RARE TOP QUARK DECAYS BEYOND THE SM

J. Guasch
ITP, Karlsruhe

- $BR(t \to b H^+)$
- $\Gamma(t \to \tilde{t} \chi^0)$

$BR(t \to b H^+)$

- MSSM
- QCD and SUSY 1-loop corr.
- Constraints:

  $\Delta\rho < 10^{-3}$ $\quad M_{SUSY^+} > 100\ GeV$

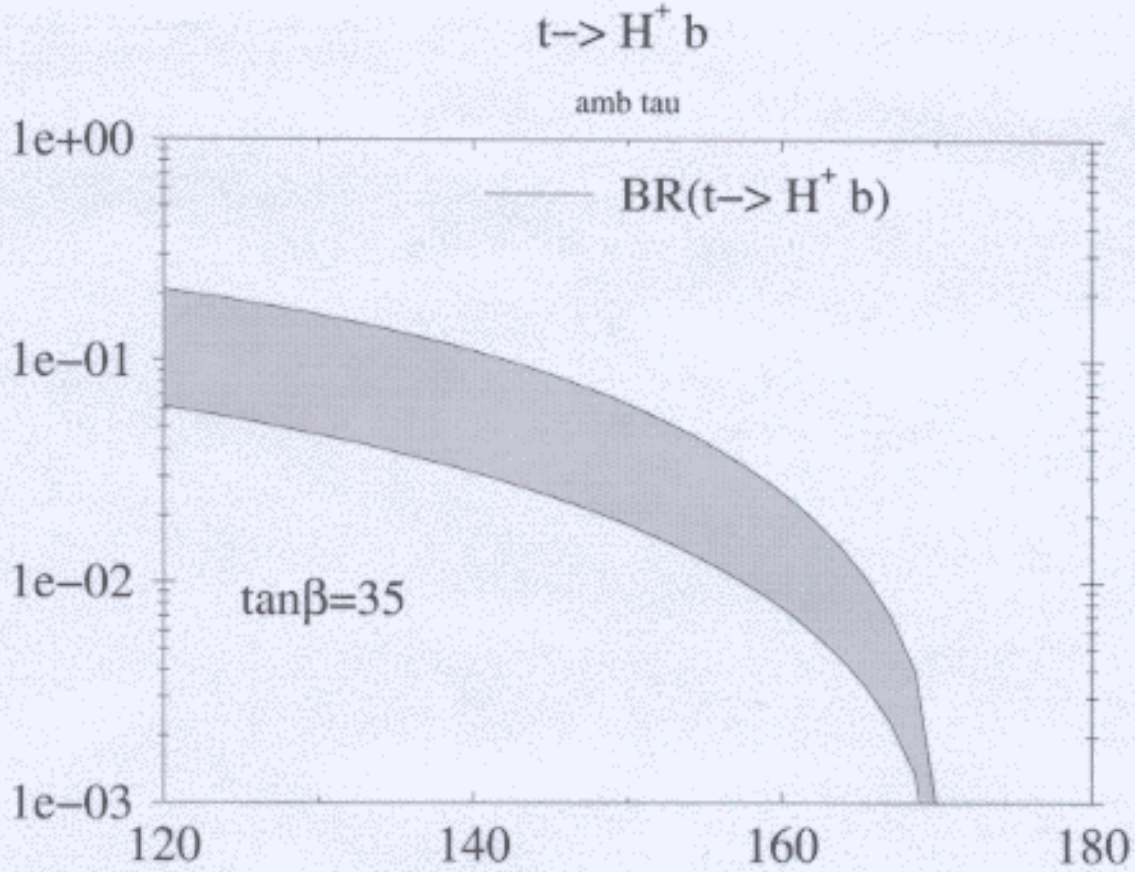
  $M_{A^0} > 90\ GeV$ $\quad \mu A_t < 0$ $\quad (b \to s\gamma)$

