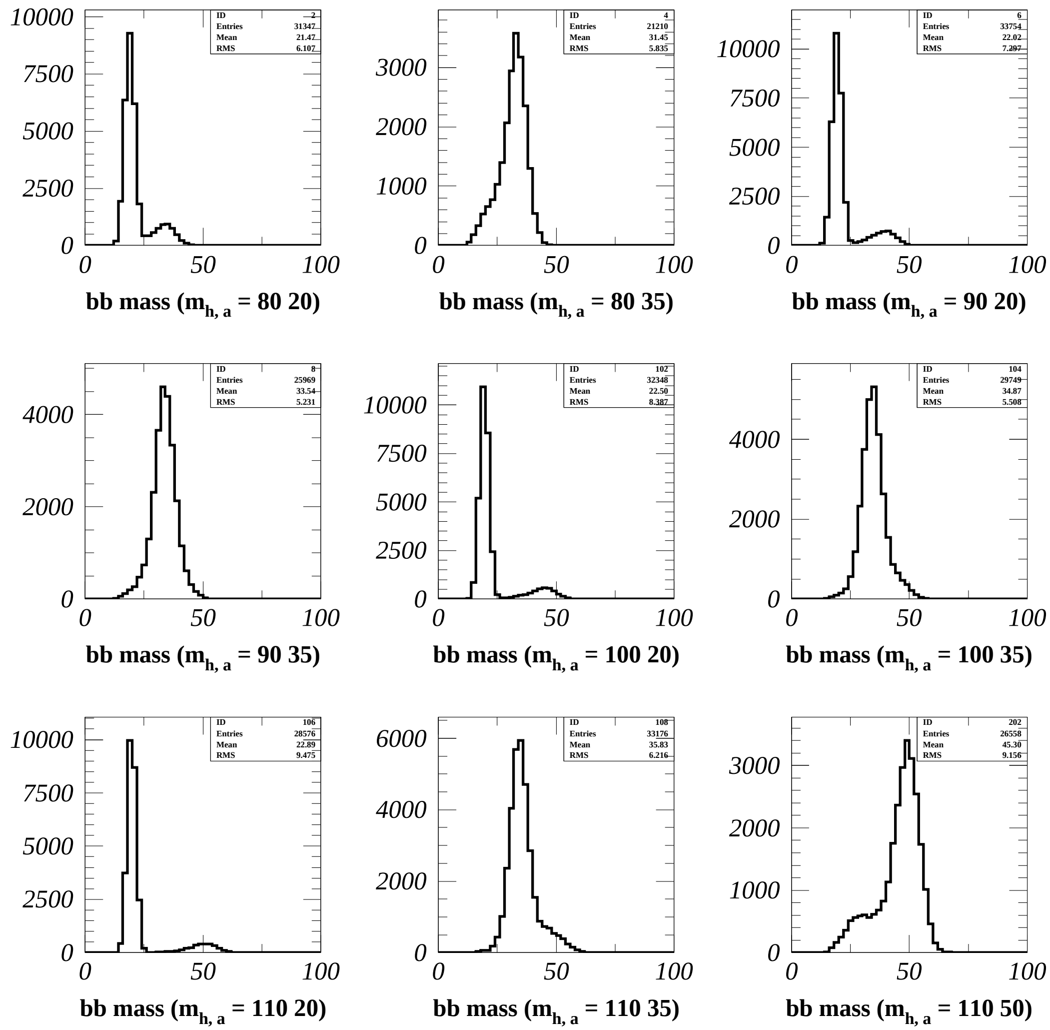
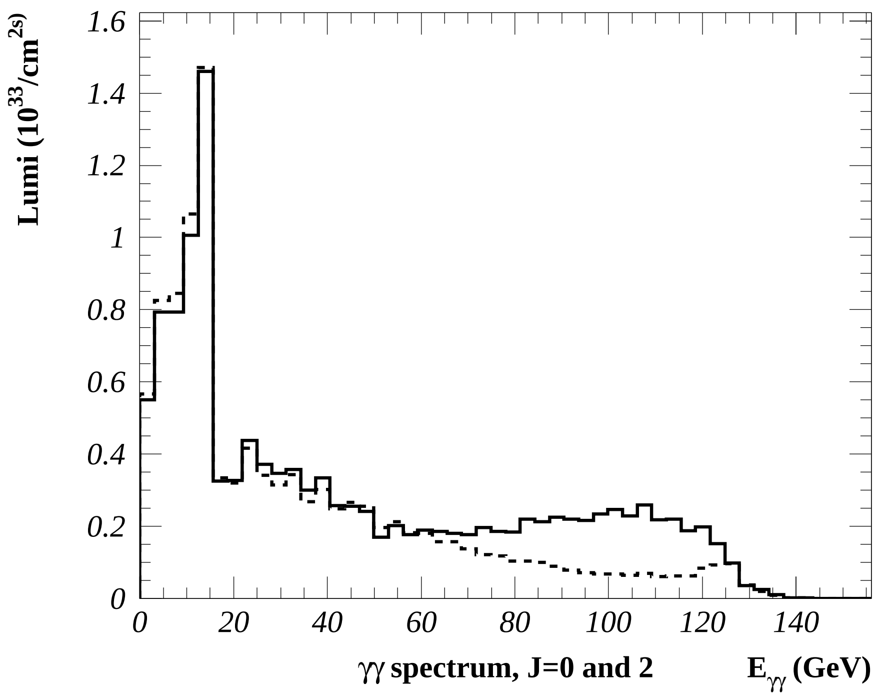
Appendix to the previous meeting: $h \to aa$

RECONSTRUCTED bb MASSES



Now switch to the new analysis: $h \to a_1 a_2$.

