[1段階]

- ~1 TeV　$\int L = 100\,pb^{-1}$
- ~1.5 TeV　$\int L = 1\,fb^{-1}$　← 2008年
- 2 TeV　$\int L = 10\,fb^{-1}$　← 2009年

56 Discovery 可 鍵 { no-lepton / one lepton

(8章) BGを如何に理解するか

SUSY scale (Meff, 5) ⟶ 7章

[2段階]

2009年 $\int L = 10\,fb^{-1}$　SUSY < 1.5 TeV

inclusive study (7章)

① Scale (Meff 5)
② lepton 数と Pt
③ 4jet or 2jet
④ $R \to bb$
⑤ high Pt b jet (+lepton?)

[3段階]

2010年以降　$\int L = 100\,fb^{-1}$ (Design L)

→ ①特定のdecay chainをえらび出して再構成

(例1) small m_0
(例2) coannilation
(例3) $\tilde{t}$の再構成　↖ あとで加える
(例4) $\tilde{b}$の〃　とバルク

ATLASの Point

SU1	DC2 stau coannihilation model (isasugra 7.69?: m0=70 GeV, m12 = 350 GeV, A0 = 0, tan beta = 10, sgn(mu) = +)	6.76
SU2	Focus Point model (isasugra 7.71: m0=3550 GeV, m12 = 300 GeV, A0 = 0, tan beta = 10, sgn(mu) = +)	4.92
SU3	DC1 bulk region model with new UE (isasugra 7.64: m0=100 GeV, m12 = 300 GeV, A0 = -300 GeV, tan beta = 6, sgn(mu) = +).	19.34
SU6	Funnel region model (isasugra 7.69: m0=320 GeV, m1/2 = 375 GeV, A0 = 0, tan beta = 50, sgn(mu) = +)	4.48
SU4	low mass point at limit of RunII reach (isasugra 7.71: m0=200 GeV, m12 = 160 GeV, A0 = -400 GeV, tan beta = 10, sgn(mu) = +)	270
SU5.x	Scan of parameter space. Proposed points: SU5.1 : (isasugra 7.71: m0=130 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.2 : (isasugra 7.71: m0=250 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.3 : (isasugra 7.71: m0=500 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.4.0: (isasugra 7.71: m0=1000 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.4.1: (isasugra 7.71: m0=2000 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.4.2: (isasugra 7.71: m0=3000 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.4.3: (isasugra 7.71: m0=4000 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.6.0 : (isasugra 7.71: m0=5000 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.6.1 : (isasugra 7.71: m0=4800 GeV, m12 = 600 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.6.2 : (isasugra 7.71: m0=6300 GeV, m12 = 1000 GeV, A0 = 0, tan beta = 10, sgn(mu) = +) SU5.6.3 : (isasugra 7.71: m0=6000 GeV, m12 = 1000 GeV, A0 = 0, tan beta = 10, sgn(mu) = +)	

SU5以外は Ω_{DM} を強く意識している $\Omega \leq 0.2$

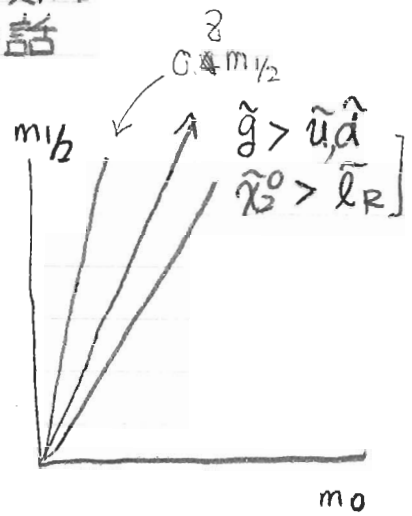
例として 何点かで 再構成を行う。

① $L = 100\,fb^{-1}$
② BGがよく分かっている
} 2010年以降の話

small m_0

[1] SPS 1a （SU3）に近い

$m_{1/2} = 400$ GeV　$m_0 = 160$ GeV
$A = -160$ GeV
$\mu > 0$
$\tan\beta = 10$

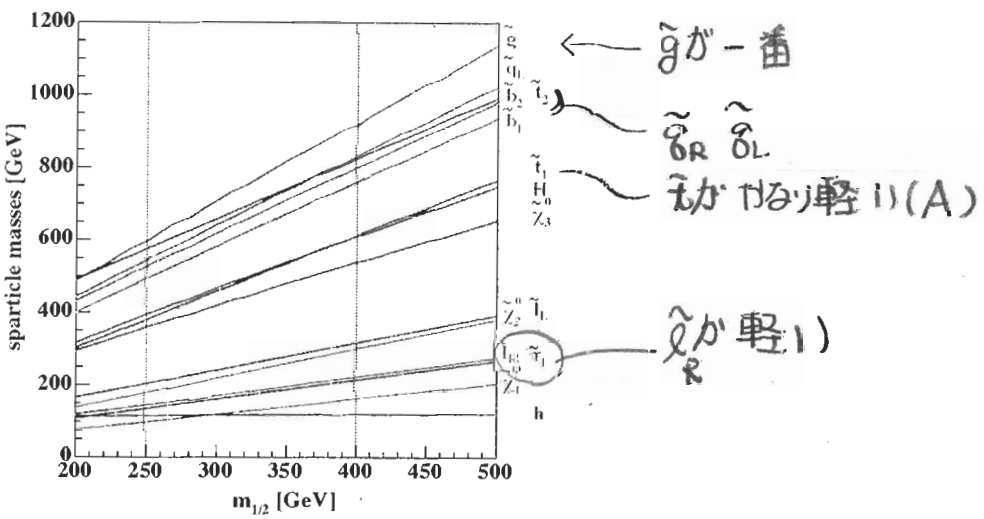


Point	$\tilde{g}$	$\tilde{d}_L$	$\tilde{d}_R$	$\tilde{u}_L$	$\tilde{u}_R$	$\tilde{b}_2$	$\tilde{b}_1$	$\tilde{t}_2$	$\tilde{t}_1$
(α)	**595.2**	**543.0**	520.1	**537.2**	520.5	**524.6**	**491.9**	574.6	379.1
(β)	**915.5**	**830.1**	799.5	**826.3**	797.3	**800.2**	**759.4**	823.8	610.4
	$\tilde{e}_L$	$\tilde{e}_R$	$\tilde{\tau}_2$	$\tilde{\tau}_1$	$\tilde{\nu}_{eL}$	$\tilde{\nu}_{\tau L}$		$H^\pm$	A
(α)	202.1	**143.0**	206.0	133.4	185.1	185.1		401.8	393.6
(β)	315.6	**221.9**	317.3	213.4	304.1	304.1		613.9	608.3
	$\tilde{\chi}_4^0$	$\tilde{\chi}_3^0$	$\tilde{\chi}_2^0$	$\tilde{\chi}_1^0$	$\tilde{\chi}_2^\pm$	$\tilde{\chi}_1^\pm$		H	h
(α)	377.8	358.3	**176.8**	**96.1**	378.2	176.4		394.2	114.0
(β)	553.3	538.4	**299.1**	**161.0**	553.3	299.0		608.9	117.9

Table 1: Masses [GeV] for the considered SPS 1a points (α) and (β) of eq. (3.2).

$\tilde{g} > \tilde{d}, \tilde{u} > \tilde{b}, \tilde{t}$ ← 2body decay

$\tilde{\chi}_2 > \tilde{\ell}_R$ ← lepton 2body decay



← $\tilde{g}$が一番

$\tilde{t}_2$ $\tilde{g}_R$ $\tilde{g}_L$

$\tilde{t}_1$ H^0 $\tilde{\chi}_3^0$ $\tilde{t}$が1番軽い(A)

$\tilde{\chi}_2^0$ $\tilde{t}_L$ $\tilde{\tau}_1$ $\tilde{\chi}_1^0$ $\tilde{\ell}_R$が軽い

	σ(SUSY)	$\sigma(\tilde{g}\tilde{g})$	$\sigma(\tilde{g}\tilde{q}_L)$	$\sigma(\tilde{g}\tilde{q}_R)$	$\sigma(\tilde{q}_L\tilde{q}_L)$	$\sigma(\tilde{q}_L\tilde{q}_R)$	$\sigma(\tilde{q}_R\tilde{q}_R)$
~~(α)~~	~~49.3~~	~~5.3~~	~~11.4~~	~~12.3~~	~~3.5~~	~~4.8~~	~~4.1~~
(β)	4.76	0.29	0.97	1.06	0.44	0.61	0.53

Table 2: Selected supersymmetry cross-sections in pb.

$\sigma(\hat{g}\hat{g}) = 1.58$ pb
$\sigma(\hat{g}\hat{q}) = 2.03$ pb
$\sigma(\hat{g}\hat{g}) = 0.29$

$\sigma(\hat{\chi}\hat{q}) + \sigma(\hat{\chi}\hat{g}) = 0.86$

		$\Sigma(\tilde{g})$	$\Sigma(\tilde{q}_L)$	$\Sigma(\tilde{q}_R)$	$\Sigma(\tilde{b}_1)$	$\Sigma(\tilde{b}_2)$	$\Sigma(\tilde{t}_1)$	$\Sigma(\tilde{\chi}_2^0)$
(α)	Direct	35.4	24.6	25.8	1.4	0.9	3.4	1.8
	Indirect	–	8.2	14.6	6.3	3.5	5.6	16.0
	Total	35.4	32.8	40.4	7.7	4.3	9.0	17.8
(β)	Direct	2.71	2.64	2.80	0.10	0.06	0.23	0.23
	Indirect	–	0.58	1.00	0.40	0.25	0.64	1.44
	Total	2.71	3.21	3.79	0.50	0.31	0.87	1.67

Table 3: Selected sparticle production rates in pb.

