Measurement of the mass of Higgs Boson using the decay channel $H \rightarrow ZZ \rightarrow 4l$

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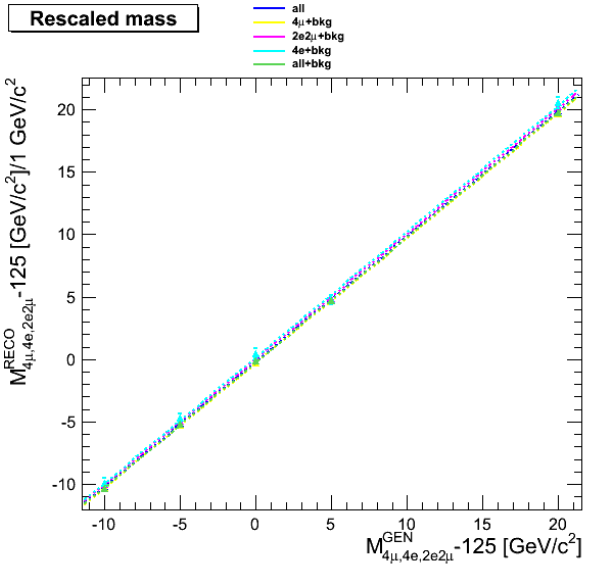
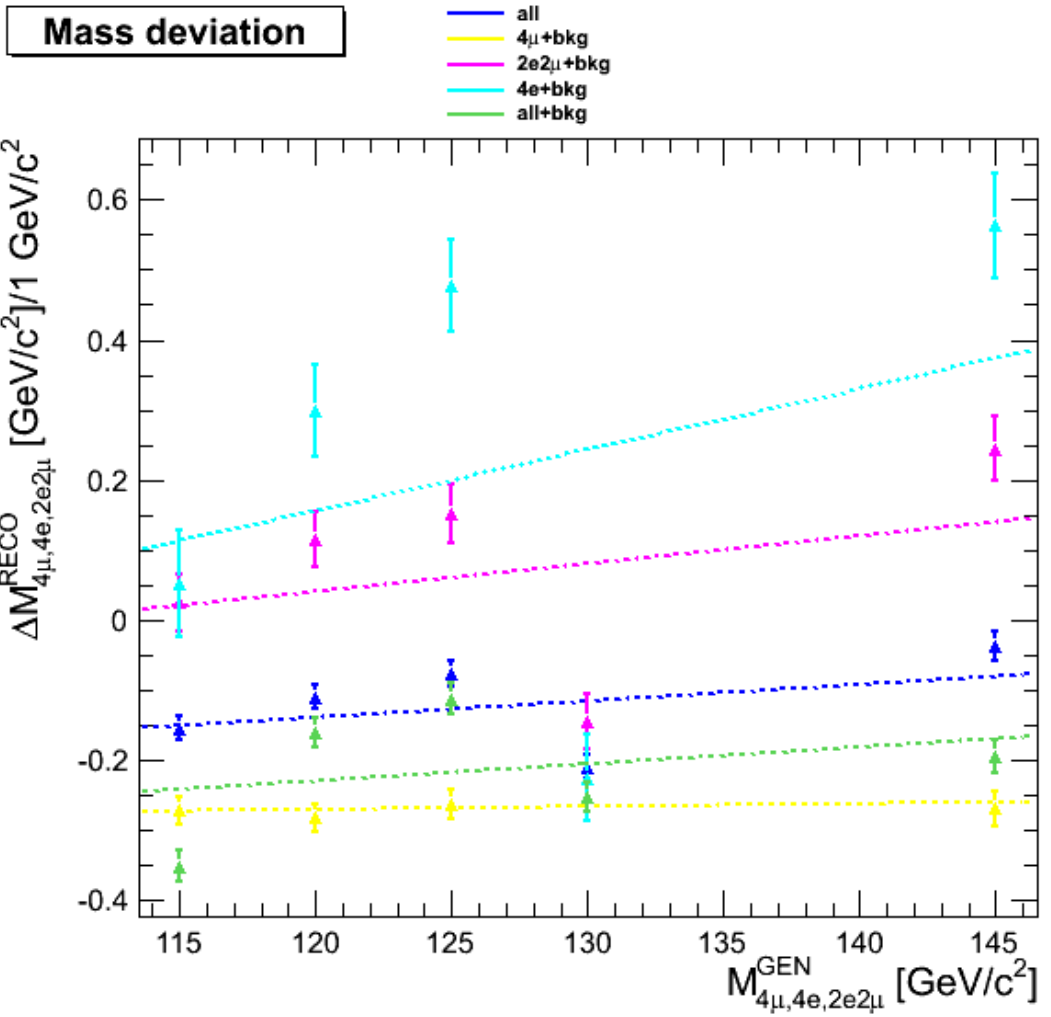
Swagata Mukherjee