• Changed slightly the $\gamma\gamma$ spectrum: increased electron energy 75 $\to$ 82 GeV in order to increase luminosity at $E_{\gamma\gamma} > 110$ GeV (no real need to redo the previous results, with $m_h \leq 110$ GeV).



- Study decays $h \to a_1 a_2 \to b\bar{b}b\bar{b}$, with the following h, a_1, a_2 mass combinations: 90, 20, 40 GeV; 110, 25, 75 GeV; 130, 30, 60 GeV and 130, 20, 85 GeV, respectively.

- Implementation of $h \to a_1 a_2$ decays in Pythia 6.158 (not trivial at all, since Pythia by default has room for only one pseudoscalar Higgs!) Needed several changes in the source code.

- Cross sections for $\gamma\gamma \to h_{SM}$ (integrated with the new luminosity spectrum) from Pythia: 29.5, 43.3, 12.7 fb for m_h= 90, 110, 130 GeV, respectively. These numbers define signal normalization.

New analysis approach required. 4 jets $\rightarrow$ 3 possible 2-jet combinations. Can't look for two equal masses! Possible approach:

- Assume some arbitrary values of m_{a1} and m_{a2} in the range 10-90 GeV (if kinematically allowed). Select jet combination which fits best this assumption.

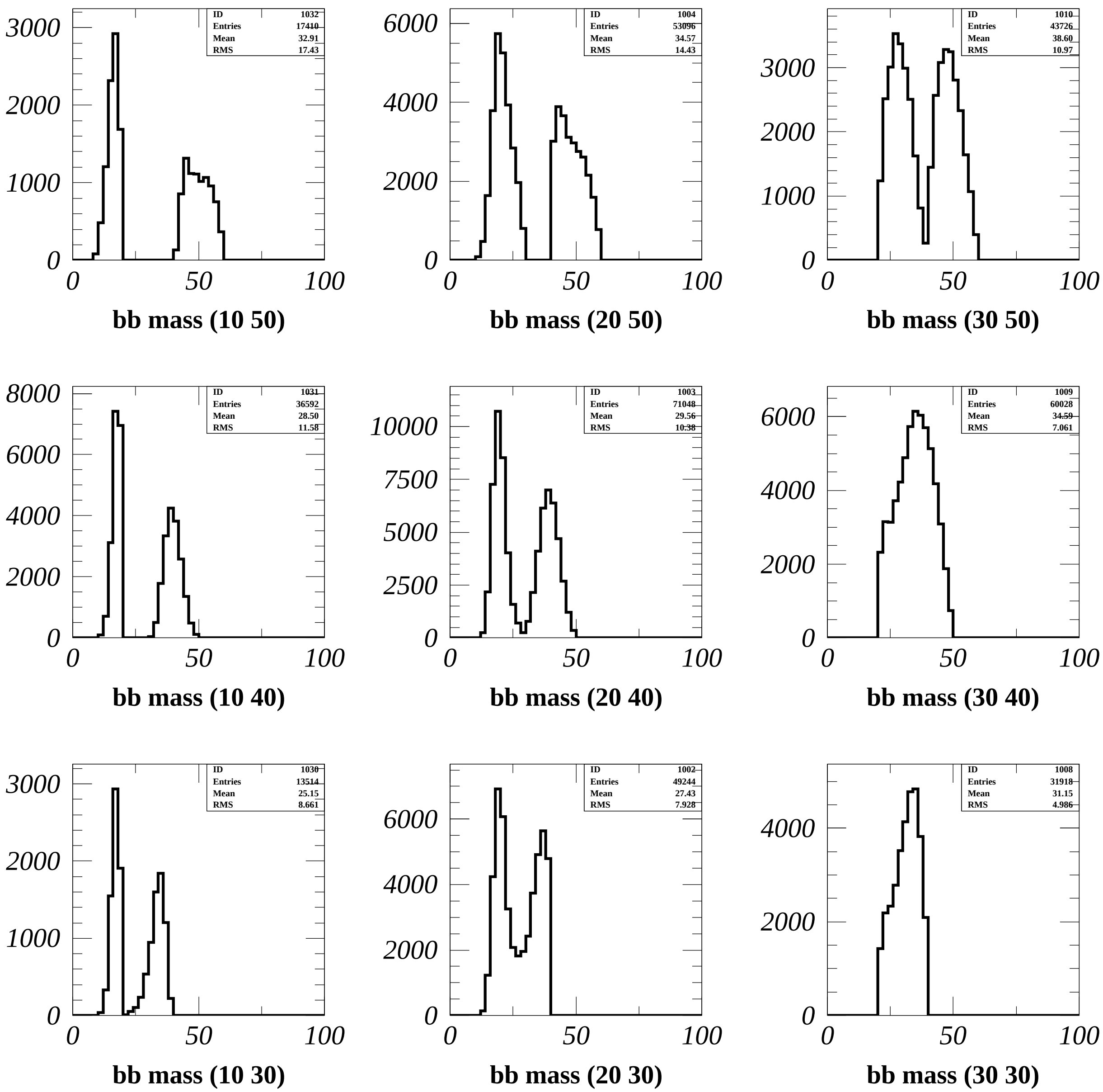
- Require $\sqrt{(M_{12} - m_{a1})^2 + (M_{34} - m_{a2})^2} < 10$ GeV and look at the number of successfully reconstructed events.