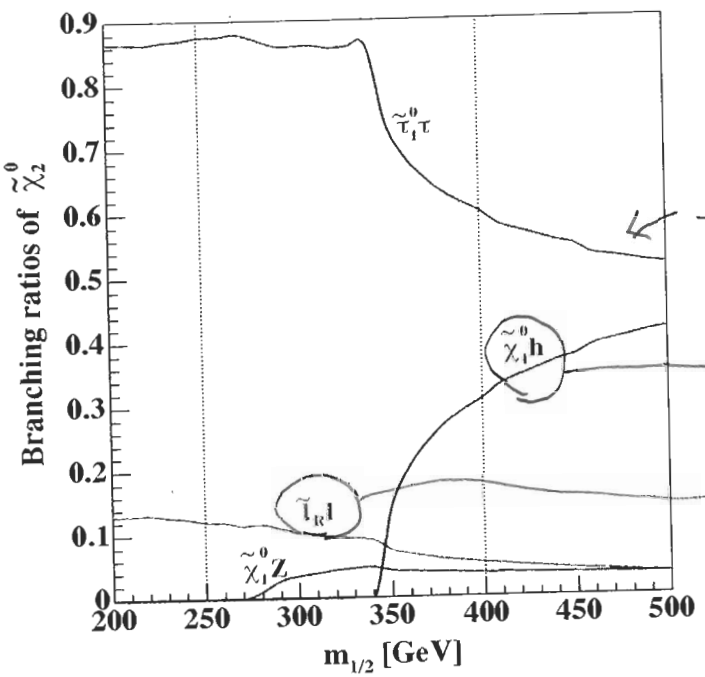
$\tilde{g} \to \tilde{q}_L q \quad \tilde{q}_R q$
mass が軽い方だけ 少しだけ 多い」

$\tilde{\chi}_2^0 \to \tilde{l}_R l \to l l \tilde{\chi}_1^0$ dilepton が "鋭い"

$\tilde{l}_L l$ が ゆるされると Br は かなり大きい

$\tilde{l}_R l$ の時は ボドボド (SUSY 6-9, 6-10)

$\tilde{\tau}_1$ τ が 主 (l 成分まざっている)



これも効いている

10% 程度 $l = e, \mu$ へ行く

ll-pairの不変質量を組む

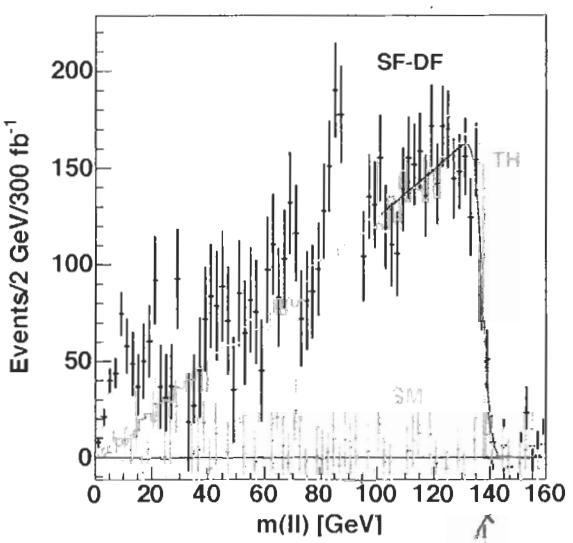
llでも chargino $\tilde{W} \to \tilde{l}\nu \to l\nu\tilde{\chi}_1^0$ も効いている

→ 同一親からと 別の親からの両方効いている

別親は e, μ が混ざる可能性(DF)が同じになる可能性(SF)と同じ

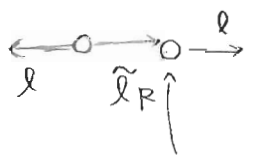
別親分は SFでの分布から DFでの分布 $(e^+\mu^-, e^-\mu^+)$ を引いて作る → 次のページ

"SF-DF" 分布



三角形("edge"分布)

$$(m_{ll}^{max})^2 = \frac{(m_{\tilde{\chi}_2^0}^2 - m_{\tilde{l}_R}^2)(m_{\tilde{l}_R}^2 - m_{\tilde{\chi}_1^0}^2)}{m_{\tilde{l}_R}^2}$$



等方的

$$m_{ll} = m_{ll}^{max}\sqrt{\frac{(1-\cos\theta)}{2}}$$

edgeになる

- "edge"になる → edge → 3つのmassの差分 (m_{ll}^{max}) → 137GeV ← "1GeV以下"の精度で決まる
- m_Zにもpeak → $\tilde{\chi}_2^0 \to Z\tilde{\chi}_1^0$ (Zだけか"Z"もあるか?)

↓

SUSY II

NO

SUSY 10-4

m_0=100GeV $m_{1/2}$=250 m_0=160 $m_{1/2}$=400

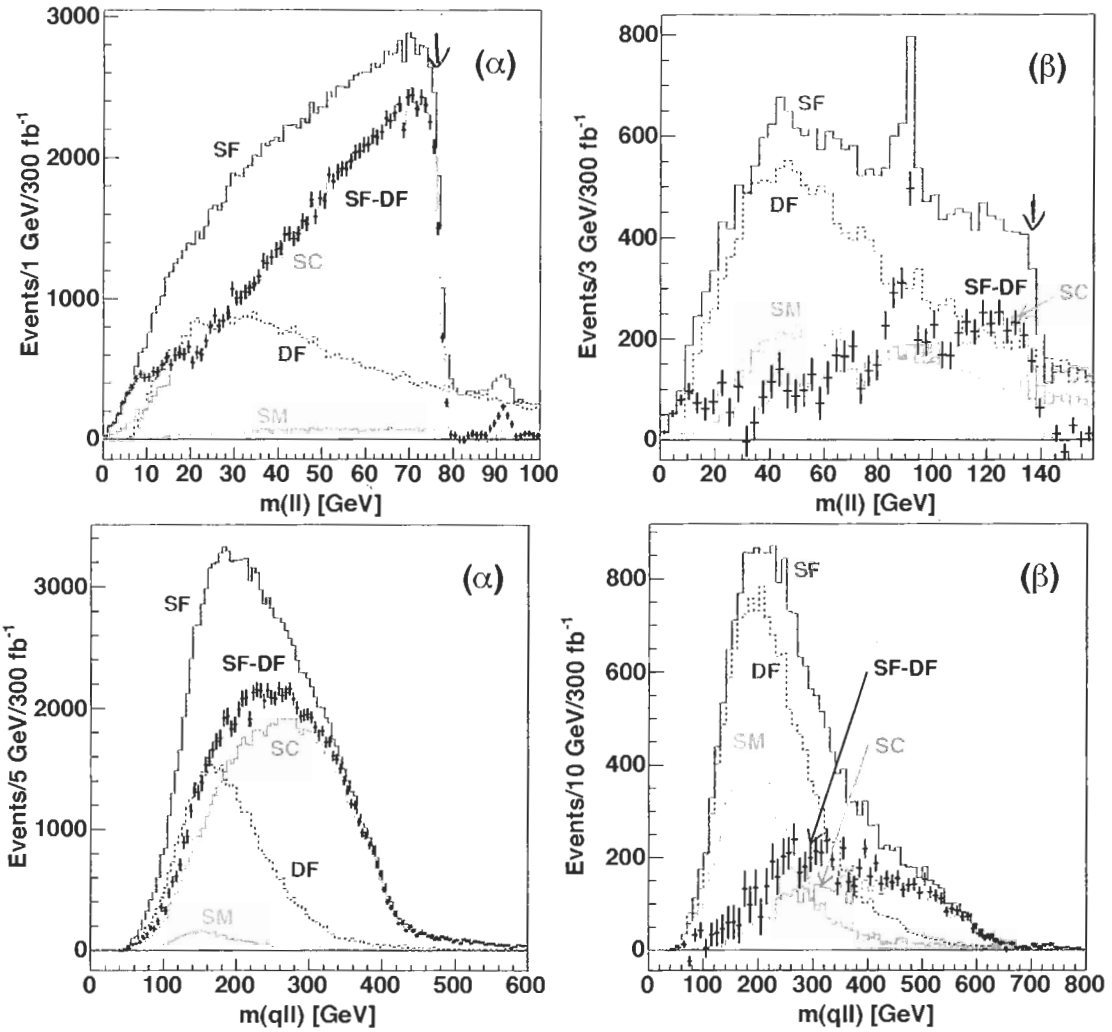


Figure 11: Different-flavour subtraction for m_{ll} and m_{qll} at (α) (left) and (β) (right). The solid/dashed red curves are the same-flavour ('SF')/different-flavour ('DF') distributions. In black, their difference, the different-flavour-subtracted distribution ('SF-DF'), is shown with error bars. The blue curve shows the part of the subtracted distribution which contains a signal chain ('SC'). The solid/dashed green curves ('SM') give the Standard Model part (completely dominated by $t\bar{t}$) of the same-flavour/different-flavour distributions. They are statistically equal and will cancel each other.

