Rare production mechanism for SUSY particles

Oct. 30th 2014
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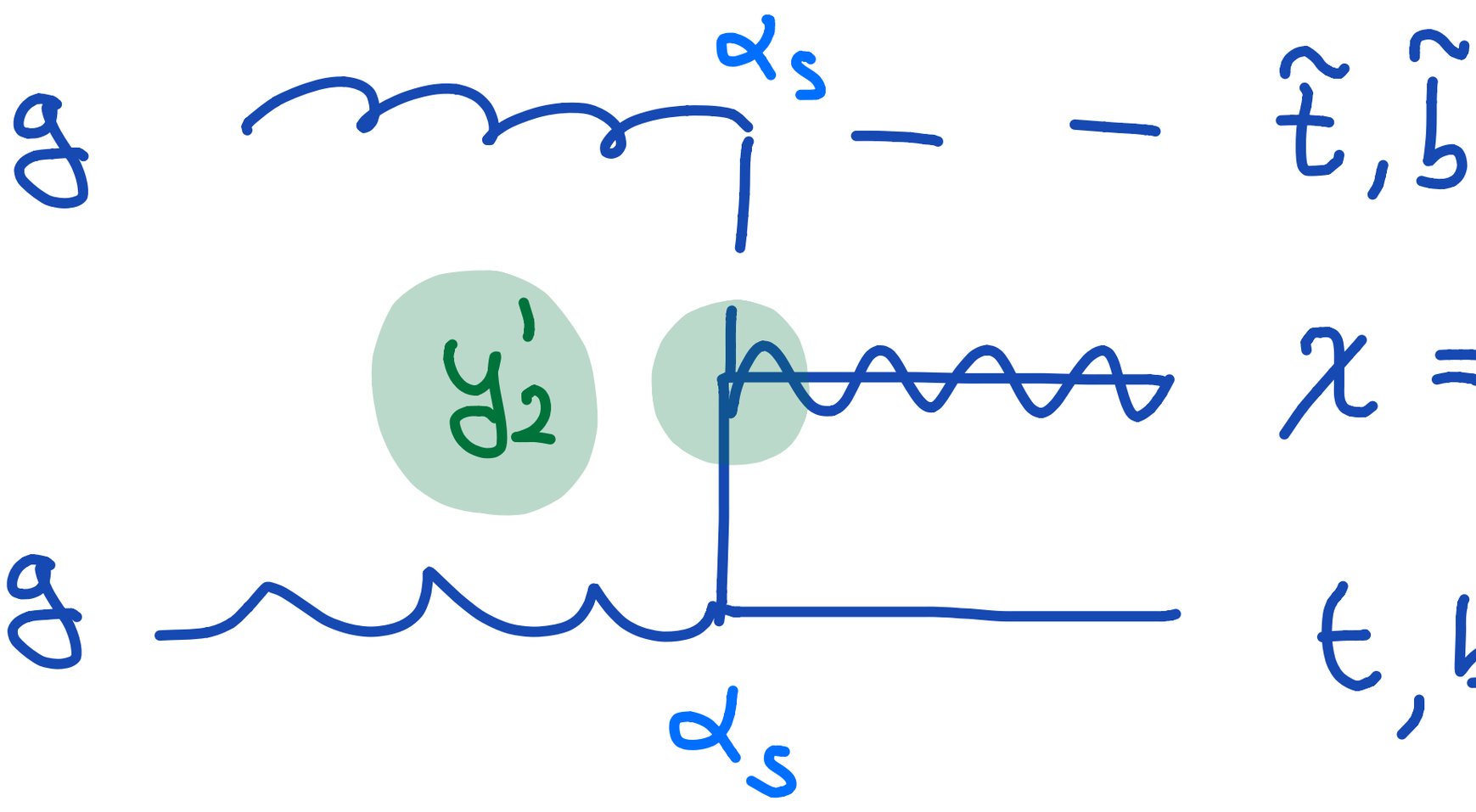
Future Hadron Collider BSM Workgroup Meeting

WIP with G. Ferretti, C. Petersson, R. Torre

see also R.Torre@2nd NPKI Workshop

$pp \rightarrow \tilde{t}\tilde{t}\,\chi^0$

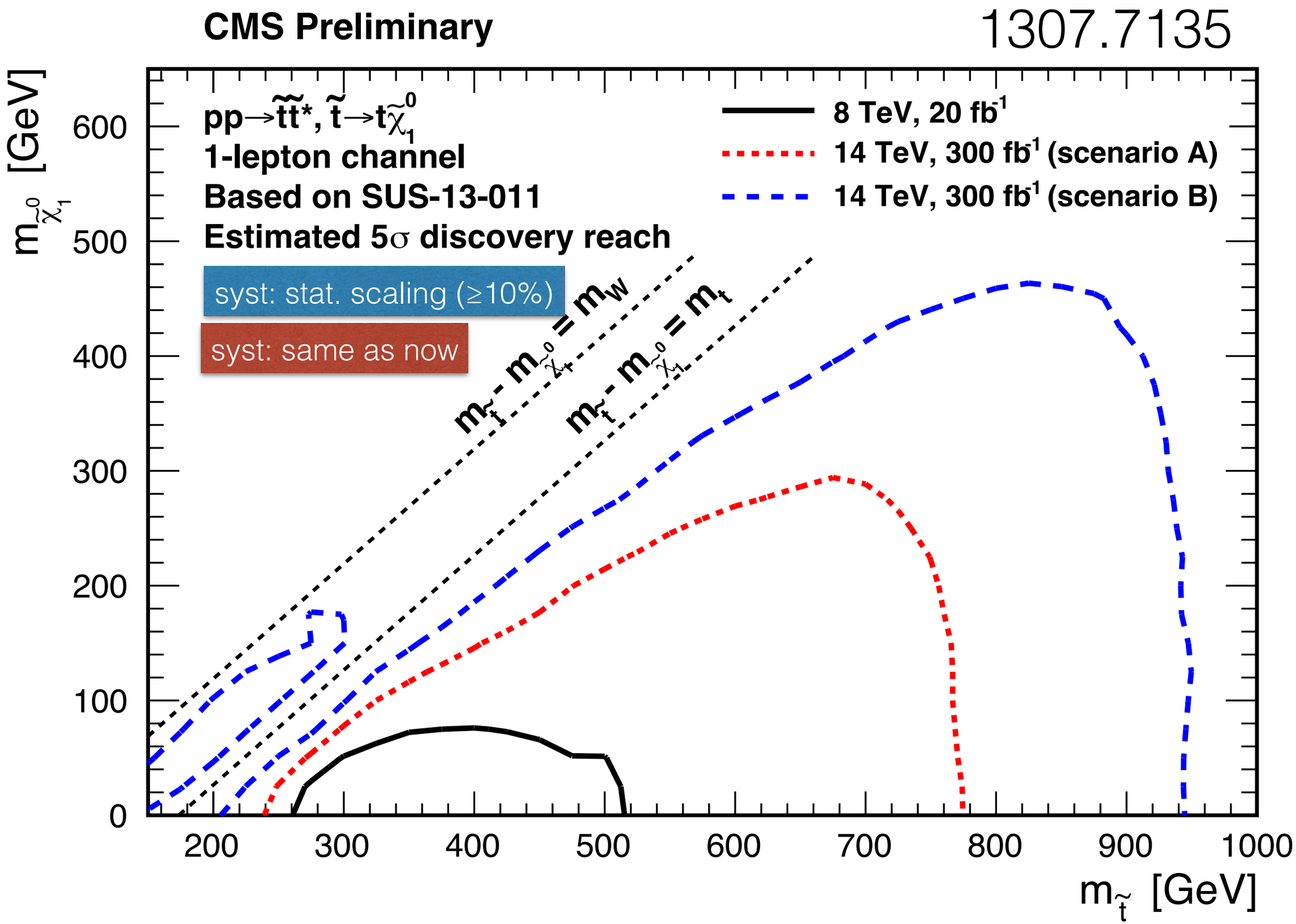
third generation SUSY couplings



SUSY couplings measurements
à la SM **$t\bar{t}$ H** for **y_{top}**

Projections

most of what is (will be) left is “compressed”

