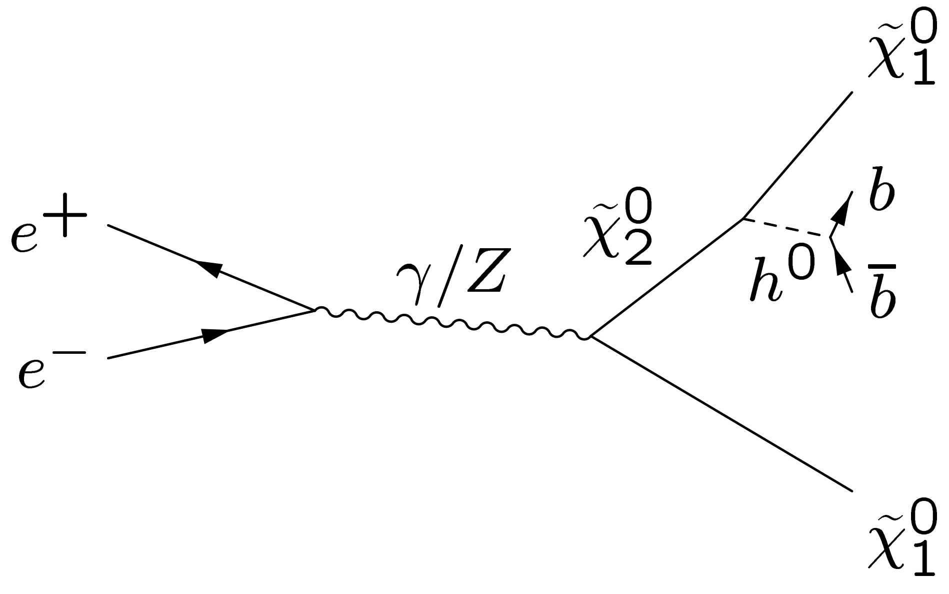
$\tilde{\chi}_1^0 \tilde{\chi}_2^0$ Signal at Point 1

Feynman diagram showing production of $\tilde{\chi}_1^0 \tilde{\chi}_2^0$ signal and how it decays given the mSUGRA parameters of Point 1:



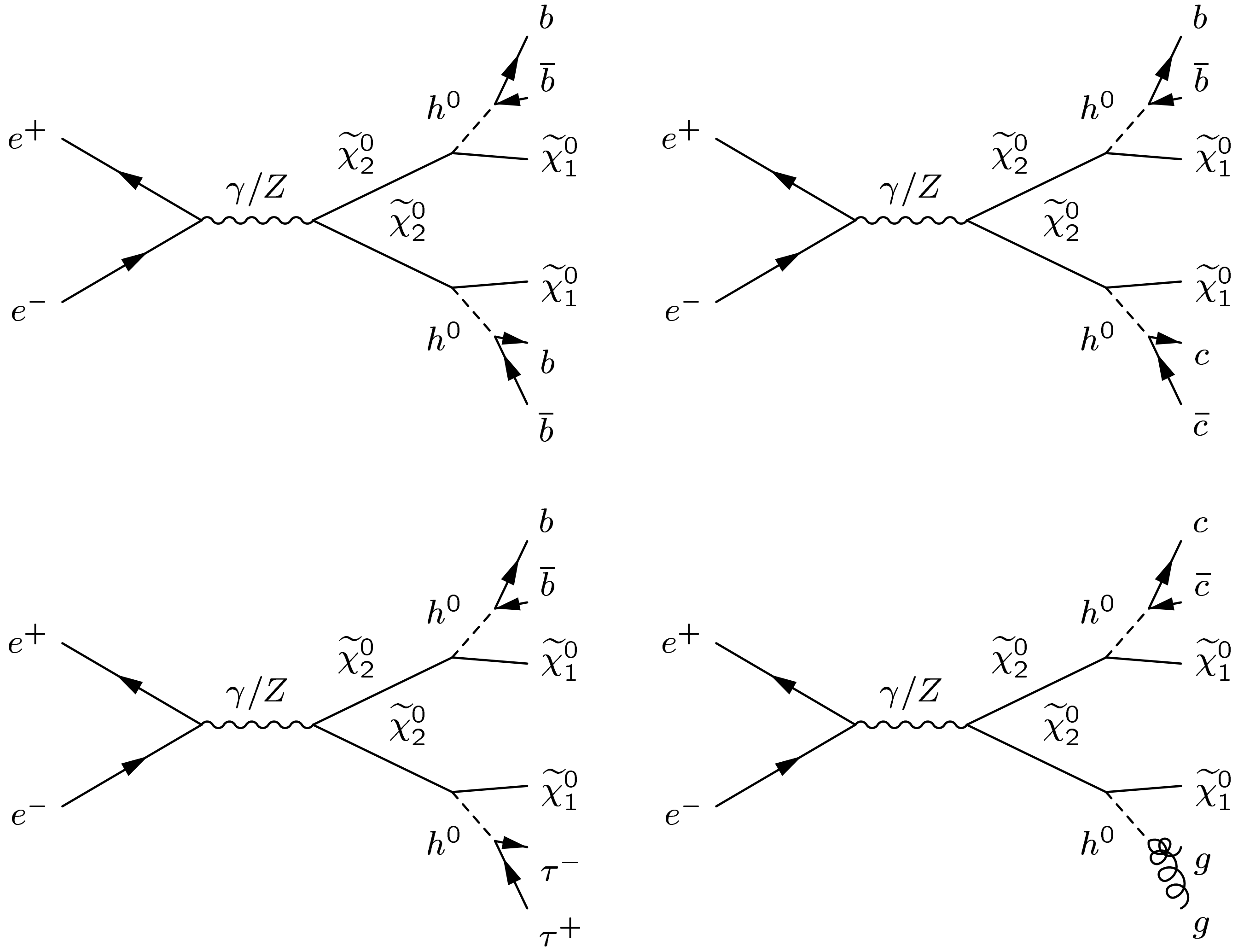
Cross Sections

These cross sections are expected for a 500 GeV center of mass energy (E_{cm}) with a 60% Polarization of electron beam:

Signal	Left (in fb)	Right (in fb)
$\tilde{\chi}_1^0\tilde{\chi}_1^0$	40	122
$\tilde{\chi}_2^0\tilde{\chi}_2^0$	32	8
$\tilde{\chi}_1^0\tilde{\chi}_2^0$	44	10
$\tilde{\chi}_1^+\tilde{\chi}_1^-$	527	132
h^0Z^0	69	58
total	712	330

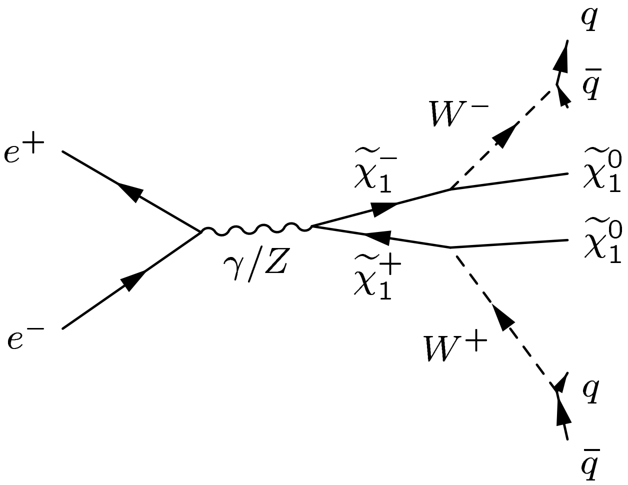
Background Signals

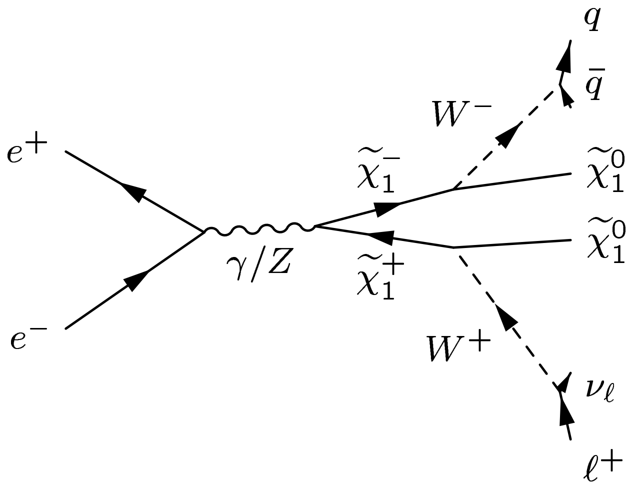
$\widetilde{\chi}_2^0\widetilde{\chi}_2^0$ Signal at Point 1:

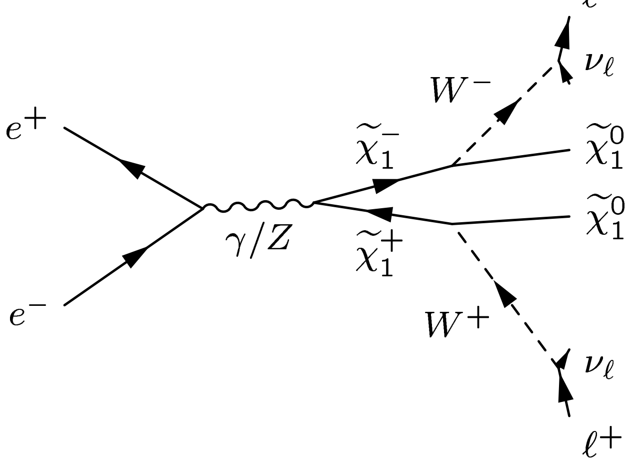


Background Signals

$\tilde{\chi}_1^+ \tilde{\chi}_1^-$ Signal at Point 1:

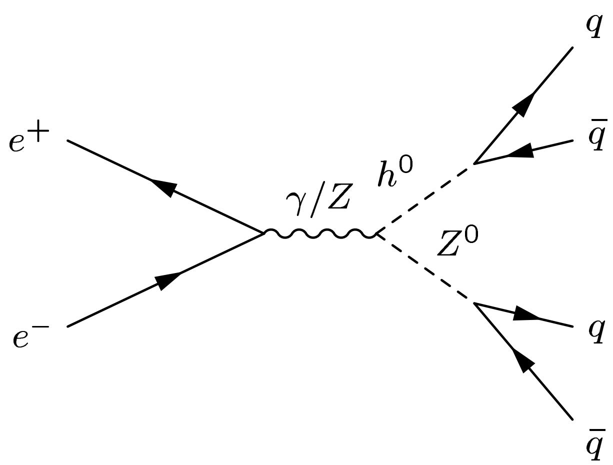


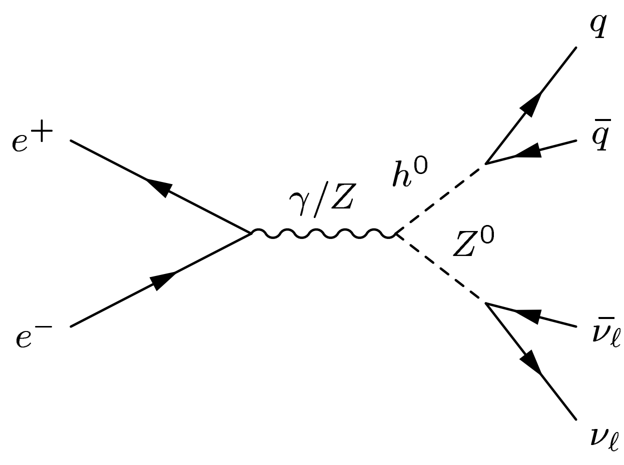


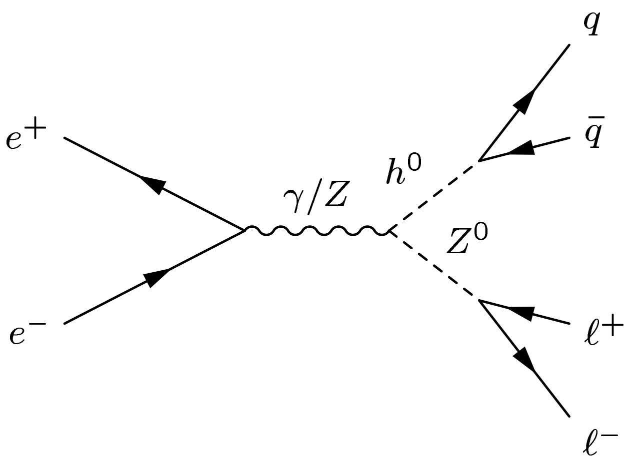


Background Signals

$h^0 Z^0$ Signal at Point 1:







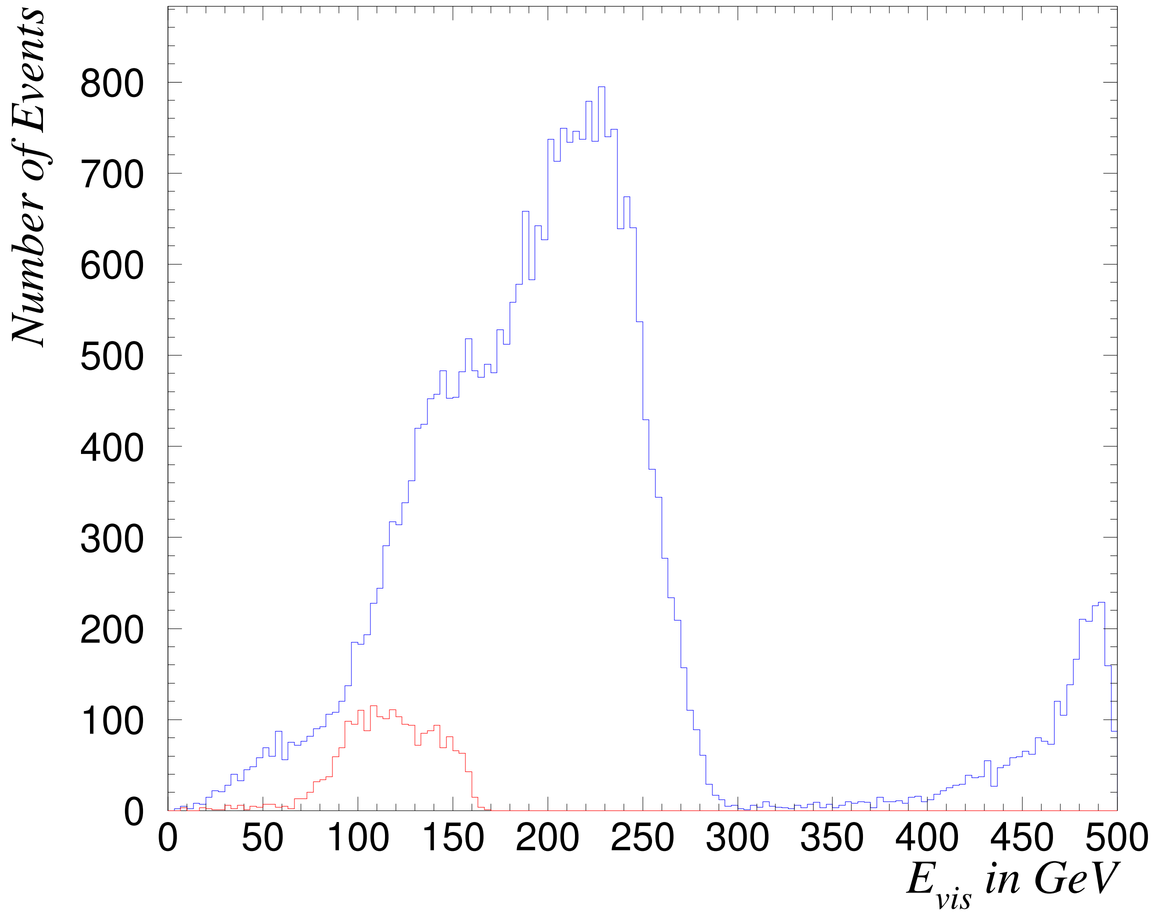
The Cuts

To enhance the $\tilde{\chi}_1^0 \tilde{\chi}_2^0$ signal over the background, events must have:

- more than three visible particles
- less than 50 GeV of energy in the backward direction (E_{back})
- less than 200 GeV of energy difference between E_{for} (energy in the forward direction) and E_{back}
- no e^+, e^-, μ^+, μ^-
- two b-quark jets