- Repeat the above steps for all kinematically allowed m_{a1}, m_{a2} combinations.

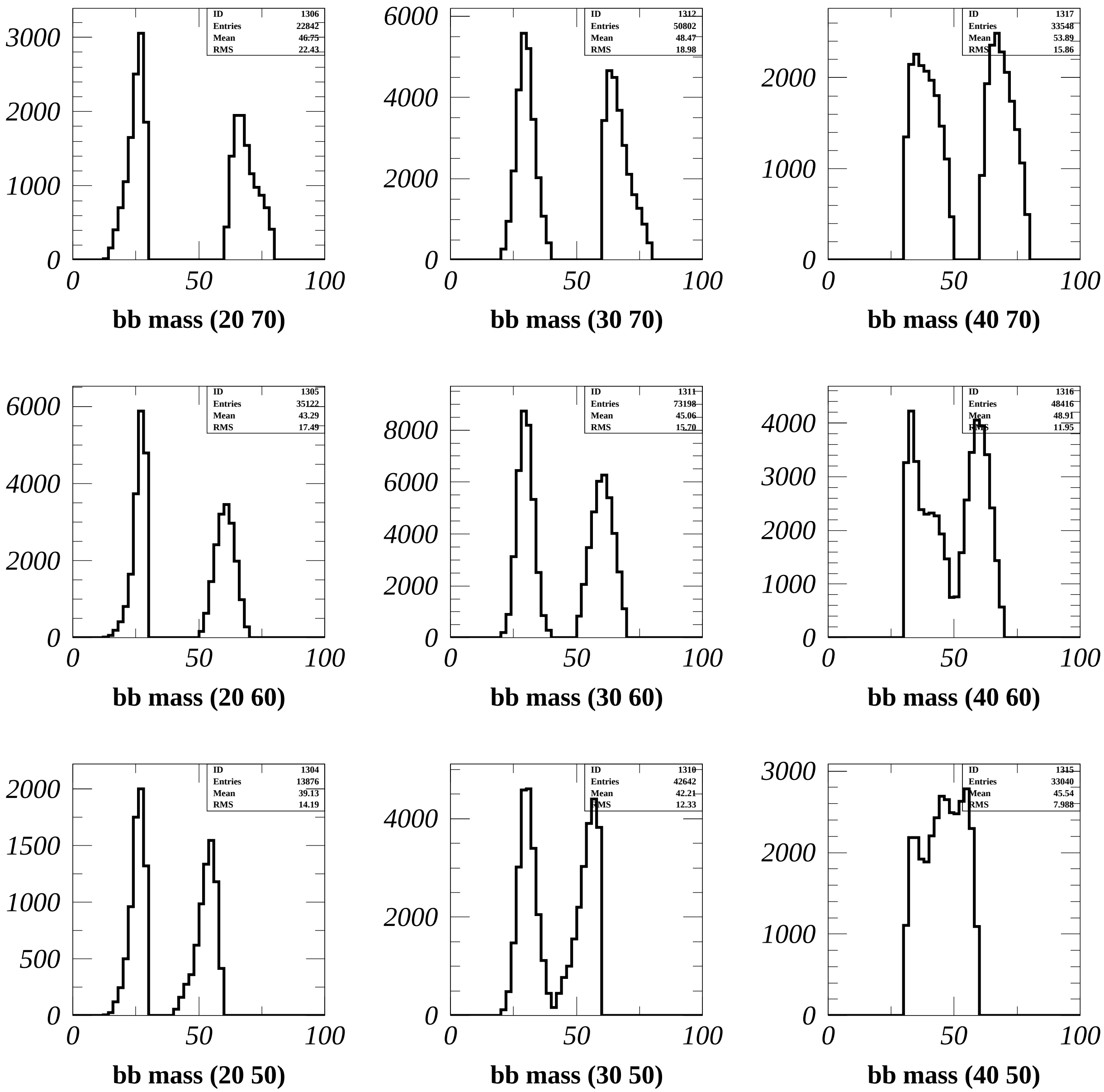
- Select the m_{a1}, m_{a2} which maximize the number of reconstructed events.

- As we get closer to the true mass values, nice Gaussian mass peaks should appear and the exact mean values can be found.