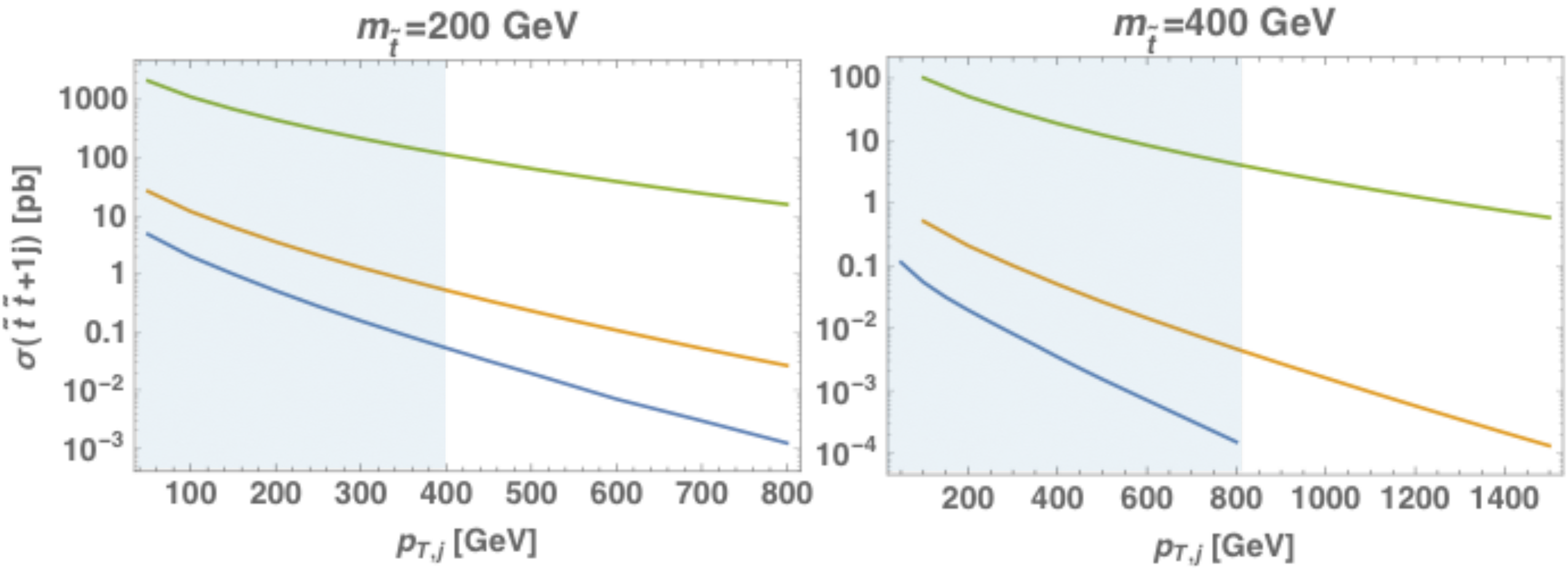


E

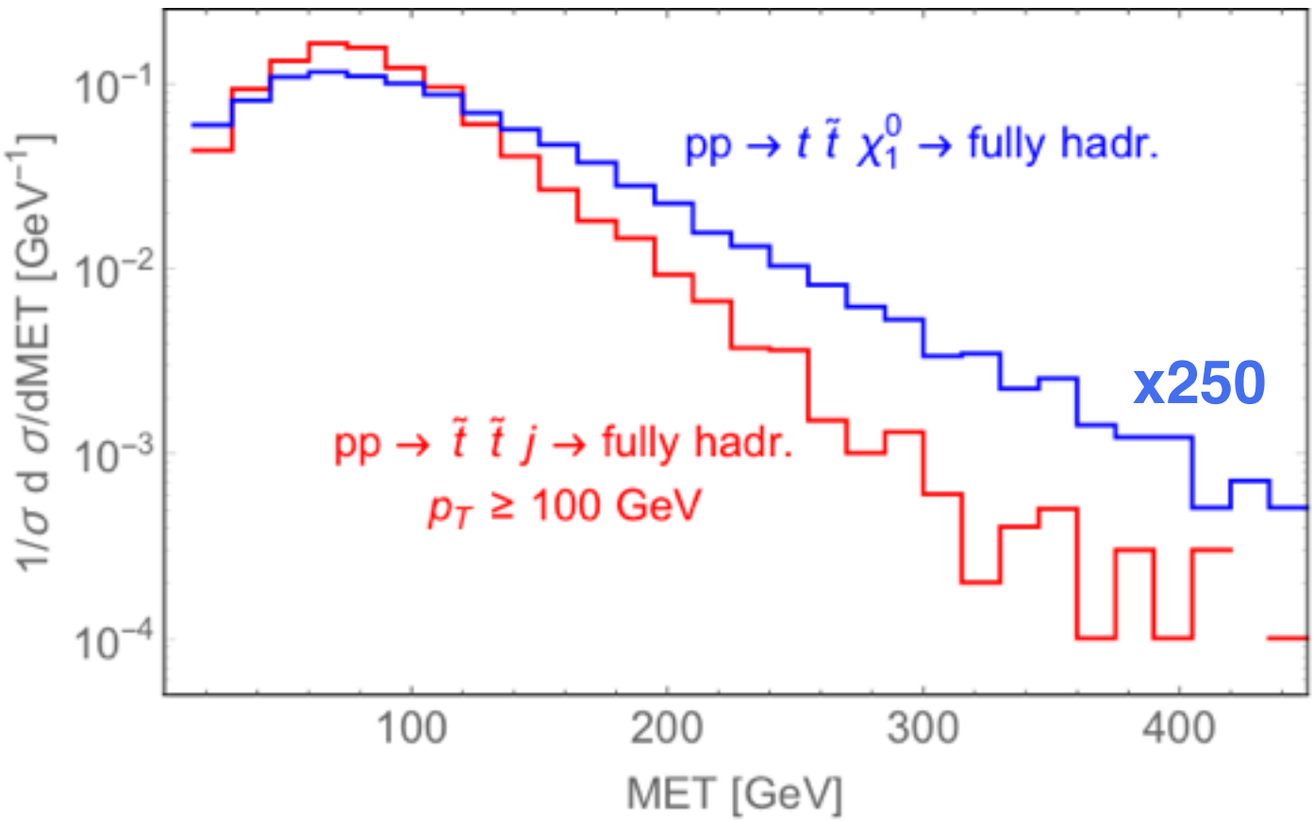
$pp \to \tilde{t}\tilde{t}$ + hard jets

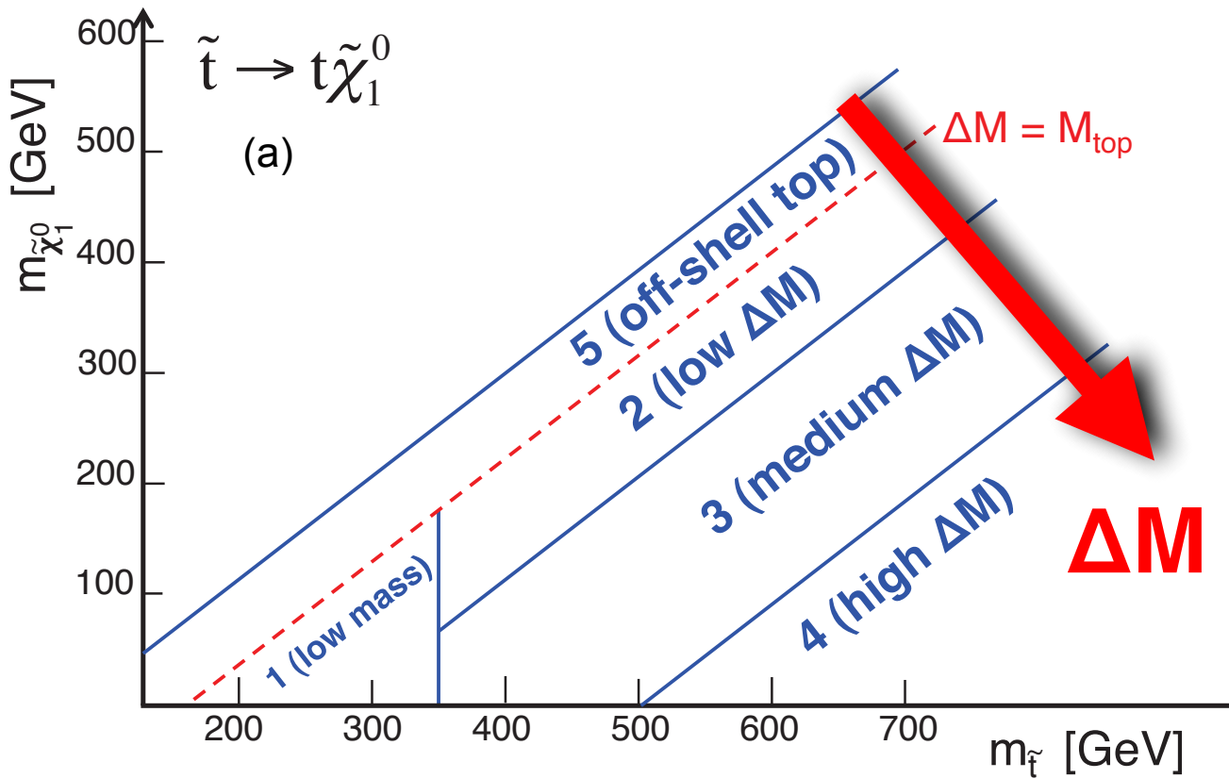
live on the tail ⇒ possible large uncertainties in the prediction

8 TeV **14 TeV** **100 TeV**



pp→ $\tilde{t}\tilde{t}\,\chi^0$ or $\tilde{t}\tilde{t}$+jets?



