Jet clustering in presence of $\gamma\gamma$ background

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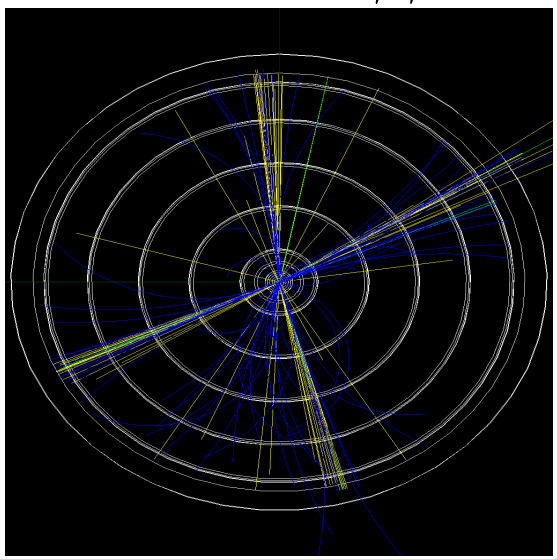
Contents

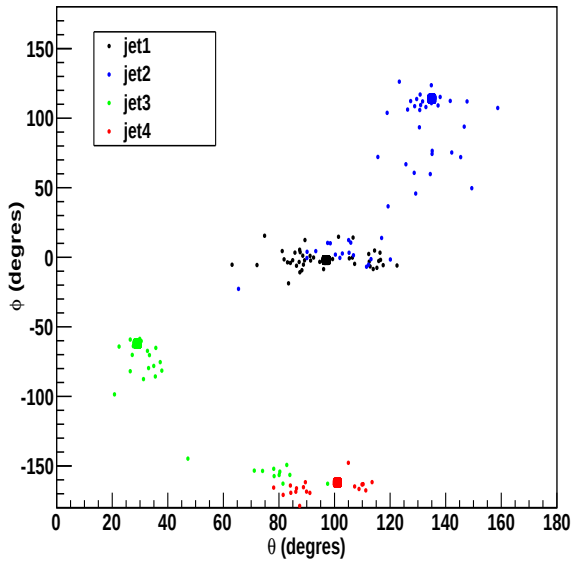
1. Studies at generator level of di-jet mass for various time stamping
   - Qualitative results & requirements
   - Jet clustering
   - Effect of $\gamma\gamma$ background
   - Tunning of Pt_{cut}
2. Conclusion

We study the SUSY process at Benchmark Point K' at $\sqrt{s} = 3$ TeV: $e^+e^- \rightarrow H^\circ A^\circ \rightarrow b\bar{b}b\bar{b}$

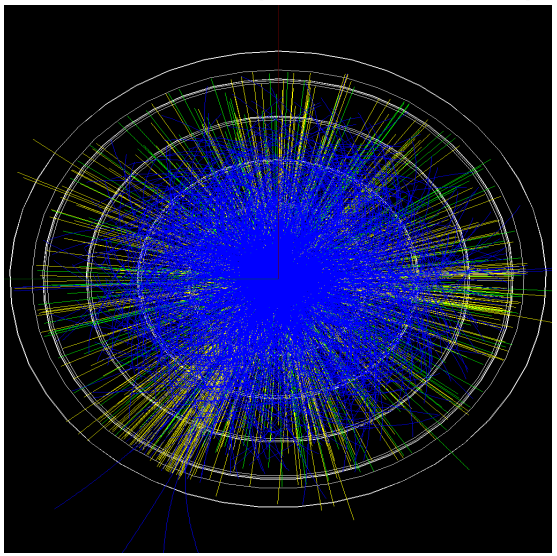
Simulation : 1000 events generated with PYTHIA 6.215 & ISASUGRA 7.69 (Initial State Radiation: ON, Beamstrahlung Effects: ON)

