Search for MSSM Higgs Bosons in Tau Pair Final States

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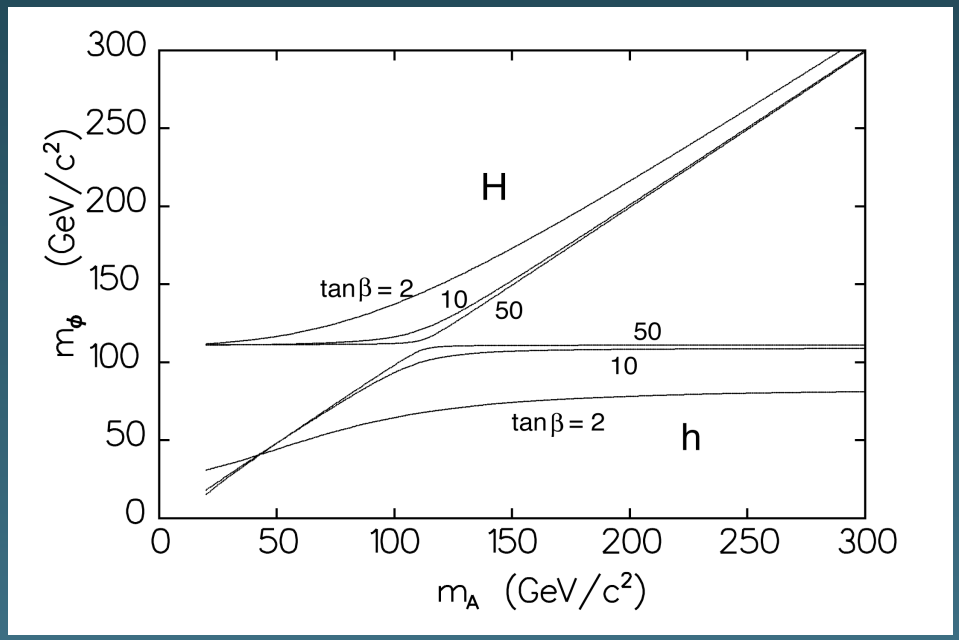
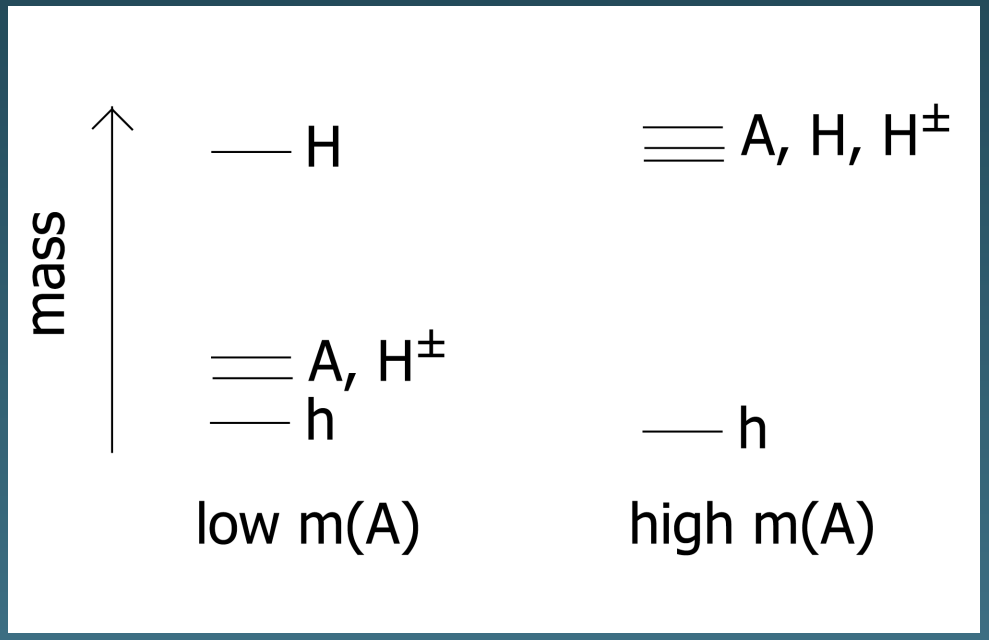
MSSM: within supersymmetry, simplest Higgs sector requires two Higgs doublets

scalars: h, H, $H^{\pm}$

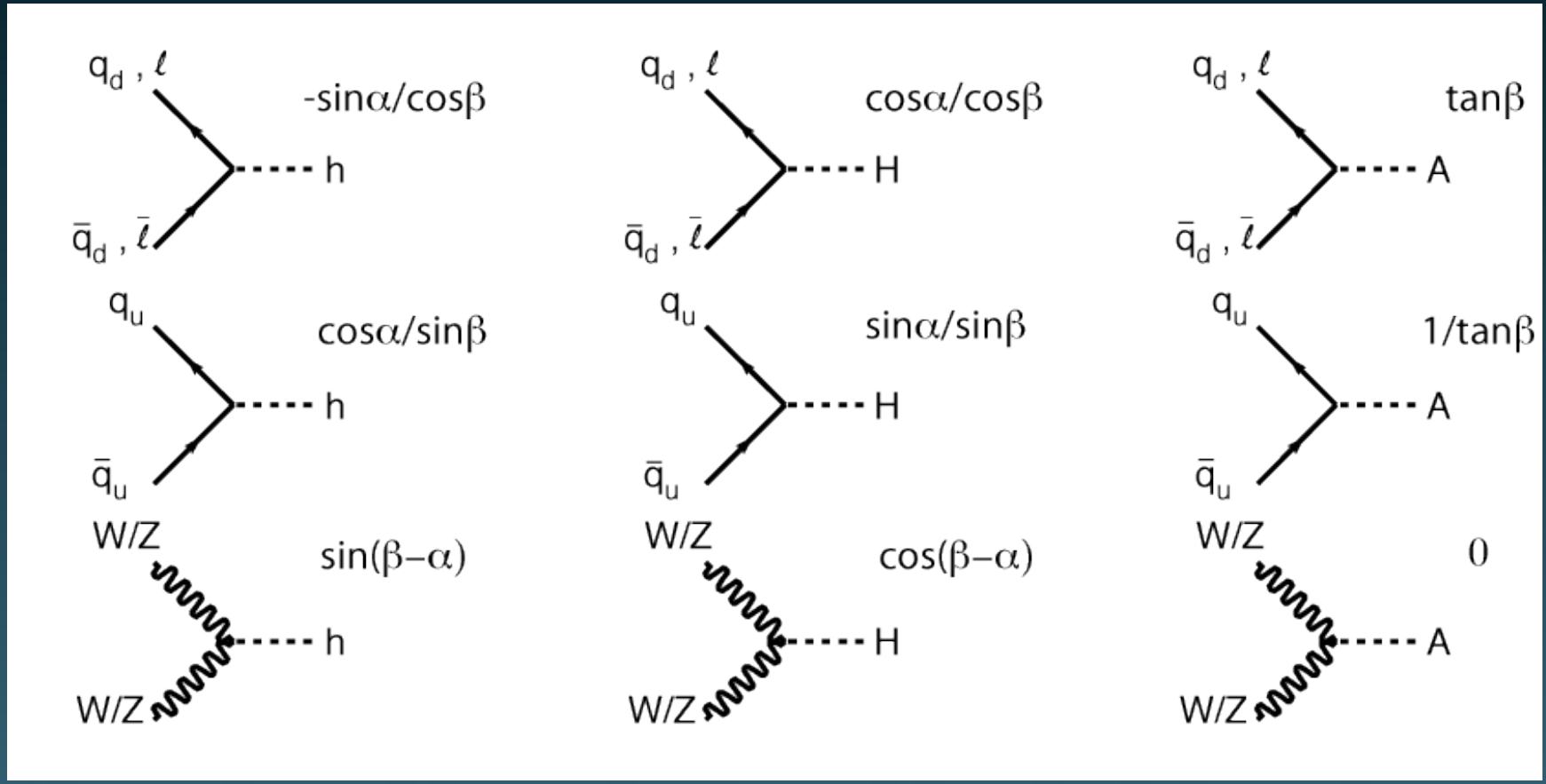
pseudoscalar: A

Can parametrize the masses of the Higgs bosons with ~two parameters: m_A, tanβ





Experimentally attractive: at large tanβ get strong enhancements to h/H/A production rates



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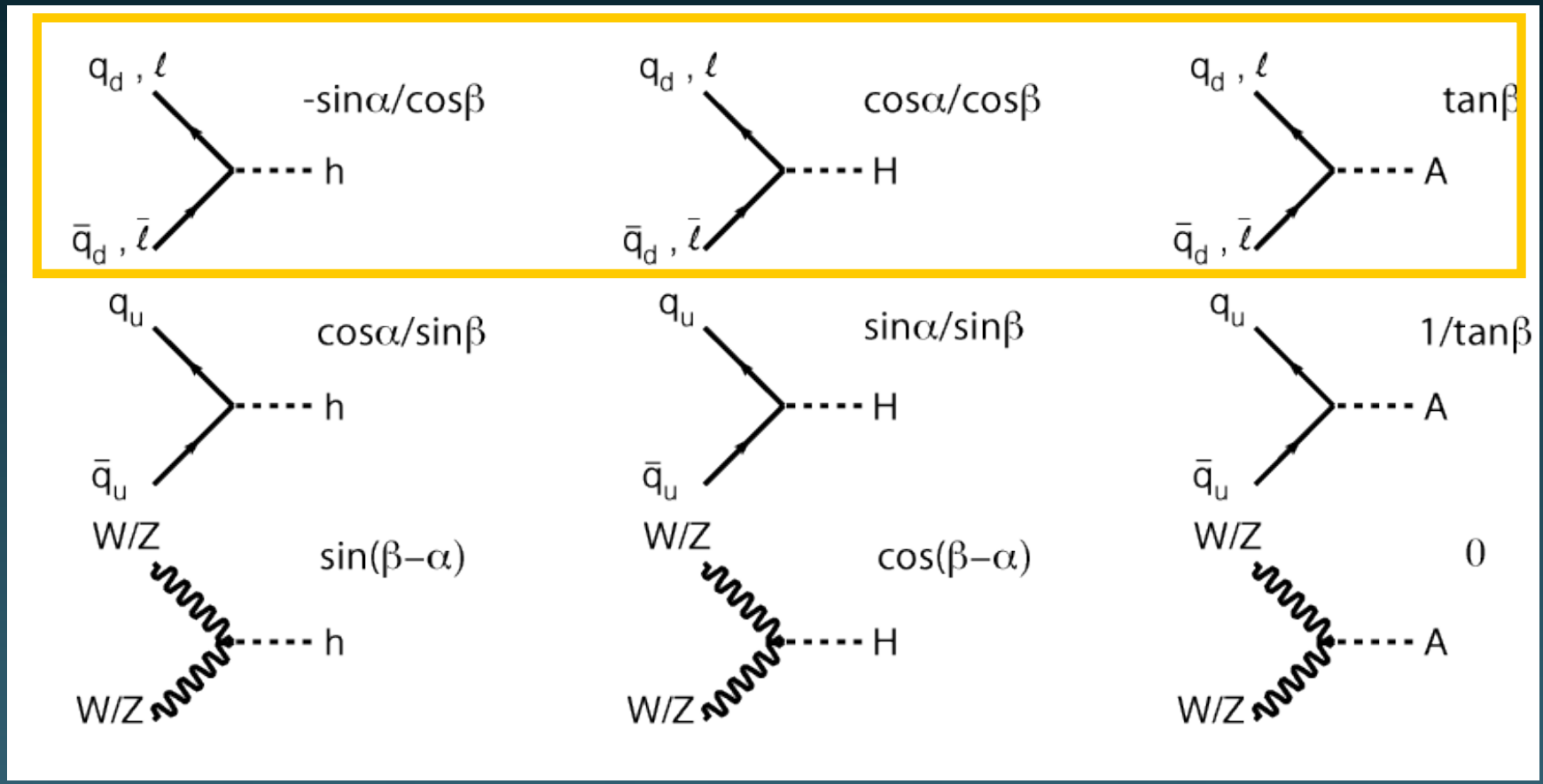

