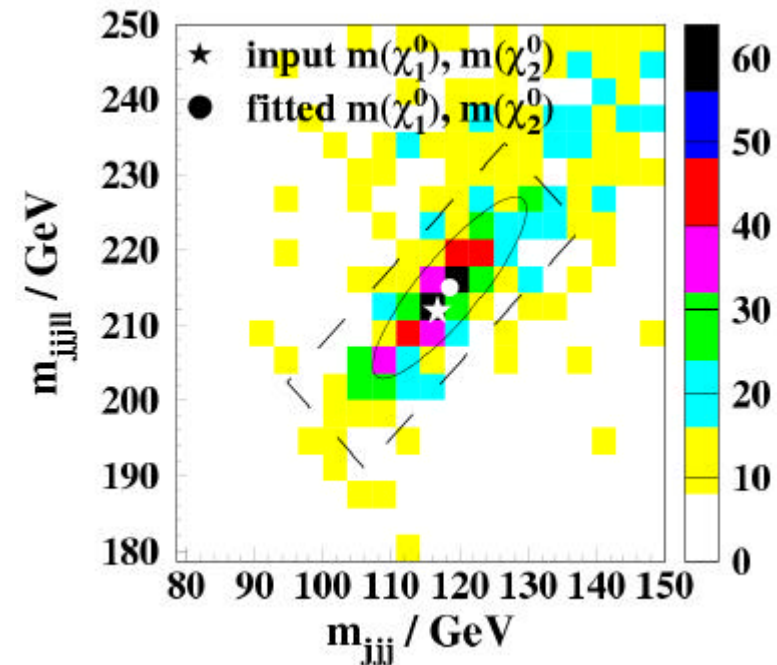
Test Models

- Our test model:
mSUGRA parameters:
 $m_0 = 100 \text{ GeV}$
 $m_{1/2} = 300 \text{ GeV}$
 $A_0 = 300 \text{ GeV}$
 $\tan\beta = 10$
 $\mu > 0$
 $\lambda''_{ijk} = 0.005$
 $\tilde{\tau}_1^0 = 116.7 \text{ GeV}$
 $\tilde{\tau}_2^0 = 211.9 \text{ GeV}$
 $\tilde{q} \approx 600 - 700 \text{ GeV}$
- Allowed \mathcal{B} couplings:
- λ''_{ijk} antisymmetric in $j \leftrightarrow k$
- Do not consider λ''_{tjk} (long lived $\tilde{\tau}_1^0$ must decay through virtual top quark)
- Couplings which can lead to decay inside the detector:
uds, udb, usb,
cbs, cdb, csb.



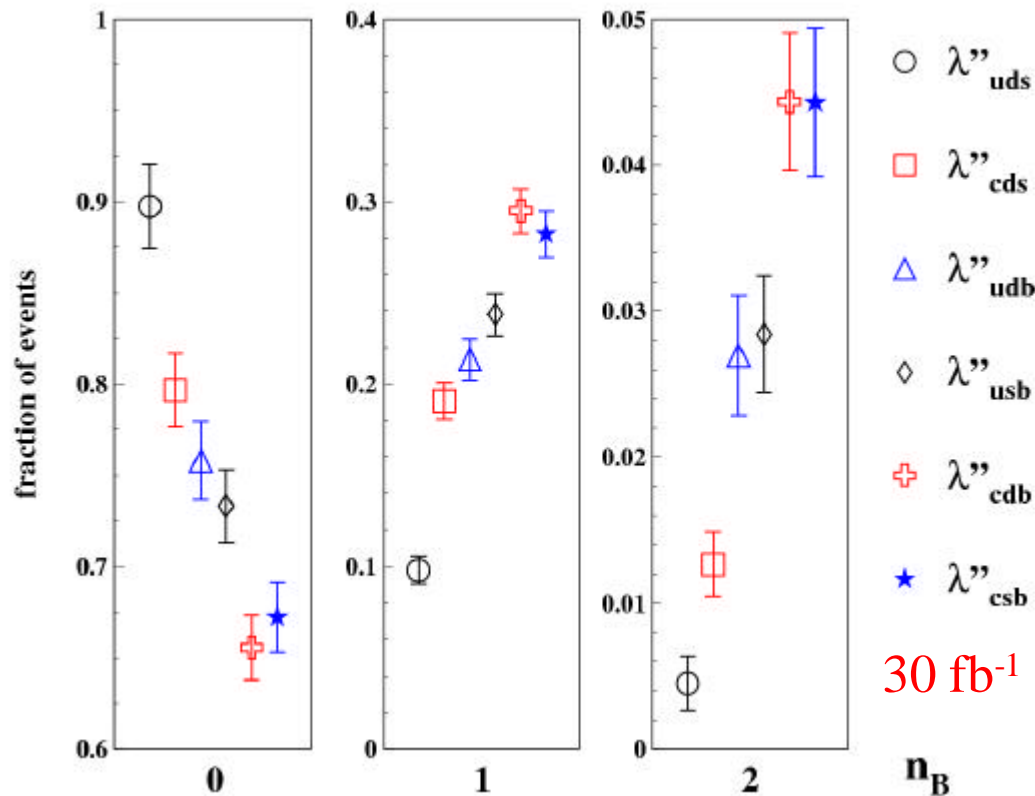
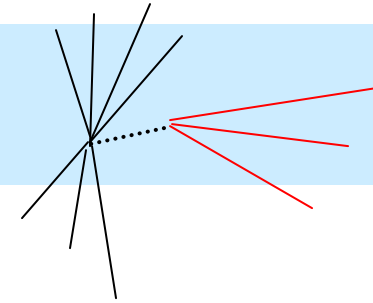
Event Generation & Selection

- Herwig 6.2
- AtfastF 2.50
- Selection of events by mass reconstruction
(hep-ph/0102173)
using \tilde{l}_R decay chain.
- Accept events within 2σ of the $\tilde{\gamma}_1^0 - \tilde{\gamma}_2^0$ mass peak.