Calibration plot

How good does the extracted mass agree with the generated mass?





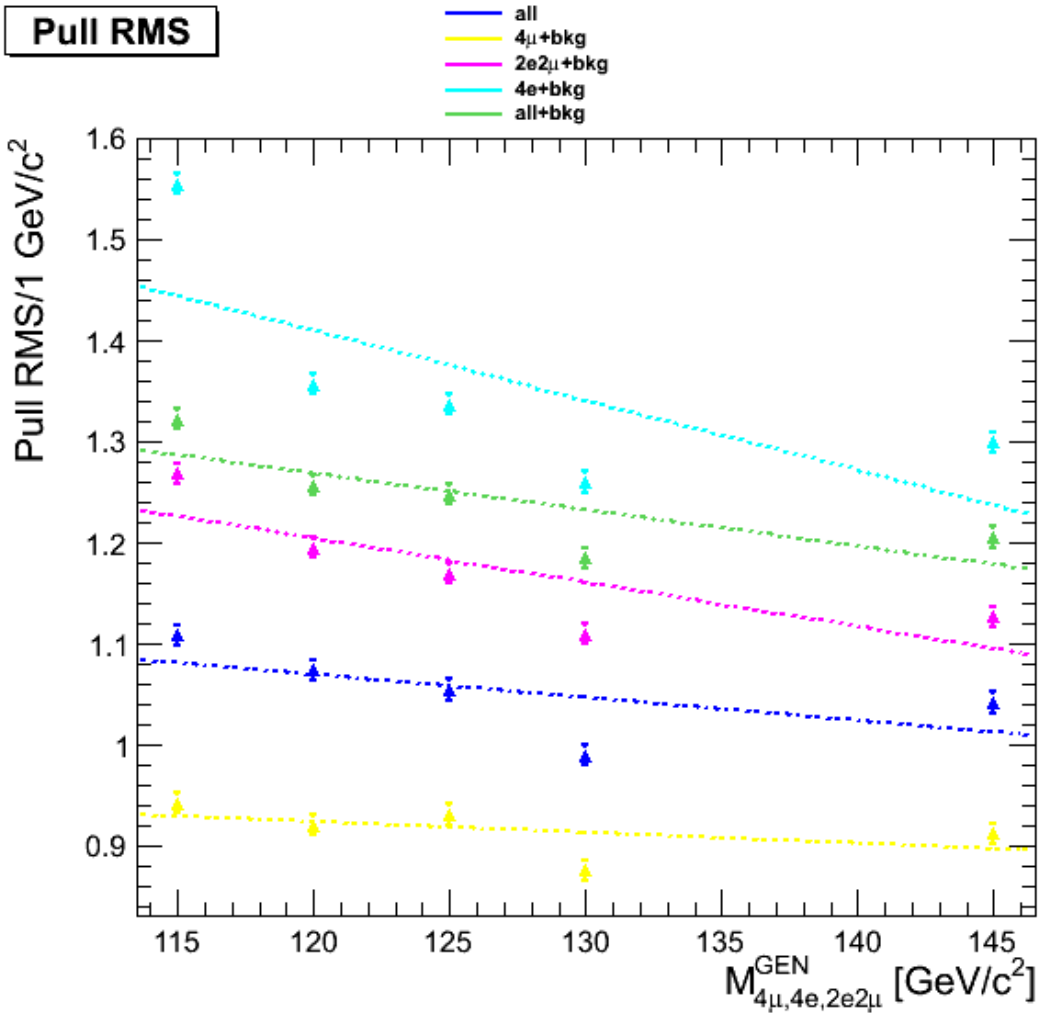
The mass deviation tends to be within
0.5 GeV for all mass points.