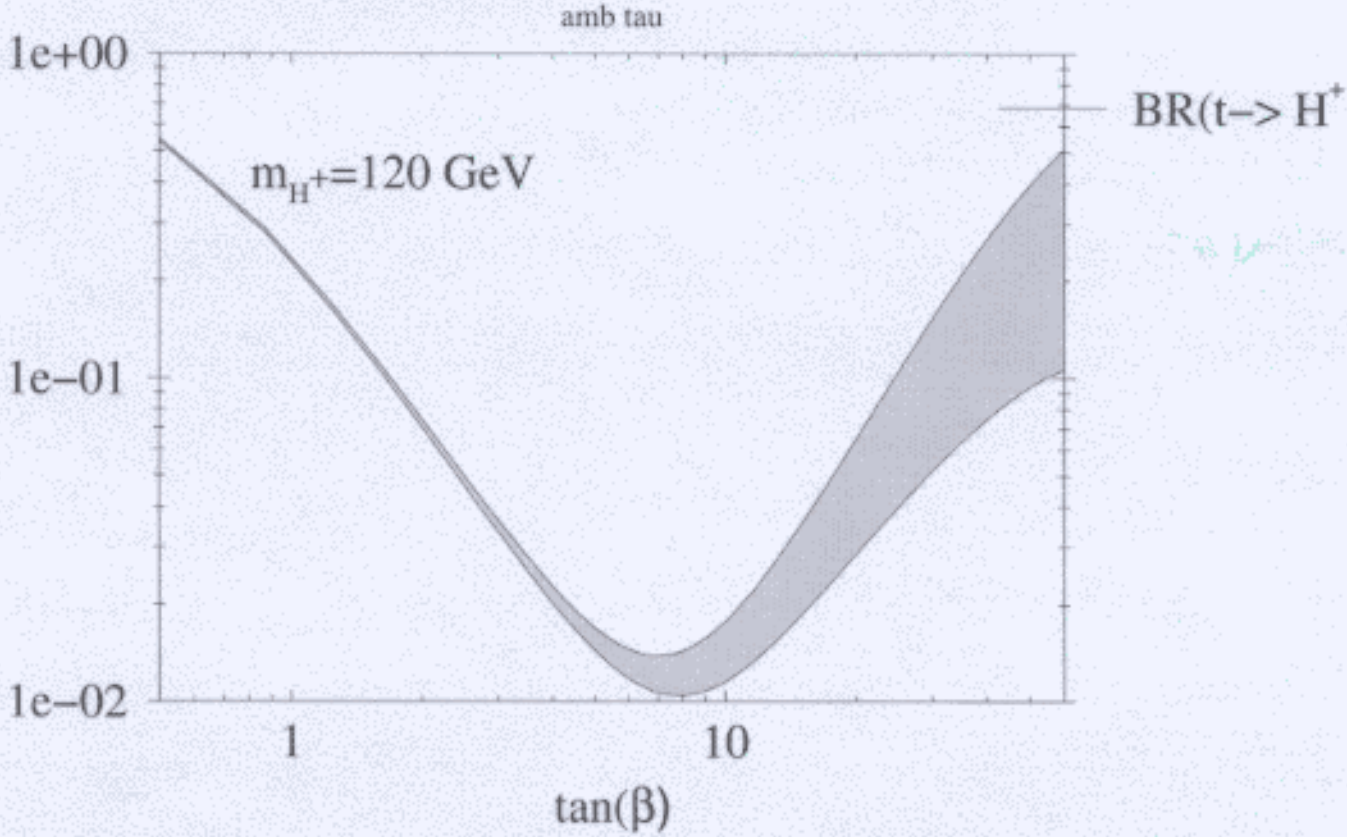
- Parameters:

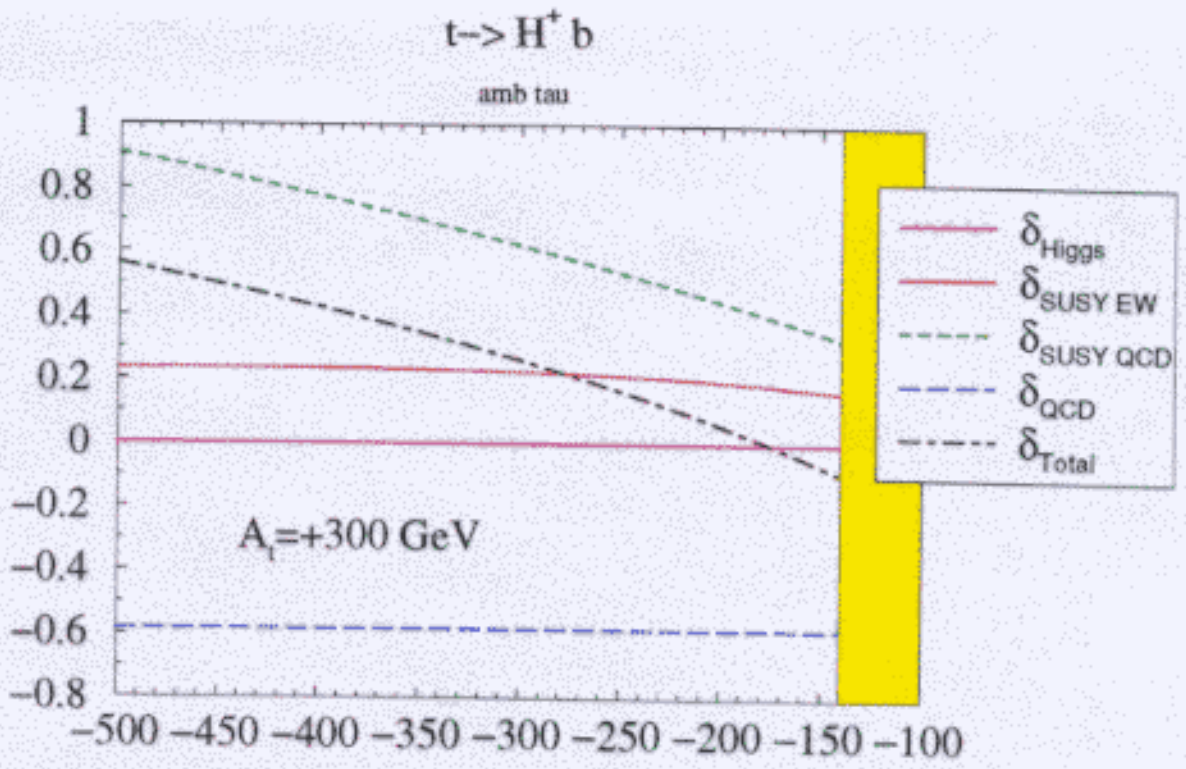
  $\tan\beta = 35$ $\quad M_{H^+} = 120\ GeV$