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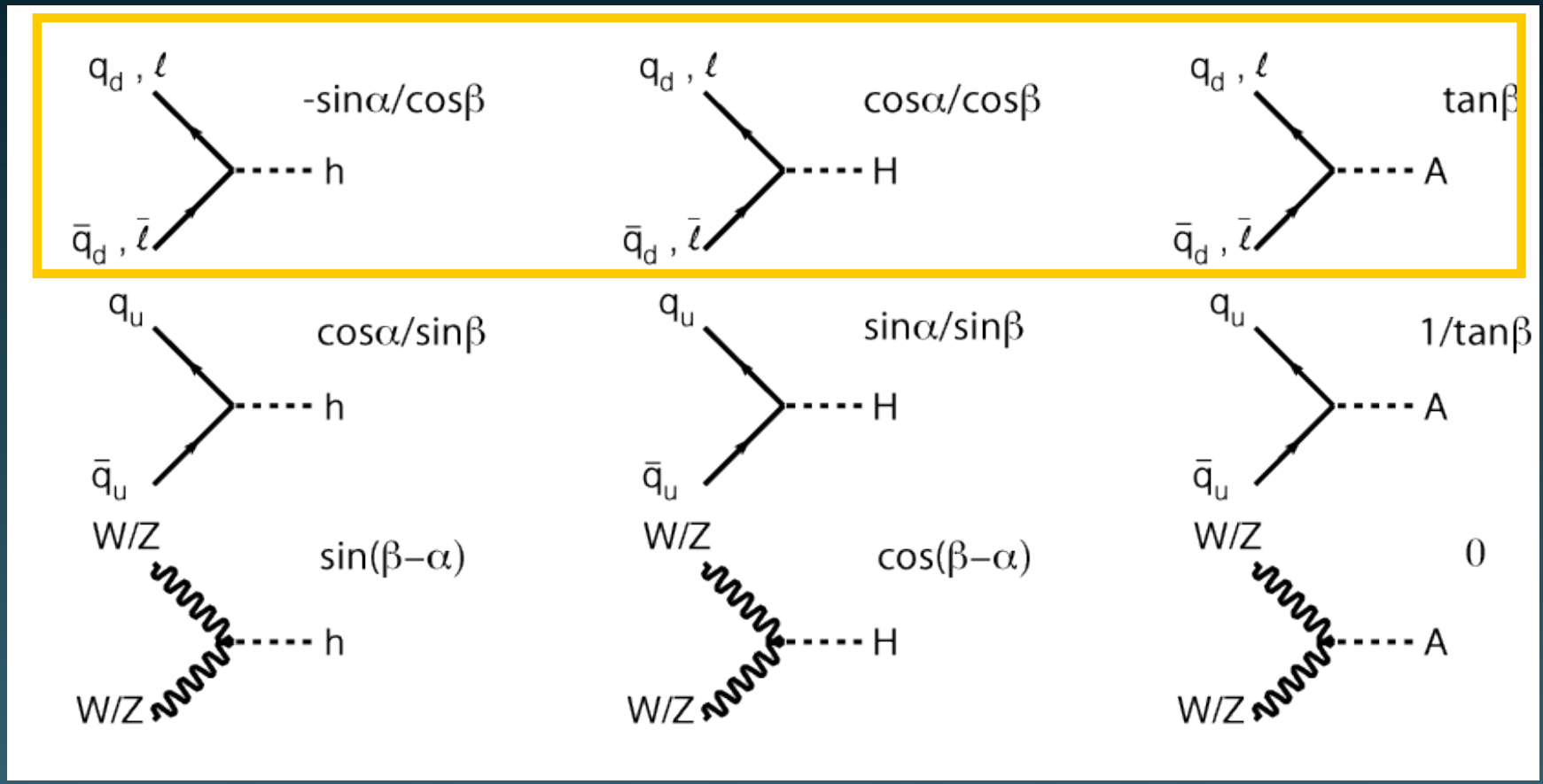
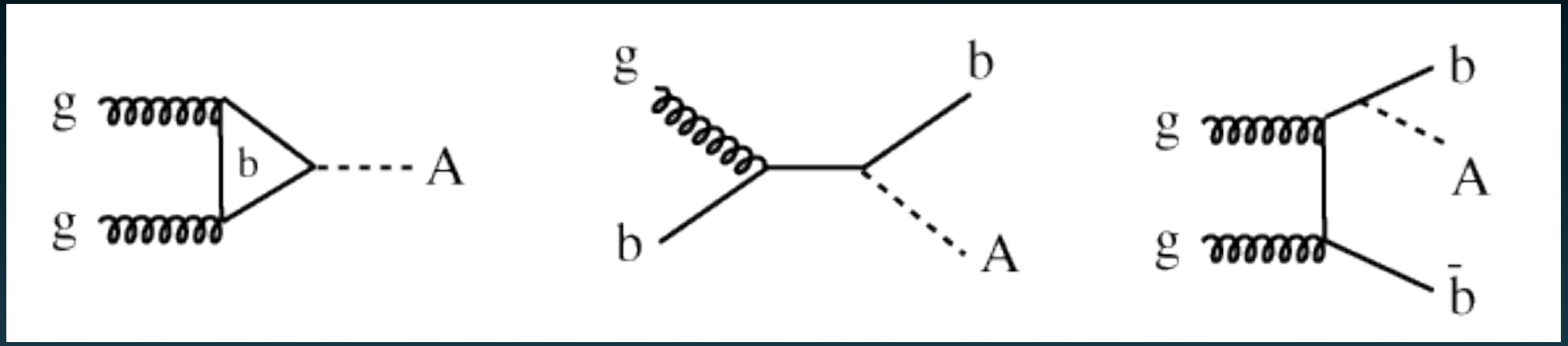
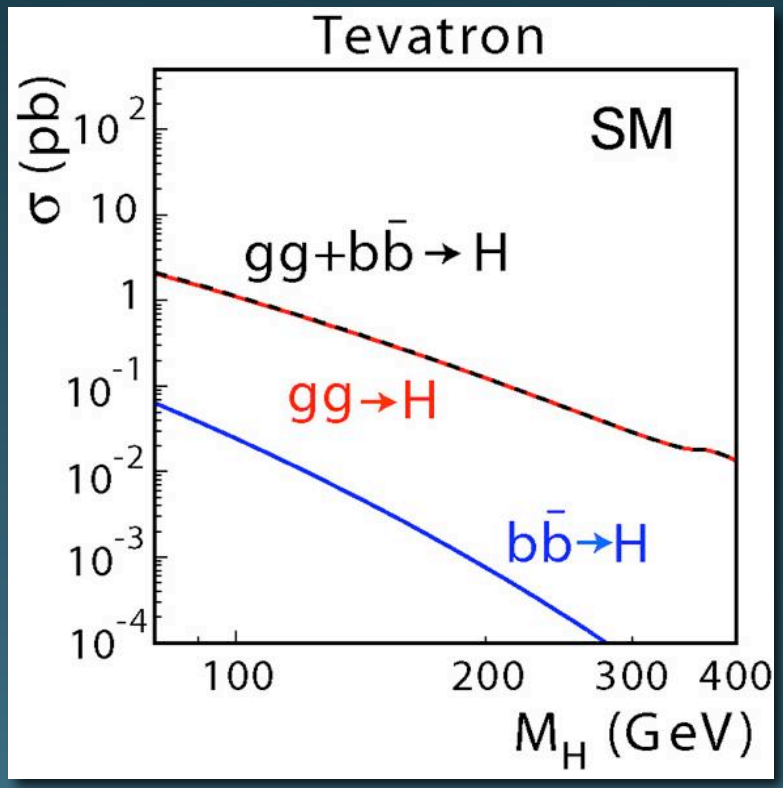
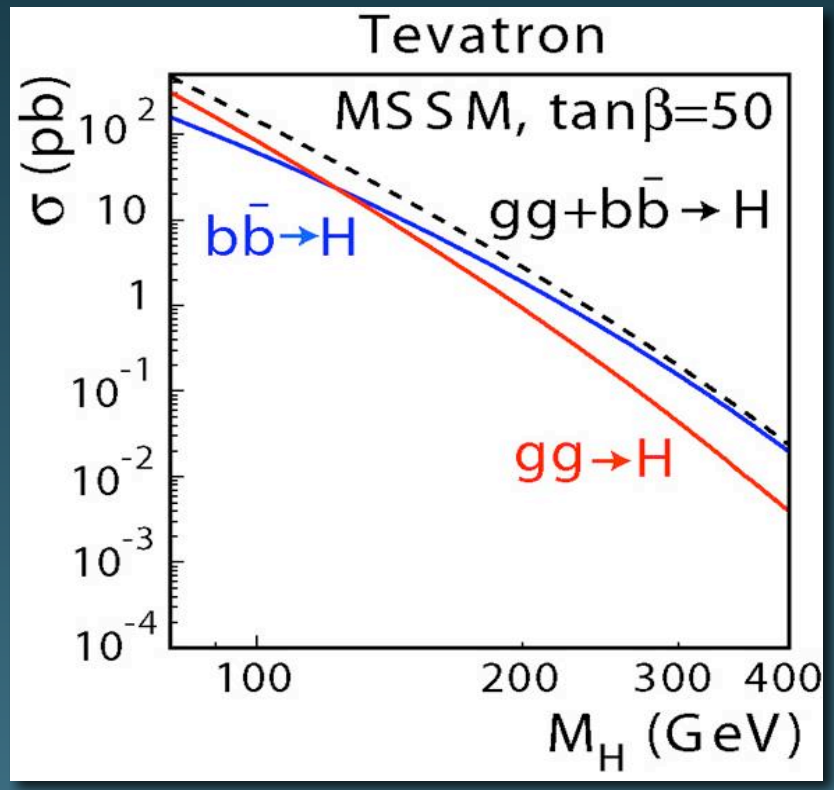
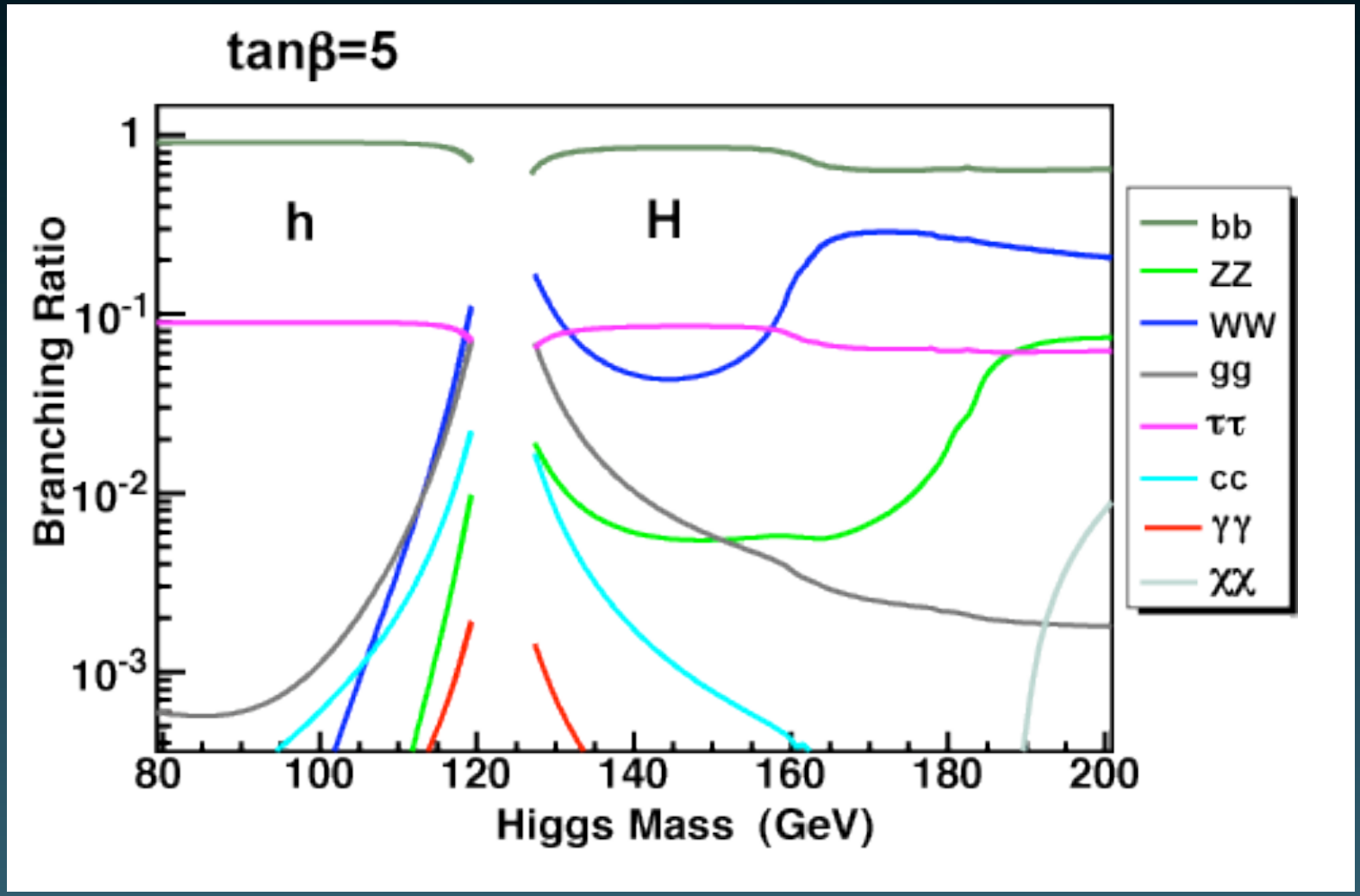