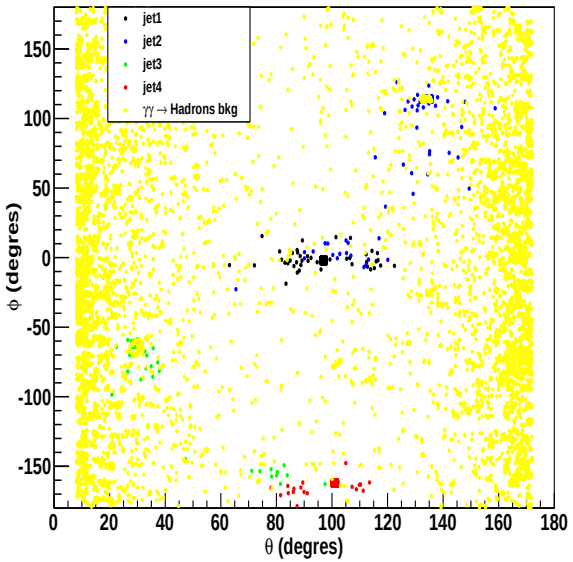
Without $\gamma\gamma$





With $\gamma\gamma$ (ts=100 ns)



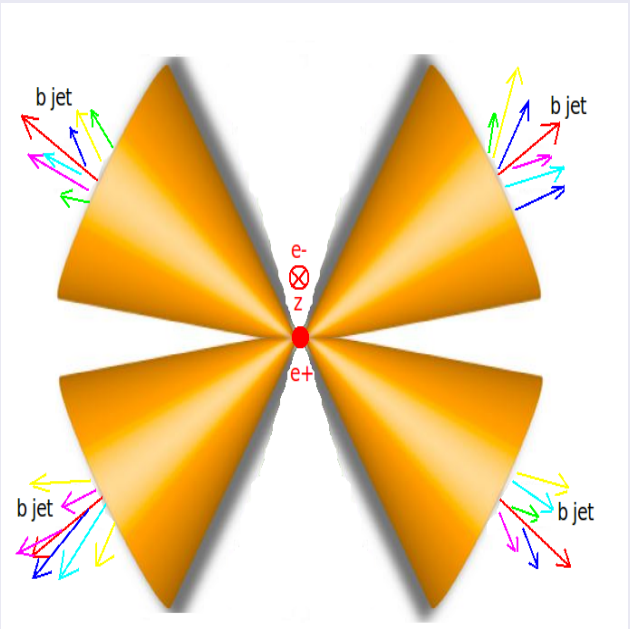


- Cross section not exactly known at higher centre-of-mass energy
- Beam parameter parametrized in GUINEAPIG : 3.3 events per bunch crossing (background)
- Signal $H^o A^o \longrightarrow b\bar{b}b\bar{b}$ cross section at 3 TeV : $\sigma = 0.3$ fb

$\Rightarrow$ Need to reduce the number of $\gamma\gamma$ events overlapped to an e^+e^- interaction