① SF-DFはわっこう大きな引き算（分母は大きな寄与）
↳ error 大

② BGもお易 ⟶ SMで leptonがあるmodeで効くのは tt̄

③ SCは正しい分布 SF-DFで正しい分布になっている

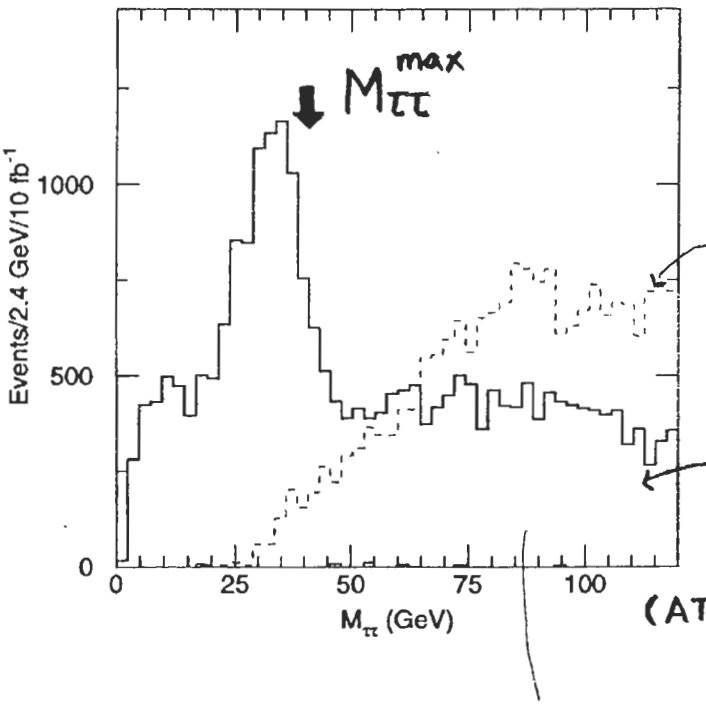
④ jet llの分布（SUSY 10-5）も "end point" 側は正しい分布になっている
↳ low M(qll) 側は overesumate

τは組めるか？

$\tilde{\chi}_2^0 \to \tau\tilde{\tau}_1$
$\hookrightarrow \tau\tilde{\chi}_1^0$

τのhadronic-decay

1-3 prong
Isolation
narron (R=0.2) cone



(ATLAS Point 6)

Even in τ-case,
"edge" appears

expected "fake τ"
contribution

Pedestal
comes from
$\tilde{\chi}_1^{\pm} \to \tilde{\tau}\nu$
(m_0=200,
$m_{1/2}$=200
$\tan\beta$=45)

分解能は悪い
(5%)
↓
νの分で不明

$M_{\tau\tau} = \frac{1}{0.66} M_{VS}$
補正

νが出ている

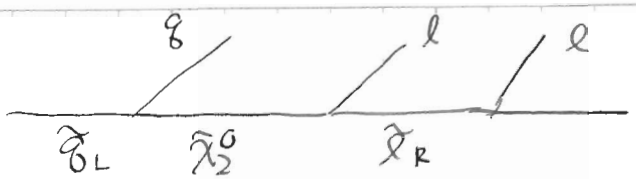
0.66は平均的
τがLなのかRなのかで違ってくる。

"DFの引き算が出来なくなる"

⇨ τのPolarizationを測定して

$\tilde{\chi}_2^0 \to \tau\tilde{\tau}_1$
$\hookrightarrow \tau\tilde{\chi}_1^0$
の成分測定

↓
難しい



M_{llq} "jet" が いっぱいある どの jet と ll を組む？

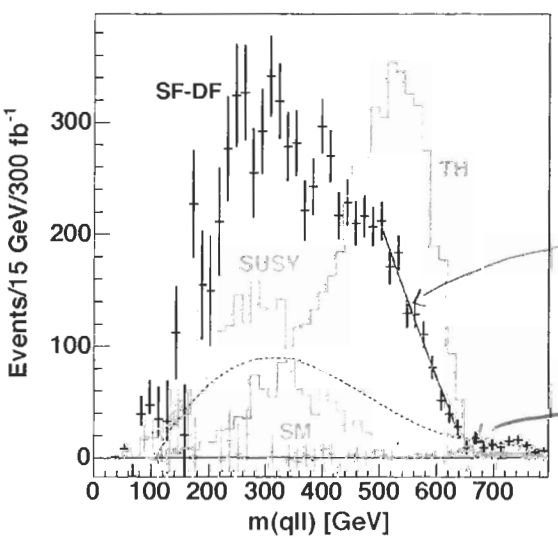
↓

- $\tilde{q} \to q\tilde{\chi}_2^0$ の "q-jet" は P_T が大きい

⇩

高い P_T jet 2本 を えらんでくる。このうち M_{llq} が 小さくなる方

(反対は 別の $\tilde{q}$ が出ているので) ↘



{ 別の方法として 10-7の別の所 が 正しくなる組み合わせが1つしかない (組み合わせのまちがいがない) ものをえらぶ。

M_{llq} が小さい方をえらんでいるので この形はうそになっているが

"end point" (edgeの方が正しい) は、正しく出ている

"ほぼ"

↓

$$(m_{\tilde{q}ll})^2 = \frac{(m^2_{\tilde{q}_L} - m^2_{\tilde{\chi}_2^0})(m^2_{\tilde{\chi}_2^0} - m^2_{\tilde{\chi}_1^0})}{m^2_{\tilde{\chi}_2^0}}$$

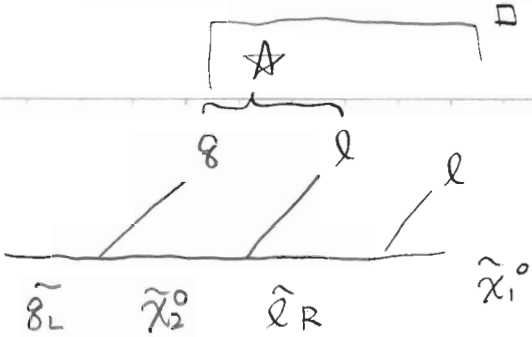
↓

655 GeV stat. err ~10 GeV

↓

{ ① の直線で 引っぱって出す。

② resolution を入れて何かの関数で fit する。



① High Pt 2jet (3jet)
② 2 lepton (only)
③ Large mET (> 300GeV
④ $\tilde{q}_R \to q\tilde{\chi}_1^0$ をえらぶ

この "end point" (edgeでない)

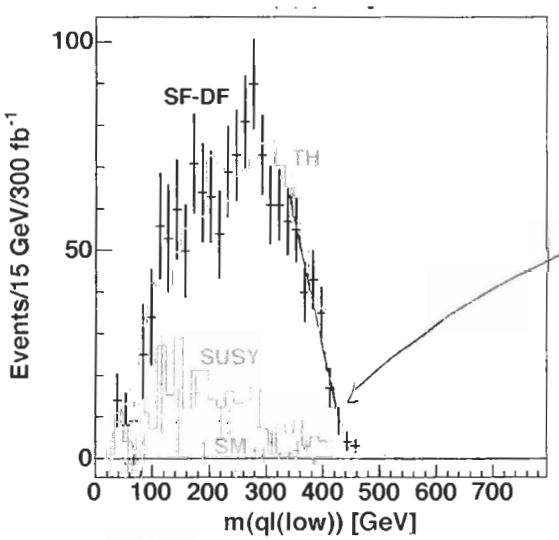
$$m^2_{q\ell} = \frac{(m^2_{\tilde{q}_L} - m^2_{\tilde{\chi}_2^0})(m^2_{\tilde{\chi}_2^0} - m^2_{\tilde{l}_R})}{m^2_{\tilde{\chi}_2^0}}$$

↑ ここが $\tilde{\chi}_1^0$ でなく $\tilde{l}_R$

さっきえらんだ q-jet と 2つの lepton のうち $m_{q\ell}$ が小さくなる方

⇩

"q, l が近い" ☆の情報になる

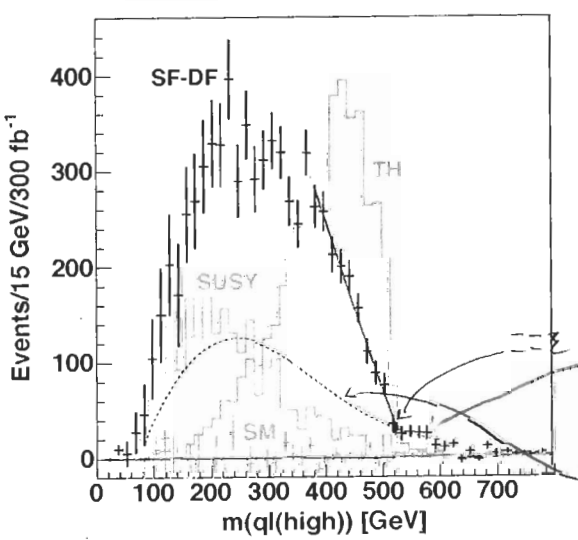


直線で fit すると 443 GeV

437, 439 GeV
$(\tilde{u}_L)$ $(\tilde{d}_L)$

数GeV ずれている OK

$m_{q\ell}$ が大きくなる方は "q, l" が
あちこち → □をえらび間違い



$$m^2_{q\ell\,(high)} = \frac{(m^2_{\tilde{q}_L} - m^2_{\tilde{\chi}_2^0})(m^2_{\tilde{l}_R} - m^2_{\tilde{\chi}_1^0})}{m^2_{\tilde{l}_R}}$$

ここを zero にする tail が出る悪い方の q をえらんでいる。
SUSY 10-6 の end point
670GeV 以上(まちがった)
の組み合わせの時の分布を作り

m_{ql}が大きくなる分布で、$m_{qll} >$ end pointをこえる
⇓
悪いものをえらんでいる
↑
Combinatorial BGをさっぴくと出る