diagrams with bbϕ vertex enhanced ∝ $\tan^2\beta$


g
g
b
A
g
b
b
A
g
b
g
A
b̄


Tevatron
SM
σ (pb)
gg+bb̄→H
gg→H
bb̄→H
M_H (GeV)


Tevatron
MSSM, tanβ=50
σ (pb)
gg+bb̄→H
bb̄→H
gg→H
M_H (GeV)



bb decays dominate but have very large QCD background

ττ decays: only 9% BR but clean final states

Tau decay modes	
$e\nu\nu$ or $\mu\nu\nu$	35%
$\pi\nu$, $K\nu$	12%
$\rho\nu$ ($\pi^+\pi^0\nu$)	26%
$\pi^+\pi^0\pi^0\nu$	11%
$\pi^+\pi^+\pi^-\nu$	11%

Must identify hadronically decaying taus, distinguish from hadronic jets from QCD processes:

- good tracking, particle ID
- good Υ/π^0 identification

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Tau pair final states	
ee, $\mu\mu$	6%
$e\mu$	6%
$\ell\tau$	44%
$\tau\tau$	42%

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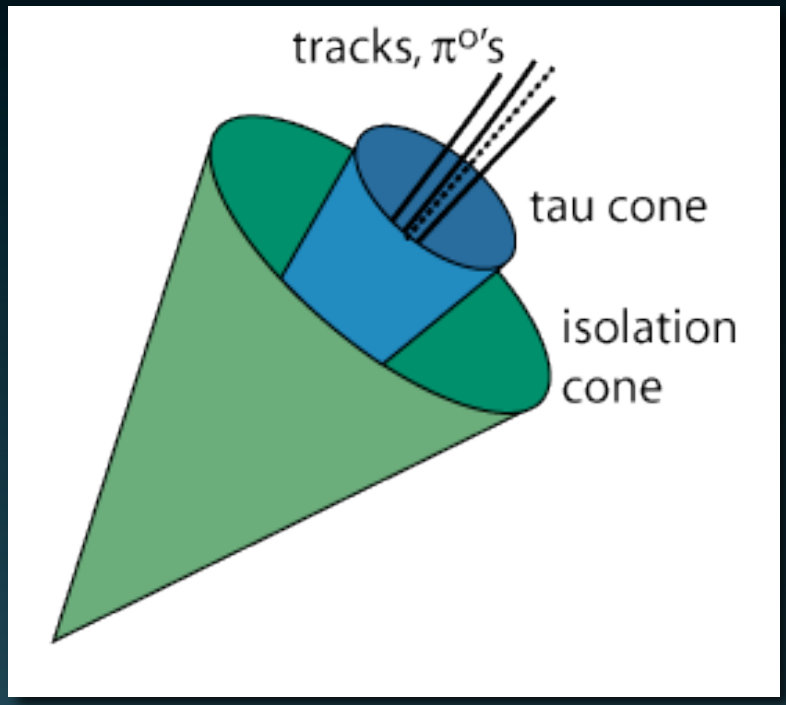
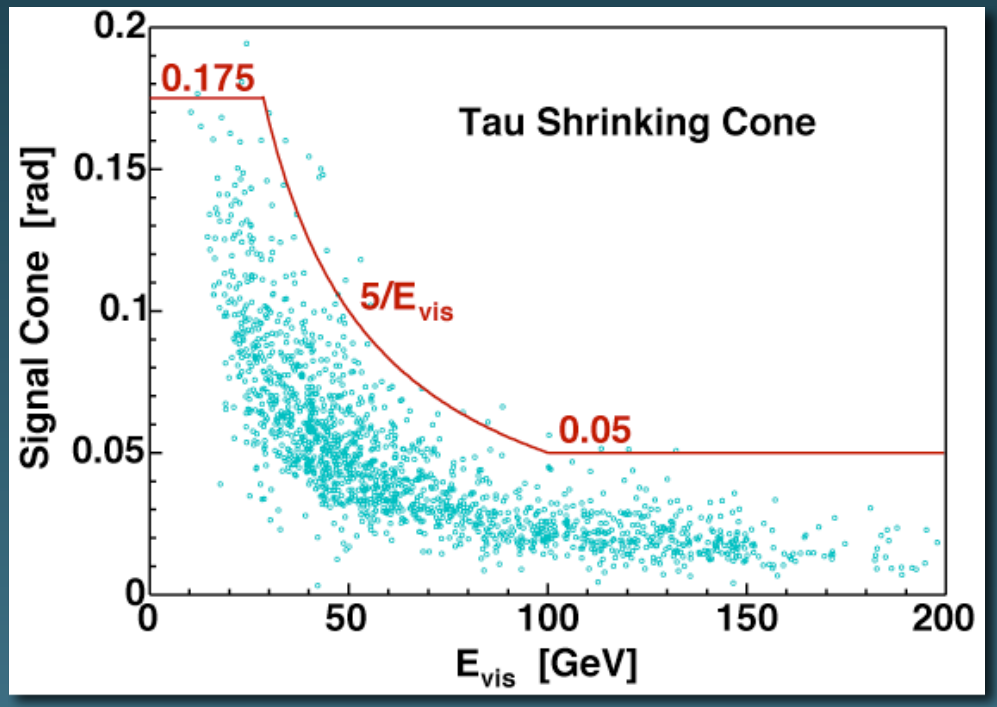
Tau ID in CDF

Straightforward cut-based method using signal and isolation cones

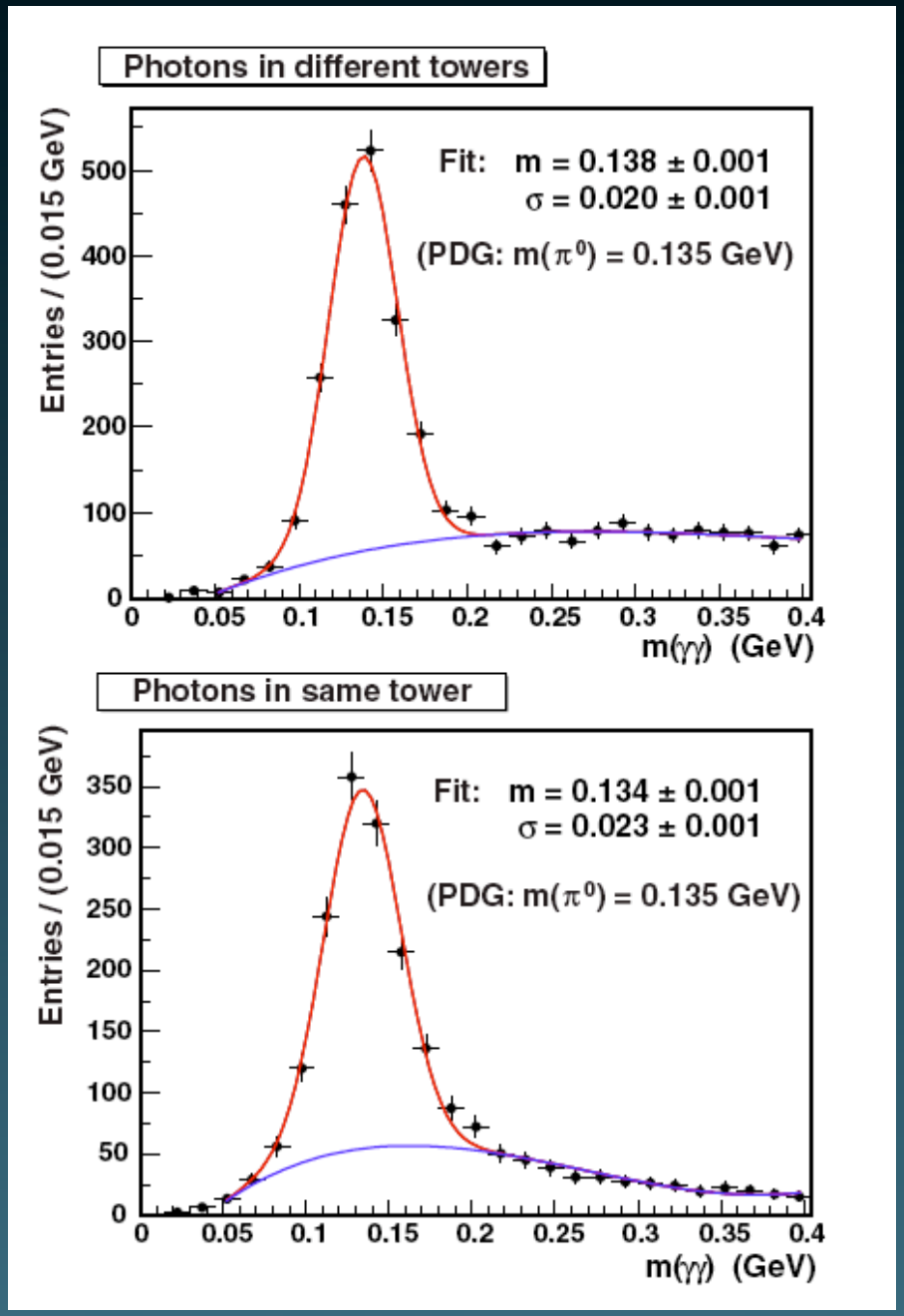
Exploit "shrinking" signal cone with increasing tau p_T