$\Rightarrow$ that requires fast time stamping capabilities

Cone jet clustering



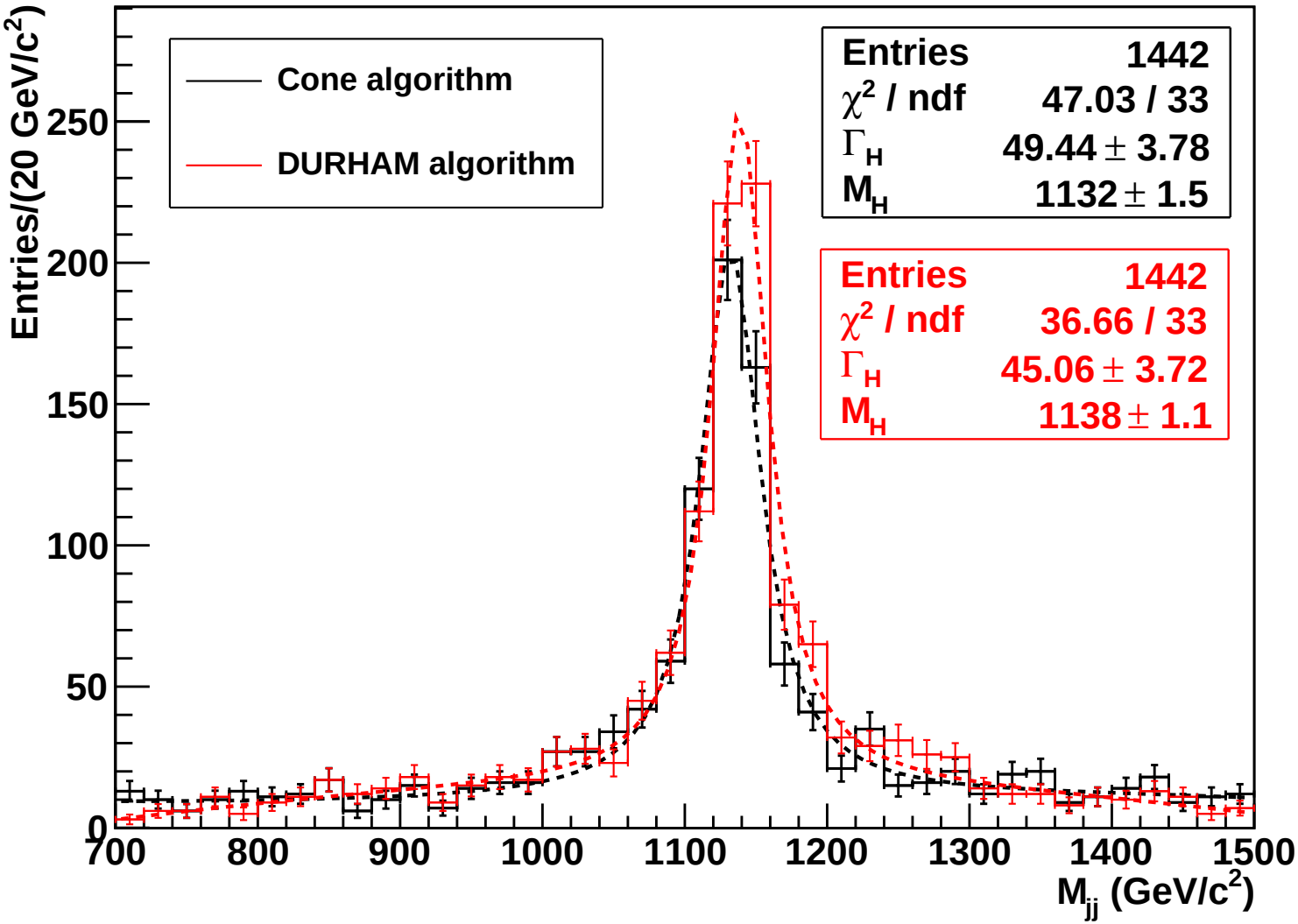
DURHAM jet clustering

$$y_{ij} = \frac{2min(E_i^2, E_j^2)(1-cos\theta_{ij})}{Q^2}$$

(i,j) $\in$ {particles}, Q : total visible energy.