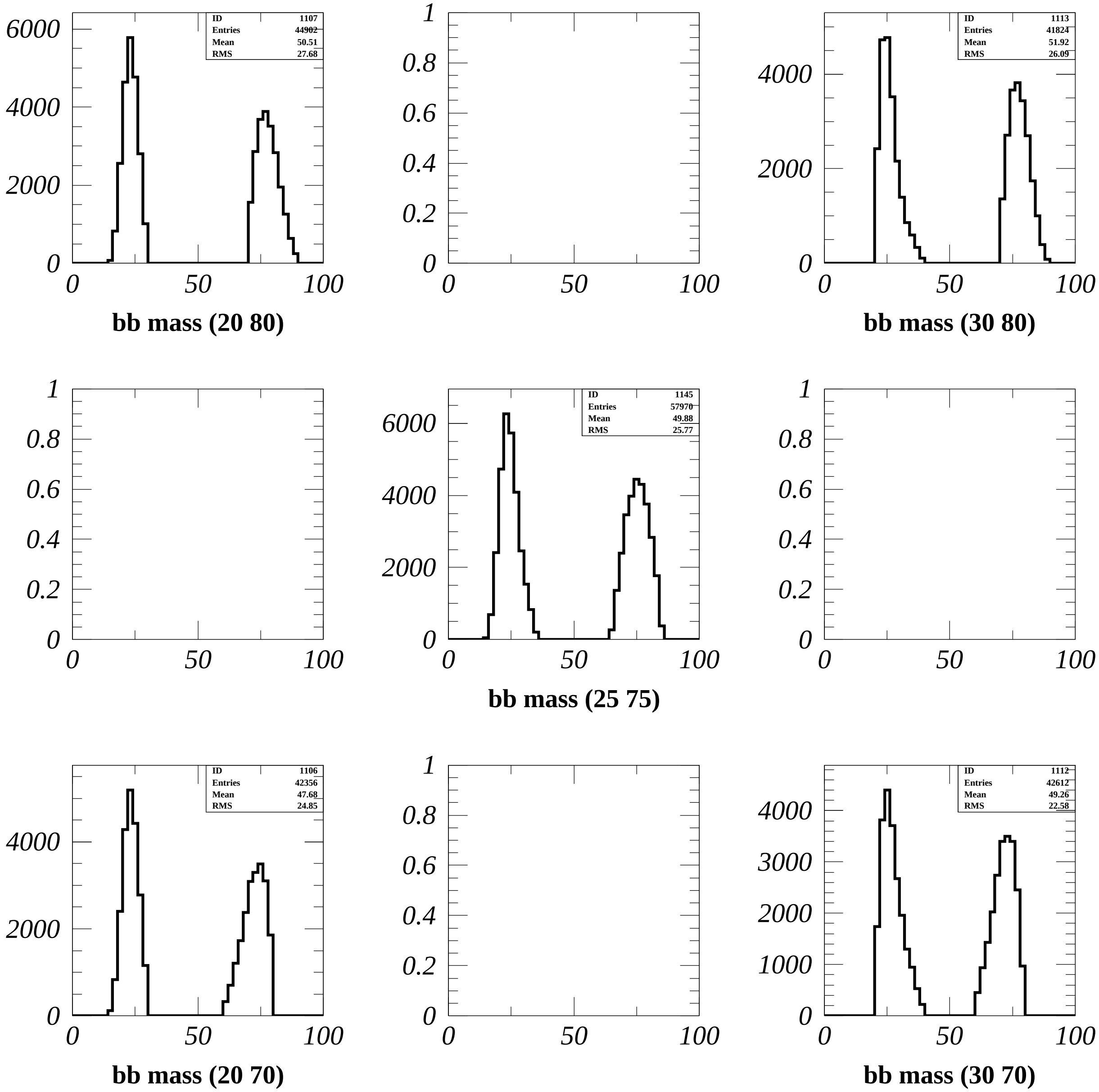
$m_{h,\,a1,\,a2}$ = 90, 20, 40 GeV



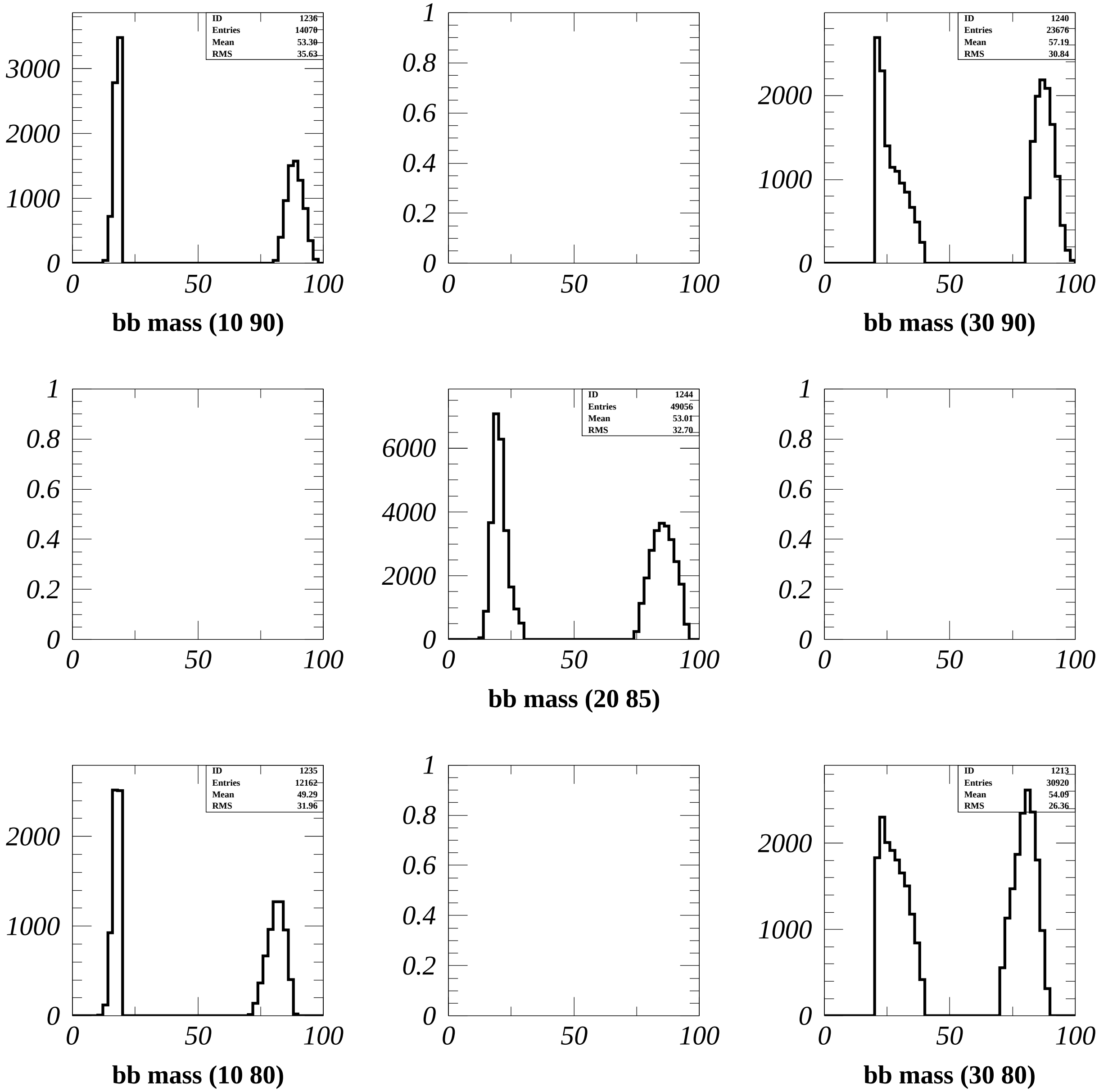
$m_{h,\,a1,\,a2}$ = 130, 30, 60 GeV

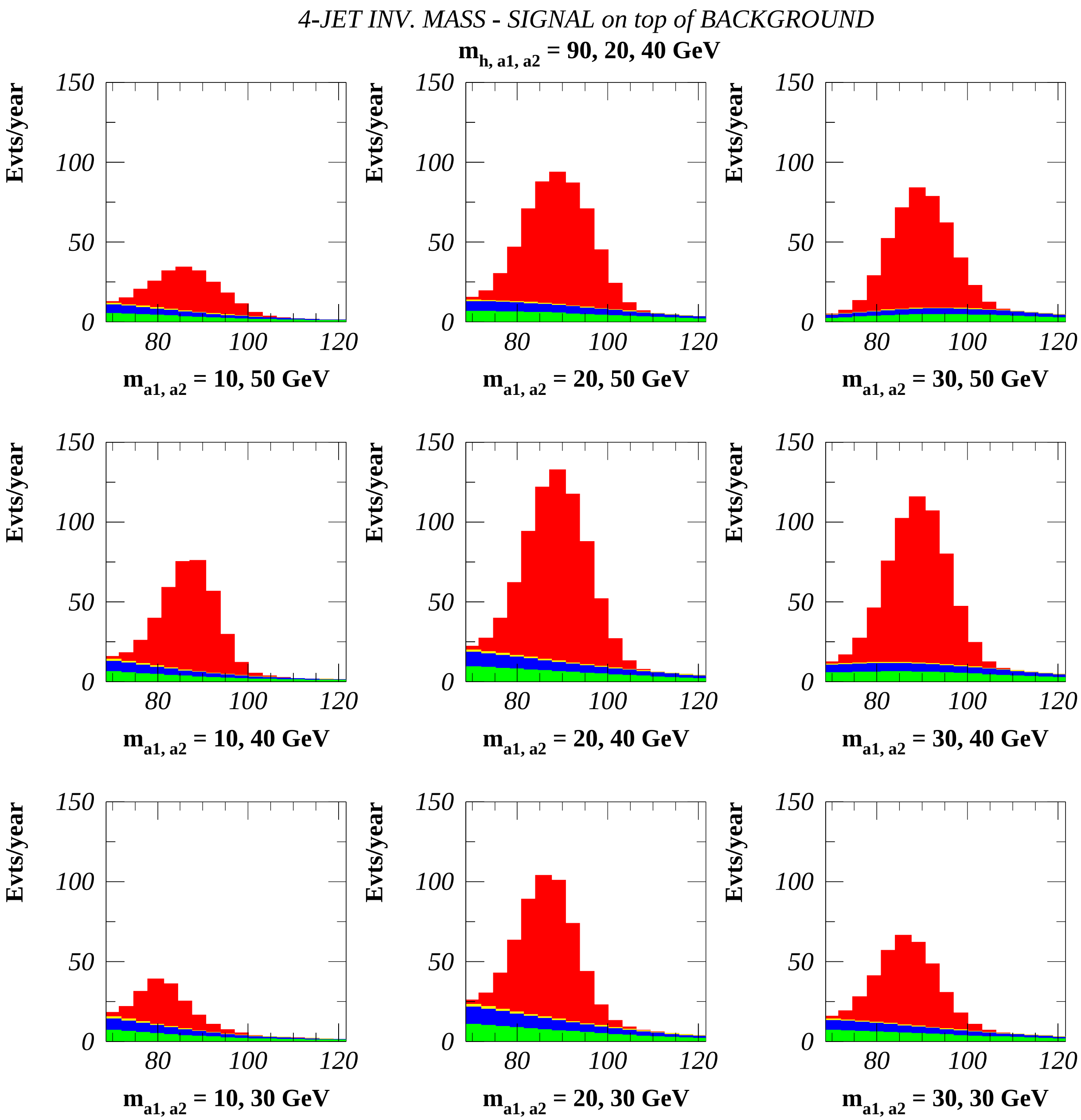


$m_{h,\,a1,\,a2}$ = 110, 25, 75 GeV

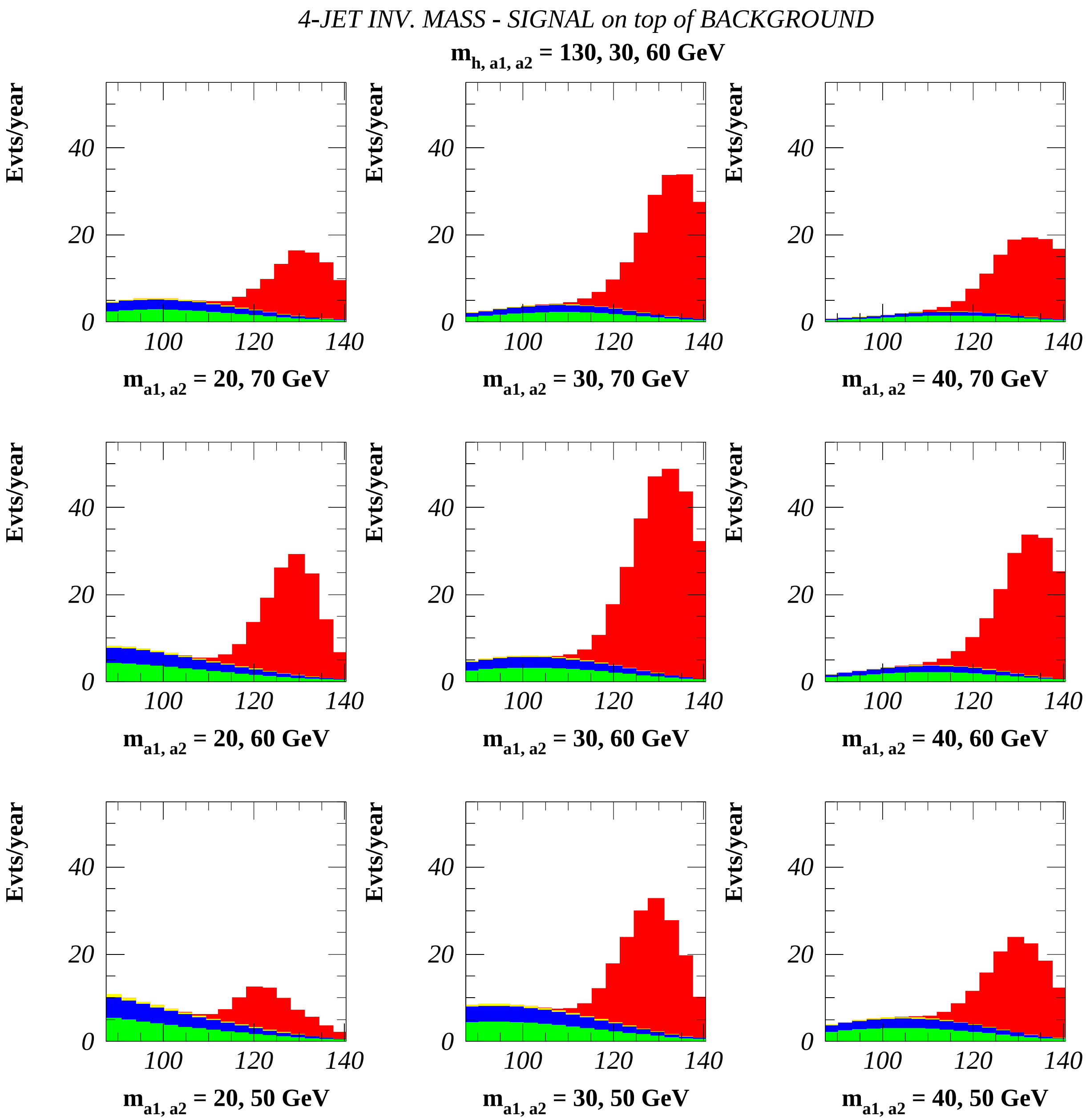


$m_{h,\,a1,\,a2}$ = 130, 20, 85 GeV