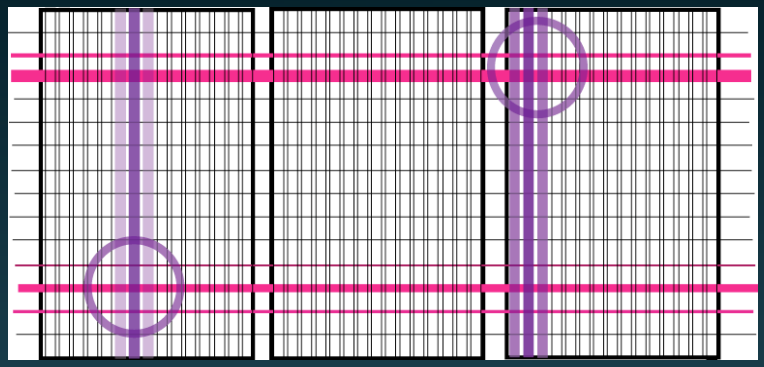
Reconstruct π^0 using shower max detector

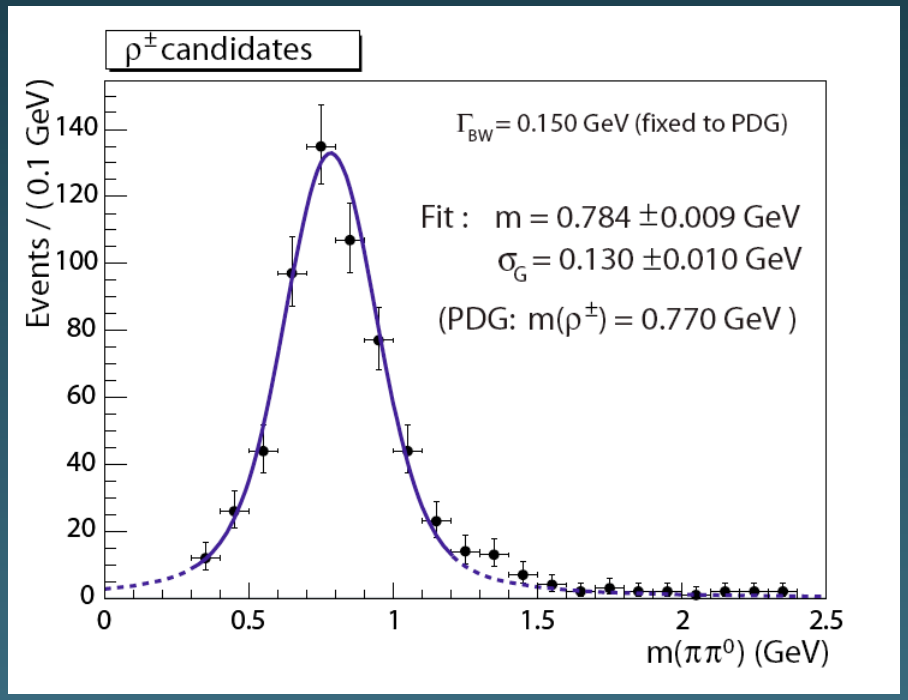




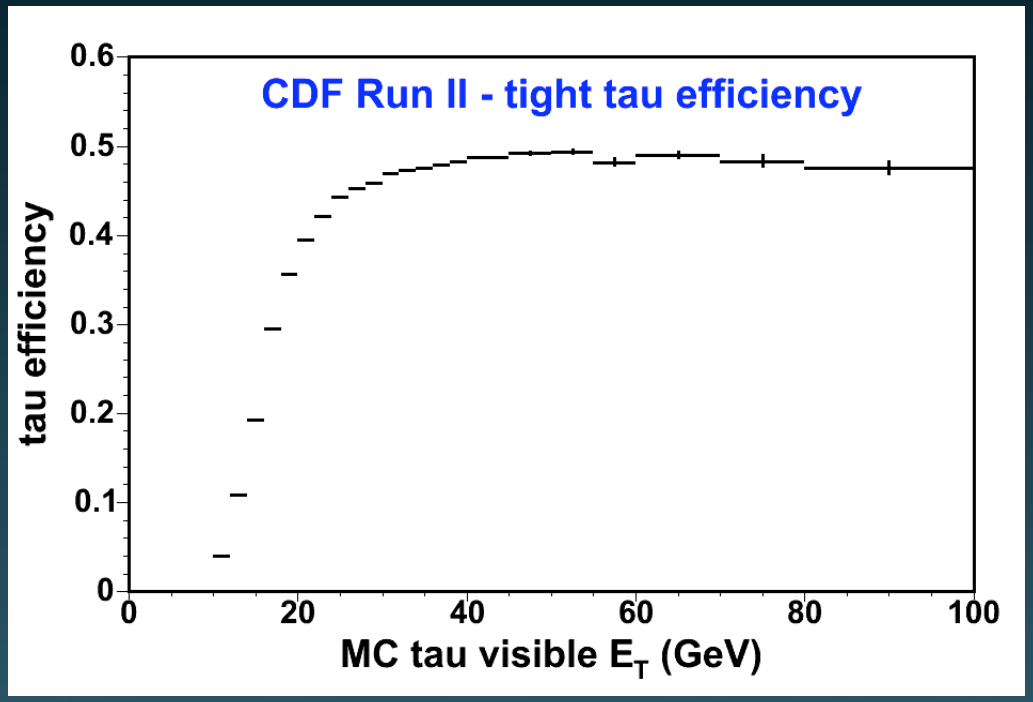
π^0 in shower max



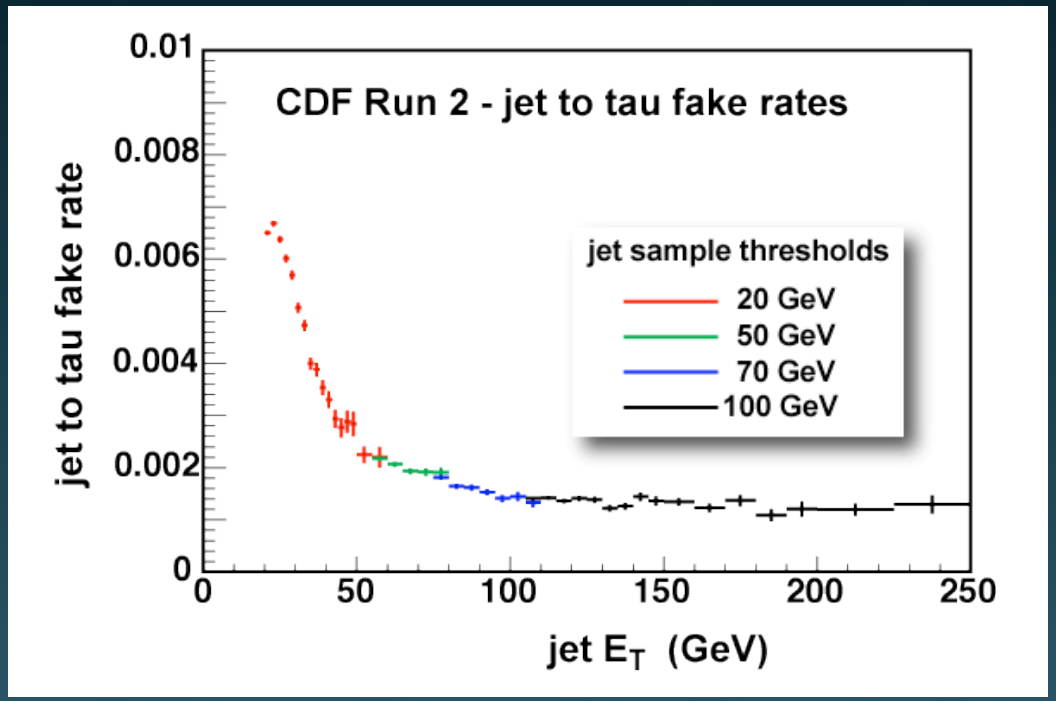




CDF tau ID performance