  $\mu = \pm 150\ GeV$ $\quad A_t = -\ Sign(\mu)\ 300\ GeV$

  $m_{\tilde{t}} = 150\ GeV$ $\quad m_{\tilde{q}} \simeq 300\ GeV$

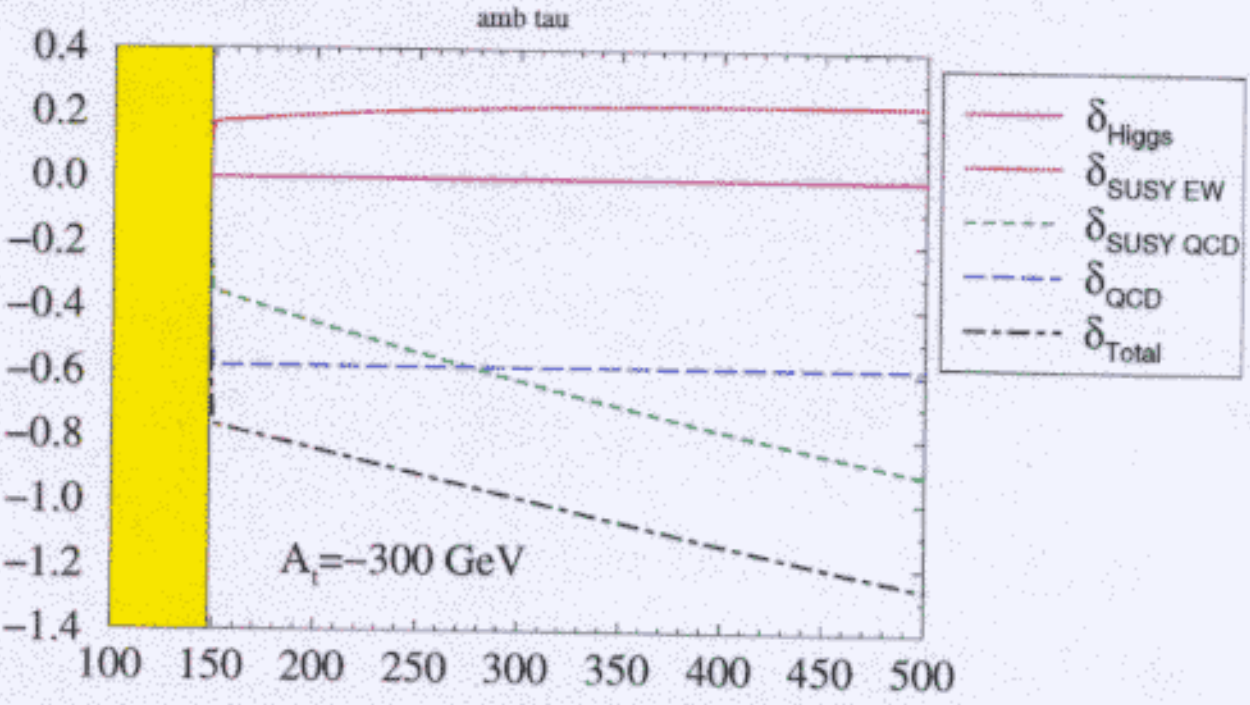

t–> H+ b
amb tau
1e+00
1e–01
1e–02
1e–03
BR(t–> H+ b)
tanβ=35
120
140
160
180
mH+


t–> H+ b
amb tau
1e+00
1e–01
1e–02
BR(t–> H+
mH+=120 GeV
1
10
tan(β)



