Moderated Discussion:

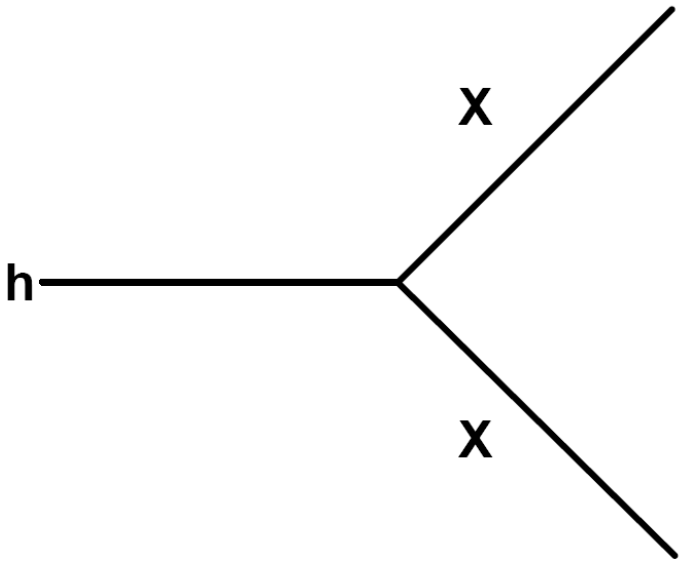
Higgs -> Missing and Visible Energy

Chang, Weiner - 0710.4591
Graesser - 0704.0438, 0705.2190
De Gouvea - 0706.1732
Kribs et.al. - 0706.3718
and others...