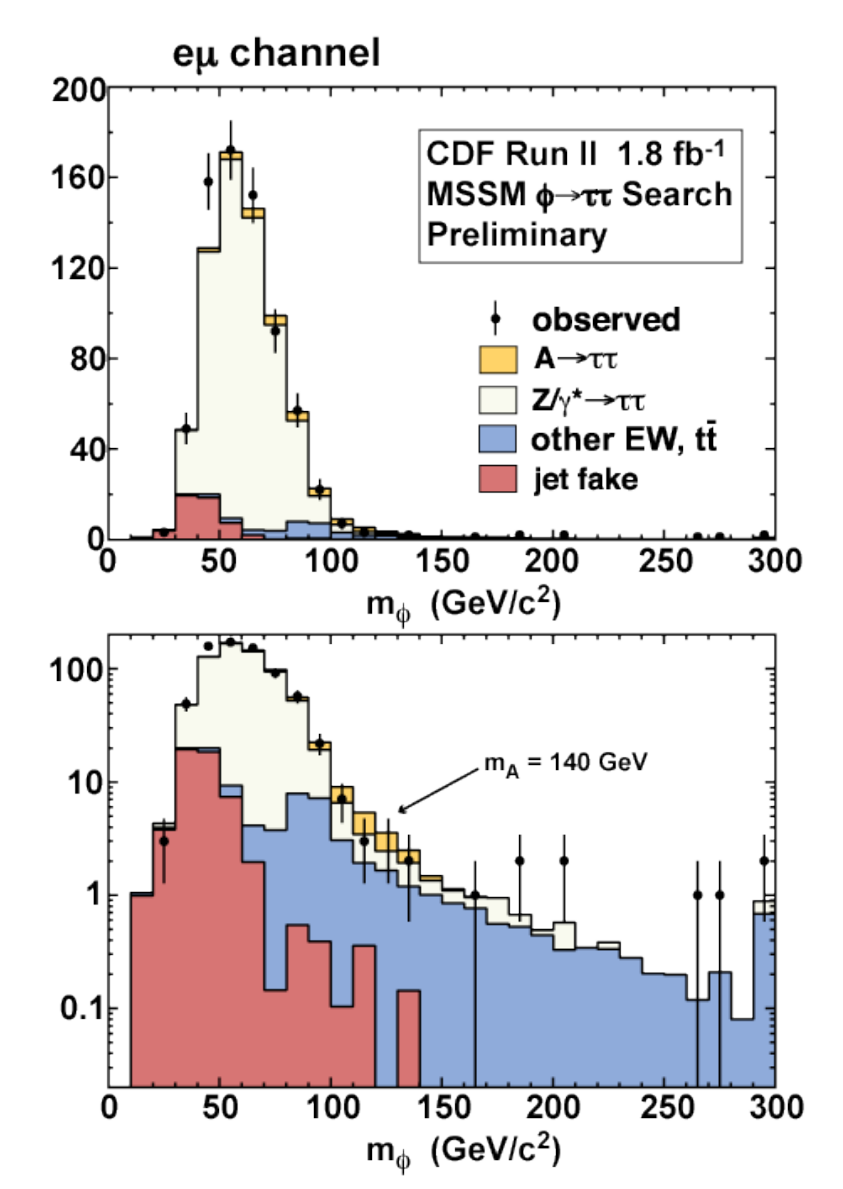


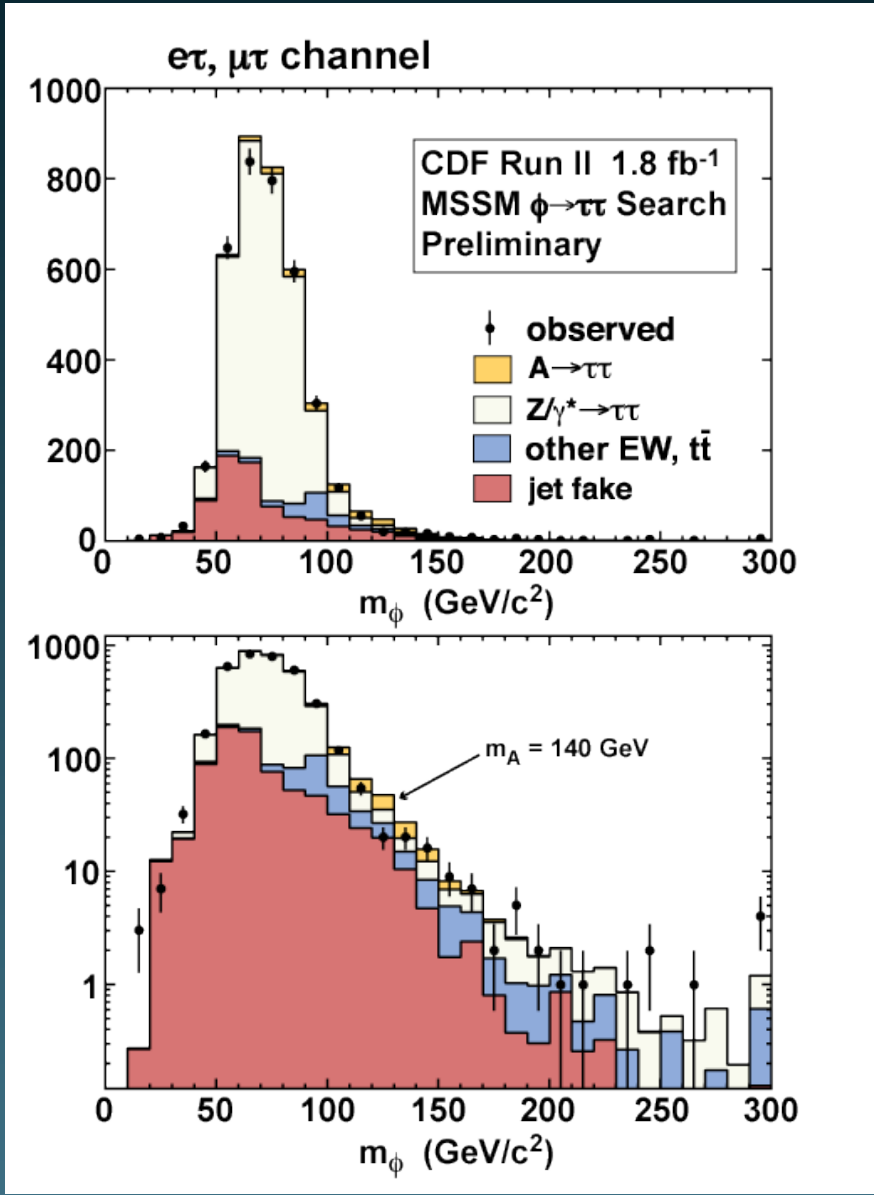
efficiency



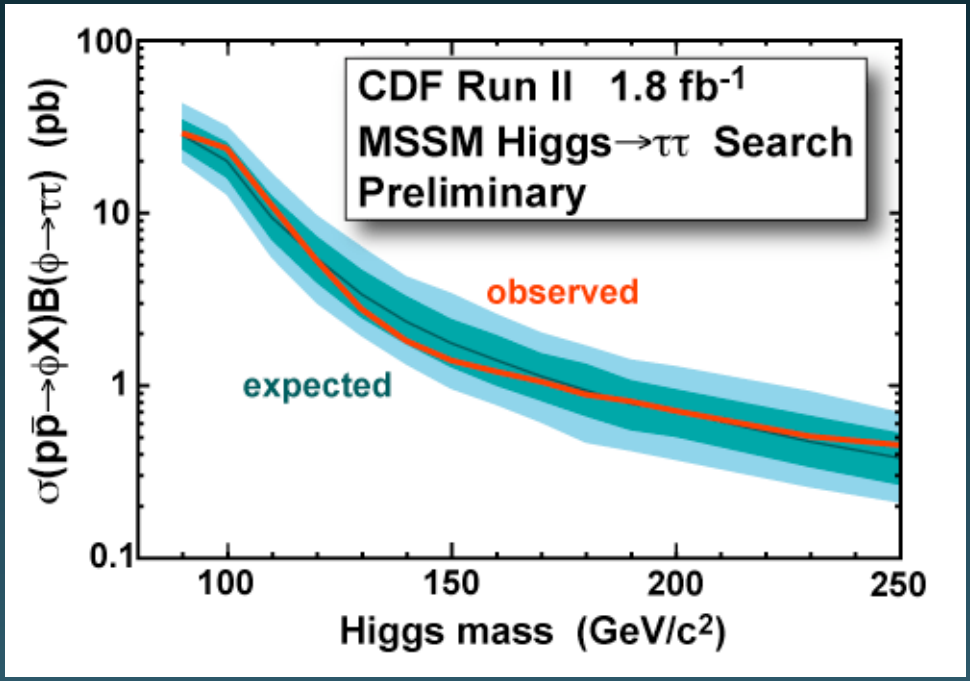
jet → tau fake rate

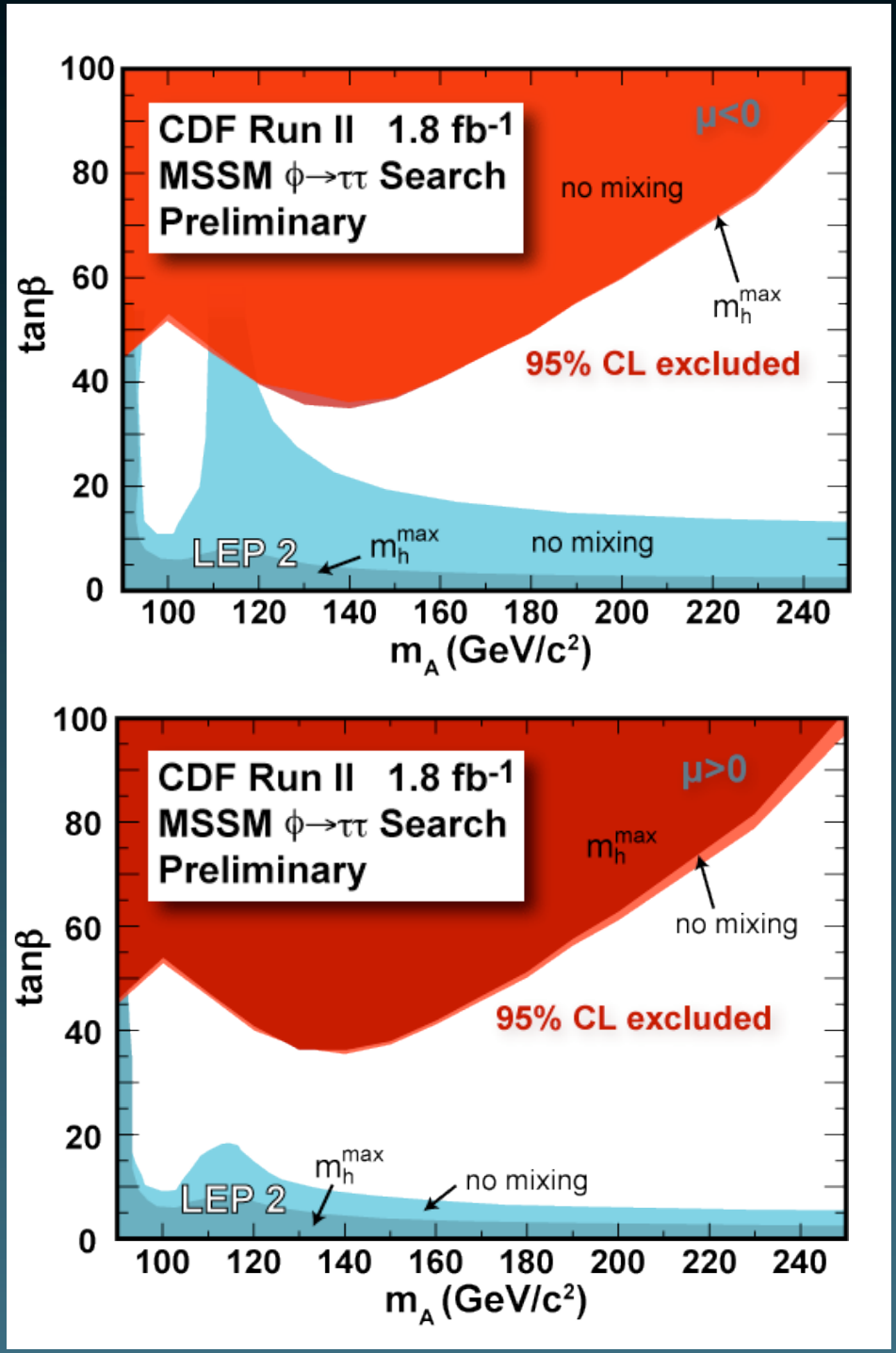
CDF search for MSSM Higgs: e+τ, μ+τ, e+μ
Use visible mass to distinguish from Z→ττ