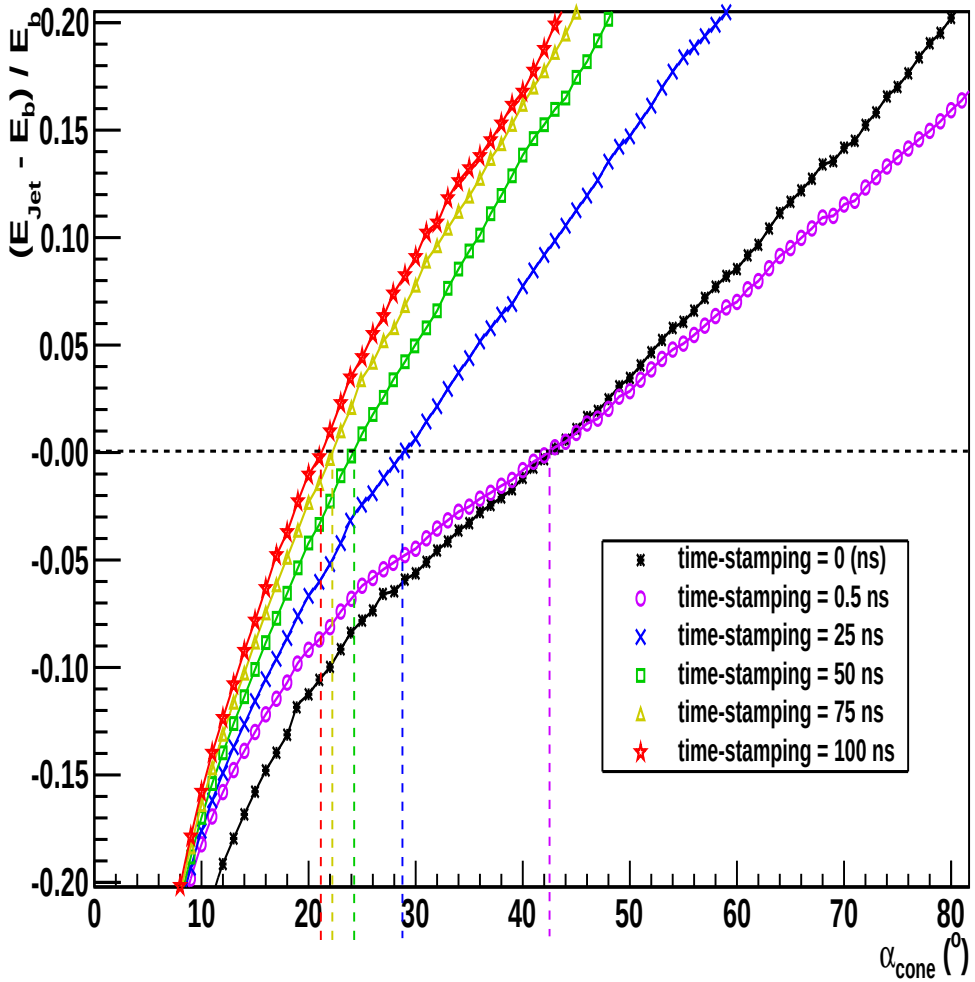
The basic principle of the algorithm:

- List all reconstructed particles.
- Calculate the 'y' value of every pair reconstructed particles (using energy and momentum).
- Pairs of 'y' less than a threshold value are associated into one jet.
- Repeat clustering with associated particles which are now treated as a single 'particle'.