Natural Progression

One State

X must decay



Two States

$H \rightarrow X_i X_j$

for i, j = 1,2

X_1 can be stable,

if X_2 is unstable

Focus on $H \rightarrow X_1 X_2 \rightarrow f\,f + \not{E}$

Limits on ff + ME

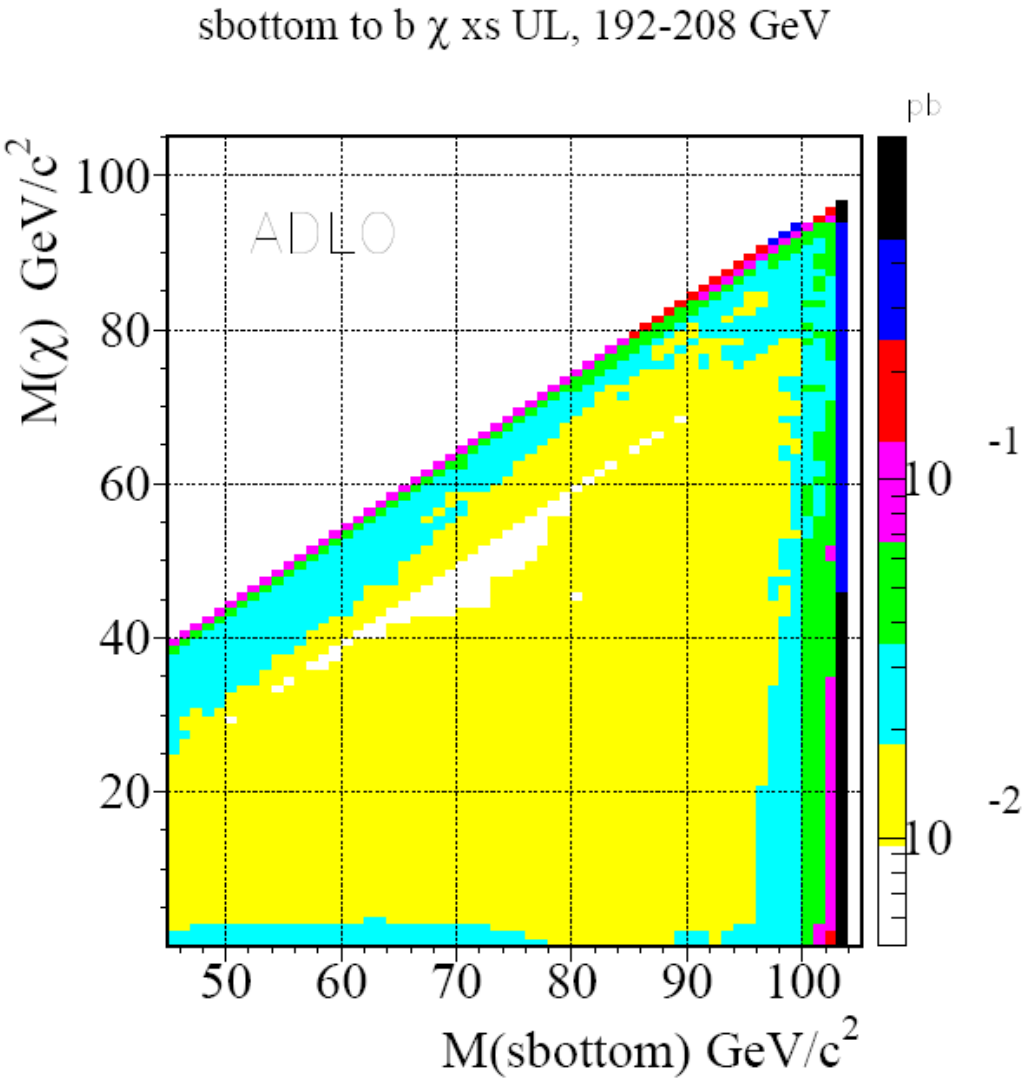
Limits at LEP, require missing energy

H-> W W* or invisible
superpartner production

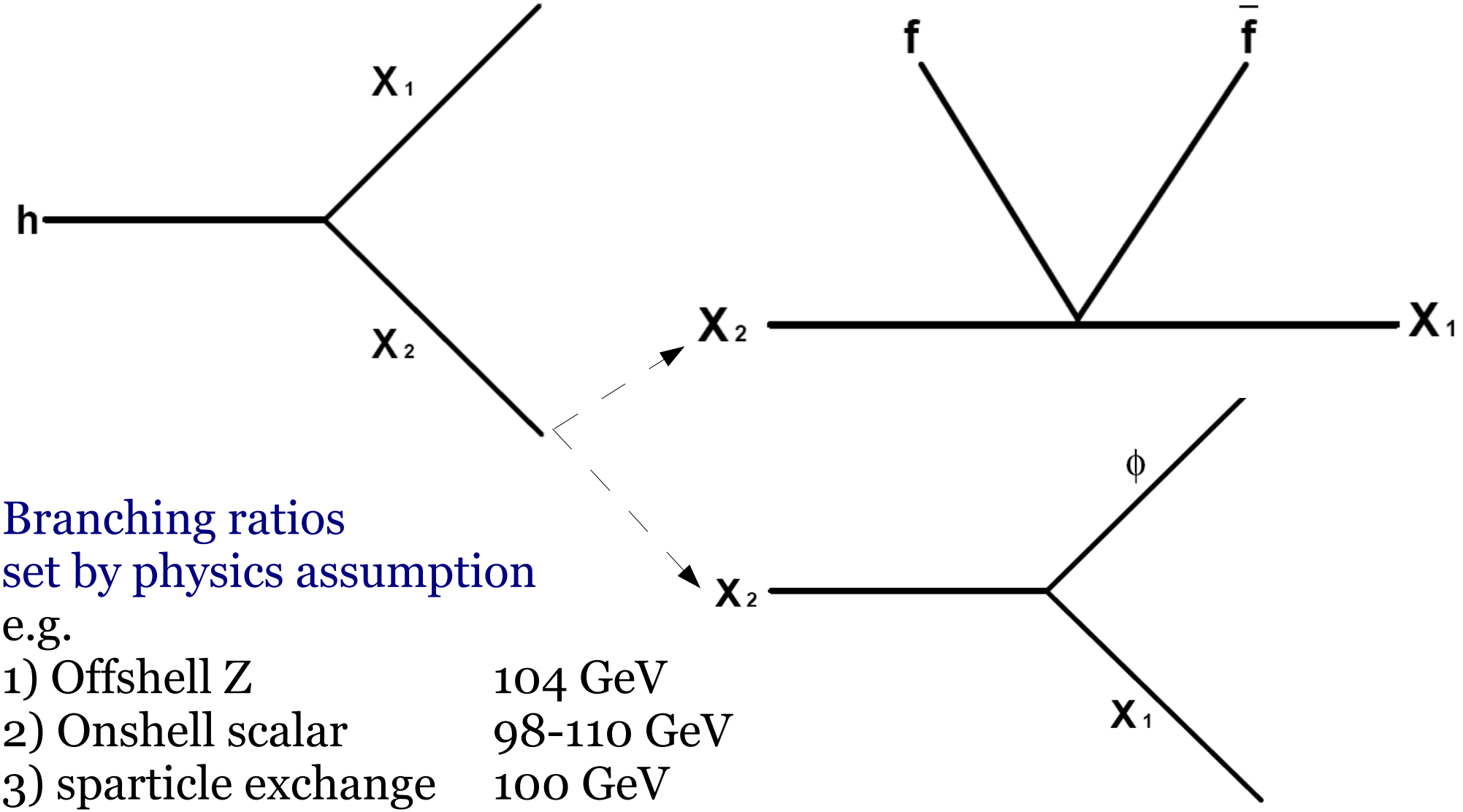
E.g. Fermion f = bottom quark

Best limit is from LEP2 limits on sbottom pair production

xsec limit <~ .02 pb
Compare w/ σ(hZ) * Br(Z invisible) ~ .1 pb



Limits on Decays with Missing Energy



Branching ratios
set by physics assumption

e.g.

1) Offshell Z	104 GeV
2) Onshell scalar	98-110 GeV
3) sparticle exchange domination	100 GeV

Models

Supersymmetric Models

Neutralinos – X1,X2 = $\chi 0$, $\chi 1$

Sneutrinos – X1,X2 = $\nu 1$, $\nu 2$

Neutrinos

Right handed neutrinos – X1,X2 = νL, νR

Model	X_1	X_2	X_2 Decay	Class
Neutrinos	ν_τ	$\nu_{\rm H}$	$\nu_{\rm H} \to Z^* + \nu_\tau, W^* + \tau$	i, ii
Neutralinos	χ_1	χ_2	$\chi_2 \to \phi + \chi_1, f\bar{f} + \chi_1$	i, iii
Sneutrinos	$\tilde{\nu}_1$	$\tilde{\nu}_2$	$\tilde{\nu}_2 \to f\bar{f} + \tilde{\nu}_1$	i