Observed limits are in good agreement with those expected:





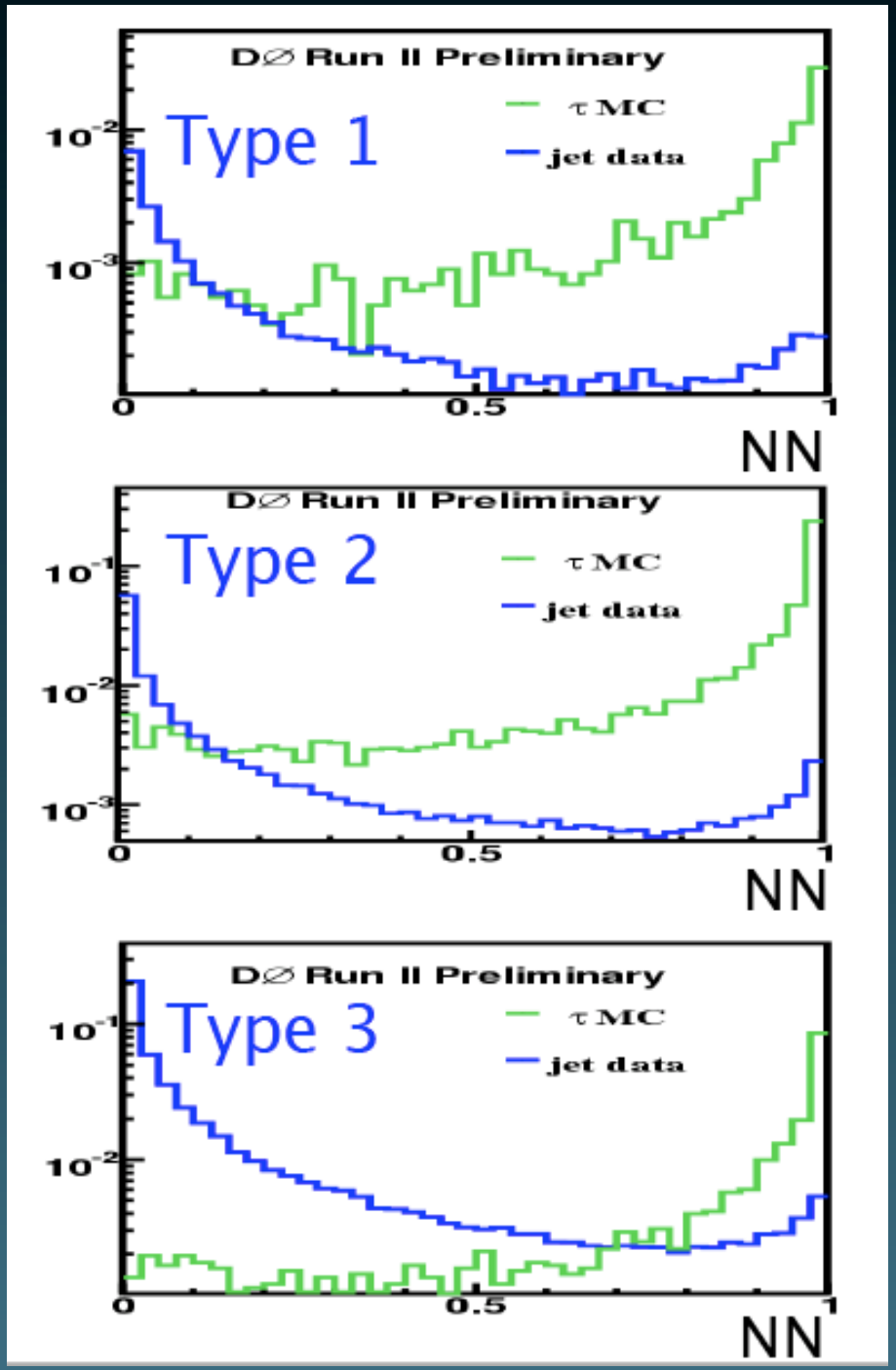
Tau results are insensitive to SUSY corrections and stop mixing assumptions

Tau ID in D0

Define categories related to tau decay mode:

1) $h^{\pm}$
2) $h^{\pm}$ + e.m. cluster(s)
3) h^{+} h^{+} h^{-}

Use NNs on each type to suppress QCD jets

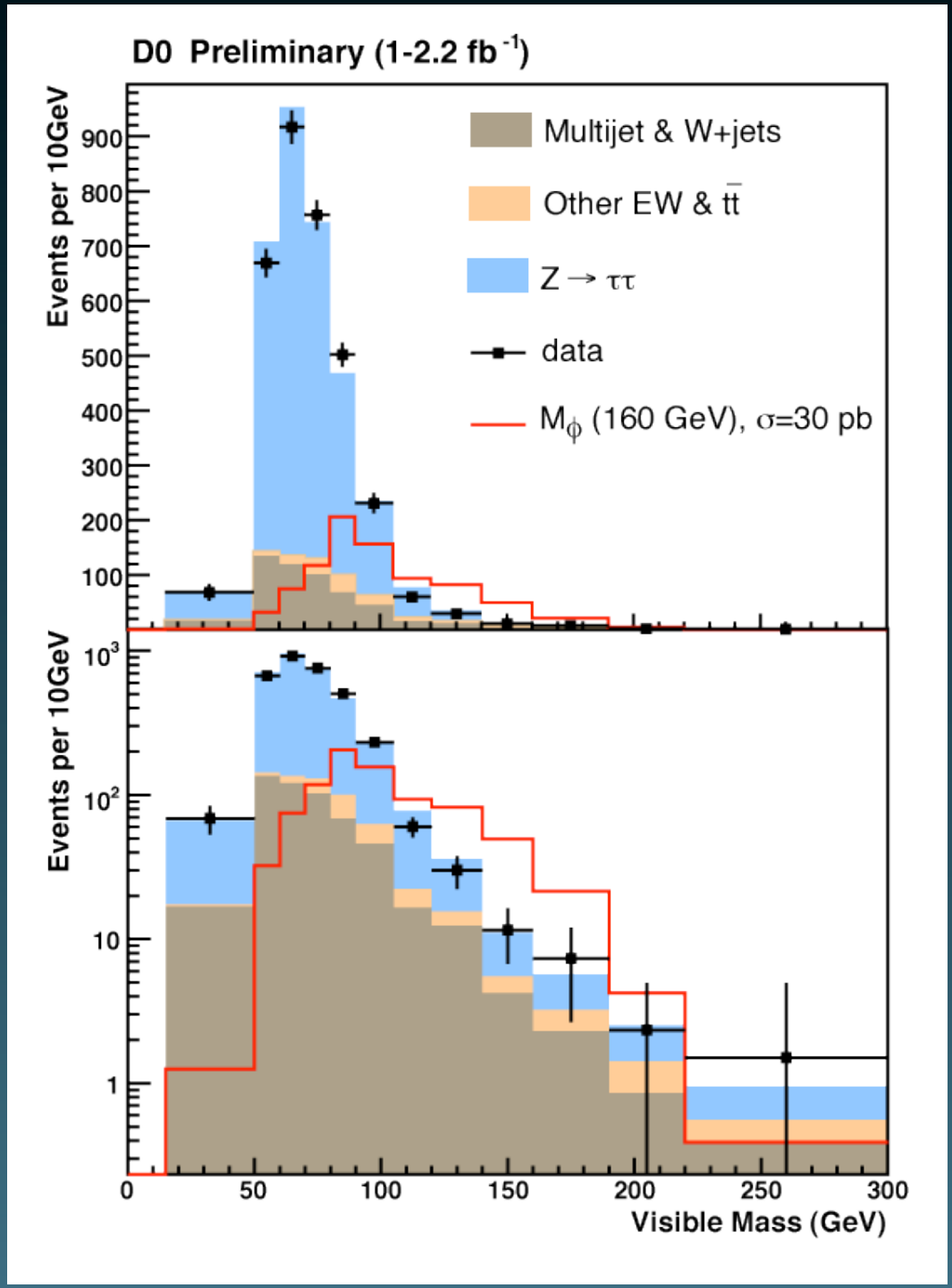


M. Bowen, Uppsala H+ Workshop 2006

D0 search for MSSM Higgs

e+τ, μ+τ, e+μ

Use visible mass to distinguish from Z→ττ



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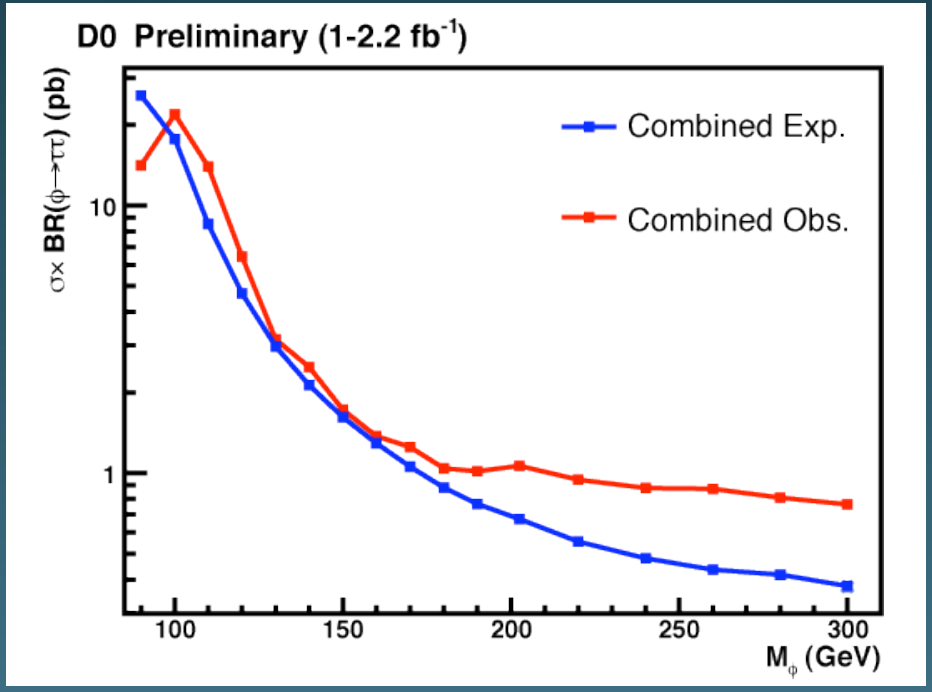
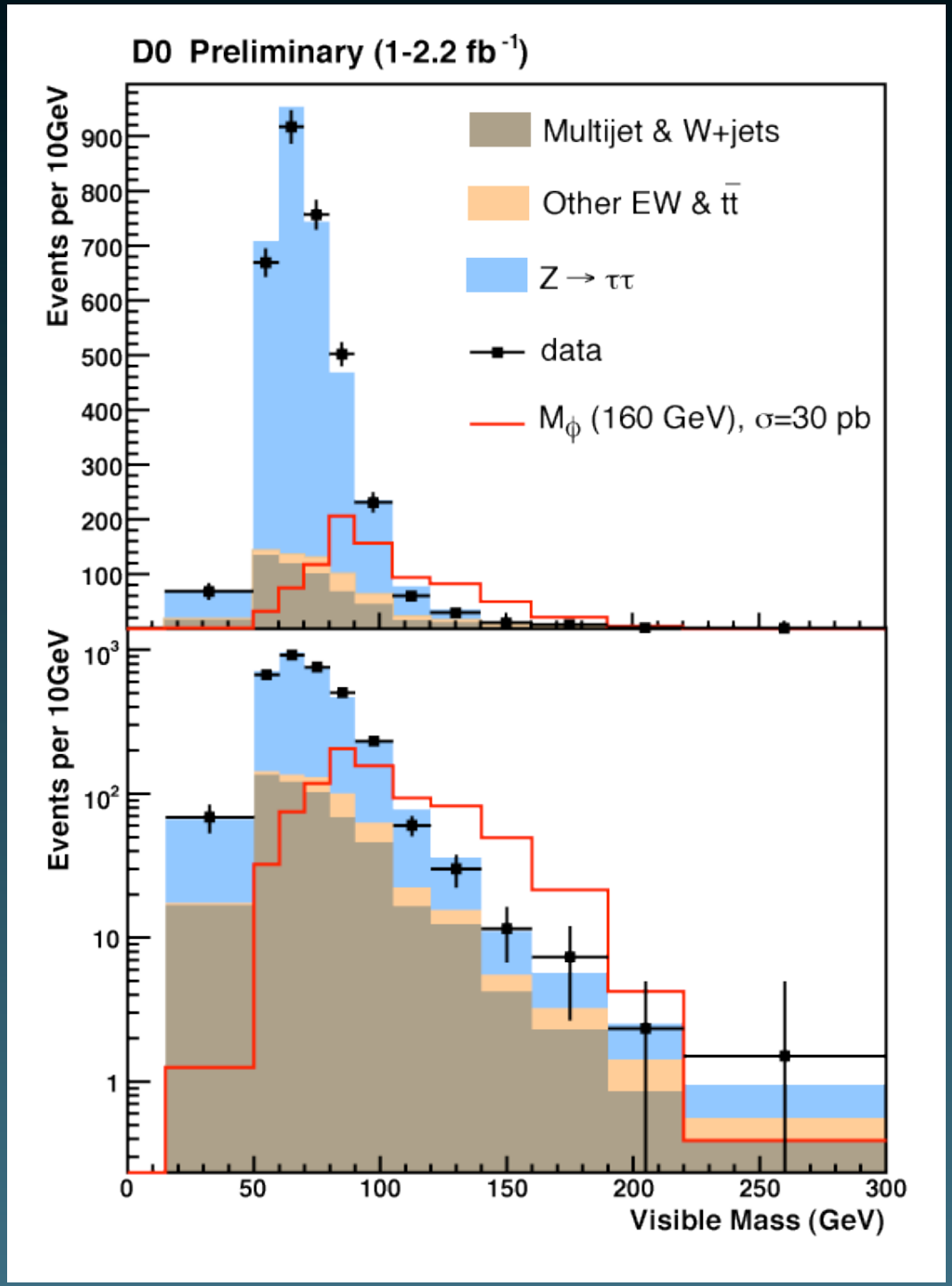
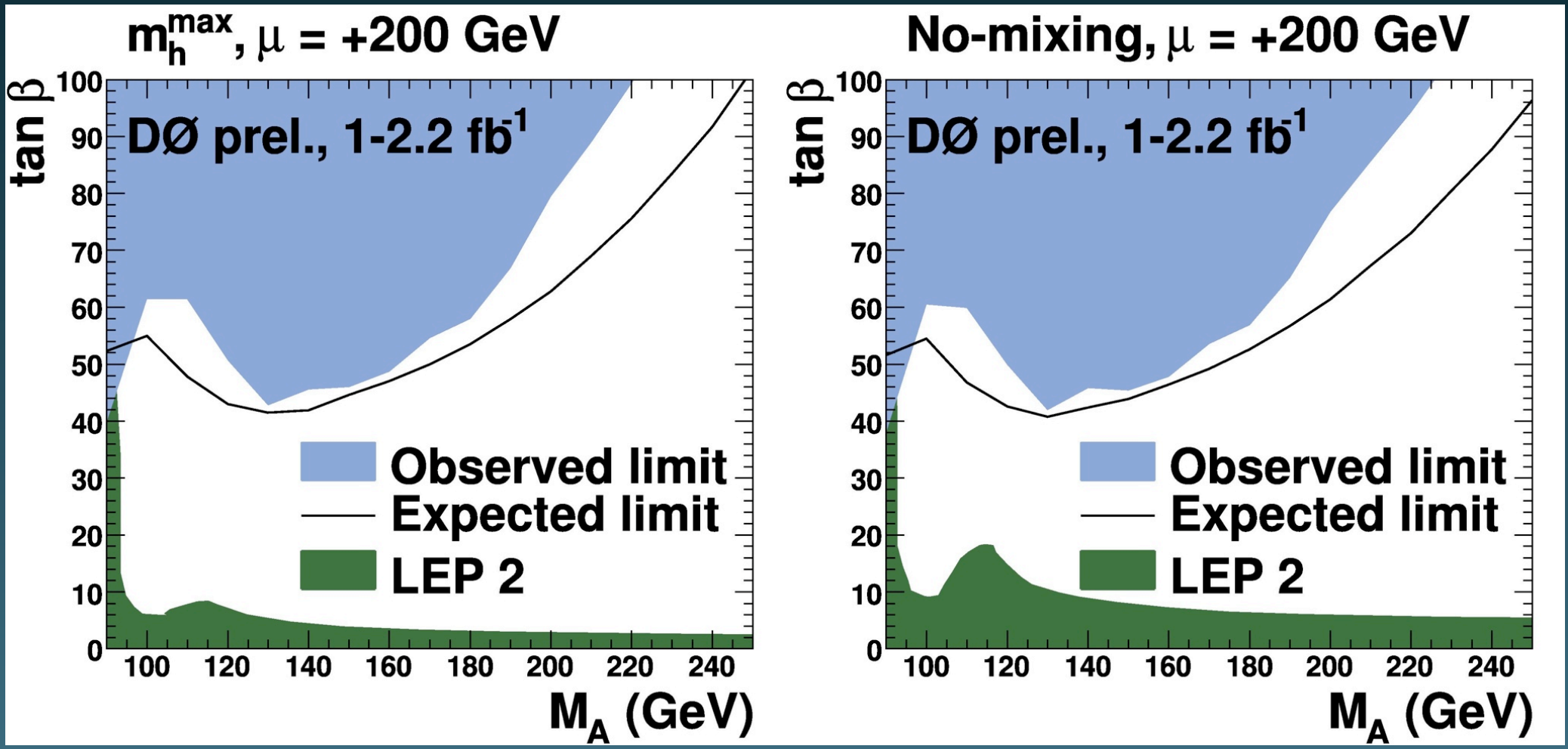




Express limits in MSSM parameter space; upward fluctuation ⇒ limits aren't quite as strong as expected

