
Pair Production of Higgs Bosons

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- The question:

“We can’t even find one, why look for two?”

- Why we need to look for Two

The 4- b final state is an important search channel that occurs in essentially all 2HDM extensions

There is significant parameter space that cannot be excluded by LEP for SUSY with explicit CP violation in the Higgs Sector

LEP mass limits for lightest CPX higgs: H_1

For $\tan \beta \gtrsim 25$ $M_{H_1} \gtrsim 60$ GeV

Exact limits depend on CP-phases of trilinear couplings

For $\tan \beta \sim 4$ $H_1 = 20$ GeV allowed

- Status and Plans

MSSM Production Processes

- The 4- b final state

Can arise via a number of different mechanisms
2HDMs, SUSY, CPX SUSY, SM, Technicolor

Standard MSSM:

$$gg \rightarrow AA$$

Proceeds via bottom loop

$\tan \beta$ enhancement not as important

Typical cross-sections 10-30 fb

Can be very large enhancements for light sbottom

$$q\bar{q}/gg \rightarrow hA$$

Two production mechanisms: DY and b loop

Cross sections at 10-100 fb

Large SUSY model dependencies

Fewer kinematic constraints

CP Violating MSSM:

$$gg \rightarrow H_2 \rightarrow H_1 H_1 \rightarrow 4b$$

H_2 similar to SM Higgs, H_1 similar to SuSy A

Cross sections tend to be large: picobarn level

SUSY model dependence arises in H_2 decay

Kinematically identical to $\rho_T \rightarrow \pi_T^0 \pi_T^0$

General Features

- There are 3 distinct scenarios to be considered:

$$X \rightarrow YY \rightarrow 4b$$

$$XY \rightarrow 4b$$

$$XX \rightarrow 4b$$

The most important search $X \rightarrow YY \rightarrow 4b$

Larger cross-sections and 3(!) mass constraints

Will focus on this channel at first

- Basic Plan

Use current hbb analysis 4 b -tag channel selection

Use loose b -tags: OR of SVT loose and SLT

Compute probability for each candidate to be consistent with a $X - Y$ mass pair

Select pairing with highest prob. for given mass

Assume all events are signal, i.e. no background subtraction

Compute limits, write it up and Publish

- Current Status

Monte Carlo samples requested

Introducing myself to the Higgs Multijet package

Stay tuned