Topic 1 – Higgs searches

Promising channels: dileptons + MET, trileptons+ MET, MET, bb + MET

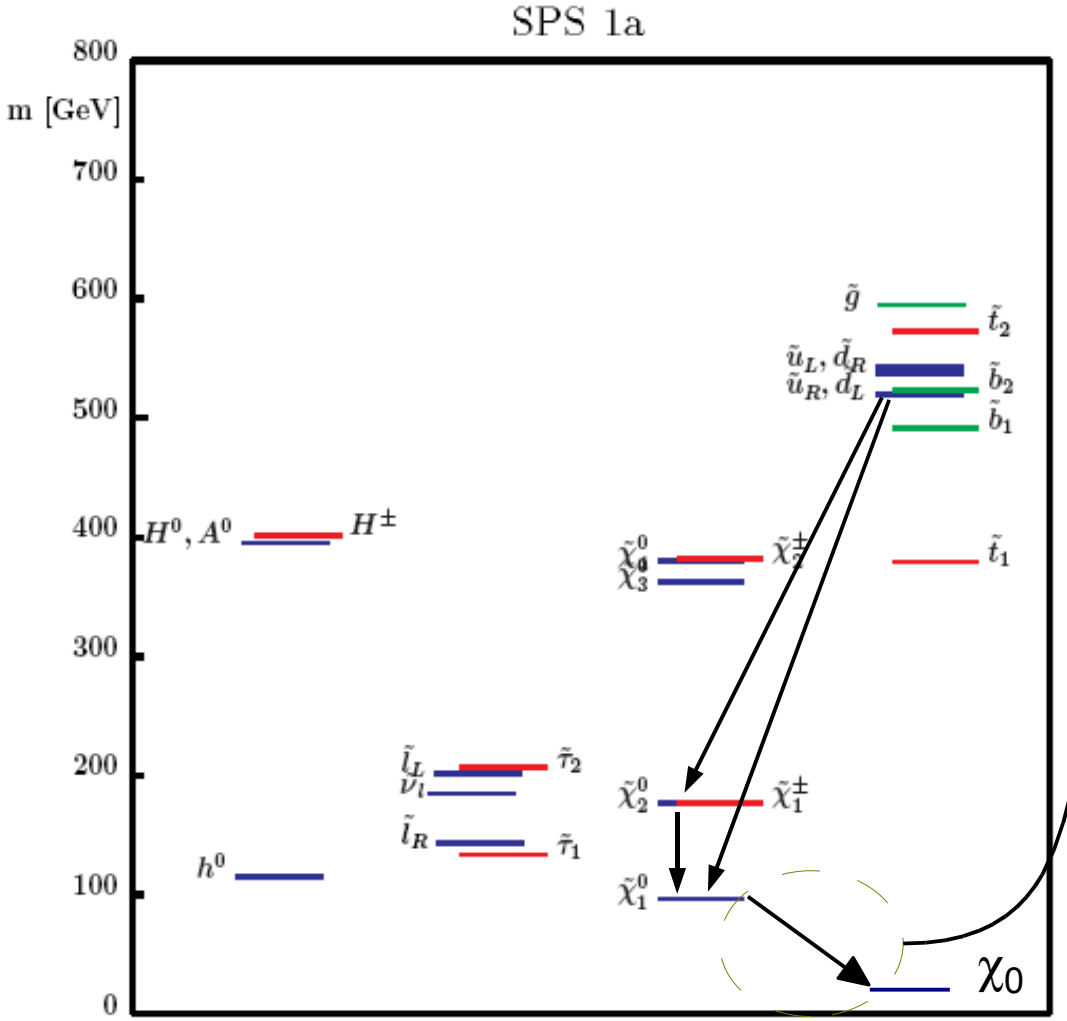
VBF seems to be required
Similar to SUSY channels

Issues:

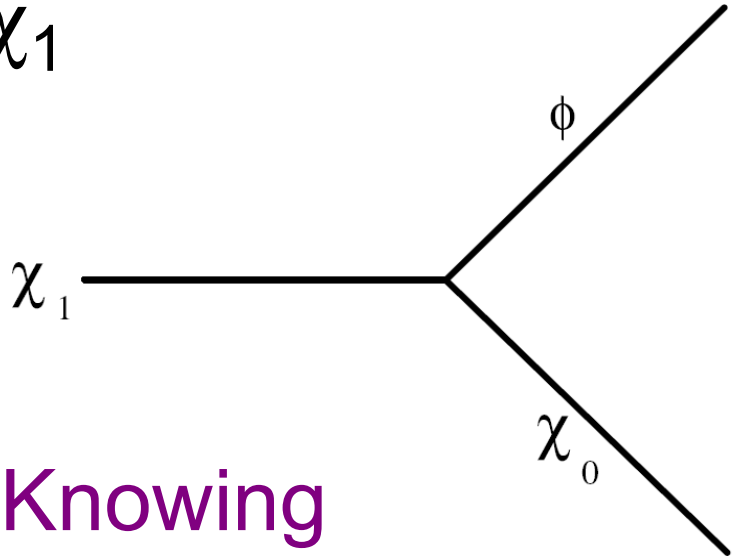
Can this be seen?

Suffer from SUSY backgrounds or potentially confused with SUSY?