380GeV ⟷ 374GeV
予測 ↑ 測定

$$(m_{ll}^{\max})^2 = \frac{(m_{\tilde{\chi}_2^0}^2 - m_{\tilde{l}_R}^2)(m_{\tilde{l}_R}^2 - m_{\tilde{\chi}_1^0}^2)}{m_{\tilde{l}_R}^2} \tag{4.3}$$

$$(m_{qll}^{\max})^2 = \begin{cases} \dfrac{(m_{\tilde{q}_L}^2 - m_{\tilde{\chi}_2^0}^2)(m_{\tilde{\chi}_2^0}^2 - m_{\tilde{\chi}_1^0}^2)}{m_{\tilde{\chi}_2^0}^2} & \text{for} \quad \dfrac{m_{\tilde{q}_L}}{m_{\tilde{\chi}_2^0}} > \dfrac{m_{\tilde{\chi}_2^0}}{m_{\tilde{l}_R}} \dfrac{m_{\tilde{l}_R}}{m_{\tilde{\chi}_1^0}} \quad (1) \\ \dfrac{(m_{\tilde{q}_L}^2 m_{\tilde{l}_R}^2 - m_{\tilde{\chi}_2^0}^2 m_{\tilde{\chi}_1^0}^2)(m_{\tilde{\chi}_2^0}^2 - m_{\tilde{l}_R}^2)}{m_{\tilde{\chi}_2^0}^2 m_{\tilde{l}_R}^2} & \text{for} \quad \dfrac{m_{\tilde{\chi}_2^0}}{m_{\tilde{l}_R}} > \dfrac{m_{\tilde{l}_R}}{m_{\tilde{\chi}_1^0}} \dfrac{m_{\tilde{q}_L}}{m_{\tilde{\chi}_2^0}} \quad (2) \\ \dfrac{(m_{\tilde{q}_L}^2 - m_{\tilde{l}_R}^2)(m_{\tilde{l}_R}^2 - m_{\tilde{\chi}_1^0}^2)}{m_{\tilde{l}_R}^2} & \text{for} \quad \dfrac{m_{\tilde{l}_R}}{m_{\tilde{\chi}_1^0}} > \dfrac{m_{\tilde{q}_L}}{m_{\tilde{\chi}_2^0}} \dfrac{m_{\tilde{\chi}_2^0}}{m_{\tilde{l}_R}} \quad (3) \\ (m_{\tilde{q}_L} - m_{\tilde{\chi}_1^0})^2 & \text{otherwise} \quad (4) \end{cases} \tag{4.4}$$

$$(m_{ql(\text{low})}^{\max}, m_{ql(\text{high})}^{\max}) = \begin{cases} (m_{ql_n}^{\max}, m_{ql_f}^{\max}) & \text{for} \quad 2m_{\tilde{l}_R}^2 > m_{\tilde{\chi}_1^0}^2 + m_{\tilde{\chi}_2^0}^2 > 2m_{\tilde{\chi}_1^0} m_{\tilde{\chi}_2^0} \quad (1) \\ (m_{ql(\text{eq})}^{\max}, m_{ql_f}^{\max}) & \text{for} \quad m_{\tilde{\chi}_1^0}^2 + m_{\tilde{\chi}_2^0}^2 > 2m_{\tilde{l}_R}^2 > 2m_{\tilde{\chi}_1^0} m_{\tilde{\chi}_2^0} \quad (2) \\ (m_{ql(\text{eq})}^{\max}, m_{ql_n}^{\max}) & \text{for} \quad m_{\tilde{\chi}_1^0}^2 + m_{\tilde{\chi}_2^0}^2 > 2m_{\tilde{\chi}_1^0} m_{\tilde{\chi}_2^0} > 2m_{\tilde{l}_R}^2 \quad (3) \end{cases} \tag{4.5}$$

$$(m_{ql_n}^{\max})^2 = \frac{(m_{\tilde{q}_L}^2 - m_{\tilde{\chi}_2^0}^2)(m_{\tilde{\chi}_2^0}^2 - m_{\tilde{l}_R}^2)}{m_{\tilde{\chi}_2^0}^2} \tag{4.6}$$

$$(m_{ql_f}^{\max})^2 = \frac{(m_{\tilde{q}_L}^2 - m_{\tilde{\chi}_2^0}^2)(m_{\tilde{l}_R}^2 - m_{\tilde{\chi}_1^0}^2)}{m_{\tilde{l}_R}^2} \tag{4.7}$$

$$(m_{ql(\text{eq})}^{\max})^2 = \frac{(m_{\tilde{q}_L}^2 - m_{\tilde{\chi}_2^0}^2)(m_{\tilde{l}_R}^2 - m_{\tilde{\chi}_1^0}^2)}{(2m_{\tilde{l}_R}^2 - m_{\tilde{\chi}_1^0}^2)} \tag{4.8}$$

$$\begin{aligned} (m_{qll(\theta > \frac{\pi}{2})}^{\min})^2 = \Big[& (m_{\tilde{q}_L}^2 + m_{\tilde{\chi}_2^0}^2)(m_{\tilde{\chi}_2^0}^2 - m_{\tilde{l}_R}^2)(m_{\tilde{l}_R}^2 - m_{\tilde{\chi}_1^0}^2) - \\ & - (m_{\tilde{q}_L}^2 - m_{\tilde{\chi}_2^0}^2) \sqrt{(m_{\tilde{\chi}_2^0}^2 + m_{\tilde{l}_R}^2)^2 (m_{\tilde{l}_R}^2 + m_{\tilde{\chi}_1^0}^2)^2 - 16 m_{\tilde{\chi}_2^0}^2 m_{\tilde{l}_R}^4 m_{\tilde{\chi}_1^0}^2} + \\ & + 2m_{\tilde{l}_R}^2 (m_{\tilde{q}_L}^2 - m_{\tilde{\chi}_2^0}^2)(m_{\tilde{\chi}_2^0}^2 - m_{\tilde{\chi}_1^0}^2) \Big] (4m_{\tilde{l}_R}^2 m_{\tilde{\chi}_2^0}^2)^{-1} \end{aligned} \tag{4.9}$$

[2] co annihilation point SU1

$m_0 = 70\ GeV$ $\tan\beta = 10.0$

$m_{1/2} = 350\ GeV$

$A_0 = 0$

mass

$\tilde{g}$ 832 GeV $\tilde{q}_L$ 760 GeV $\tilde{q}_R$ 735 GeV

$\tilde{e}_L$ 255 GeV $\tilde{e}_R$ 156 GeV $\tau_{1/2} = 147 / 257$ GeV

$\tilde{\chi}_1^0 = 137$ GeV $\tilde{\chi}_2^0 = 264$ GeV

$\Delta m(\tilde{e}_R - \tilde{\chi}_1^0) = 10\ GeV$

$\Delta m(\tilde{\tau}_1 - \tilde{\chi}^0) = 10\ GeV$

→ 宇宙初期

Process	fb
$pp \to \tilde{g}\,\tilde{g}$	554
$pp \to \tilde{q}_L \tilde{q}_L$	665
$pp \to \tilde{q}_R \tilde{q}_R$	779
$pp \to \tilde{q}_L \tilde{q}_R$	885
$pp \to \tilde{q}_R \tilde{g}$	1757
$pp \to \tilde{q}_L \tilde{g}$	1620
$pp \to \tilde{\chi}_1^{\pm} \tilde{q}_L$	154
$pp \to \tilde{\ell}\tilde{\ell}\ (\ell = e, \mu)$	15
$pp \to \tilde{\chi}_1^{\pm} \tilde{\chi}_1^{\pm}$	140
$pp \to \tilde{\chi}_1^{\pm} \tilde{\chi}_2^0$	258
$pp \to \tilde{b}_1 \tilde{b}_1$	160
$pp \to \tilde{b}_2 \tilde{b}_2$	32
$pp \to \tilde{t}_1 \tilde{t}_1$	49
$pp \to \tilde{t}_2 \tilde{t}_2$	38

$\tilde{q}\tilde{q}$も大きい.

$\tilde{q}\tilde{g}$が主

$\tilde{q}_L$ の方が $\tilde{\chi}_2^0$ より重い
$\tilde{l}_L$

$\tilde{q}_L \to \tilde{\chi}_2^0 + q$
$\hookrightarrow l \tilde{l}_{L,R} \to l + \tilde{\chi}_1^0$

$Br(\tilde{q}_L \to q \tilde{\chi}_2^0) = 32\%$
$Br(\tilde{q}_L \to q \tilde{\chi}_1^+) = 65\%$
2:1