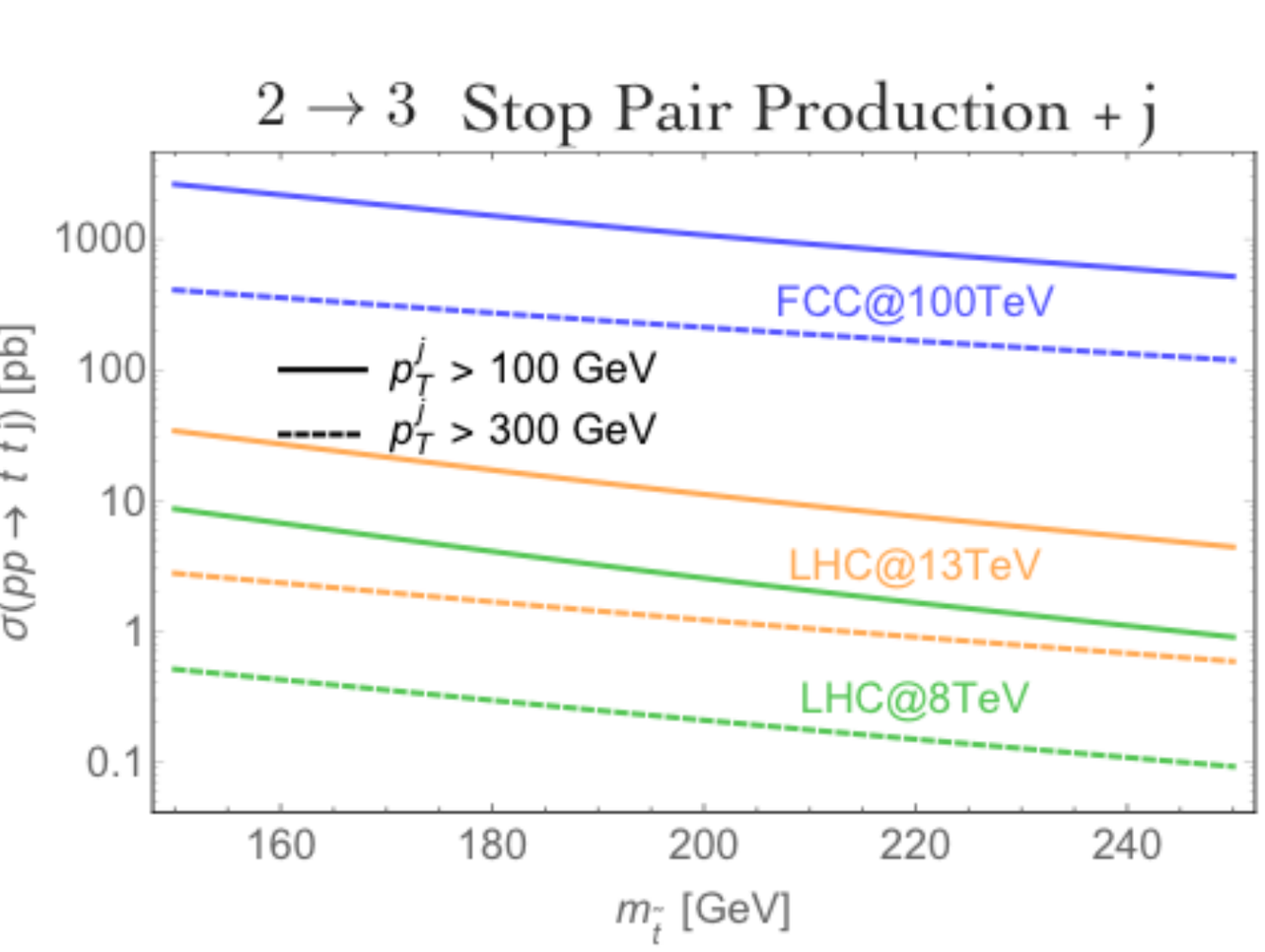


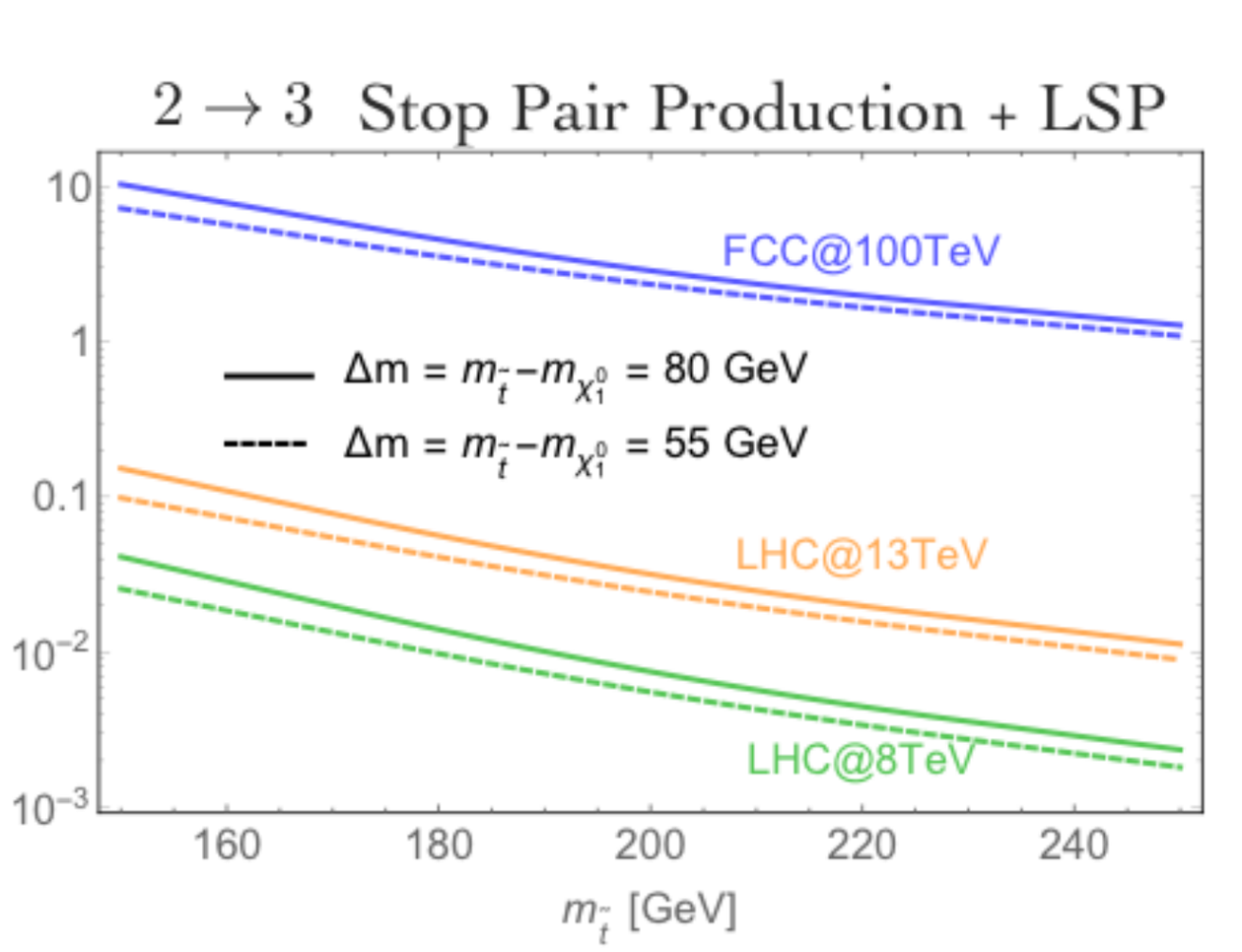
mET~M_χ <u>without</u> ΔM($\tilde{t}$,LSP)