Vertex Tagging



Tagging Efficiency
applied to AtIfast
from full simulations:

b-jets 1 / 3.0
c-jets 1 / 22.9
other jets 1 / 1400

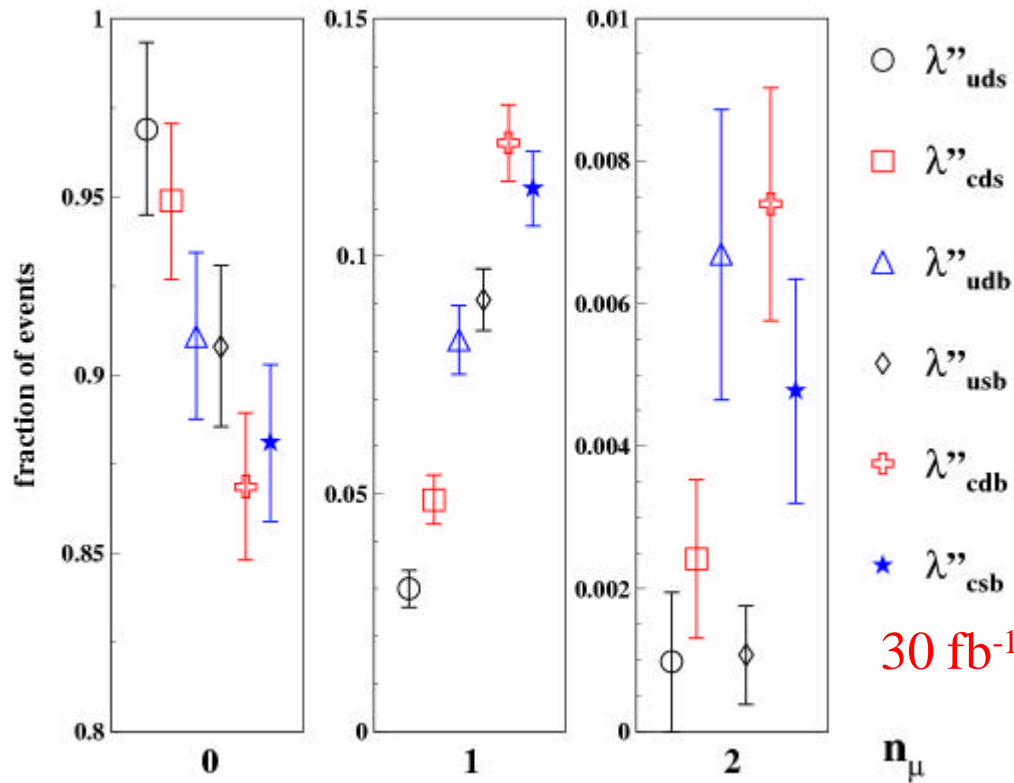
(p_T and h dependent)

30 fb⁻¹

- Statistical separation of b and c from light quarks.
- Ambiguity between s and d .

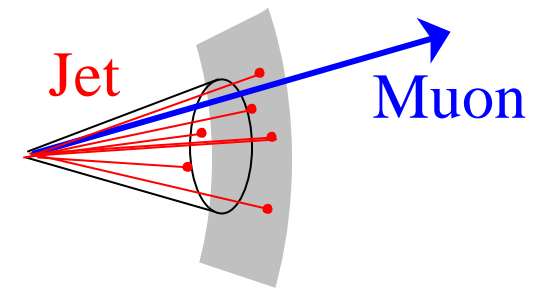


Non-Isolated Muons



Muons are
“non-isolated” if
within jet cone.

Cone radius = 0.4



- Also provides discrimination.
- Still viable if decay is beyond Inner Detector



Statistical Significance

Distinguishing		Vertexing		Muons		Combined
I''_{ijk} from I''_{lmn}		χ^2 / df	P / %	χ^2 / df	P / %	σ
uds	udb	59.1/1	-	28.7/1	-	9.4
	usb	73.0/1	-	31.7/1	-	10.2
	cds	30.5/1	-	4.0/1	4	5.9
	cdb	106.9/1	-	47.2/1	-	12.4
	csb	113.4/1	-	49.2/1	-	12.8
udb	usb	1.6/2	44	0.4/1	54	1.4
	cds	10.3/2	1	13.0/1	-	4.8
	cdb	18.3/2	-	6.8/2	3	5
	csb	16.3/2	-	5.1/2	8	4.6
usb	cds	17.5/2	-	17.2/1	-	5.9
	cdb	12.1/2	-	5.1/1	2	4.2
	csb	9.9/2	1	3.1/1	8	3.6
cds	cdb	56.1/2	-	37.4/1	-	9.7
	csb	55.8/2	-	35.3/1	-	9.5
cdb	csb	0.6/2	72	1.3/2	51	1.4

$$\chi^2 = \sum_i \frac{(x_i - y_i)^2}{s_x^2 + s_y^2}$$

with x_i, y_i the
fraction of events
with i muons (or
 i vertex tags)

P < 1% not shown

All distinguished at 3.5 σ , except for an ambiguity $d \leftrightarrow s$



Conclusions

- Can identify jets from $\Upsilon_1^0 \rightarrow q_1 q_2 q_3$
- Statistical separation of c and b from light quark jets.
- Remaining ambiguity from $d \leftrightarrow s$
- Dominant coupling could be identified at $> 3.5 \sigma$

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