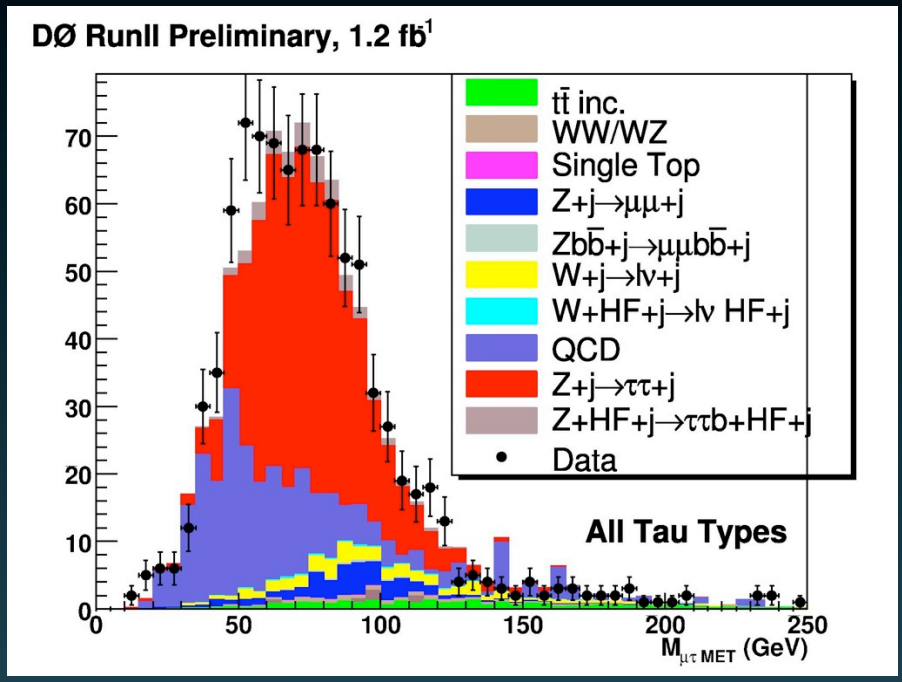


D0 search for MSSM ϕ + b

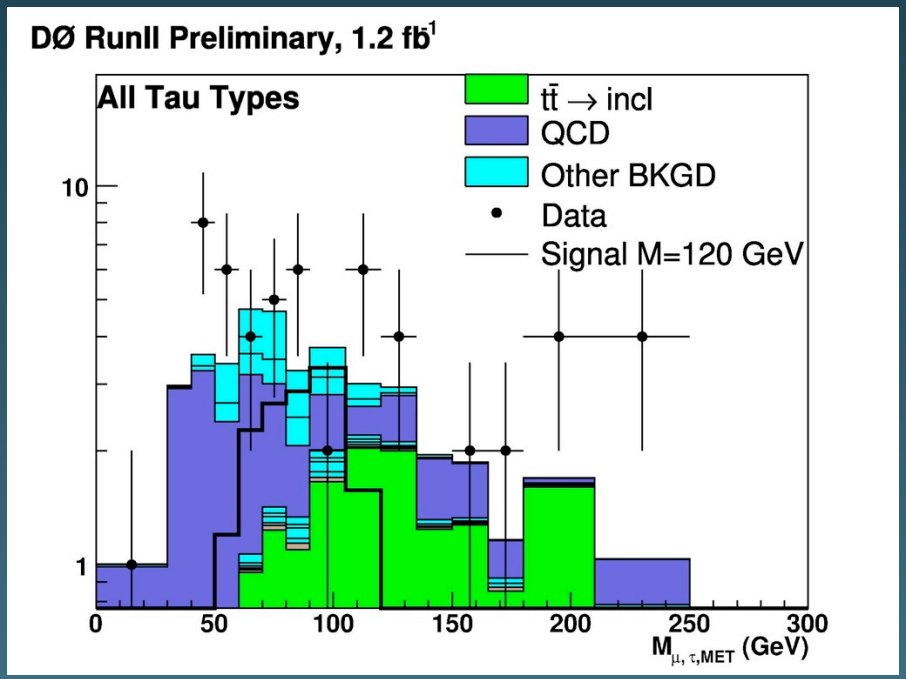
Select $\mu + \tau + b$ events

Backgrounds from

- Z + b
- Z + c
- Z + q (mistag)
- W + jets
- $t\bar{t}$
- QCD multijet

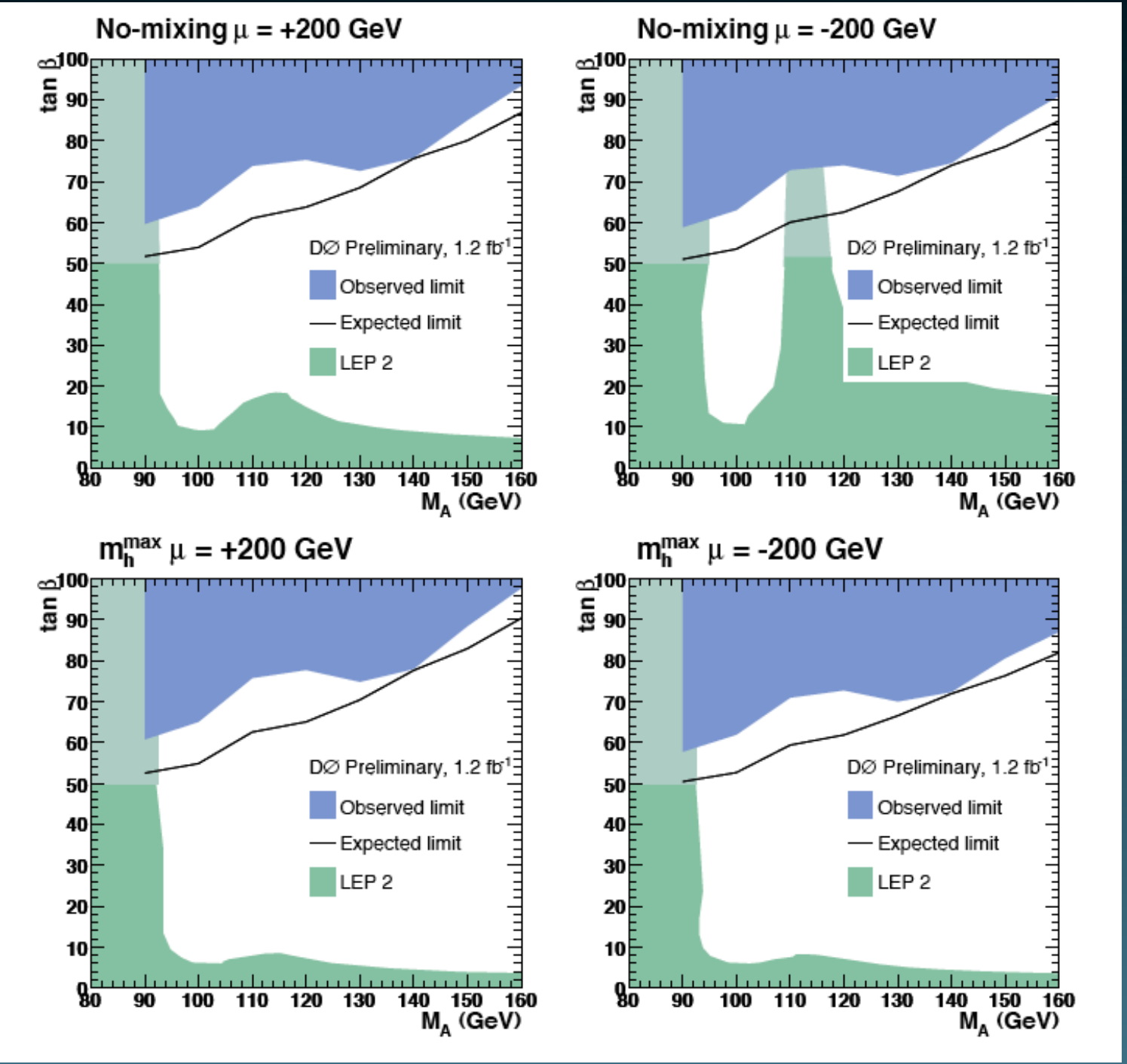


before b tagging



after b tagging

Interpret limits in the MSSM parameter space:



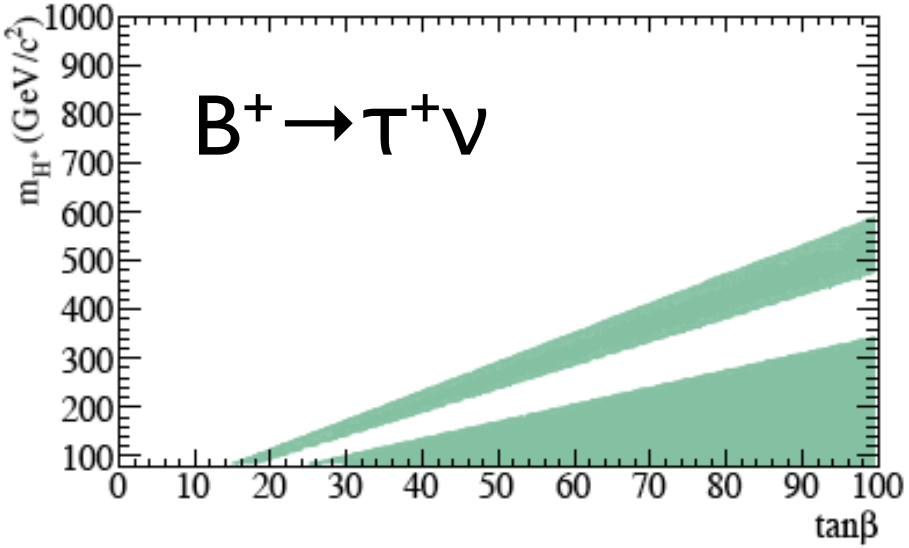
Want to combine all these results!

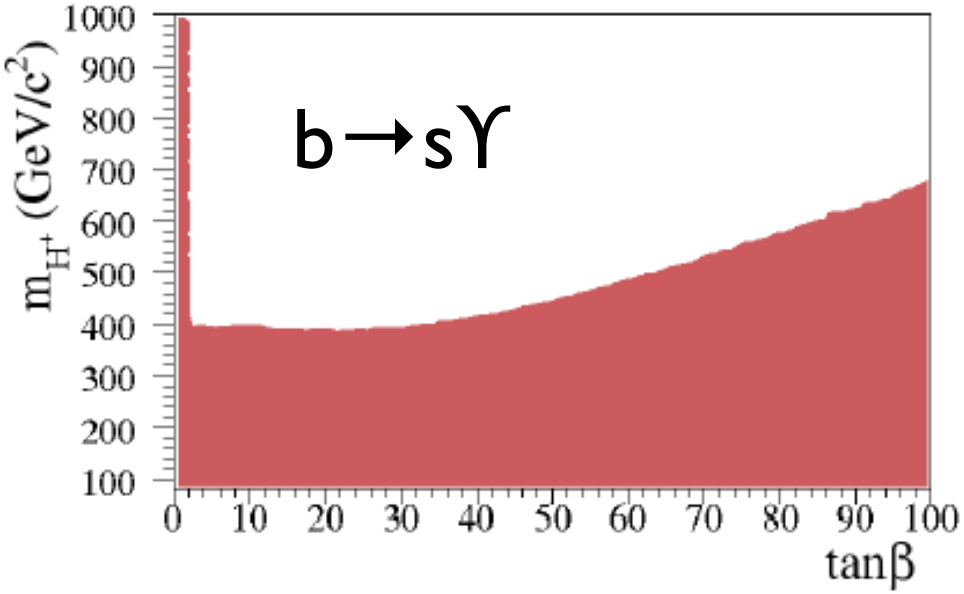
D0 has combined all their own channels...see next talk by Fiera Ritzadinova

Formal combination of CDF and D0 coming soon!

Updates to these results using ~5 fb^{-1} coming!

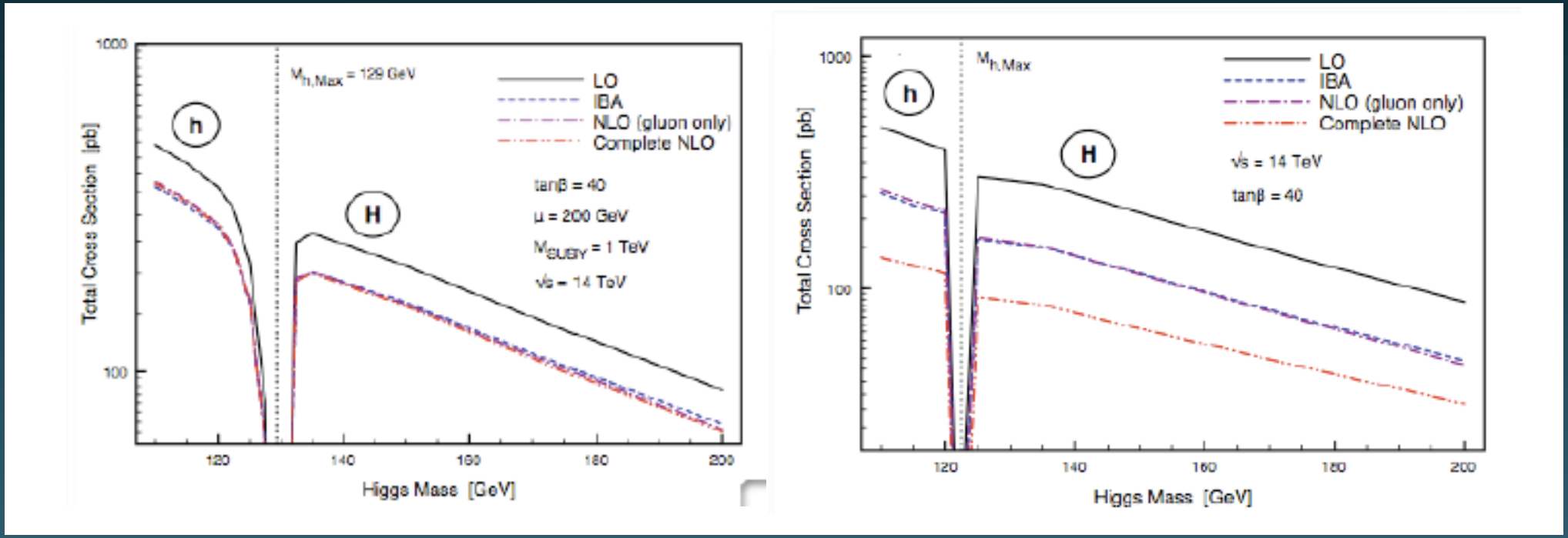
Bucket of cold water #1: limits from B decays





M. Barrett, arXiv:0903.4855

Bucket of cold water #2: strong SUSY corrections



C. Jackson, this parallel session

Including squark loops can dramatically suppress MSSM Higgs production; need to see effect at Tevatron