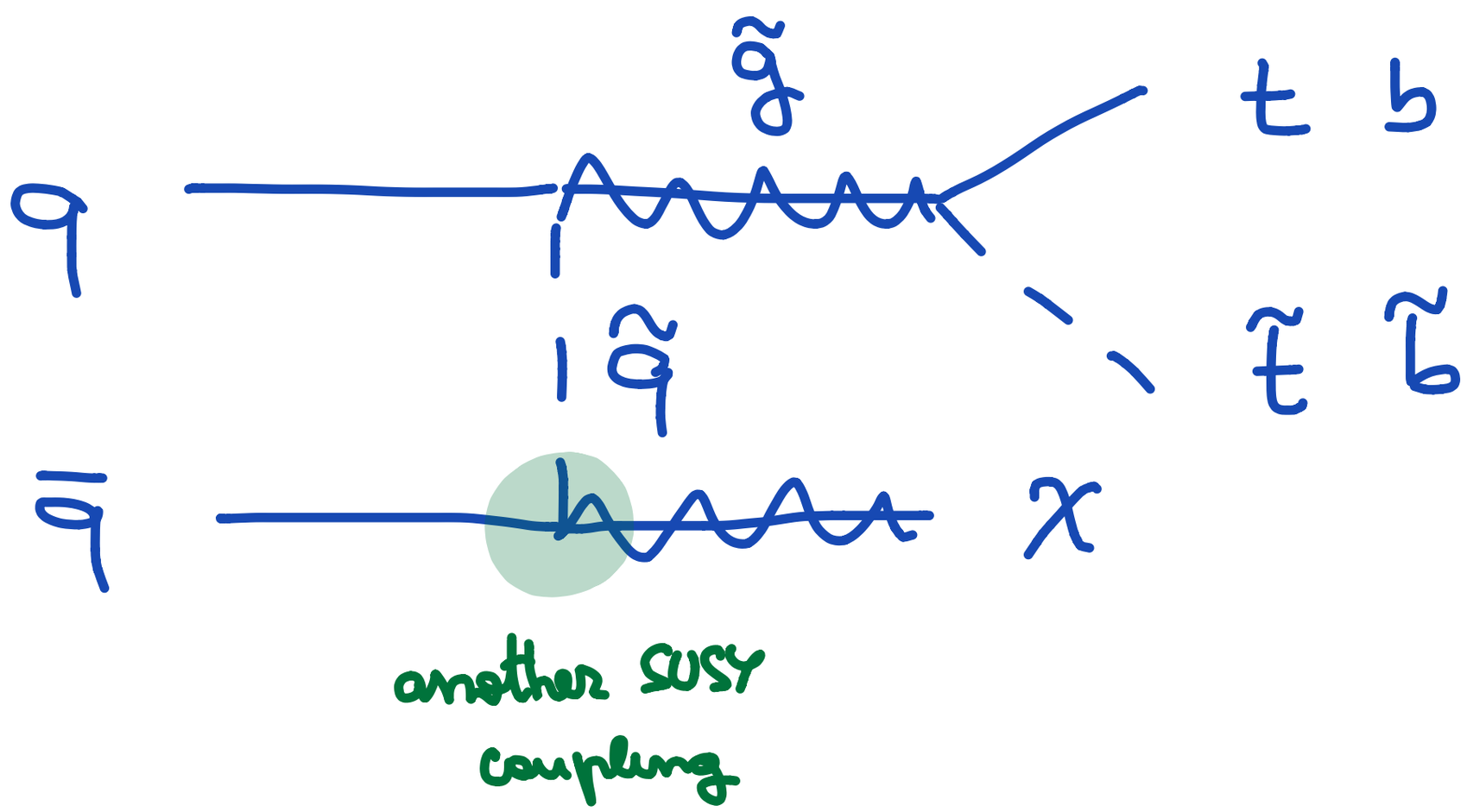
mET <u>without</u> ISR

<u>see also R.Torre@2nd NPKI Workshop</u>

Material for the discussion time

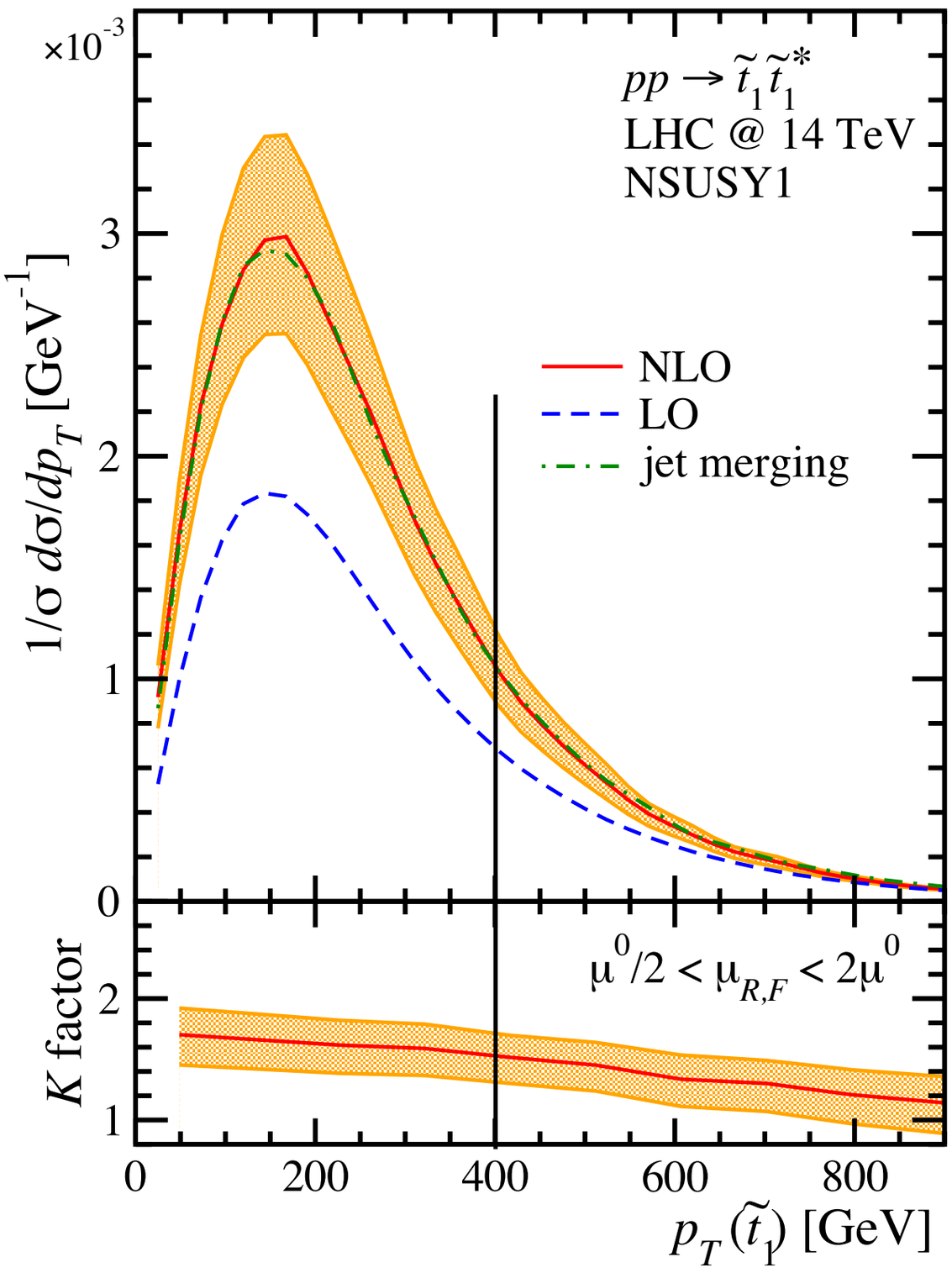

2 → 3 Stop Pair Production + j
σ(pp → t̃ t̃ j) [pb]
1000
100
10
1
0.1
FCC@100TeV
p_T^j > 100 GeV
p_T^j > 300 GeV
LHC@13TeV
LHC@8TeV
160
180
200
220
240
$m_{\tilde{t}}$ [GeV]


2 → 3 Stop Pair Production + LSP
10
1
0.1
10^{-2}
10^{-3}
FCC@100TeV
Δm = $m_{\tilde{t}}$ − $m_{\chi_1^0}$ = 80 GeV
Δm = $m_{\tilde{t}}$ − $m_{\chi_1^0}$ = 55 GeV
LHC@13TeV
LHC@8TeV
160
180
200
220
240
$m_{\tilde{t}}$ [GeV]