Uncut Signals

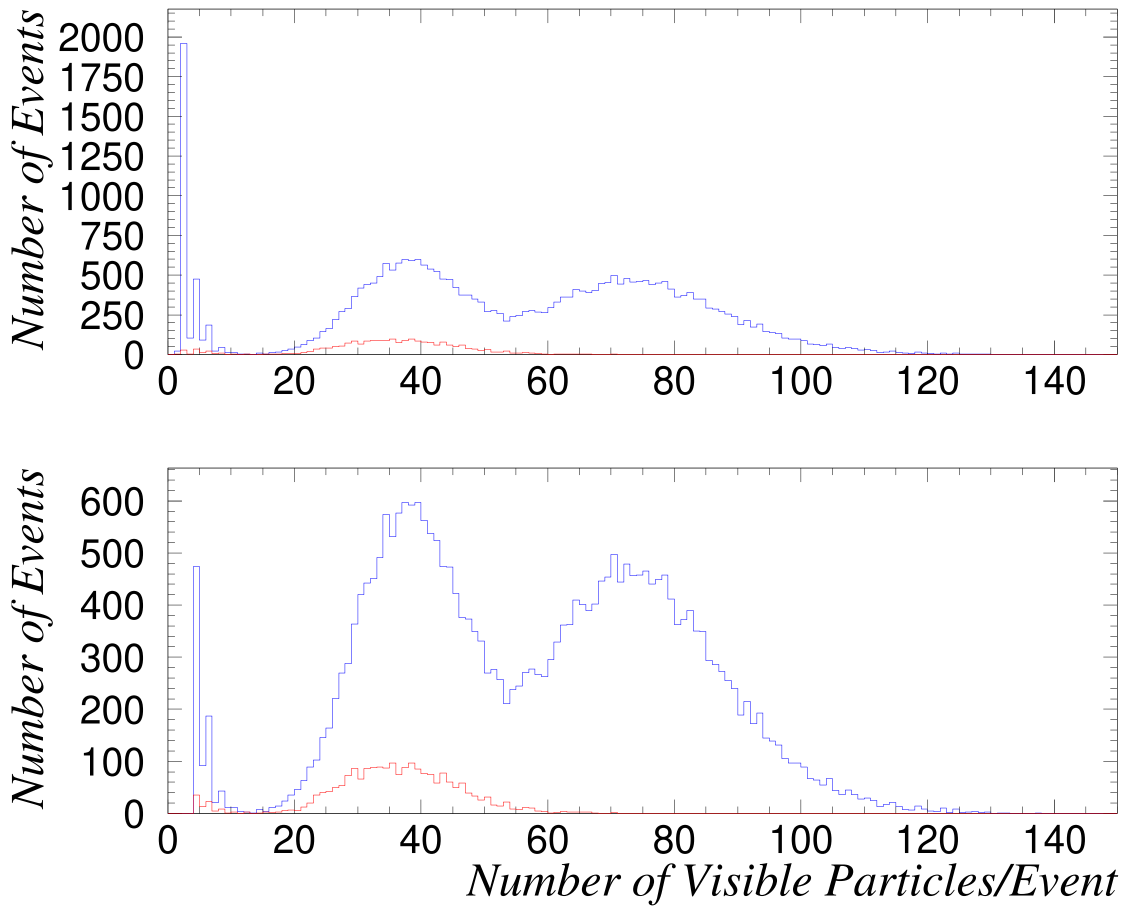
Visible Energy (E_{vis}) of Uncut Signals:



Note: In this and all following plots, red plot is the $\tilde{\chi}_1^0\tilde{\chi}_2^0$ signal; blue plot is the supersymmetric background.

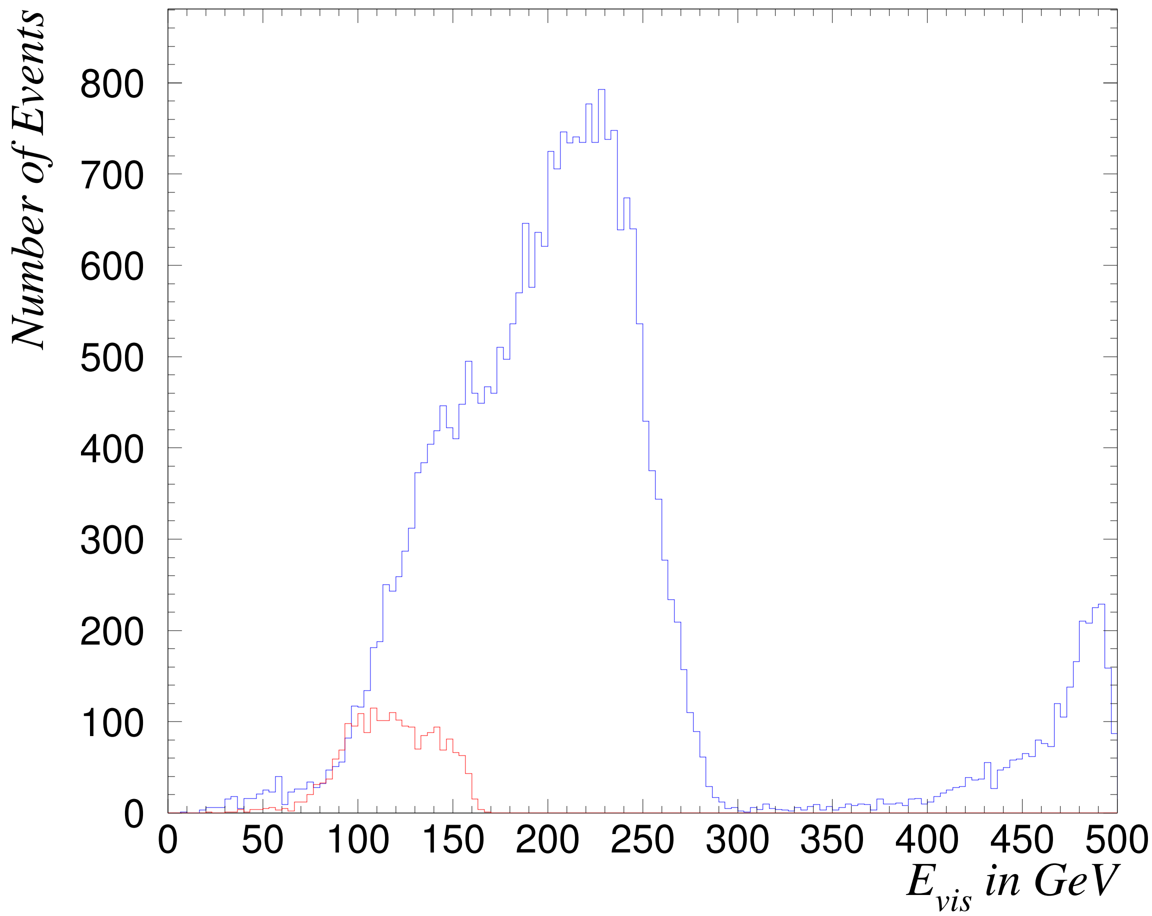
Cut 1

Plots showing the number of visible particles in the signals before (top) and after (bottom) requiring the number of visible particles to be greater than 3:



Effect of Cut 1

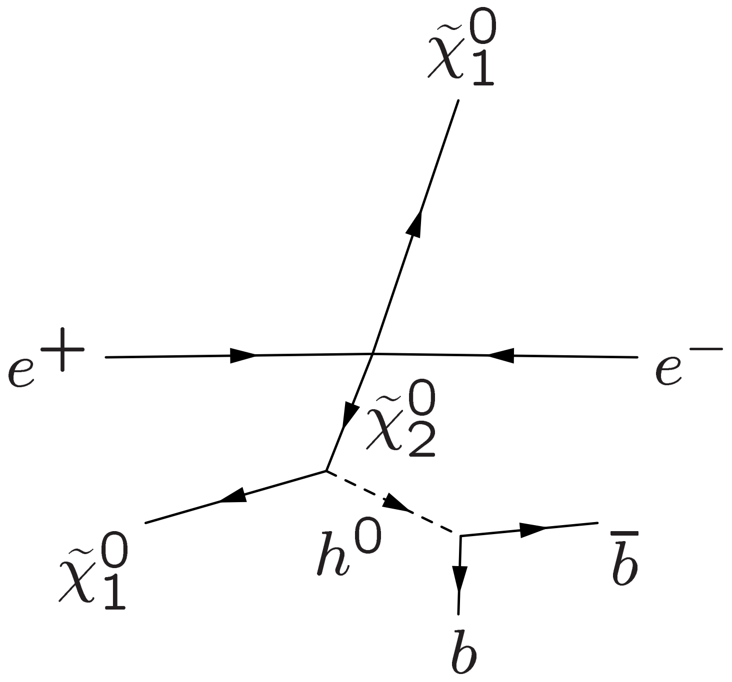
E_{vis} of signals after requiring the number of visible particles to be greater than 3:



$\boxed{\text{Cut 2}}$

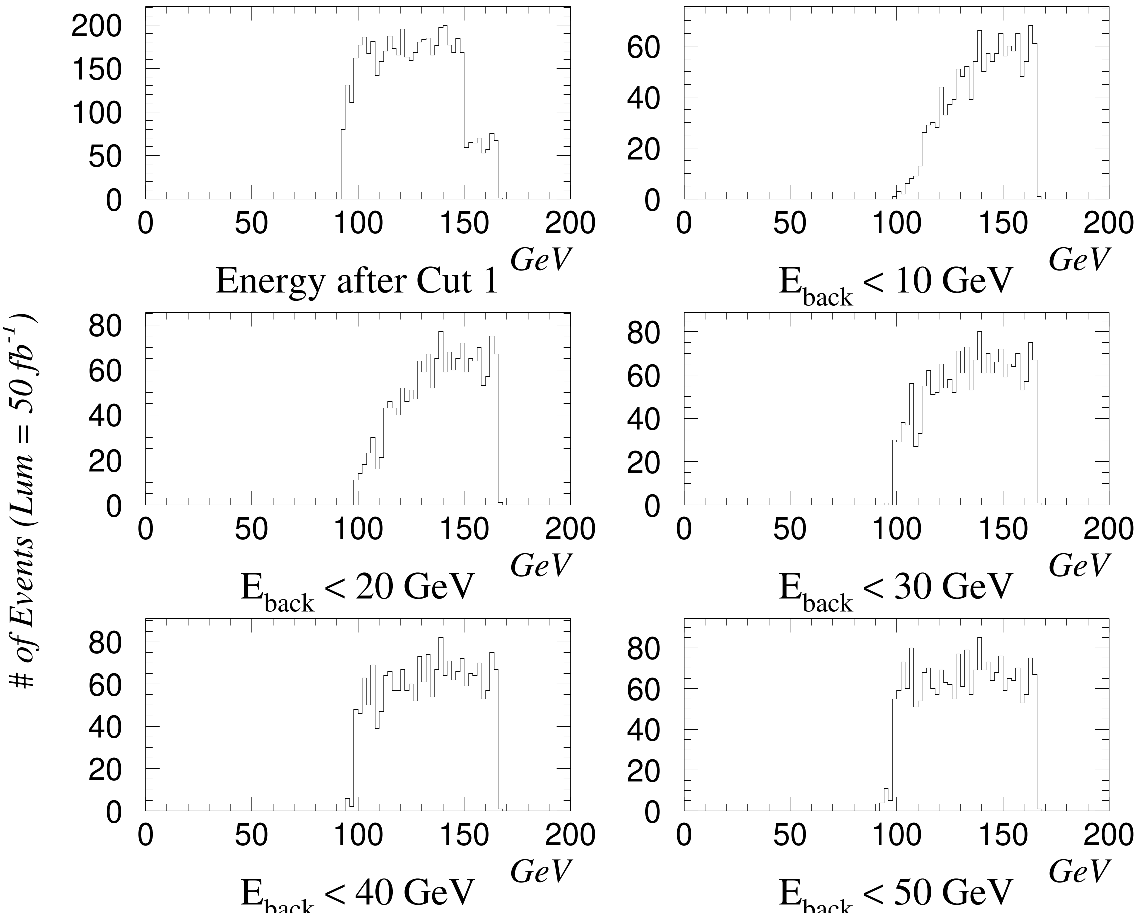
Diagram illustrating the asymmetry of the $\tilde{\chi}_1^0 \tilde{\chi}_2^0$ signal.

This asymmetry suggests a rather low E_{back}



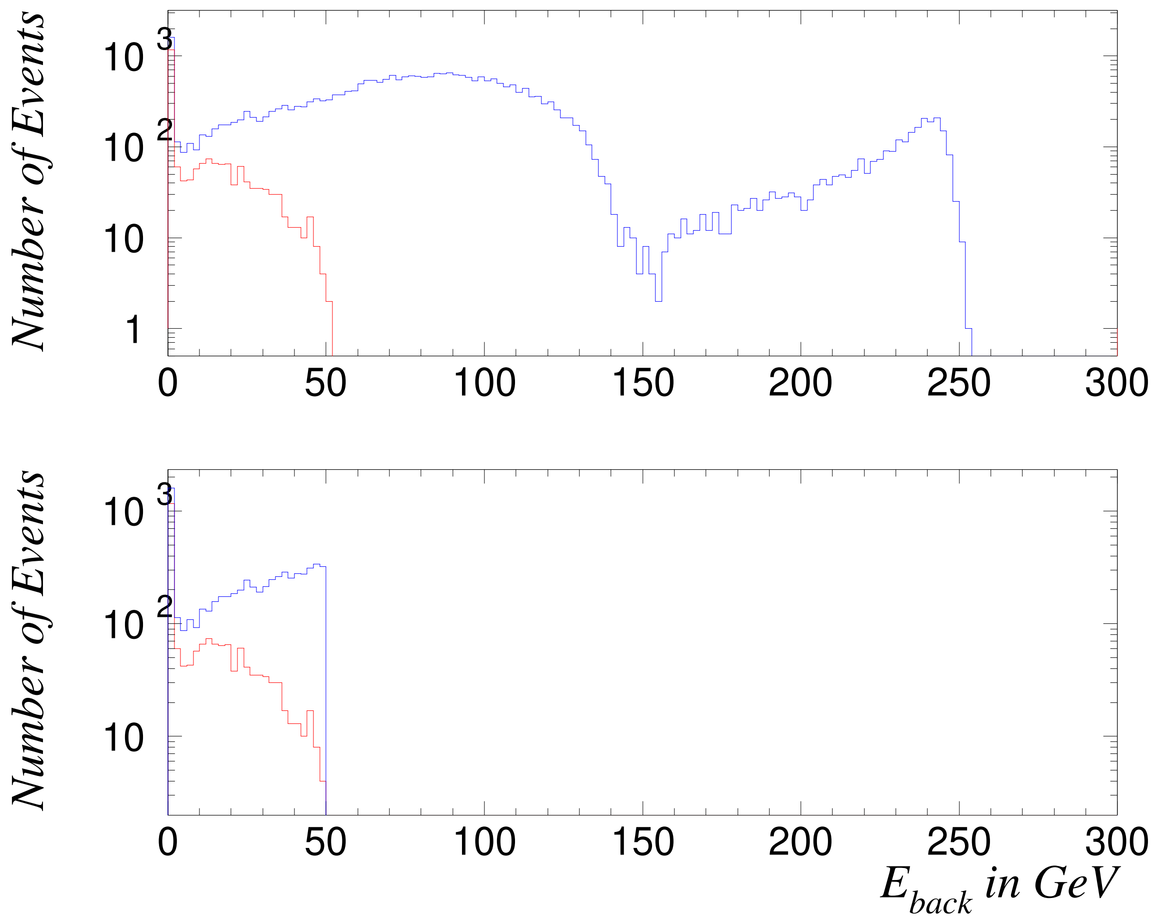
Cut 2

The effects of different E$_{back}$ cuts on the energy of the Higgs particle after Cut 1:



Cut 2

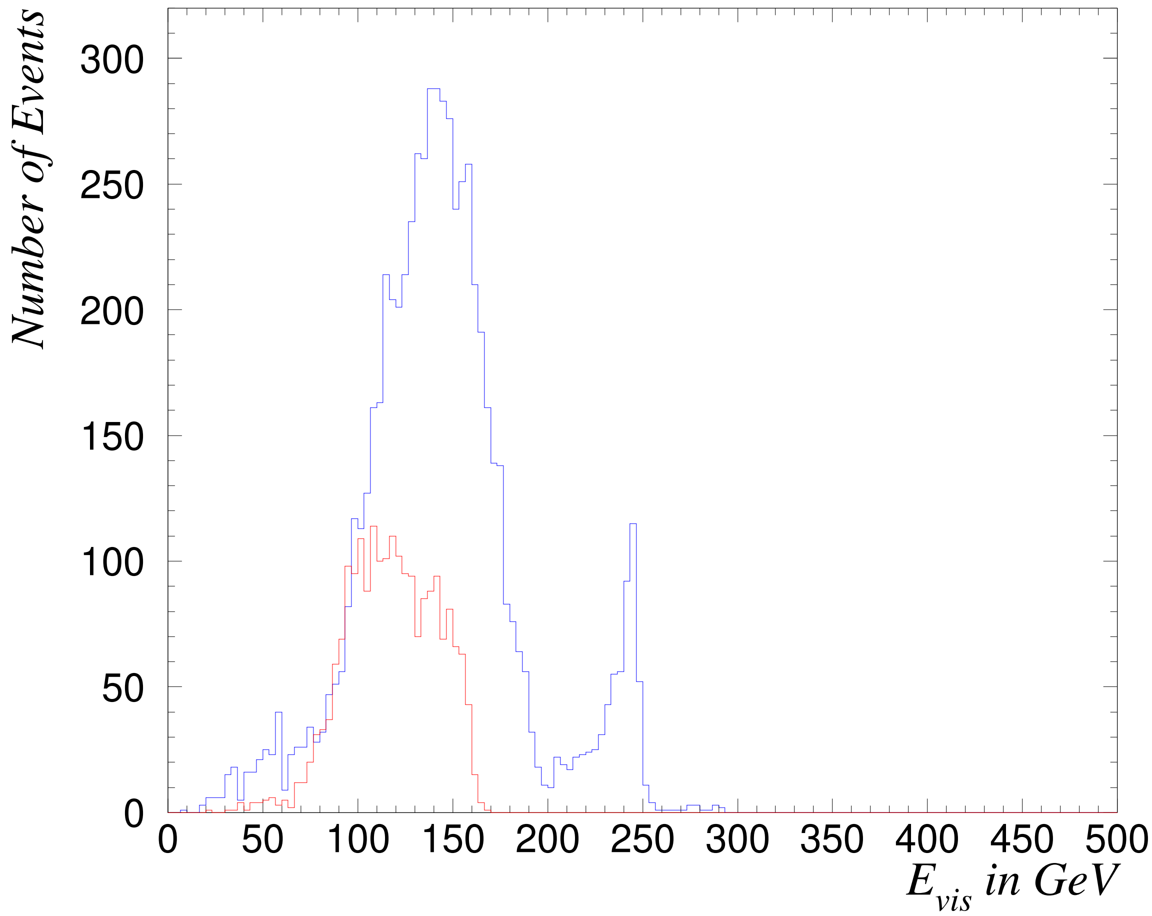
Plots of the energy in the backward direction (E_{back}) of signals before (top) and after (bottom) requiring E_{back} to be less than 50 GeV:



Note that the above plots use the logarithmic scale.

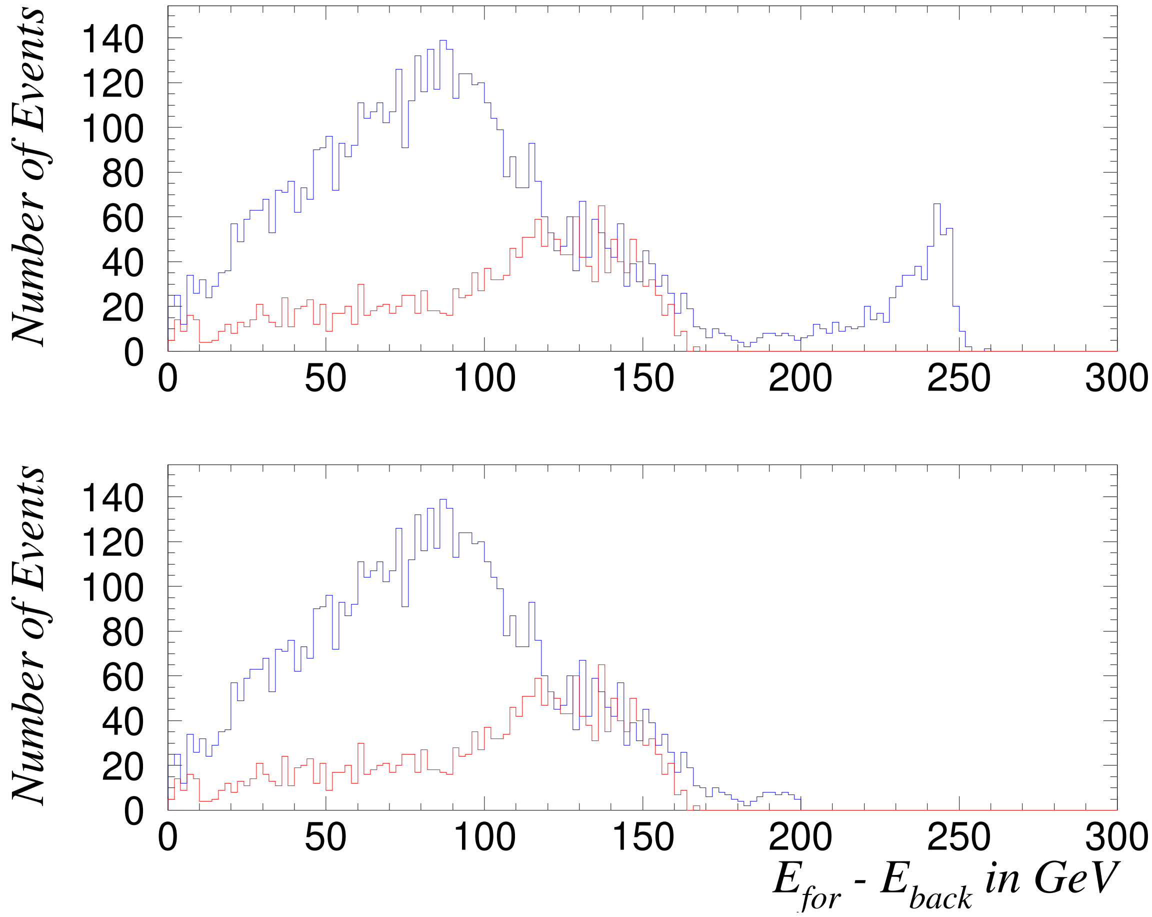
Effect of Cut 2

E_{vis} of signals after requiring E_{back} to be less than 50 GeV:



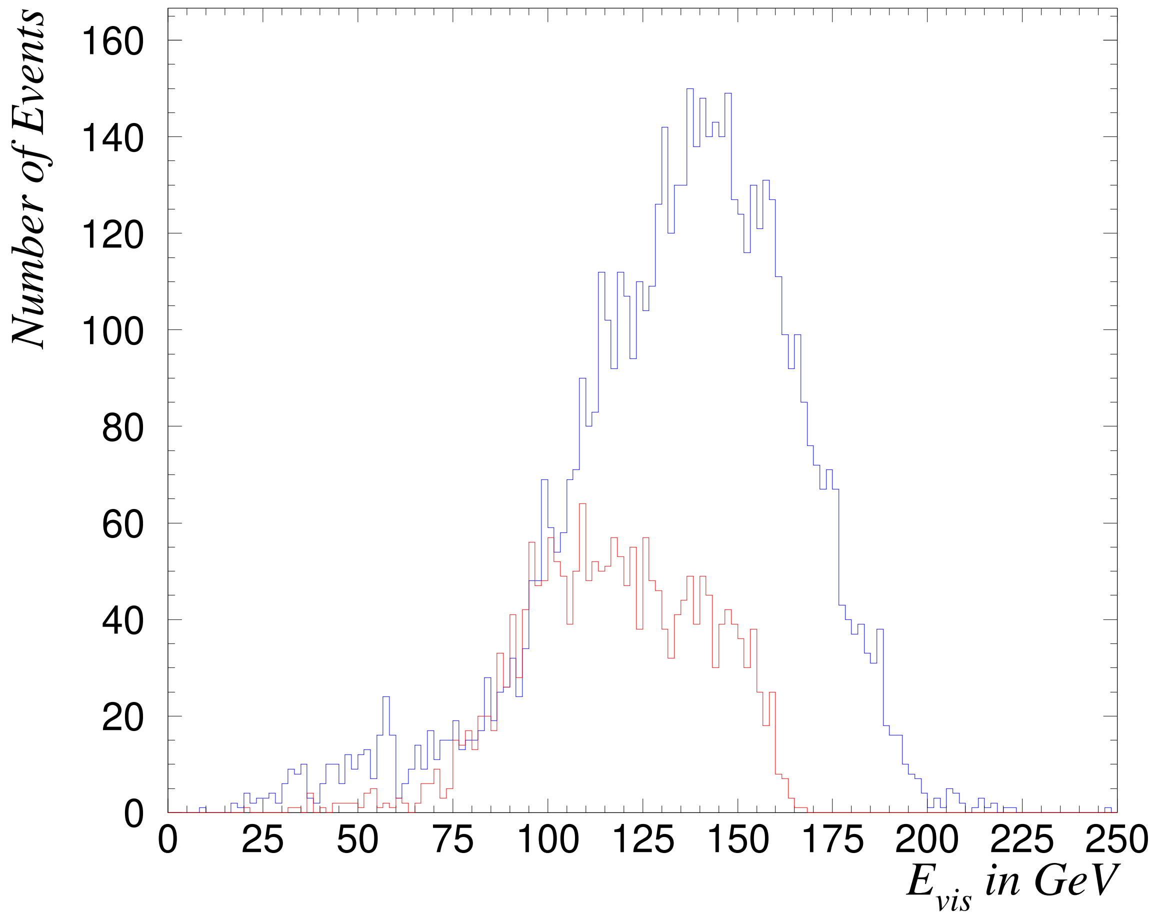
Cut 3

Plots of the difference in energy between
E_{for} and E_{back} of signals
before (top) and after (bottom) requiring
$E_{for} - E_{back}$ to be less than 200 GeV:



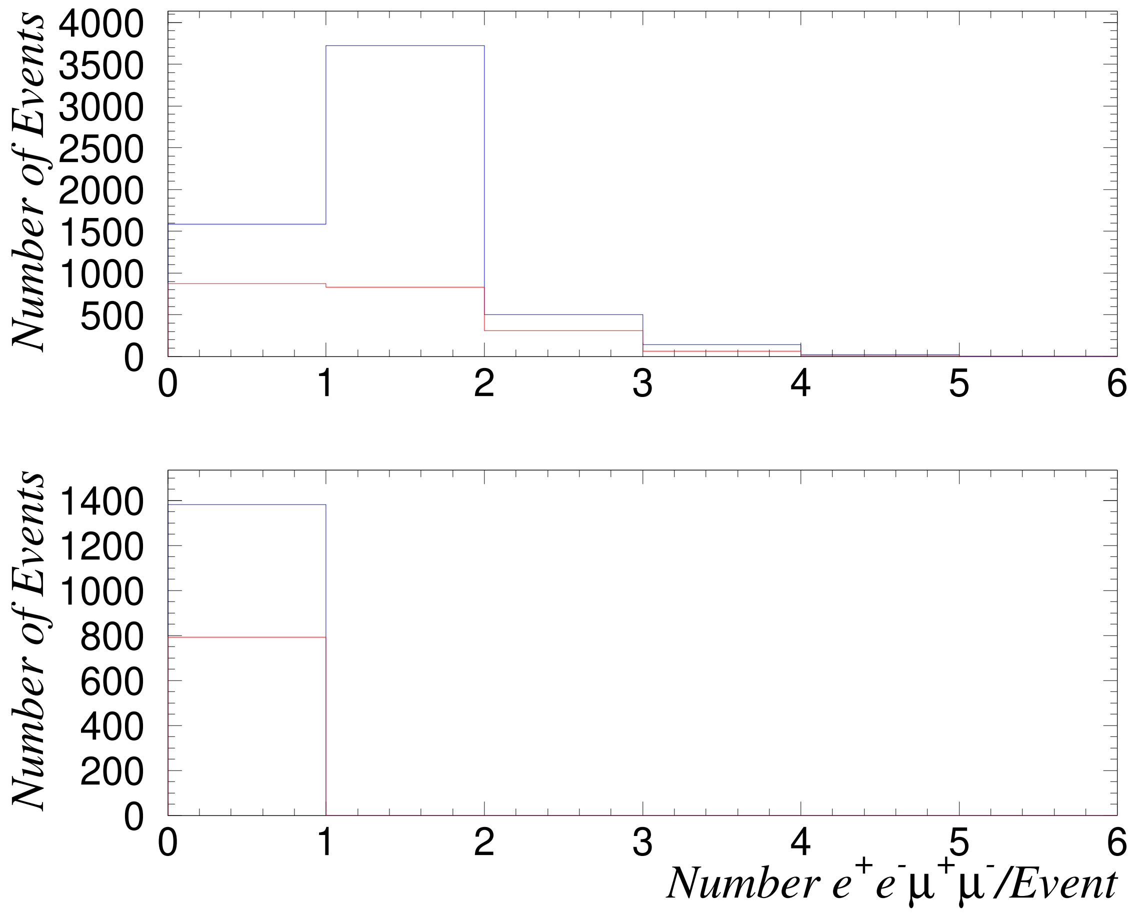
Effect of Cut 3

E_{vis} of signals after requiring $E_{for} - E_{back}$ to be less than 200 GeV:



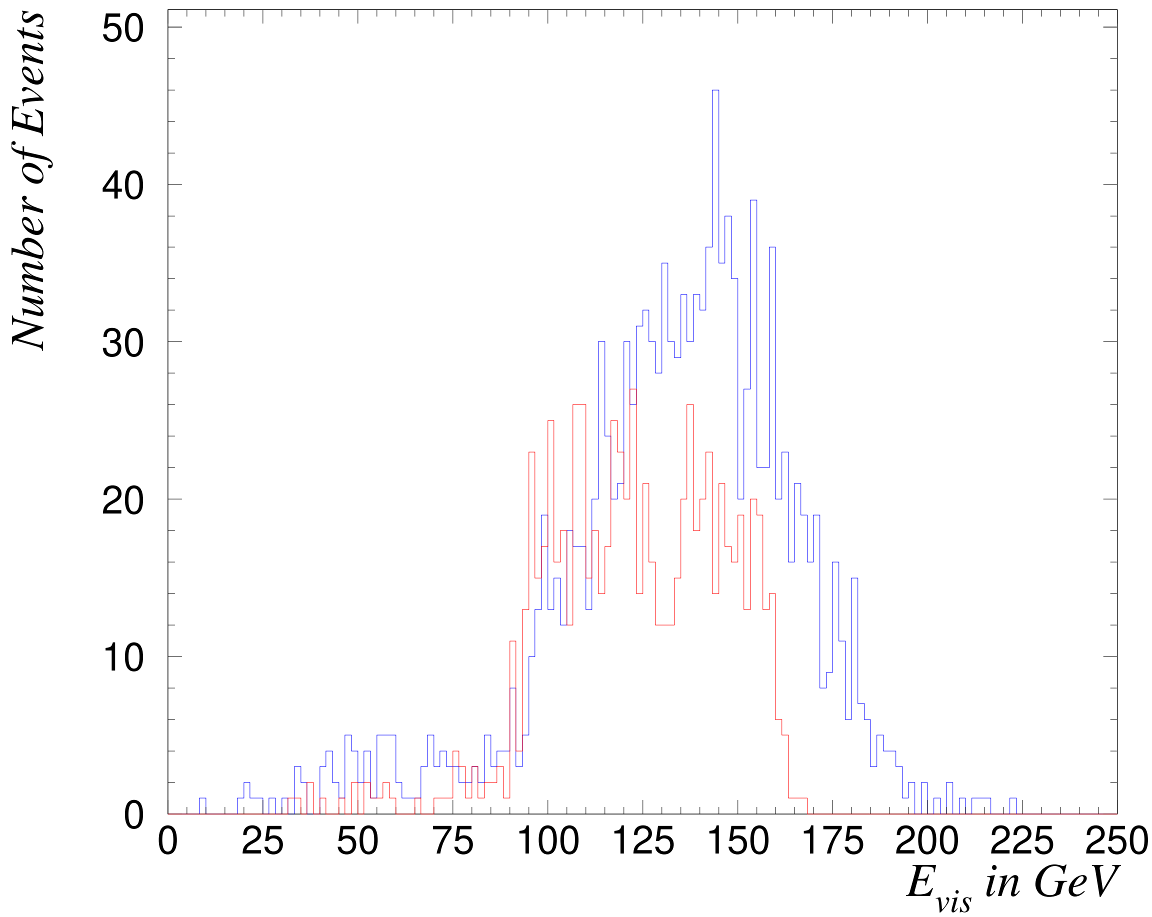
Cut 4

Plots of the number of electrons and muons (e^+, e^-, μ^+, μ^-) before (top) and after(bottom) removing events which contained those leptons:



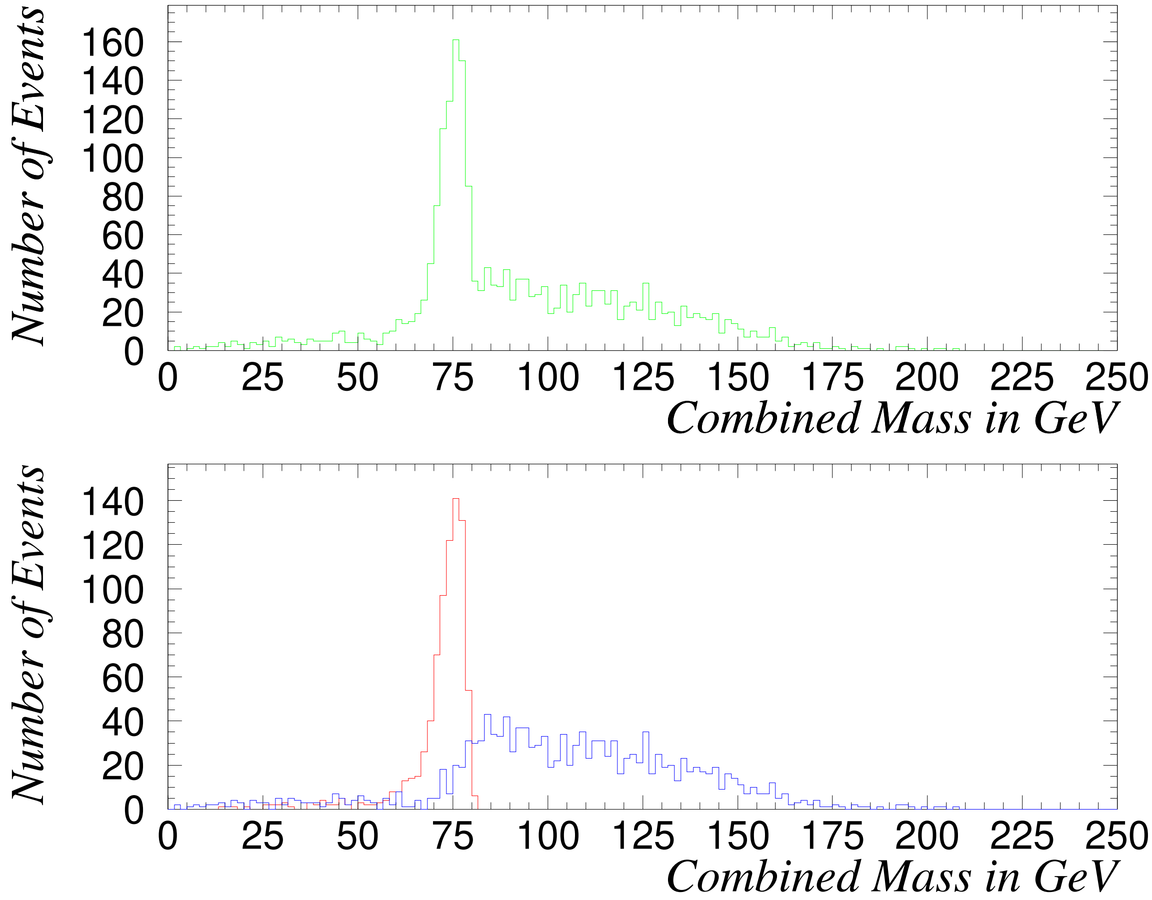
Effect of Cut 4

E_{vis} of signals after removing events with e^+, e^-, μ^+, μ^-:



Cut 5

Plots of the combined mass of the reconstructed b-quark jets after Cut 4:



Top plot: $\tilde{\chi}_1^0\tilde{\chi}_2^0$ signal + background.

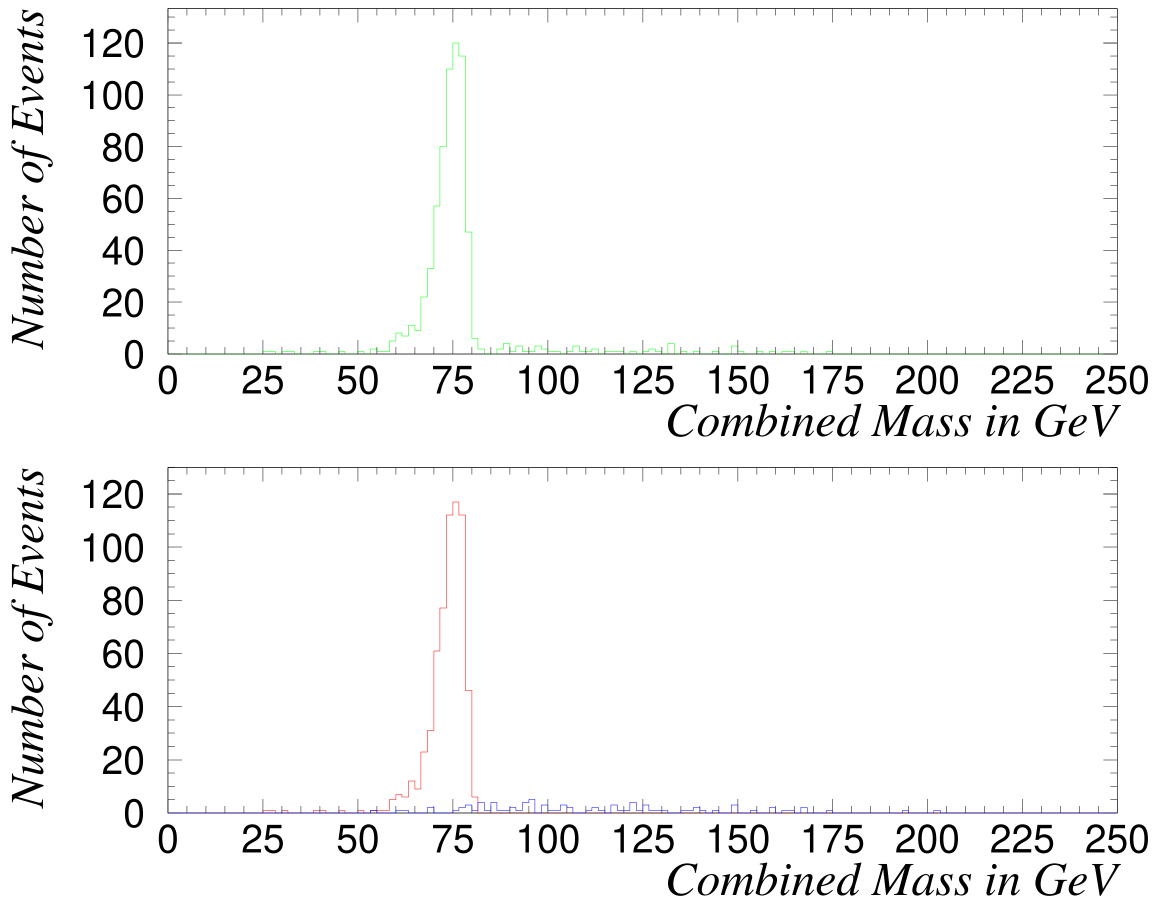
Bottom plot: $\tilde{\chi}_1^0\tilde{\chi}_2^0$ − red. background − blue .

Main background remaining: $\tilde{\chi}_1^+\tilde{\chi}_1^-$.

By requiring 2 b-quark jets, $\tilde{\chi}_1^+\tilde{\chi}_1^-$ should be greatly reduced.