OUTPUTFILENAME = 'mu_____', MT = 175.0000 , MB = 4.70 , DETALL = 1, TAU = 1, PROCES = 1, MASASLOOP = 1,
TB = 35.0 , MHPLUS = 120.0000 ,

MSB_ENTRY = 300.0000 , AB = 300.0000 , MU = 500.0000 , M = 150.0000 , ESCALA = 1.00 , MST_ENTRY = 150.0000 ,
AT = 300.0000 , MSUP_ENTRY = 300.0000 , MSNEUT_ENTRY = 300.0000 , MG = 300.0000 ,
SQ = 1, STB = 1, SL = 1, CN = 1, HIGGS = 1, SQCD = 1, QCD = 1, EBOD = 1,
TRIA = 2, XINICIAL = −500.0000 , XFINAL = 500.0000 , N_X = 200, ATAU = 300.0000 , AUP = 300.0000



OUTPUTFILENAME = 'mu_____', MT = 175.0000 , MB = 4.70 , DETALL = 1, TAU = 1, PROCES = 1, MASASLOOP = 1,

TB = 35.0 , MHPLUS = 120.0000 ,
MSB_ENTRY = 300.0000 , AB = 300.0000 , MU = 500.0000 , M = 150.0000 , ESCALA = 1.00 , MST_ENTRY = 150.0000 ,
AT = −300.0000 , MSUP_ENTRY = 300.0000 , MSNEUT_ENTRY = 300.0000 , MG = 300.0000 ,
SQ = 1, STB = 1, SL = 1, CN = 1, HIGGS = 1, SQCD = 1, QCD = 1, EBOD = 1,
TRIA = 2, XINICIAL = −500.0000 , XFINAL = 500.0000 , N_X = 200, ATAU = 300.0000 , AUP = 300.0000

- Large and non-decoupling

1-loop corrections

- Resumation can be done:

M. Carena et al. NPB 577, 88 hep-ph/9912516

$$\Gamma \sim m_b (1 + \delta_{QCD} + \delta_{SUSY}) \longrightarrow \frac{m_b(Q)}{1 - \delta_{SUSY}}$$

e.g. ($\mu > 0$) $\delta_{QCD} = -60\%$, $\delta_{SUSY} = -50\%$

$\rightarrow \delta\Gamma = -70\%$

To do:

- Put resumation in Plot (easy)

- Put limits on M_{H^+} from $t \to H^+ b$ @ Tevatron (cut on large BR)
  $BR \lesssim 20\%$

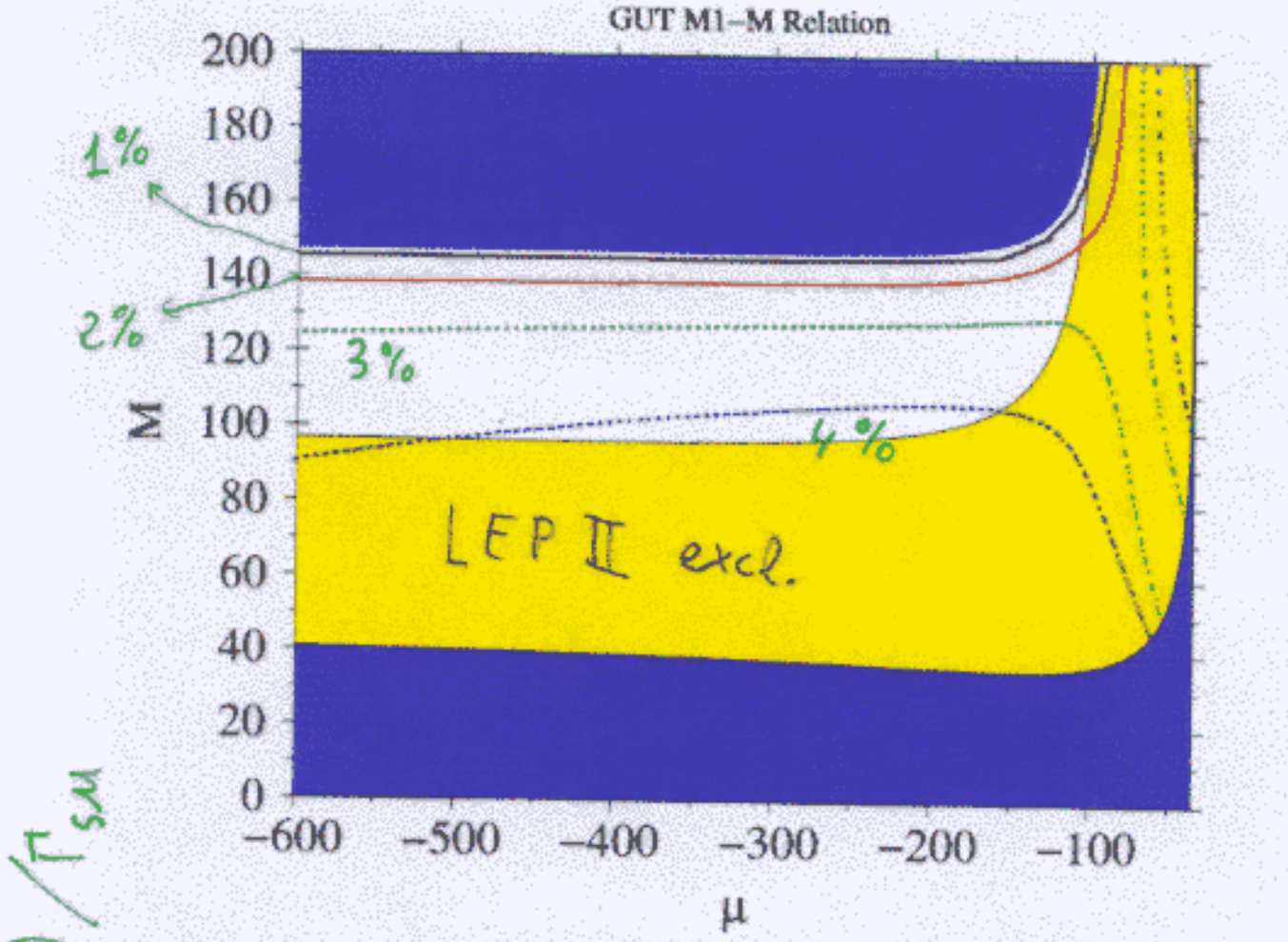
a) - BR vs. M_{H^+} ($\tan\beta$ fixed)