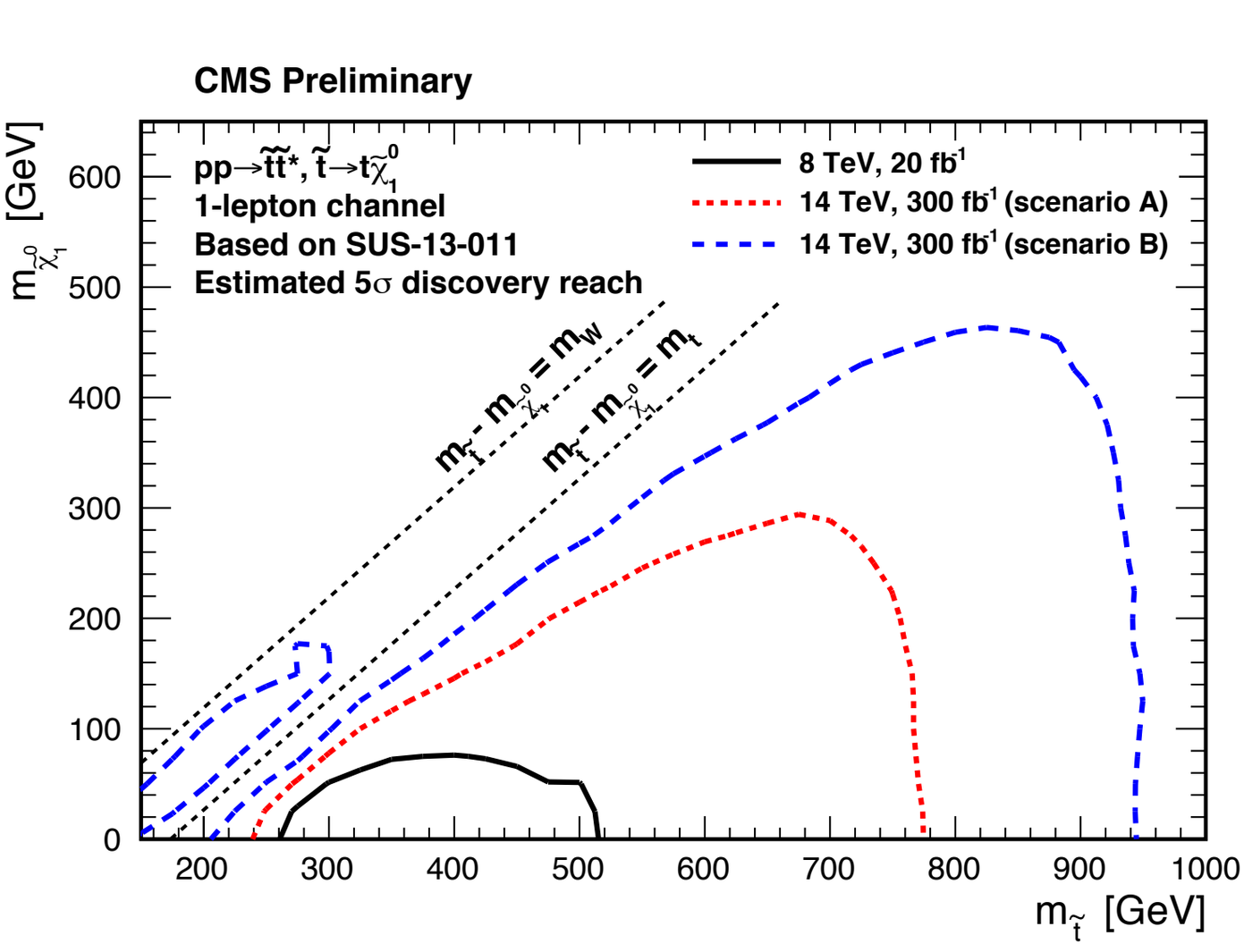

g̃
t b
q
q̃
t̃ b̃
q̄
χ
another SUSY
coupling

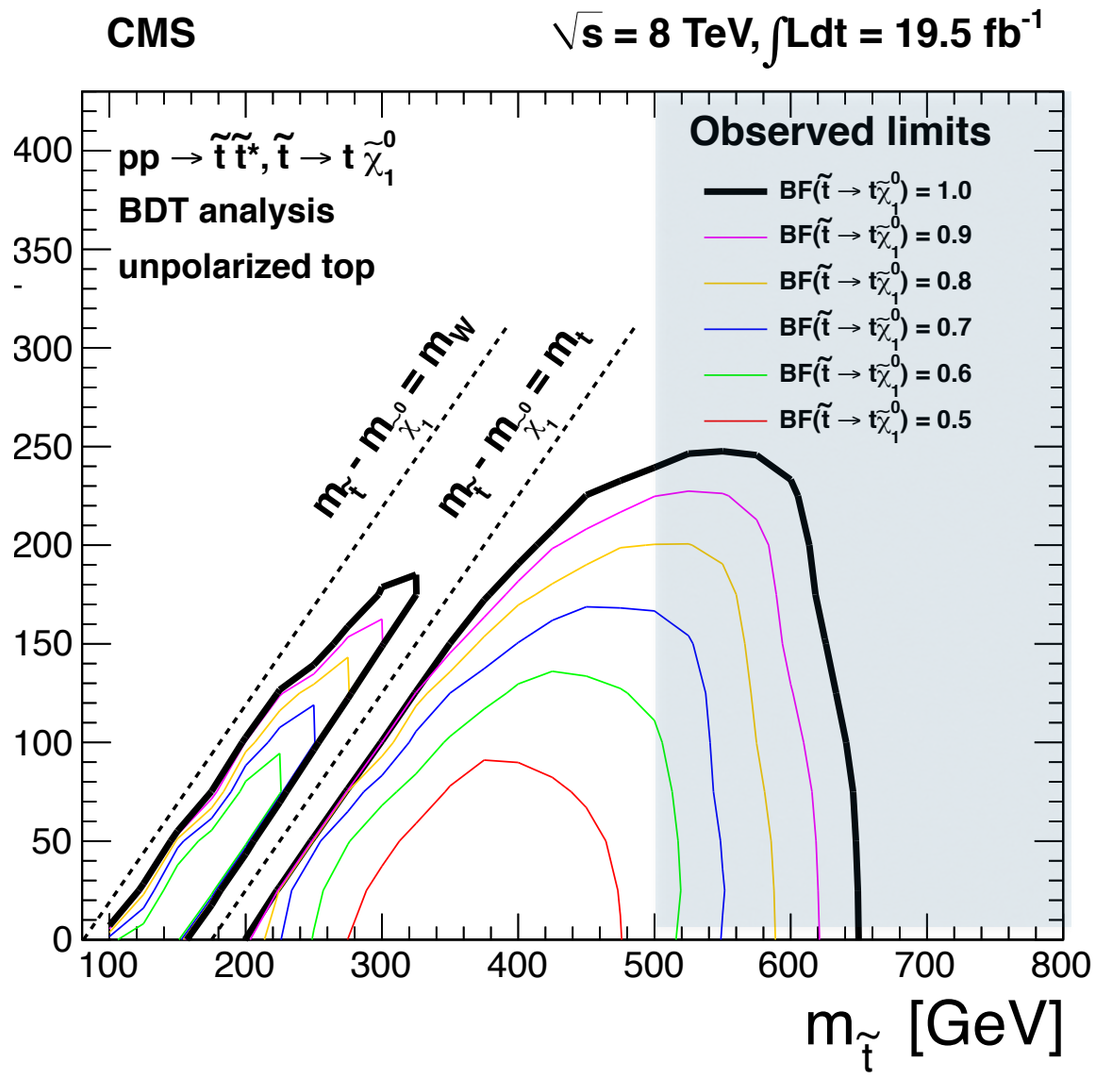
$pp \to \tilde{t}\tilde{t}$ @ NLO

1407.4302



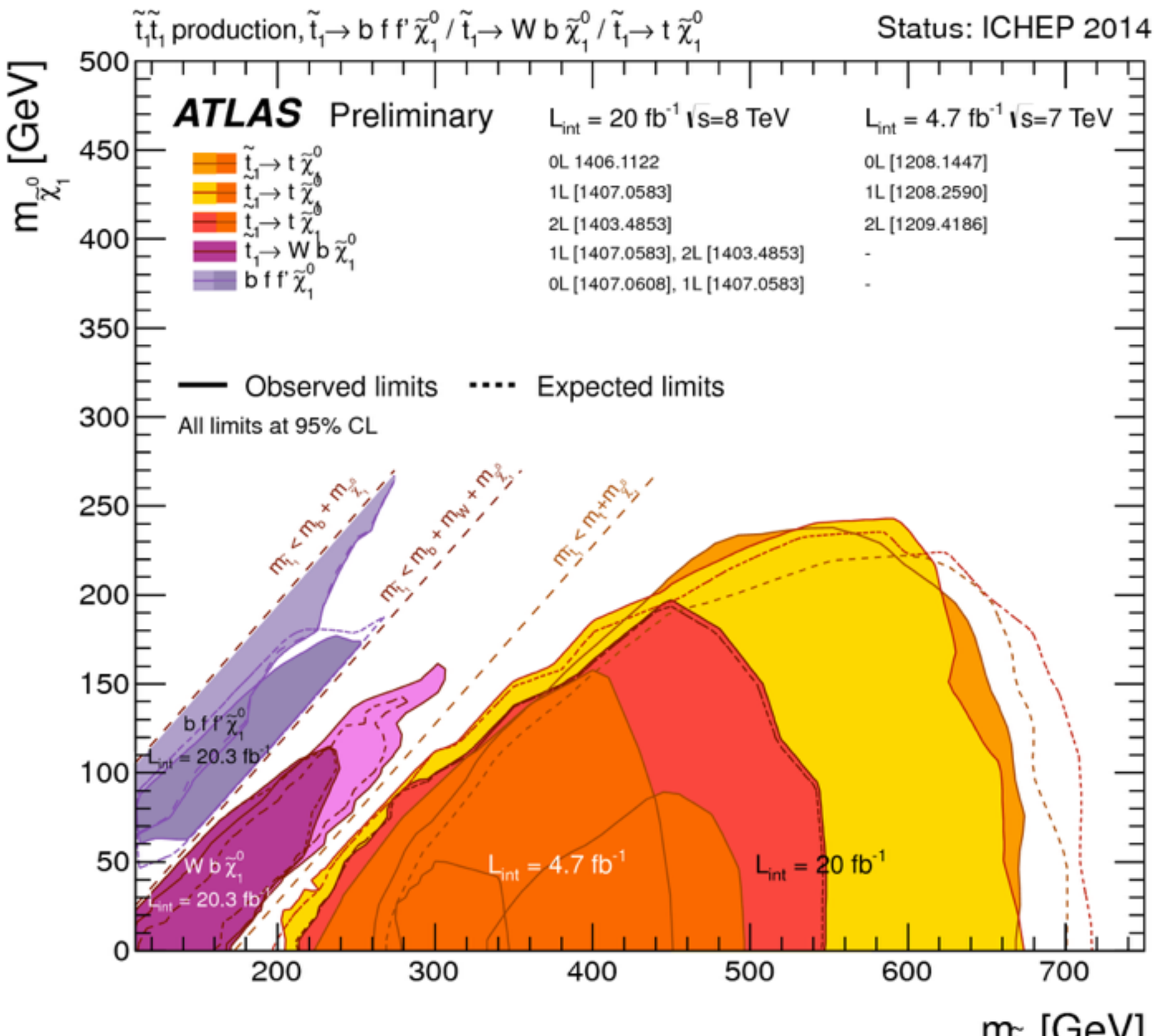
30% uncertainty at NLO


CMS Preliminary
pp→t̃t̃*, t̃→tχ̃⁰₁
1-lepton channel
Based on SUS-13-011
Estimated 5σ discovery reach
8 TeV, 20 fb⁻¹
14 TeV, 300 fb⁻¹ (scenario A)
14 TeV, 300 fb⁻¹ (scenario B)
m_t̃ - m_χ̃⁰₁ = m_W
m_t̃ - m_χ̃⁰₁ = m_t
m_χ̃⁰₁ [GeV]
m_t̃ [GeV]


CMS
√s = 8 TeV, ∫Ldt = 19.5 fb⁻¹
pp → t̃ t̃*, t̃ → t χ̃⁰₁
BDT analysis
unpolarized top
Observed limits
BF(t̃ → tχ̃⁰₁) = 1.0
BF(t̃ → tχ̃⁰₁) = 0.9
BF(t̃ → tχ̃⁰₁) = 0.8
BF(t̃ → tχ̃⁰₁) = 0.7
BF(t̃ → tχ̃⁰₁) = 0.6
BF(t̃ → tχ̃⁰₁) = 0.5
m_t̃ - m_χ̃⁰₁ = m_W
m_t̃ - m_χ̃⁰₁ = m_t
m_t̃ [GeV]