Cut 5

Plots of the combined mass of reconstructed b-quark jets after Cut 5:

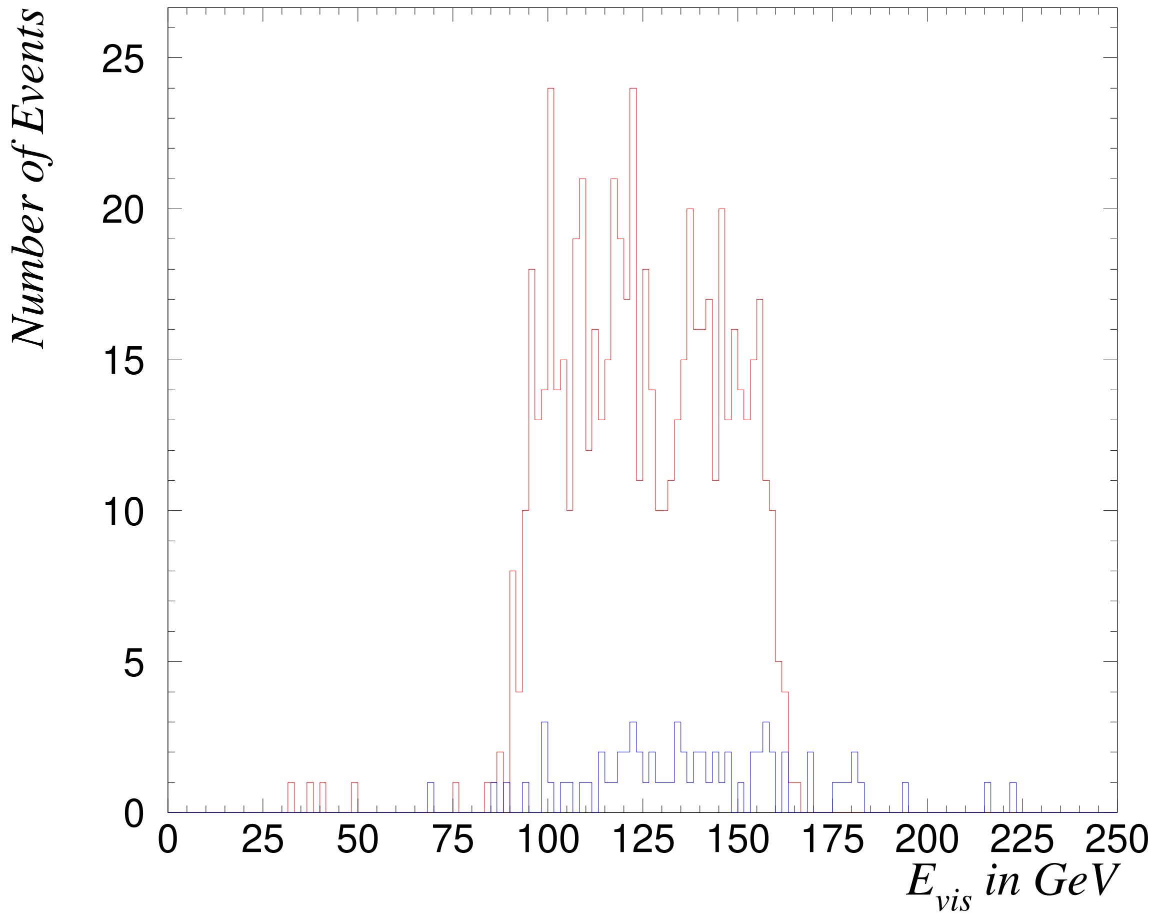


From these plots, the mass of the h^0 is 84.1 GeV.

Top plot: $\tilde{\chi}_1^0\tilde{\chi}_2^0$ signal + background.
Bottom plot: $\tilde{\chi}_1^0\tilde{\chi}_2^0$ − red. background − blue .
By requiring 2 b-quark jets, background was greatly reduced.

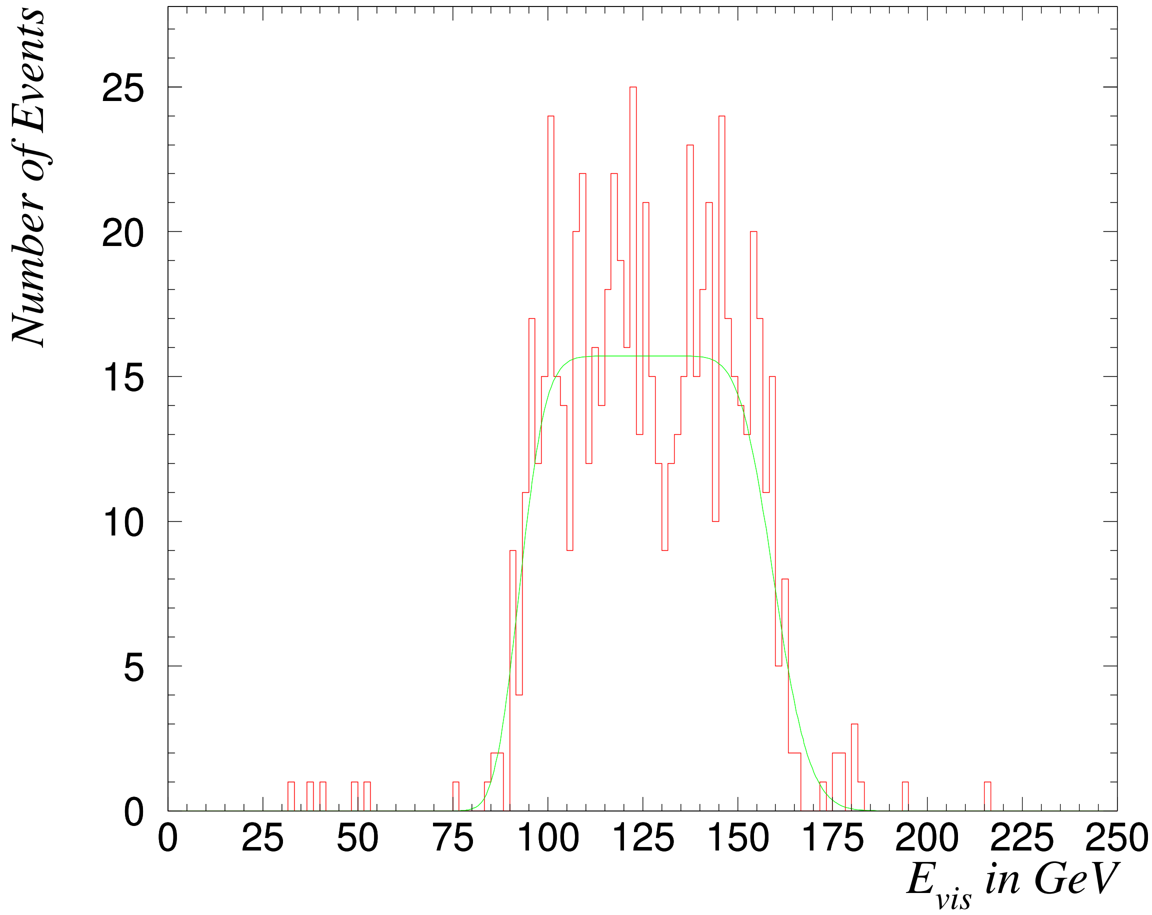
Effect of Cut 5

E_{vis} of signals after requiring events to have 2 b-quark jets:



After All Cuts

Box fit of signal after all cuts:



By using a box fit, we get the E_{min} and E_{max}, which we use to find the masses of the $\widetilde{\chi}_1^0$ and $\widetilde{\chi}_2^0$ particles.

Particle Masses

The following are the masses of the $\widetilde{\chi}_1^0$ and $\widetilde{\chi}_2^0$ particles, determined using the Endpoint Method:

Particle	Calculated Mass	Error	Theoretical Mass	Discrepancy
$\widetilde{\chi}_1^0$	81.3 GeV	$\pm$2.0 GeV	86.1 GeV	4.8 GeV
$\widetilde{\chi}_2^0$	177.9 GeV	$\pm$1.6 GeV	175.5 GeV	2.4 GeV

The following is the mass of the h^0 particle, determined using the average combined mass in the reconstructed b-quark jets.

Particle	Calculated Mass	Theoretical Mass	Discrepancy
h^0	84.1 GeV	83.3 GeV	0.8 GeV