Effects in SUSY cascades



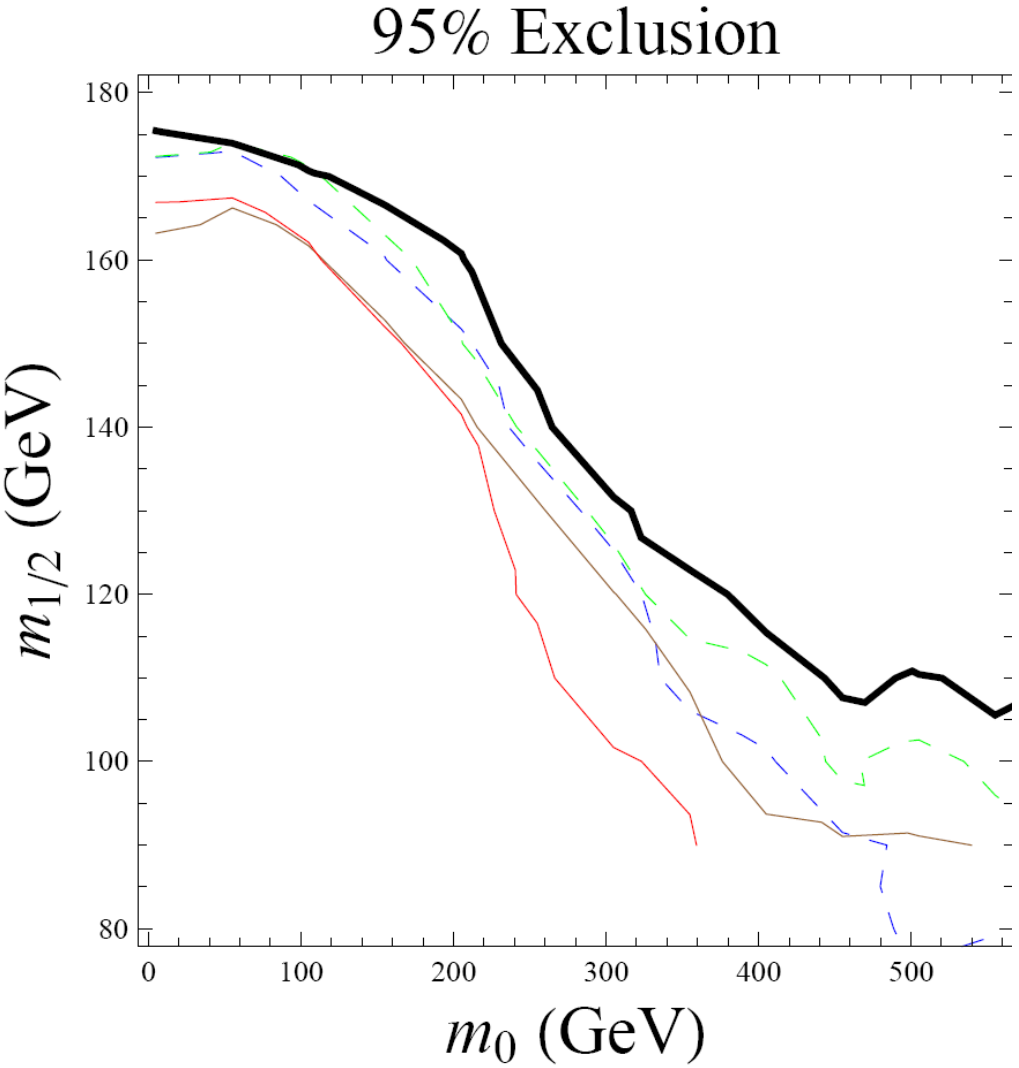
Supersymmetric particle cascade to LSP χ_0 through χ_1