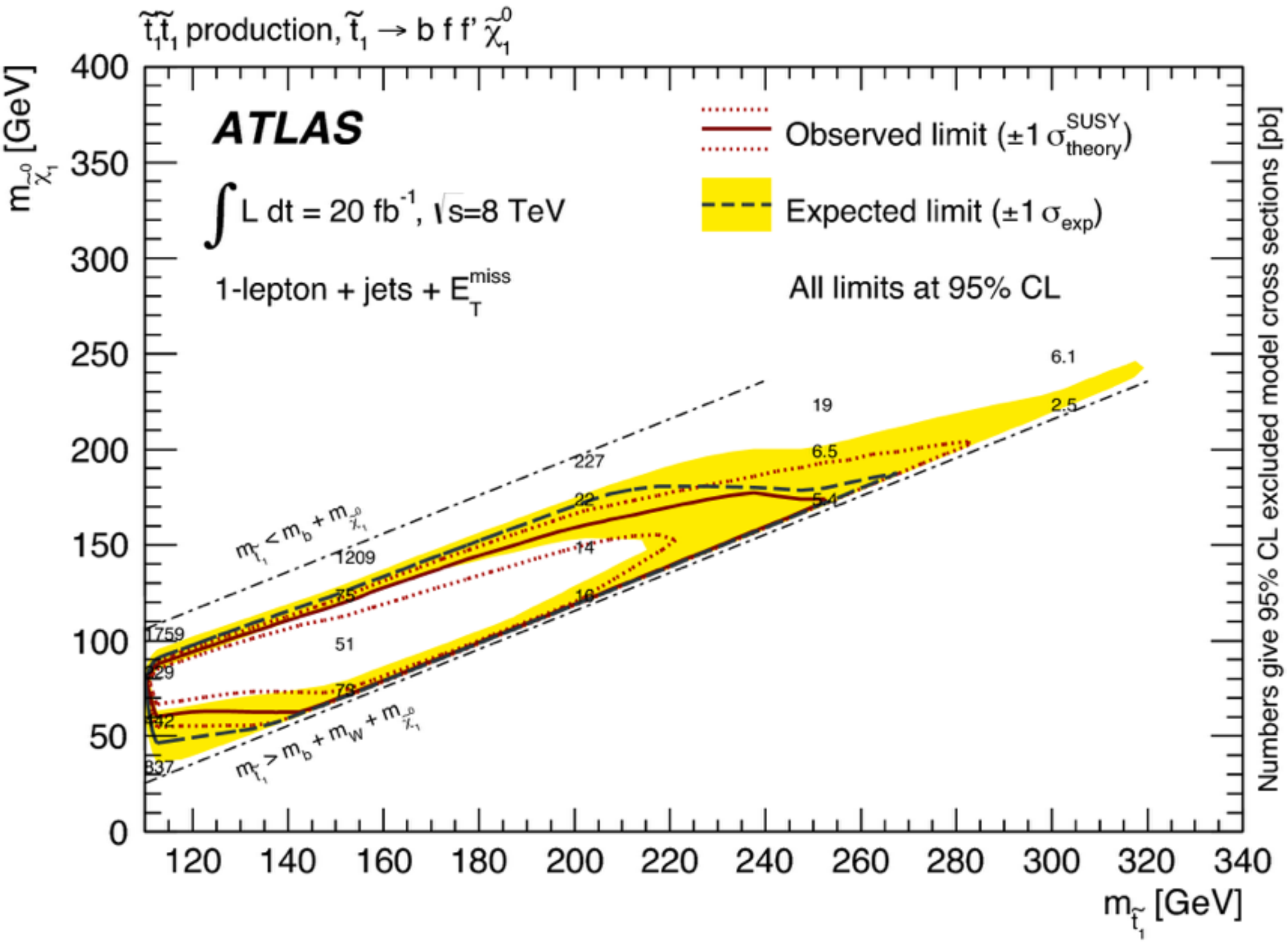
back

Focus on $\tilde{t} \rightarrow b\, ff' \chi^0$



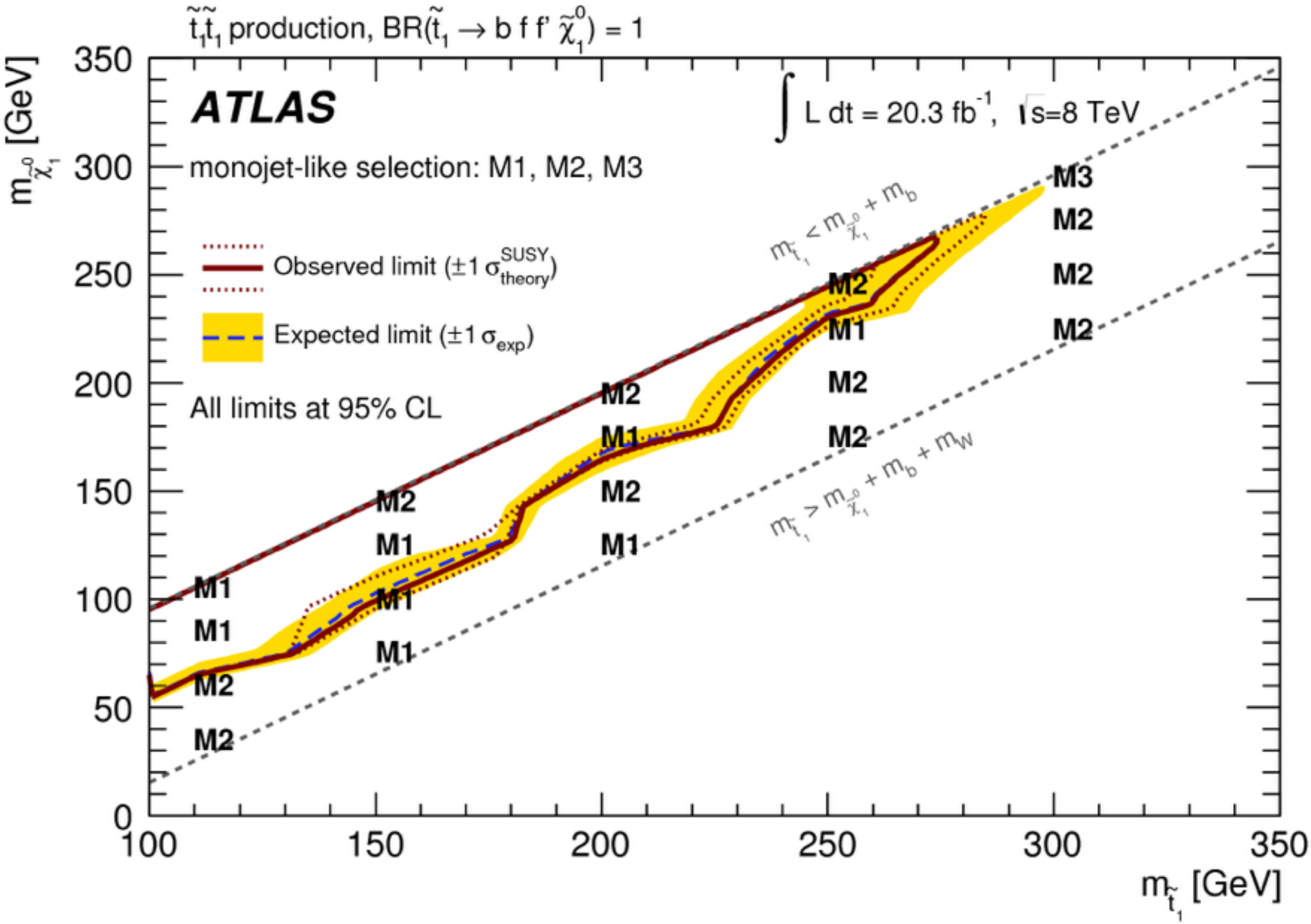
Bounds for $\tilde{t} \rightarrow b\, ff'\chi^0$

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PAPERS/SUSY-2013-15/



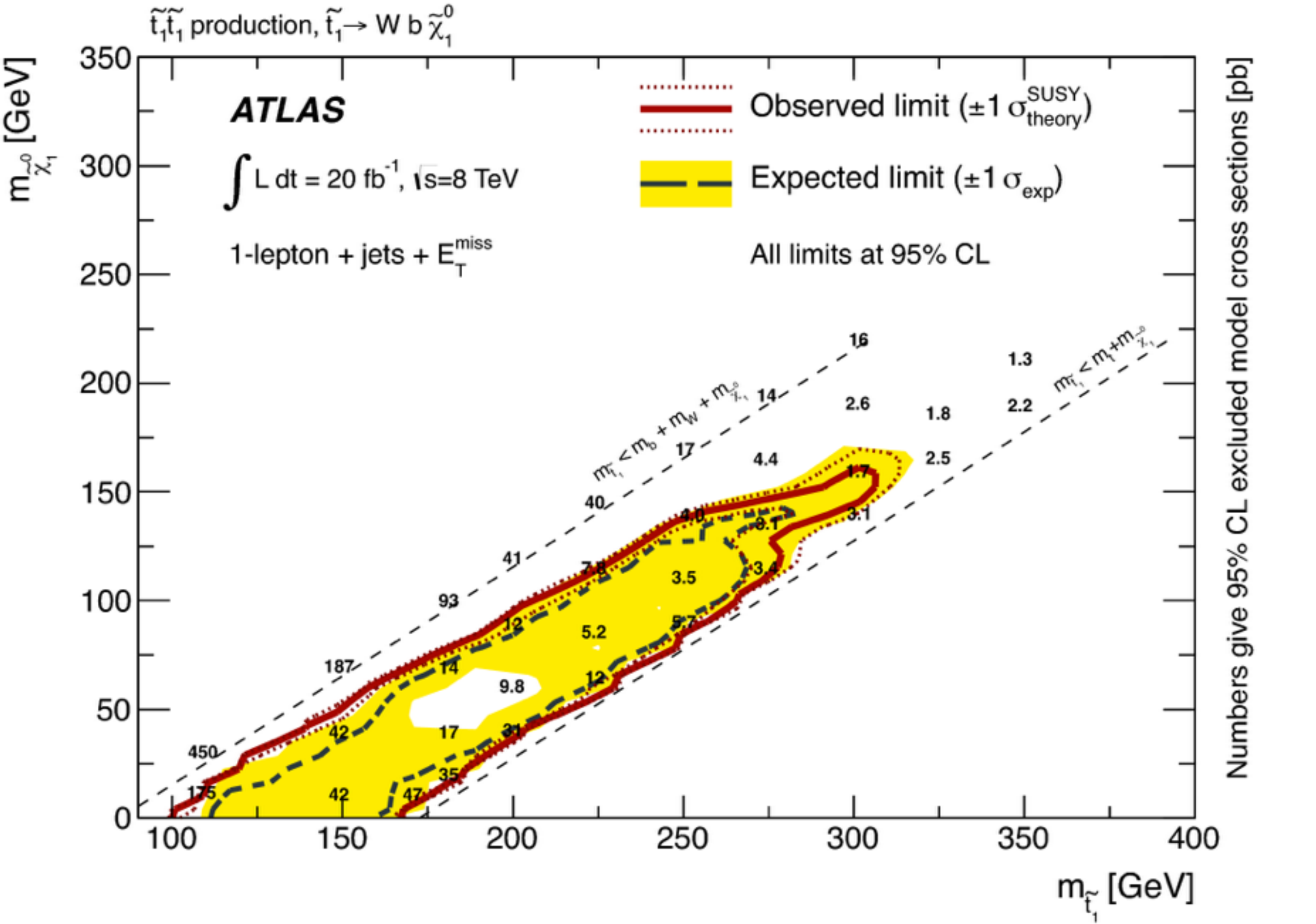
Bounds for $\tilde{t} \rightarrow b\, ff'\chi^0$

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PAPERS/SUSY-2013-21/



Bounds for $\tilde{t} \rightarrow b\, W\, \chi^0$ 1 lepton

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PAPERS/SUSY-2013-15/



Bounds for $\tilde{t} \rightarrow b\, W\, \chi^0$

2 leptons

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PAPERS/SUSY-2013-19/

2 leptons is never better than 1 lepton

2 leptons is more stable than 1 lepton