- BR vs. $\tan\beta$ (M_{H^+} fixed)

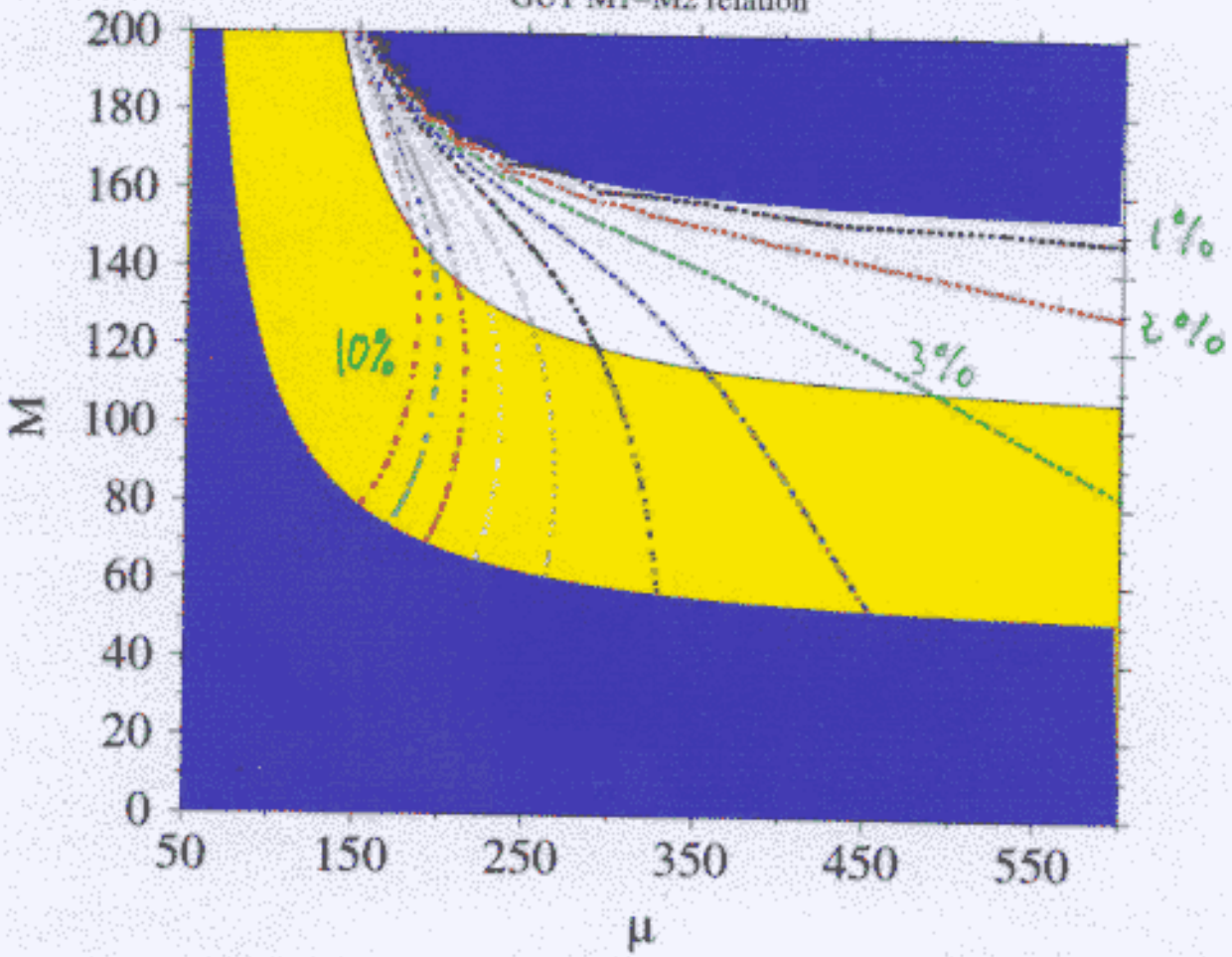
1.- Min and Max (band too broad)