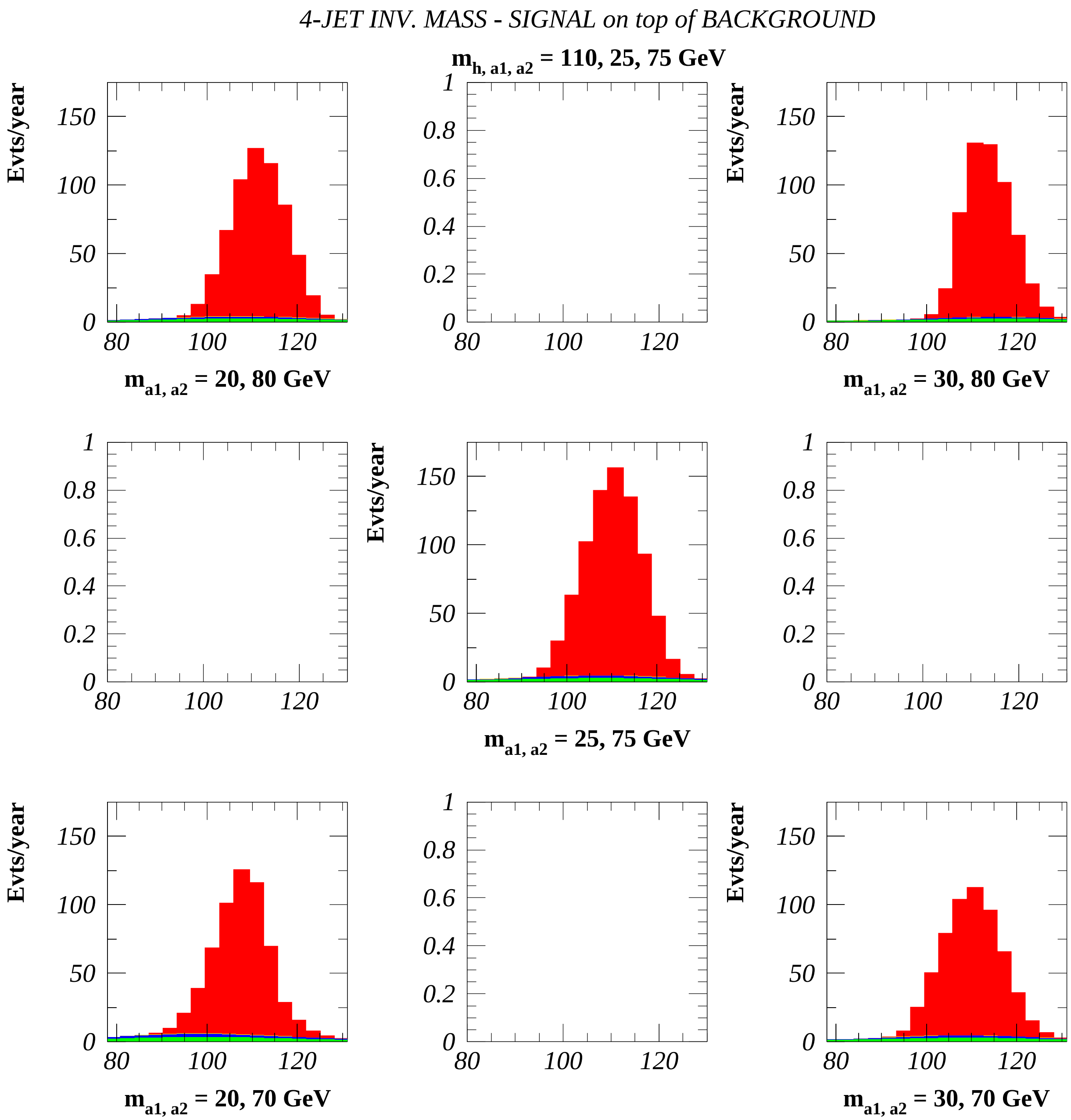


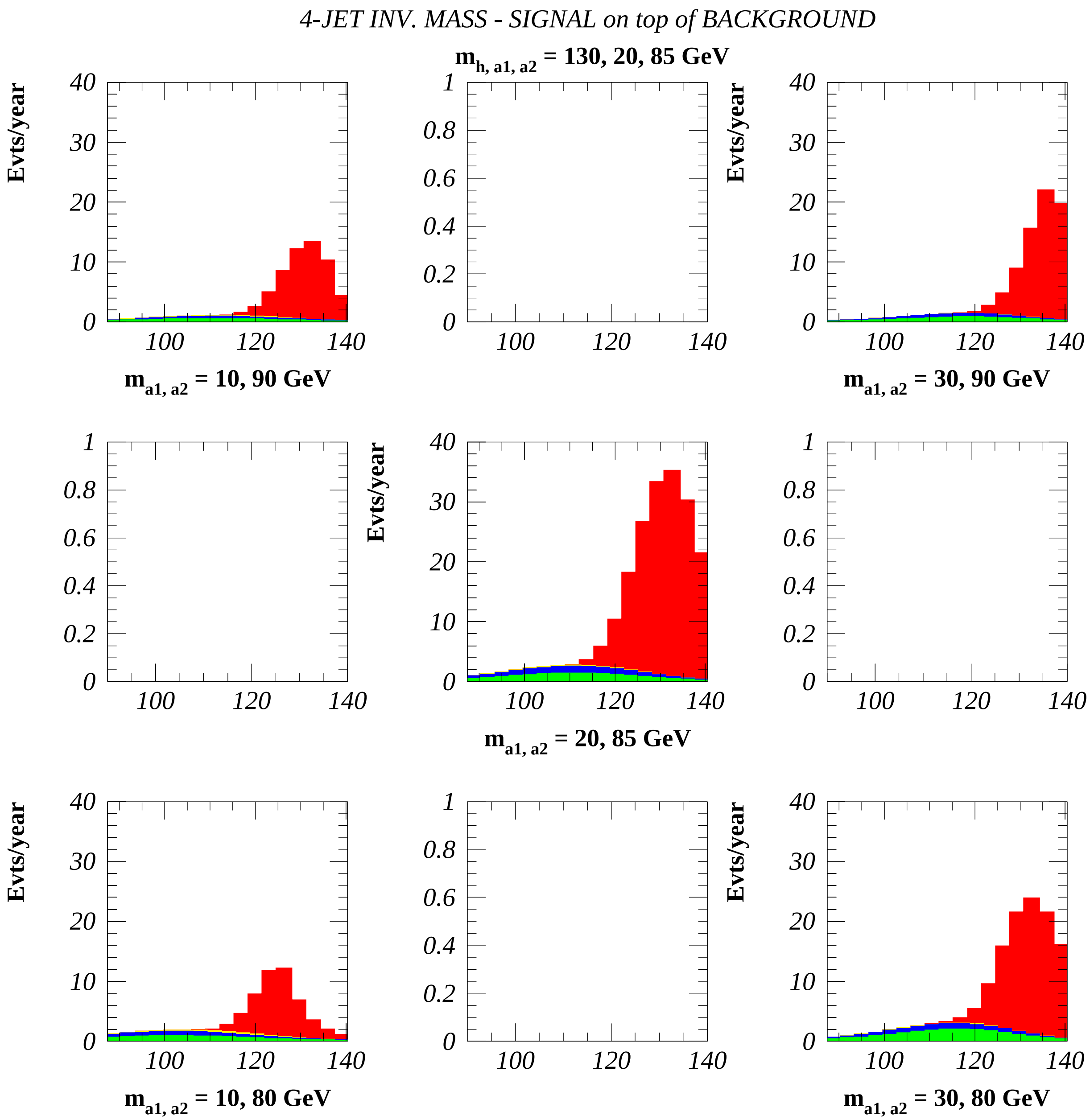


4-JET INV. MASS - SIGNAL on top of BACKGROUND
$m_{h,\,a1,\,a2}$ = 90, 20, 40 GeV
Evts/year
$m_{a1,\,a2}$ = 10, 50 GeV
$m_{a1,\,a2}$ = 20, 50 GeV
$m_{a1,\,a2}$ = 30, 50 GeV
$m_{a1,\,a2}$ = 10, 40 GeV