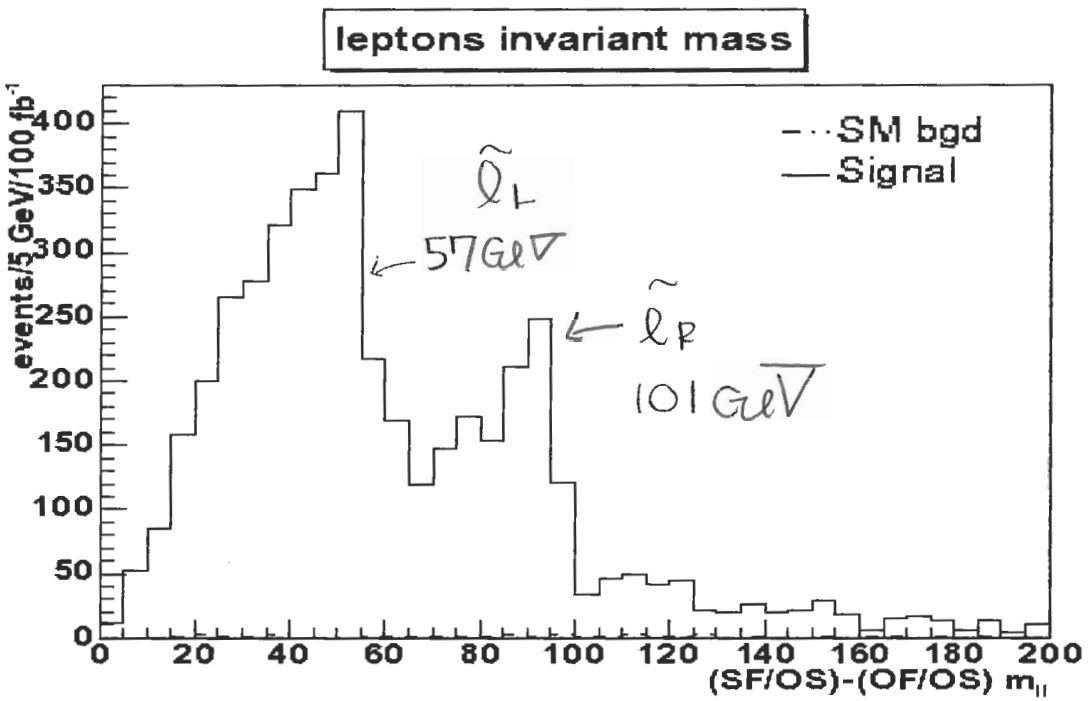
$Br(\tilde{\chi}_2^0 \to \tilde{l}_L l) = 6\%$
$Br(\tilde{\chi}_2^0 \to \tilde{l}_R l) = 3\%$

⇩

leptonが2つある

↙

leptonのedgeが2つある



- mET 7300
- 2lepton (Pt≥10GeV)
- jet 1. ≥150GeV
- SF-DF

$\tilde{l}_R - \tilde{\chi}_1^0 = 10GeV$ → $\tilde{l}_R \hookrightarrow l \tilde{\chi}_1^0$
↪ soft な分布になる

looseな条件で di-lepton をさがすこと

$\tilde{\chi}_2 \to \tilde{\tau}^{\pm}_{1,2} + \tau^{\mp}$ $\quad Br(\tilde{\chi}_2^0 \to \tilde{\tau}_1^{\pm} \tau^{\mp}) \sim 19\%$

↳ $\tau^{\pm} \tilde{\chi}_1^0$

↳ massの差 10 GeV (Soft τ-ID)

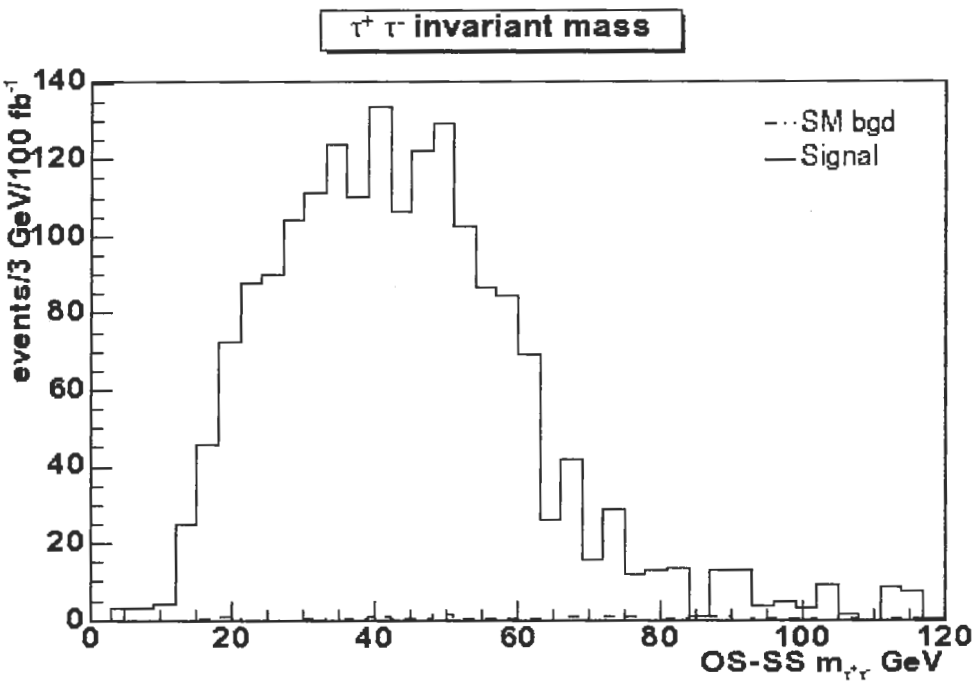
- $mE_T > 300$ GeV
- 1 tau $Pt > 40$ GeV　　2 tau $Pt \leq 25$ GeV

↓

fake tau を入れると BG が ふえる可.

$\tilde{\chi}_1^{\pm} \to \tau\nu$ も交かいている (+−) − (++)

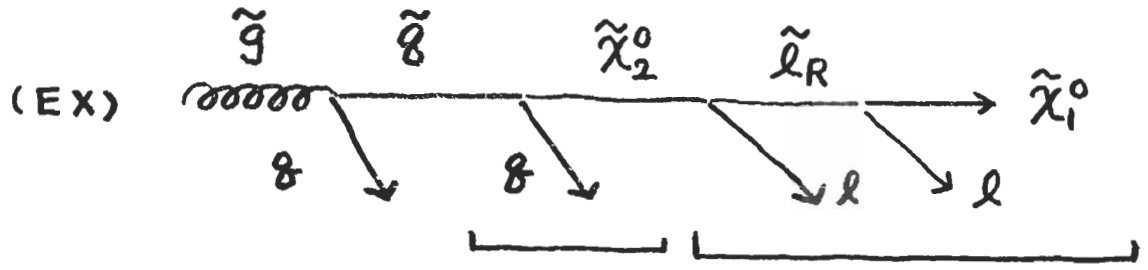
で引き算



"τ-ID"

2body-decay chain

最低3段連続する 2body-decayがある時



未知変数 4つ $\tilde{q}_L$ mass $\tilde{\chi}_2^0$ mass $\tilde{l}_R$ mass $\tilde{\chi}_1^0$ mass

4~5つの分布

↓

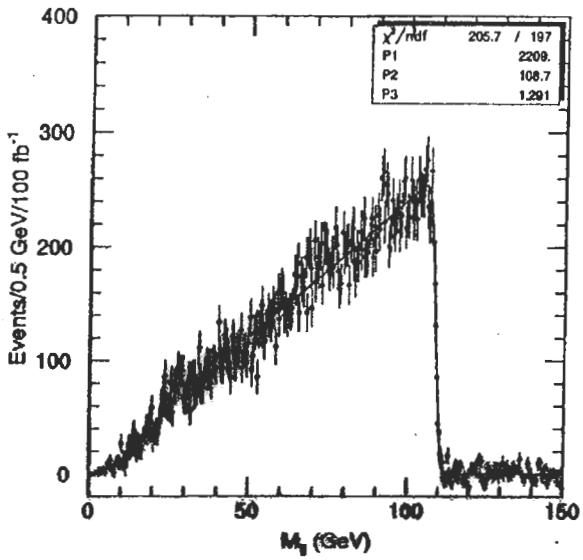
model independentに massを決めることが可能

例 $\tilde{g}, \tilde{q}$ ~700GeV

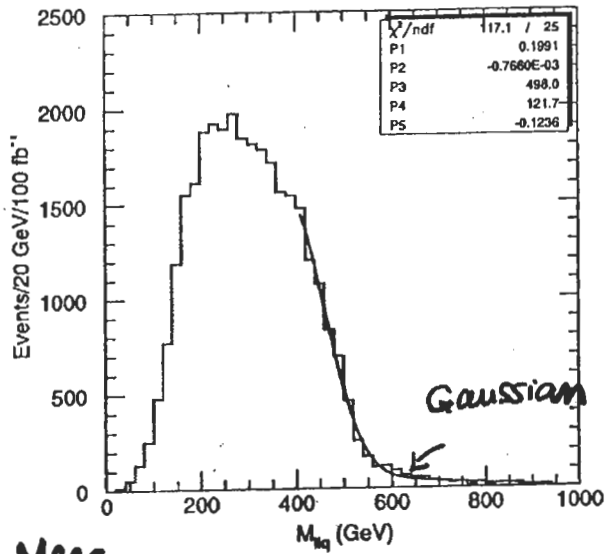
$m_{\tilde{q}}$ ~3% $m_{\tilde{\chi}_2^0}$ ~6%

$m_{\tilde{R}}$ ~9% $m_{\tilde{\chi}_1^0}$ ~12% の精度 $\int L = 100 fb^{-1}$

(図4.2)