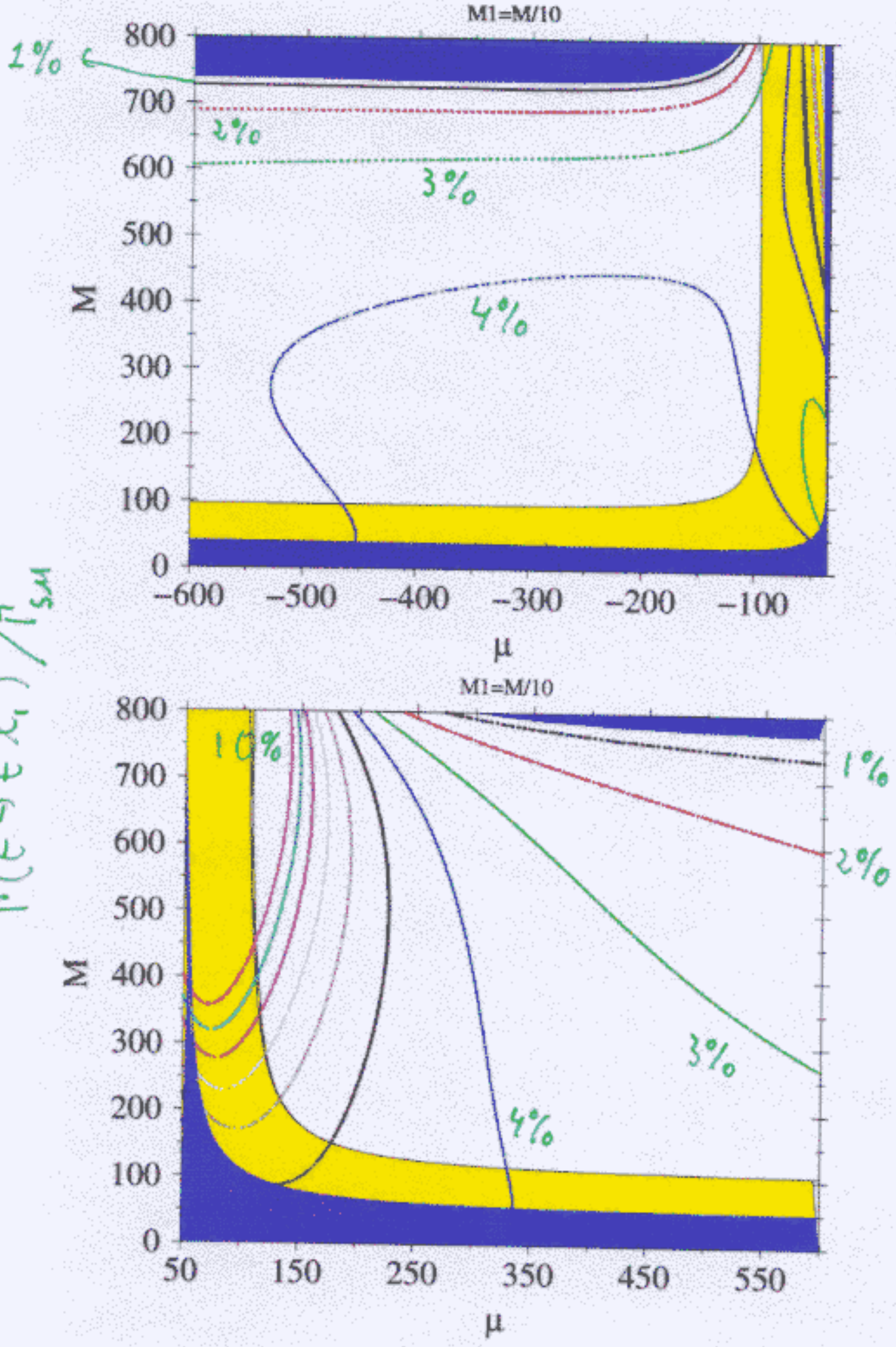
2.- Typical parameters