$m_{a1,\,a2}$ = 20, 40 GeV
$m_{a1,\,a2}$ = 30, 40 GeV
$m_{a1,\,a2}$ = 10, 30 GeV
$m_{a1,\,a2}$ = 20, 30 GeV
$m_{a1,\,a2}$ = 30, 30 GeV



4-JET INV. MASS - SIGNAL on top of BACKGROUND
m_{h, a1, a2} = 130, 30, 60 GeV
Evts/year
40
20
0
100
120
140
m_{a1, a2} = 20, 70 GeV
m_{a1, a2} = 30, 70 GeV
m_{a1, a2} = 40, 70 GeV
m_{a1, a2} = 20, 60 GeV
m_{a1, a2} = 30, 60 GeV
m_{a1, a2} = 40, 60 GeV
m_{a1, a2} = 20, 50 GeV
m_{a1, a2} = 30, 50 GeV
m_{a1, a2} = 40, 50 GeV


4-JET INV. MASS - SIGNAL on top of BACKGROUND
$m_{h,\, a1,\, a2}$ = 110, 25, 75 GeV
Evts/year
$m_{a1,\, a2}$ = 20, 80 GeV
$m_{a1,\, a2}$ = 30, 80 GeV
$m_{a1,\, a2}$ = 25, 75 GeV
$m_{a1,\, a2}$ = 20, 70 GeV
$m_{a1,\, a2}$ = 30, 70 GeV


4-JET INV. MASS - SIGNAL on top of BACKGROUND
m_h, a1, a2 = 130, 20, 85 GeV
Evts/year
m_a1, a2 = 10, 90 GeV
m_a1, a2 = 30, 90 GeV
m_a1, a2 = 20, 85 GeV
m_a1, a2 = 10, 80 GeV
m_a1, a2 = 30, 80 GeV