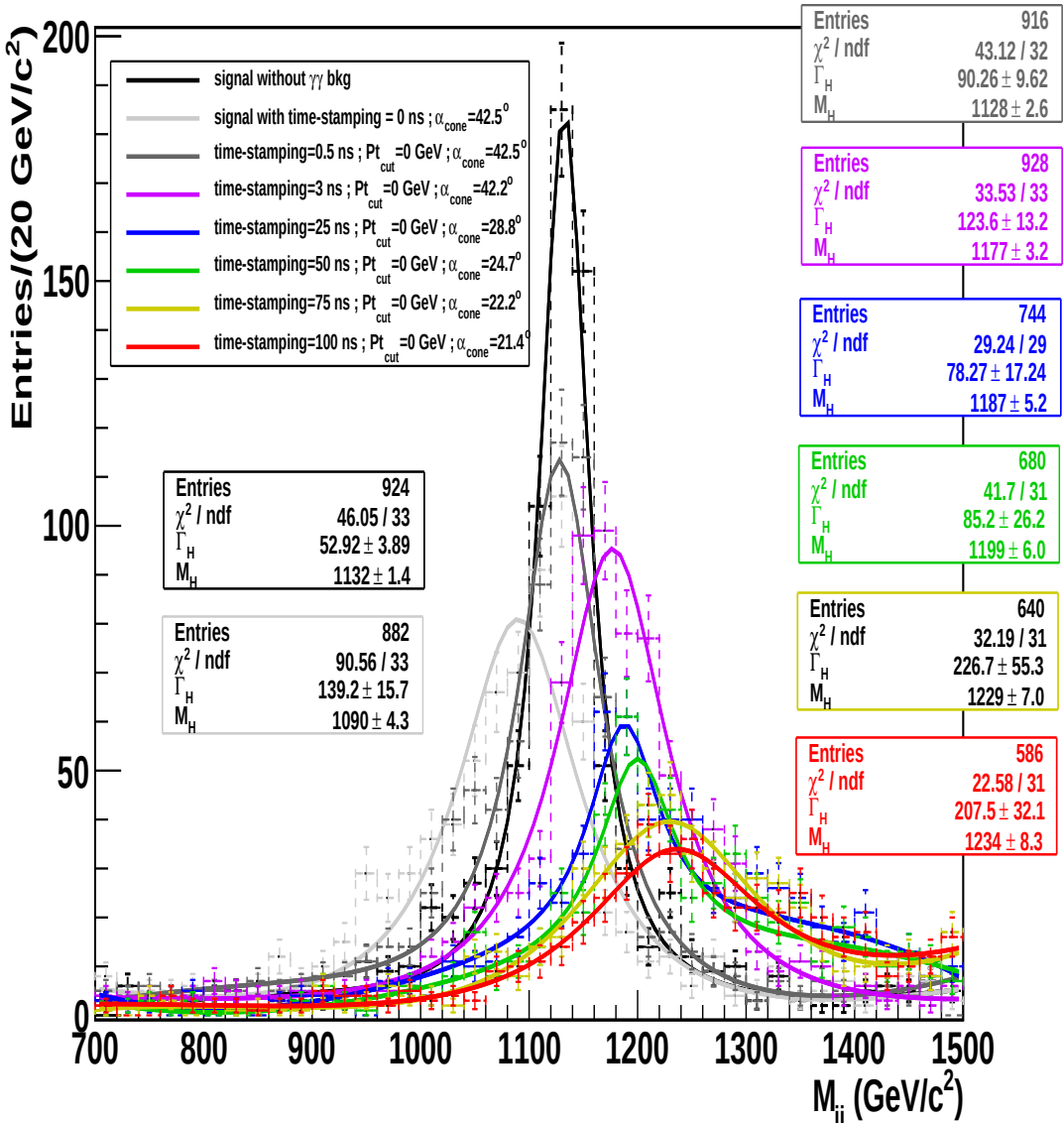

Cone algorithm
DURHAM algorithm
Entries 1442
χ^2 / ndf 47.03 / 33
Γ_H 49.44 ± 3.78
M_H 1132 ± 1.5
Entries 1442
χ^2 / ndf 36.66 / 33
Γ_H 45.06 ± 3.72
M_H 1138 ± 1.1
Entries/(20 GeV/c^2)
0
50
100
150
200
250
700
800
900
1000
1100
1200
1300
1400
1500
M_{jj} (GeV/c^2)