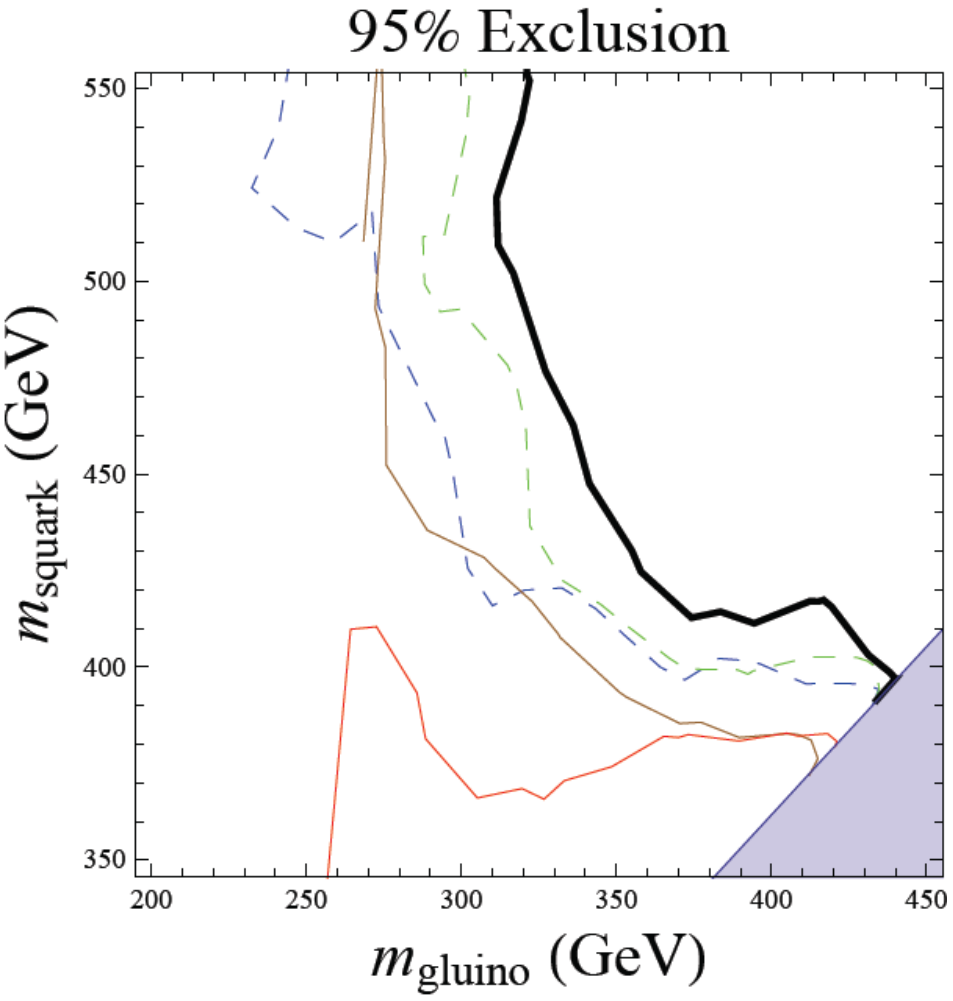


Knowing $\chi_1 \rightarrow \chi_0$ decay predict Higgs decay

Effects on gluino/squark limits

D0 squark search





Unmodified, Phi(bb), Phi($\tau\tau$), Offshell Z, 3body(visible)

Topic 2 – Deducing Higgs decay

If SUSY is found and no SM Higgs (~ 30 fb^-1), can Higgs decay be deduced by extracting

$\chi 1 \rightarrow \chi 0$ + Phi, where Phi -> bb, tau tau
with mPhi ~ 5-20 GeV

Can we extract mass of Phi, Branching ratios?

$\chi 1 \rightarrow \chi 0$ + ff, a 3 body decay

Can we extract Branching ratios?

How useful is this for designing searches for H-> $\chi 1$ $\chi 0$?
Triggers, Cuts?

Also...

Displaced vertices (Graesser) H-> NN

Two per Higgs, e.g. BR's for N below

final state	Branching Fraction
light quark flavors + charged lepton	$6c_W/N_{tot} \simeq 0.50$
light quarks + missing energy	$1.5c_Z/N_{tot} \simeq 0.13$
$c\bar{c}$ + missing energy	$0.43c_Z/N_{tot} \simeq 0.036$
$b\bar{b}$ + missing energy	$0.55c_Z/N_{tot} \simeq 0.046$
two charged leptons and missing energy	$(2c_W + 0.59 + 0.26c_Z)/N_{tot} \simeq 0.24$
neutrinos	$\approx (1/8 + c_Z/2)/N_{tot} \simeq 0.05$

Not missing energy, but generally

A worry, in general, will we trigger efficiently on nonstandard Higgses?

H-> n SM implies pT ~ mH/n ~ (100/n) GeV

e.g. H-> 4 photons

Question: Worth it to design multiple object triggers with reduced thresholds?

Naively can be fit in the trigger budget with little “cost” and can help in many scenarios (this, hidden valley, unparticles, quirks)