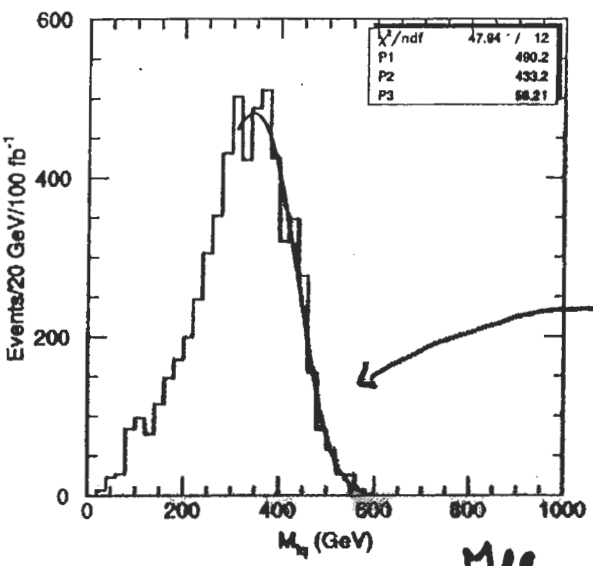


Mll



Mllq

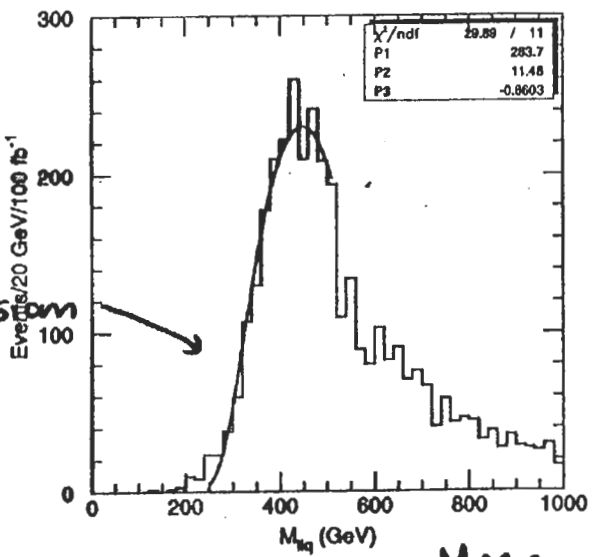
J1, J2のうち、qはllqがminになる様えらぶ



Mllq

qはJ1, J2のうち
llqがminになる様

lqのlはlqがmaxになる様



Gaussian

Mllq

qはJ1

resolutionをconvoluteしてedgeを出す.

[3] $\tilde{t}$の再構成 SU3

```
M_0,  M_(1/2),  A_0,  tan(beta),  sgn(mu),  M_t =
  100.000   300.000  -300.000     6.000     1.0   175.000

ISASUGRA unification:
M_GUT      = 0.212E+17   g_GUT          =0.712      alpha_GUT =0.040
FT_GUT     = 0.519       FB_GUT         = 0.030     FL_GUT = 0.041

1/alpha_em =  127.96     sin**2(thetaw) =0.2312     alpha_s   =0.118
M_1        =  120.74     M_2            =  232.38   M_3       =  686.47
mu(Q)      =  459.73     B(Q)           =   92.95   Q         =  524.45
M_H1^2     = 0.469E+05   M_H2^2         =-0.203E+06

ISAJET masses (with signs):
M(GL)  =   717.46
M(UL)  =   631.51   M(UR)  =   611.81   M(DL)  =   636.27   M(DR) =   610.69
M(B1)  =   575.23   M(B2)  =   610.74   M(T1)  =   424.12   M(T2) =   650.50
M(SN)  =   216.96   M(EL)  =   230.47   M(ER)  =   155.42
M(NTAU)=   216.29   M(TAU1)=   150.01   M(TAU2)=   232.15
M(Z1)  =  -117.91   M(Z2)  =  -218.61   M(Z3)  =   463.98   M(Z4) =  -480.57
M(W1)  =  -218.34   M(W2)  =  -480.13
M(HL)  =   114.82   M(HH)  =   512.56   M(HA)  =   511.53   M(H+) =   517.85

theta_t=   0.9951   theta_b=   0.2205   theta_l=   1.3858   alpha_h=   0.1766

NEUTRALINO MASSES (SIGNED) =  -117.912  -218.614   463.982  -480.568
EIGENVECTOR 1       =   0.04581  -0.11288  -0.04452   0.99155
EIGENVECTOR 2       =   0.13135  -0.22074  -0.96357  -0.07446
EIGENVECTOR 3       =  -0.70936  -0.70027   0.06712  -0.04393
EIGENVECTOR 4       =   0.69098  -0.66945   0.25502  -0.09668

CHARGINO MASSES (SIGNED)  =  -218.343  -480.134
GAMMAL, GAMMAR            =   1.89746   1.76397


ISAJET equivalent input:
MSSMA:   717.46  459.73  511.53    6.00
MSSMB:   633.65  610.20  612.81  225.84  149.47
MSSMC:   574.08  608.58  478.53  225.20  147.46 -637.56-1060.93 -484.50
MSSMD: SAME AS MSSMB (DEFAULT)
MSSME:   120.74  232.38


ISASUSY decay modes:
Parent --> daughters                  Width          Branching ratio

TP     -->  UP     DB     BT        0.40737E+00    0.33333E+00
TP     -->  CH     SB     BT        0.40737E+00    0.33333E+00
TP     -->  E+     NUE    BT        0.13579E+00    0.11111E+00
TP     -->  MU+    NUM    BT        0.13579E+00    0.11111E+00
TP     -->  TAU+   NUT    BT        0.13579E+00    0.11111E+00

GLSS   -->  W1SS+  BT     TB        0.22443E-02    0.15757E-03
GLSS   -->  W1SS-  TP     BB        0.22443E-02    0.15757E-03
GLSS   -->  Z1SS   TP     TB        0.40289E-03    0.28286E-04
GLSS   -->  Z2SS   TP     TB        0.89636E-03    0.62933E-04
GLSS   -->  Z3SS   GL               0.18495E-03    0.12985E-04
GLSS   -->  UBL    UP               0.43383E+00    0.30458E-01
GLSS   -->  UPL    UB               0.43383E+00    0.30458E-01
GLSS   -->  DBL    DN               0.38981E+00    0.27368E-01
GLSS   -->  DNL    DB               0.38981E+00    0.27368E-01
GLSS   -->  UBR    UP               0.63641E+00    0.44682E-01
GLSS   -->  UPR    UB               0.63641E+00    0.44682E-01
GLSS   -->  DBR    DN               0.64888E+00    0.45557E-01
GLSS   -->  DNR    DB               0.64888E+00    0.45557E-01
GLSS   -->  SBL    ST               0.38981E+00    0.27368E-01
GLSS   -->  STL    SB               0.38981E+00    0.27368E-01
GLSS   -->  SBR    ST               0.64888E+00    0.45557E-01
GLSS   -->  STR    SB               0.64888E+00    0.45557E-01
GLSS   -->  CBL    CH               0.43376E+00    0.30454E-01
GLSS   -->  CHL    CB               0.43376E+00    0.30454E-01
GLSS   -->  CBR    CH               0.63635E+00    0.44677E-01
GLSS   -->  CHR    CB               0.63635E+00    0.44677E-01
GLSS   -->  BB1    BT               0.10722E+01    0.75281E-01
GLSS   -->  BT1    BB               0.10722E+01    0.75281E-01
GLSS   -->  BB2    BT               0.66182E+00    0.46465E-01
GLSS   -->  BT2    BB               0.66182E+00    0.46465E-01
GLSS   -->  TB1    TP               0.11668E+01    0.81922E-01
GLSS   -->  TP1    TB               0.11668E+01    0.81922E-01

UPL    -->  Z1SS   UP               0.46530E-01    0.76961E-02
UPL    -->  Z2SS   UP               0.19665E+01    0.32526E+00
```