For cone jet clustering

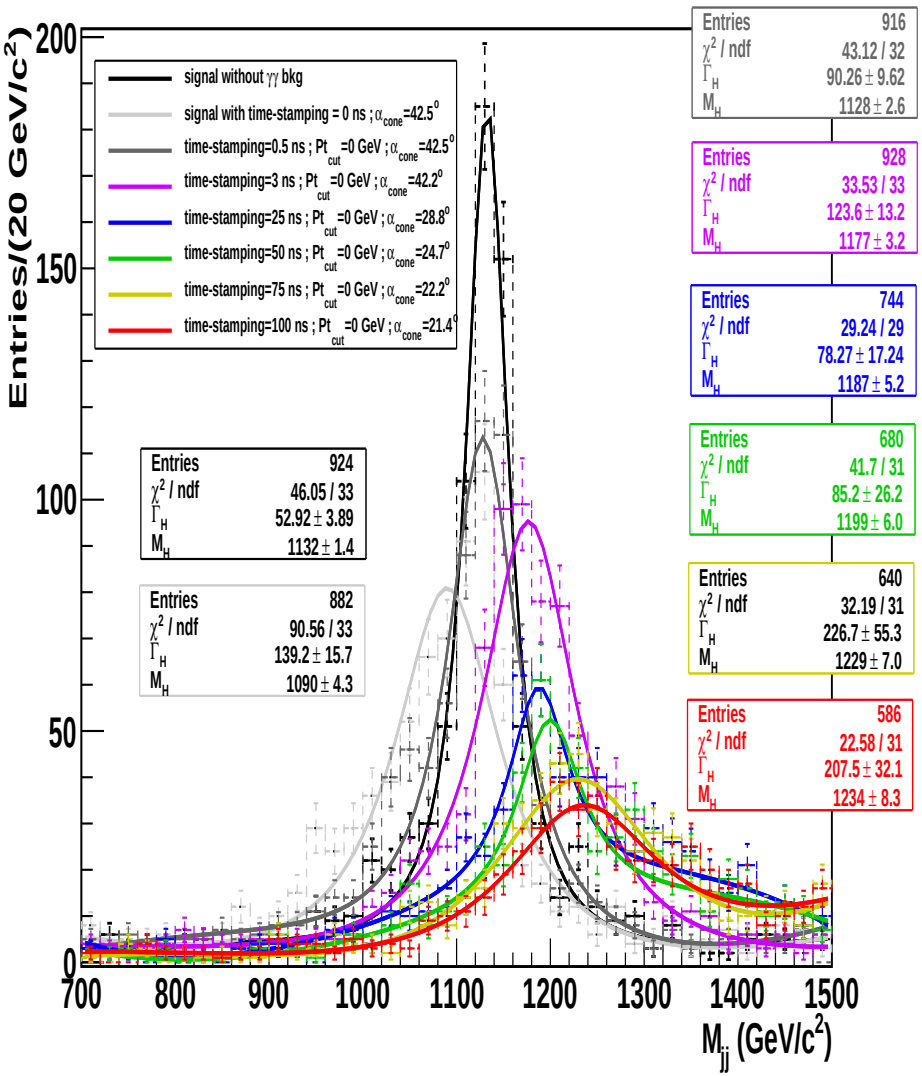
- Define optimal α_{cone} as zero of $f \mapsto \frac{E_{jet} - E_{quark}}{E_{quark}}$
- Time-stamping $\nearrow \Rightarrow$ α_{cone} $\searrow$
  explanation : space 'randomly full of stanger hadrons'