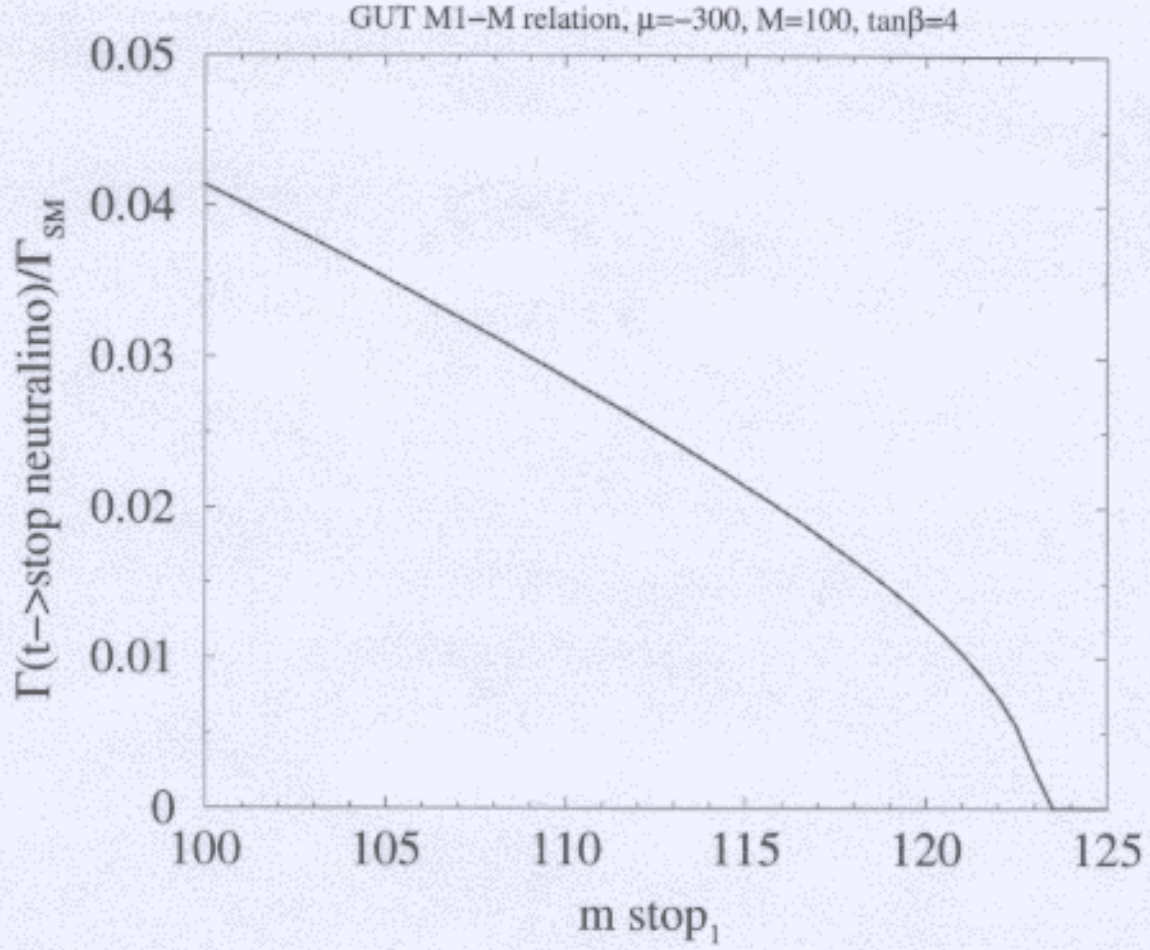
- 2HDM ($b \to s\gamma$: $M_{H^+} > 150$ GeV (?))