$\tilde{g} \to q\bar{q}\tilde{\chi}_{(L,R)}$ ~ 6% × 4

$\tilde{g} \to b\bar{b}_1$ 14%

$\tilde{g} \to t\bar{t}_1$ 16%

NC

SUSY

10-15

UPL	-->	Z3SS	UP		0.19665E-02	0.32526E-03
UPL	-->	Z4SS	UP		0.26538E-01	0.43895E-02
UPL	-->	W1SS+	DN		0.39695E+01	0.65655E+00
UPL	-->	W2SS+	DN		0.34905E-01	0.57732E-02
DNL	-->	Z1SS	DN		0.12782E+00	0.21703E-01
DNL	-->	Z2SS	DN		0.18797E+01	0.31916E+00
DNL	-->	Z3SS	DN		0.33216E-02	0.56398E-03
DNL	-->	Z4SS	DN		0.36782E-01	0.62452E-02
DNL	-->	W1SS-	UP		0.37397E+01	0.63496E+00
DNL	-->	W2SS-	UP		0.10232E+00	0.17374E-01
STL	-->	Z1SS	ST		0.12782E+00	0.21703E-01
STL	-->	Z2SS	ST		0.18797E+01	0.31916E+00
STL	-->	Z3SS	ST		0.33216E-02	0.56398E-03
STL	-->	Z4SS	ST		0.36782E-01	0.62453E-02
STL	-->	W1SS-	CH		0.37396E+01	0.63496E+00
STL	-->	W2SS-	CH		0.10232E+00	0.17373E-01
CHL	-->	Z1SS	CH		0.46529E-01	0.76960E-02
CHL	-->	Z2SS	CH		0.19665E+01	0.32526E+00
CHL	-->	Z3SS	CH		0.19664E-02	0.32525E-03
CHL	-->	Z4SS	CH		0.26537E-01	0.43893E-02
CHL	-->	W1SS+	ST		0.39695E+01	0.65656E+00
CHL	-->	W2SS+	ST		0.34905E-01	0.57733E-02
BT1	-->	Z1SS	BT		0.13412E+00	0.22864E-01
BT1	-->	Z2SS	BT		0.15522E+01	0.26460E+00
BT1	-->	Z3SS	BT		0.46673E-02	0.79564E-03
BT1	-->	Z4SS	BT		0.15893E-01	0.27093E-02
BT1	-->	W1SS-	TP		0.21287E+01	0.36288E+00
BT1	-->	W-	TP1		0.20306E+01	0.34615E+00
TP1	-->	Z1SS	TP		0.41726E+00	0.24545E+00
TP1	-->	Z2SS	TP		0.17273E+00	0.10161E+00
TP1	-->	W1SS+	BT		0.11100E+01	0.65294E+00
UPR	-->	Z1SS	UP		0.12606E+01	0.99351E+00
UPR	-->	Z2SS	UP		0.58489E-02	0.46096E-02
UPR	-->	Z3SS	UP		0.48244E-03	0.38022E-03
UPR	-->	Z4SS	UP		0.18978E-02	0.14957E-02
DNR	-->	Z1SS	DN		0.31449E+00	0.99354E+00
DNR	-->	Z2SS	DN		0.14580E-02	0.46061E-02
DNR	-->	Z3SS	DN		0.11919E-03	0.37656E-03
DNR	-->	Z4SS	DN		0.46798E-03	0.14785E-02
STR	-->	Z1SS	ST		0.31449E+00	0.99354E+00
STR	-->	Z2SS	ST		0.14580E-02	0.46061E-02
STR	-->	Z3SS	ST		0.11919E-03	0.37656E-03
STR	-->	Z4SS	ST		0.46798E-03	0.14785E-02
CHR	-->	Z1SS	CH		0.12606E+01	0.99351E+00
CHR	-->	Z2SS	CH		0.58489E-02	0.46096E-02
CHR	-->	Z3SS	CH		0.48242E-03	0.38020E-03
CHR	-->	Z4SS	CH		0.18977E-02	0.14956E-02
BT2	-->	Z1SS	BT		0.29430E+00	0.43817E+00
BT2	-->	Z2SS	BT		0.58028E-01	0.86396E-01
BT2	-->	Z3SS	BT		0.95456E-02	0.14212E-01
BT2	-->	Z4SS	BT		0.13265E-01	0.19749E-01
BT2	-->	W1SS-	TP		0.81563E-01	0.12144E+00
BT2	-->	W-	TP1		0.21495E+00	0.32003E+00
TP2	-->	W1SS+	BT		0.19827E+01	0.26583E+00
TP2	-->	W2SS+	BT		0.94686E+00	0.12695E+00
TP2	-->	Z0	TP1		0.27277E+01	0.36571E+00
TP2	-->	HL0	TP1		0.68778E+00	0.92214E-01
TP2	-->	Z1SS	TP		0.25664E+00	0.34409E-01
TP2	-->	Z2SS	TP		0.79250E+00	0.10626E+00
TP2	-->	Z3SS	TP		0.64385E-01	0.86324E-02
EL-	-->	Z1SS	E-		0.13237E+00	0.82487E+00
EL-	-->	Z2SS	E-		0.98336E-02	0.61277E-01
EL-	-->	W1SS-	NUE		0.18271E-01	0.11385E+00
MUL-	-->	Z1SS	MU-		0.13237E+00	0.82487E+00
MUL-	-->	Z2SS	MU-		0.98333E-02	0.61274E-01
MUL-	-->	W1SS-	NUM		0.18271E-01	0.11385E+00
TAU1-	-->	Z1SS	TAU-		0.10738E+00	0.10000E+01
NUEL	-->	Z1SS	NUE		0.15761E+00	0.99997E+00
NUEL	-->	TAU1+	E-	NUT	0.46002E-05	0.29187E-04
NUML	-->	Z1SS	NUM		0.15761E+00	0.99997E+00
NUML	-->	TAU1+	MU-	NUT	0.46002E-05	0.29187E-04
NUTL	-->	Z1SS	NUT		0.15631E+00	0.99922E+00
NUTL	-->	TAU1-	NUT	TAU+	0.14524E-04	0.92842E-04
NUTL	-->	TAU1-	NUE	E+	0.13429E-04	0.85841E-04

$\tilde{u}_L \to \tilde{\chi} d_L$ (60%) CC

$\tilde{d}_L \to \tilde{\chi}_2 d$ NC

$\leftarrow d_L \to \tilde{\chi} u$ (60%) CC

30% $\tilde{b}_1^{(L)} \to \tilde{\chi}_2^0 b$

70% $\tilde{b}_1 \to \tilde{t} W$, $t \tilde{W}$

70% $\tilde{t}_1 \to b \tilde{\chi}_1^+$ (CC)

NO.
SUSY
10-16

NUTL	-->	TAU1-	NUM	MU+	0.13429E-04	0.85841E-04
NUTL	-->	TAU1-	UP	DB	0.40286E-04	0.25752E-03
NUTL	-->	TAU1-	CH	SB	0.40286E-04	0.25752E-03
ER-	-->	Z1SS	E-		0.14020E+00	0.10000E+01
MUR-	-->	Z1SS	MU-		0.14020E+00	0.10000E+01
TAU2-	-->	Z1SS	TAU-		0.14914E+00	0.81305E+00
TAU2-	-->	Z2SS	TAU-		0.11906E-01	0.64904E-01
TAU2-	-->	W1SS-	NUT		0.22386E-01	0.12204E+00
Z2SS	-->	Z1SS	Z0		0.43930E-03	0.25580E-01
Z2SS	-->	Z1SS	E-	E+	0.22158E-04	0.12903E-02
Z2SS	-->	Z1SS	MU-	MU+	0.22158E-04	0.12903E-02
Z2SS	-->	Z1SS	TAU-	TAU+	0.20556E-04	0.11970E-02
Z2SS	-->	ER-	E+		0.75490E-03	0.43957E-01
Z2SS	-->	ER+	E-		0.75490E-03	0.43957E-01
Z2SS	-->	MUR-	MU+		0.75490E-03	0.43957E-01
Z2SS	-->	MUR+	MU-		0.75490E-03	0.43957E-01
Z2SS	-->	TAU1-	TAU+		0.64769E-02	0.37715E+00
Z2SS	-->	TAU1+	TAU-		0.64769E-02	0.37715E+00
Z2SS	-->	NUEL	ANUE		0.87750E-04	0.51096E-02
Z2SS	-->	ANUEL	NUE		0.87750E-04	0.51096E-02
Z2SS	-->	NUML	ANUM		0.87750E-04	0.51096E-02
Z2SS	-->	ANUML	NUM		0.87750E-04	0.51096E-02
Z2SS	-->	NUTL	ANUT		0.17242E-03	0.10040E-01
Z2SS	-->	ANUTL	NUT		0.17242E-03	0.10040E-01
Z3SS	-->	W1SS+	W-		0.96517E+00	0.30285E+00
Z3SS	-->	W1SS-	W+		0.96517E+00	0.30285E+00
Z3SS	-->	Z1SS	Z0		0.31233E+00	0.98003E-01
Z3SS	-->	Z2SS	Z0		0.78266E+00	0.24558E+00
Z3SS	-->	Z1SS	HL0		0.49808E-01	0.15629E-01
Z3SS	-->	Z2SS	HL0		0.43119E-01	0.13530E-01
Z3SS	-->	EL-	E+		0.10245E-02	0.32148E-03
Z3SS	-->	EL+	E-		0.10245E-02	0.32148E-03
Z3SS	-->	MUL-	MU+		0.10245E-02	0.32148E-03
Z3SS	-->	MUL+	MU-		0.10245E-02	0.32148E-03
Z3SS	-->	ER-	E+		0.17971E-02	0.56388E-03
Z3SS	-->	ER+	E-		0.17971E-02	0.56388E-03
Z3SS	-->	MUR-	MU+		0.17971E-02	0.56388E-03
Z3SS	-->	MUR+	MU-		0.17971E-02	0.56388E-03
Z3SS	-->	TAU1-	TAU+		0.62363E-02	0.19568E-02
Z3SS	-->	TAU1+	TAU-		0.62363E-02	0.19568E-02
Z3SS	-->	TAU2-	TAU+		0.75387E-02	0.23655E-02
Z3SS	-->	TAU2+	TAU-		0.75387E-02	0.23655E-02
Z3SS	-->	NUEL	ANUE		0.49719E-02	0.15601E-02
Z3SS	-->	ANUEL	NUE		0.49719E-02	0.15601E-02
Z3SS	-->	NUML	ANUM		0.49719E-02	0.15601E-02
Z3SS	-->	ANUML	NUM		0.49719E-02	0.15601E-02
Z3SS	-->	NUTL	ANUT		0.49889E-02	0.15654E-02
Z3SS	-->	ANUTL	NUT		0.49889E-02	0.15654E-02
Z4SS	-->	W1SS+	W-		0.10645E+01	0.28031E+00
Z4SS	-->	W1SS-	W+		0.10645E+01	0.28031E+00
Z4SS	-->	Z1SS	Z0		0.61730E-01	0.16256E-01
Z4SS	-->	Z2SS	Z0		0.67413E-01	0.17752E-01
Z4SS	-->	Z1SS	HL0		0.26809E+00	0.70598E-01
Z4SS	-->	Z2SS	HL0		0.68578E+00	0.18059E+00
Z4SS	-->	EL-	E+		0.24469E-01	0.64436E-02
Z4SS	-->	EL+	E-		0.24469E-01	0.64436E-02
Z4SS	-->	MUL-	MU+		0.24469E-01	0.64436E-02
Z4SS	-->	MUL+	MU-		0.24469E-01	0.64436E-02
Z4SS	-->	ER-	E+		0.91675E-02	0.24141E-02
Z4SS	-->	ER+	E-		0.91675E-02	0.24141E-02
Z4SS	-->	MUR-	MU+		0.91675E-02	0.24141E-02
Z4SS	-->	MUR+	MU-		0.91675E-02	0.24141E-02
Z4SS	-->	TAU1-	TAU+		0.84341E-02	0.22210E-02
Z4SS	-->	TAU1+	TAU-		0.84341E-02	0.22210E-02
Z4SS	-->	TAU2-	TAU+		0.34007E-01	0.89553E-02
Z4SS	-->	TAU2+	TAU-		0.34007E-01	0.89553E-02
Z4SS	-->	NUEL	ANUE		0.60949E-01	0.16050E-01
Z4SS	-->	ANUEL	NUE		0.60949E-01	0.16050E-01
Z4SS	-->	NUML	ANUM		0.60949E-01	0.16050E-01
Z4SS	-->	ANUML	NUM		0.60949E-01	0.16050E-01
Z4SS	-->	NUTL	ANUT		0.61140E-01	0.16100E-01
Z4SS	-->	ANUTL	NUT		0.61140E-01	0.16100E-01
W1SS+	-->	Z1SS	E+	NUE	0.14491E-04	0.92636E-03
W1SS+	-->	Z1SS	MU+	NUM	0.14491E-04	0.92636E-03
W1SS+	-->	Z1SS	TAU+	NUT	0.14060E-04	0.89880E-03
W1SS+	-->	Z1SS	W+		0.45211E-02	0.28902E+00
W1SS+	-->	NUEL	E+		0.13864E-03	0.88630E-02
W1SS+	-->	NUML	MU+		0.13824E-03	0.88371E-02
W1SS+	-->	NUTL	TAU+		0.15674E-03	0.10020E-01
W1SS+	-->	TAU1+	NUT		0.10645E-01	0.68051E+00
W2SS+	-->	Z1SS	W+		0.25142E+00	0.62434E-01
W2SS+	-->	Z2SS	W+		0.11318E+01	0.28106E+00
W2SS+	-->	TP1	BB		0.31488E+00	0.78191E-01