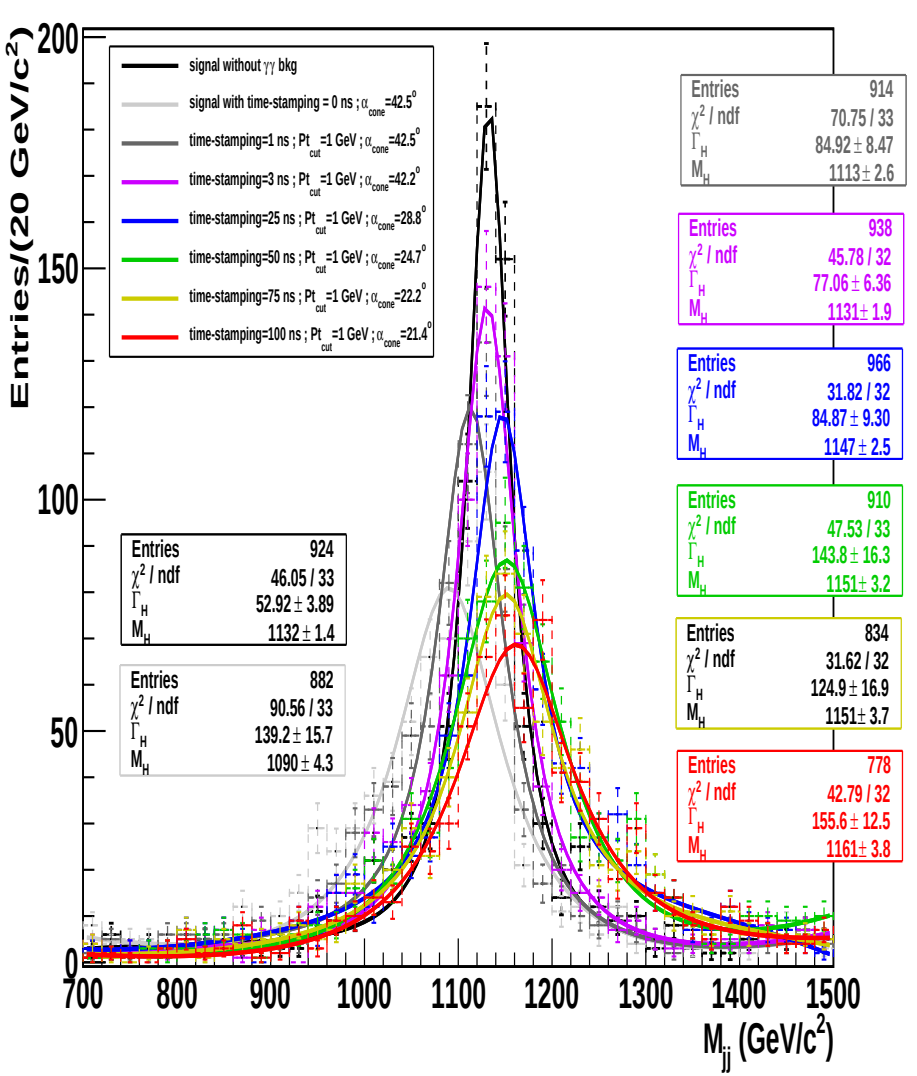
- Black curve : signal without hadrons background
- Light gray curve : stop jet clustering as soon as hadrons bkg appear
- Time-stamping $\nearrow \Rightarrow$ Mjj $\nearrow$ but event cuts $\Rightarrow$ statistics $\searrow$