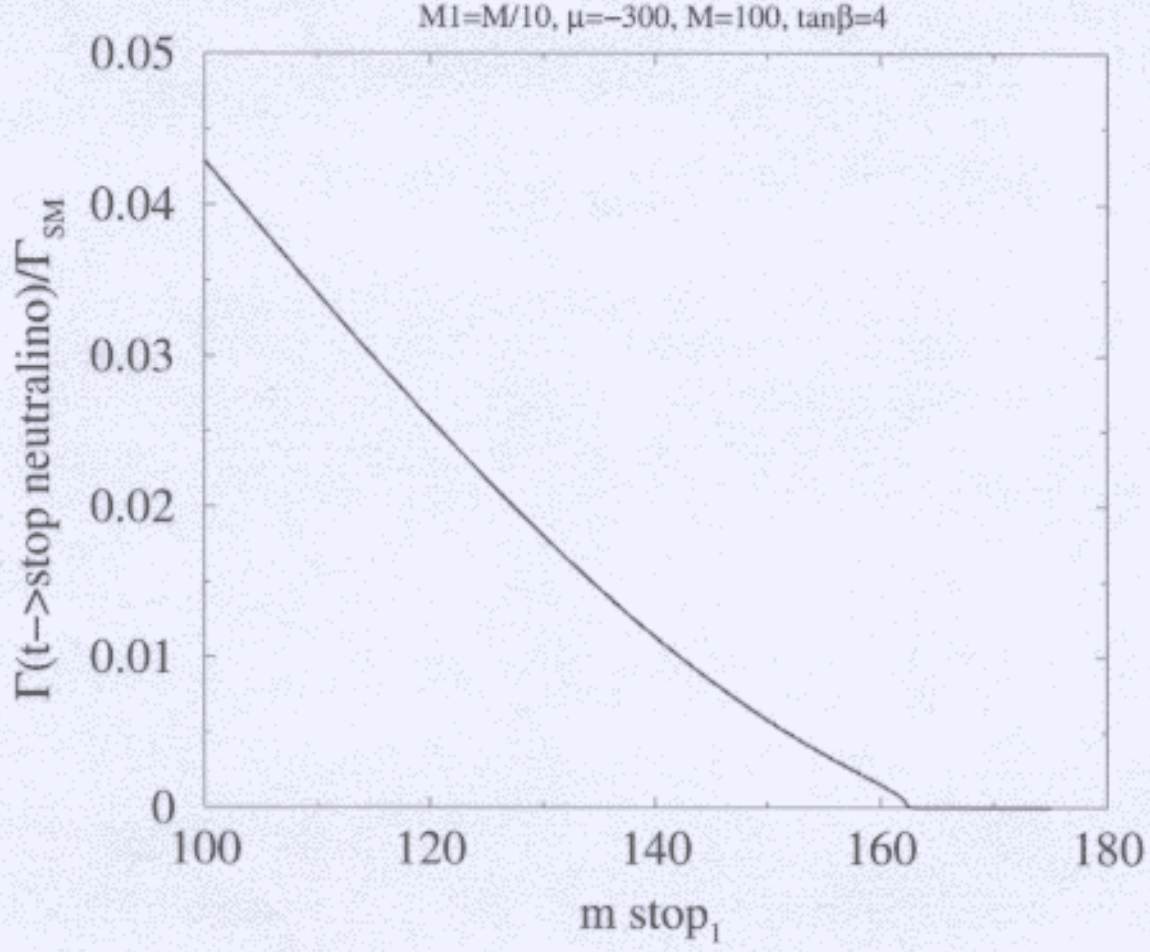


$\Gamma(\tilde{e}_R \to e \chi_1^0)/\Gamma_{SM}$




M1=M/10
1%
2%
3%
4%
M
μ
800
700
600
500
400
300
200
100
0
-600
-500
-400
-300
-200
-100
M1=M/10
10%
1%
2%
3%
4%
M
μ
50
150
250
350
450
550


GUT M1−M relation, μ=−300, M=100, tanβ=4
0.05
0.04
0.03
0.02
0.01
0
Γ(t−>stop neutralino)/Γ SM
100
105
110
115
120
125
m stop1


M1=M/10, μ=−300, M=100, tanβ=4
0.05
0.04
0.03
0.02
0.01
0
Γ(t−>stop neutralino)/Γ SM
100
120
140
160
180
m stop1

$\Gamma(t \to \tilde{t}\,\chi^0)$

- After LEPII still phase space

  $M_{SUSY} > 100$ GeV

  $\tan\beta = 4 \quad m_{\tilde{t}} = 100$ GeV

  $A_t = -\,\mathrm{sign}(\mu)\ 200$ GeV

- Usually (GUT): $M_1 = \frac{5}{3}\tan^2\theta_W M \approx \frac{M}{2}$

  → Parameter space small

- No GUT → e.g. $M_1 = \frac{M}{10}$

To Do:

- QCD corrections (−10%)

A. Djouadi et al. PRD 54, 5529 hep-ph/9605340

a) $m_{\tilde{t}} = 100$ GeV, $\mu - M$ plane

b) Γ/Γ_{SM} vs. $m_{\tilde{t}}$, plot of Γ_{max}