$\tilde{\chi}_2^0 \to e\tilde{e}/\mu\tilde{\mu}$ 10%
$\tilde{\chi}_2^0 \to \tau\tilde{\tau}$ 70%

$\tilde{\chi}_3^0 \to W^{\pm}\tilde{W}^{\mp}$

↓

HWWの結合

$\tilde{\chi}_4^0 \to W^{\pm}\tilde{W}^{\mp}$

NO.
SUSY
10-17

W2SS+	-->	NUEL	E+		0.47218E-01	0.11725E-01
W2SS+	-->	NUML	MU+		0.47218E-01	0.11725E-01
W2SS+	-->	NUTL	TAU+		0.57147E-01	0.14191E-01
W2SS+	-->	EL+	NUE		0.12340E+00	0.30642E-01
W2SS+	-->	MUL+	NUM		0.12340E+00	0.30642E-01
W2SS+	-->	TAU1+	NUT		0.13398E-02	0.33271E-03
W2SS+	-->	TAU2+	NUT		0.13075E+00	0.32467E-01
W2SS+	-->	W1SS+	Z0		0.10021E+01	0.24885E+00
W2SS+	-->	W1SS+	HL0		0.79631E+00	0.19774E+00
HL0	-->	MU-	MU+		0.95108E-06	0.17560E-03
HL0	-->	TAU-	TAU+		0.27201E-03	0.50224E-01
HL0	-->	ST	SB		0.11424E-04	0.21092E-02
HL0	-->	BT	BB		0.45180E-02	0.83419E+00
HL0	-->	CH	CB		0.19817E-03	0.36590E-01
HL0	-->	GM	GM		0.73791E-05	0.13624E-02
HL0	-->	GL	GL		0.16089E-03	0.29707E-01
HL0	-->	W+	E-	ANUE	0.12862E-04	0.23748E-02
HL0	-->	W+	MU-	ANUM	0.12862E-04	0.23748E-02
HL0	-->	W+	TAU-	ANUT	0.12862E-04	0.23748E-02
HL0	-->	W+	UB	DN	0.38586E-04	0.71243E-02
HL0	-->	W+	CB	ST	0.38586E-04	0.71243E-02
HL0	-->	W-	E+	NUE	0.12862E-04	0.23748E-02
HL0	-->	W-	MU+	NUM	0.12862E-04	0.23748E-02
HL0	-->	W-	TAU+	NUT	0.12862E-04	0.23748E-02
HL0	-->	W-	UP	DB	0.38586E-04	0.71243E-02
HL0	-->	W-	CH	SB	0.38586E-04	0.71243E-02
HL0	-->	Z0	NUE	ANUE	0.10730E-05	0.19811E-03
HL0	-->	Z0	NUM	ANUM	0.10730E-05	0.19811E-03
HL0	-->	Z0	NUT	ANUT	0.10730E-05	0.19811E-03
HL0	-->	Z0	E-	E+	0.54001E-06	0.99705E-04
HL0	-->	Z0	MU-	MU+	0.54001E-06	0.99705E-04
HL0	-->	Z0	TAU-	TAU+	0.54001E-06	0.99705E-04
HL0	-->	Z0	UP	UB	0.18500E-05	0.34158E-03
HL0	-->	Z0	CH	CB	0.18500E-05	0.34158E-03
HL0	-->	Z0	DN	DB	0.23833E-05	0.44004E-03
HL0	-->	Z0	ST	SB	0.23833E-05	0.44004E-03
HL0	-->	Z0	BT	BB	0.23833E-05	0.44004E-03
HH0	-->	MU-	MU+		0.13335E-03	0.11364E-03
HH0	-->	TAU-	TAU+		0.38191E-01	0.32546E-01
HH0	-->	ST	SB		0.15726E-02	0.13402E-02
HH0	-->	BT	BB		0.50855E+00	0.43338E+00
HH0	-->	CH	CB		0.22513E-04	0.19185E-04
HH0	-->	TP	TB		0.46141E+00	0.39321E+00
HH0	-->	GL	GL		0.77619E-03	0.66146E-03
HH0	-->	W+	W-		0.50427E-02	0.42973E-02
HH0	-->	Z0	Z0		0.24269E-02	0.20681E-02
HH0	-->	Z1SS	Z1SS		0.11179E-01	0.95267E-02
HH0	-->	Z1SS	Z2SS		0.40008E-01	0.34095E-01
HH0	-->	Z2SS	Z2SS		0.19825E-01	0.16894E-01
HH0	-->	W1SS+	W1SS-		0.48218E-01	0.41091E-01
HH0	-->	HL0	HL0		0.72802E-02	0.62041E-02
HH0	-->	EL-	EL+		0.63022E-03	0.53706E-03
HH0	-->	ER-	ER+		0.85643E-03	0.72984E-03
HH0	-->	MUL-	MUL+		0.63011E-03	0.53697E-03
HH0	-->	MUR-	MUR+		0.85626E-03	0.72969E-03
HH0	-->	TAU1-	TAU1+		0.41151E-02	0.35068E-02
HH0	-->	TAU1-	TAU2+		0.68530E-02	0.58400E-02
HH0	-->	TAU2-	TAU1+		0.68530E-02	0.58400E-02
HH0	-->	NUEL	ANUEL		0.26663E-02	0.22722E-02
HH0	-->	NUML	ANUML		0.26663E-02	0.22722E-02
HH0	-->	NUTL	ANUTL		0.26868E-02	0.22896E-02
HA0	-->	MU-	MU+		0.13353E-03	0.84271E-04
HA0	-->	TAU-	TAU+		0.38245E-01	0.24136E-01
HA0	-->	ST	SB		0.15748E-02	0.99385E-03
HA0	-->	BT	BB		0.50952E+00	0.32155E+00
HA0	-->	CH	CB		0.19666E-04	0.12411E-04
HA0	-->	TP	TB		0.71943E+00	0.45403E+00
HA0	-->	GL	GL		0.64192E-03	0.40511E-03
HA0	-->	Z1SS	Z1SS		0.18793E-01	0.11860E-01
HA0	-->	Z1SS	Z2SS		0.96210E-01	0.60717E-01
HA0	-->	Z2SS	Z2SS		0.10909E+00	0.68844E-01
HA0	-->	W1SS+	W1SS-		0.70637E-01	0.44578E-01
HA0	-->	HL0	Z0		0.44363E-02	0.27997E-02
HA0	-->	TAU1-	TAU1+		0.12868E-02	0.81206E-03
HA0	-->	TAU2-	TAU2+		0.66650E-03	0.42062E-03
HA0	-->	TAU1-	TAU2+		0.69350E-02	0.43766E-02
HA0	-->	TAU2-	TAU1+		0.69350E-02	0.43766E-02
H+	-->	NUM	MU+		0.13526E-03	0.11311E-03
H+	-->	NUT	TAU+		0.38740E-01	0.32396E-01
H+	-->	CH	SB		0.14757E-02	0.12340E-02
H+	-->	TP	BB		0.99972E+00	0.83601E+00
H+	-->	W1SS+	Z1SS		0.12469E+00	0.10427E+00
H+	-->	W1SS+	Z2SS		0.56470E-03	0.47223E-03
H+	-->	HL0	W+		0.47541E-02	0.39756E-02
H+	-->	EL+	NUEL		0.27575E-02	0.23059E-02
H+	-->	MUL+	NUML		0.27573E-02	0.23058E-02
H+	-->	TAU1+	NUTL		0.19277E-01	0.16121E-01