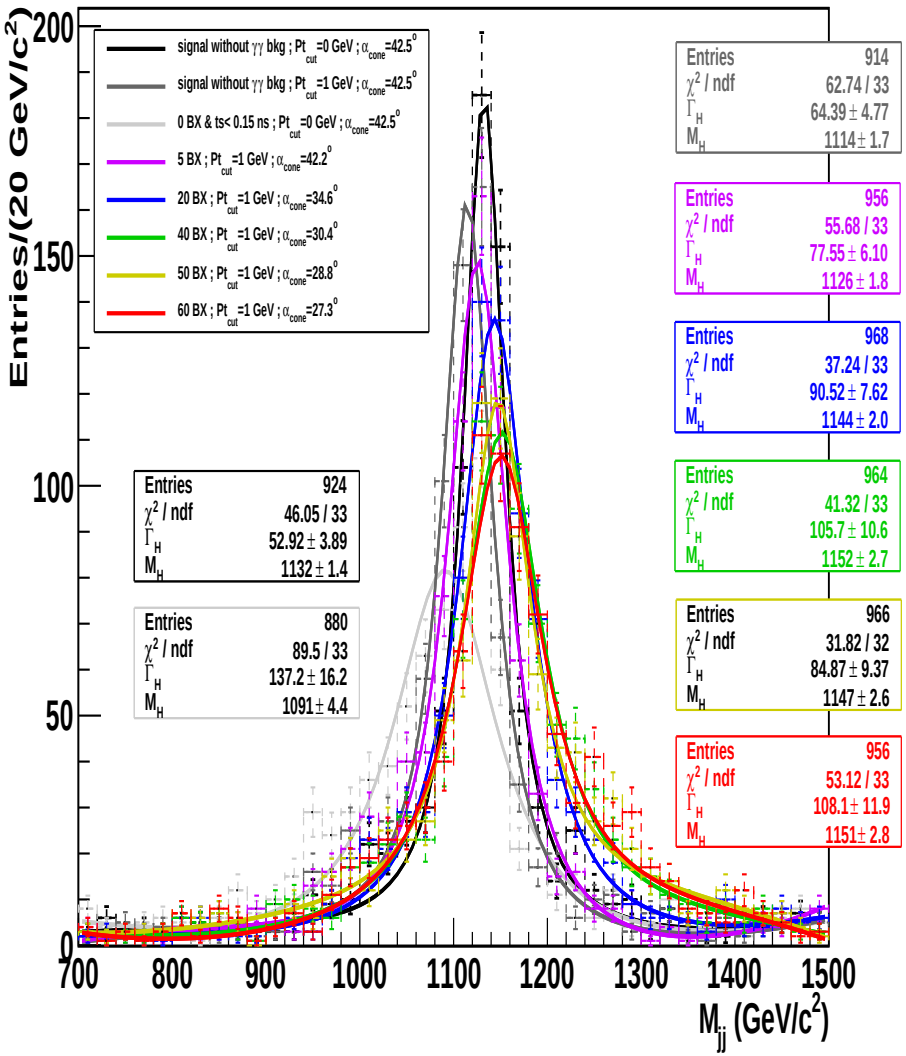
Without Pt_{cut}



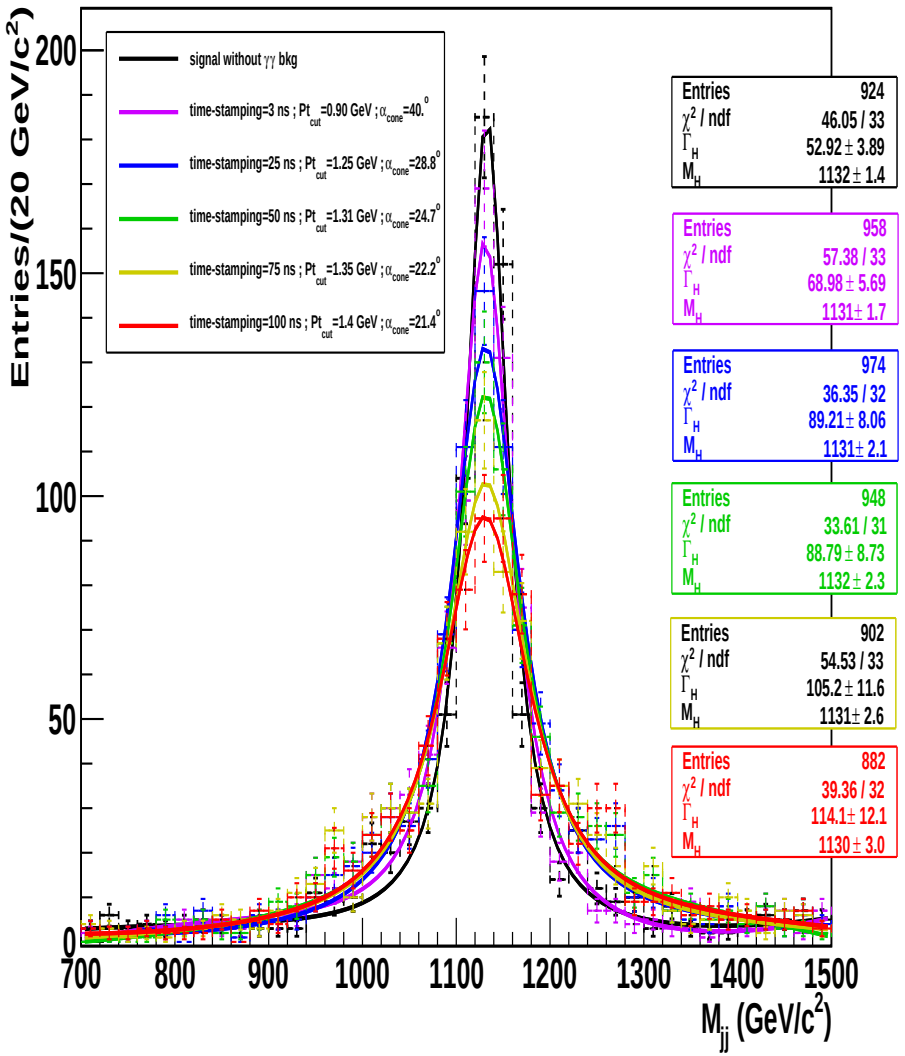
With Pt_{cut}=1 GeV



For low number of bunch crossing



With optimal Pt_{cut}



- At 3 TeV, SUSY heavy Higgs signal is totaly dominated by background coming from $\gamma\gamma$
- $\gamma\gamma \rightarrow$ hadrons background events overlapped to an e^+e^- interaction requires fast time stamping capabilities
- A first way to improve signal : come from analysis procedure during the jet clustering
  $\rightarrow$ i.e impact of $\gamma\gamma$ to hadrons background events can be tuned with Pt_{cut}