Remark that the deviation gets larger after we took background into account.

Is the estimated mass uncertainty correct?

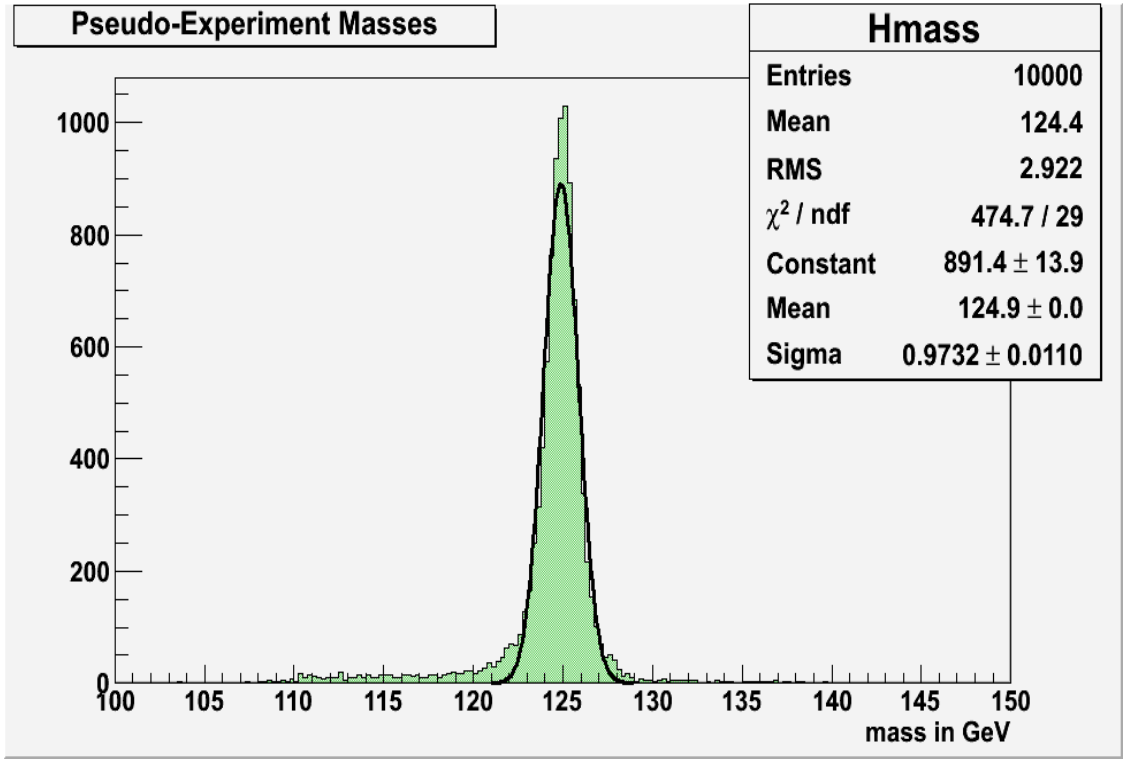
- What is pull?
  Pull=$(M-M_{Expected})/\sigma_{Assumed}$
- RMS of pull will be close to 1 when $\sigma_{Assumed}$ is correct.

The green plot shows that we've underestimated the σ by a factor~1.3



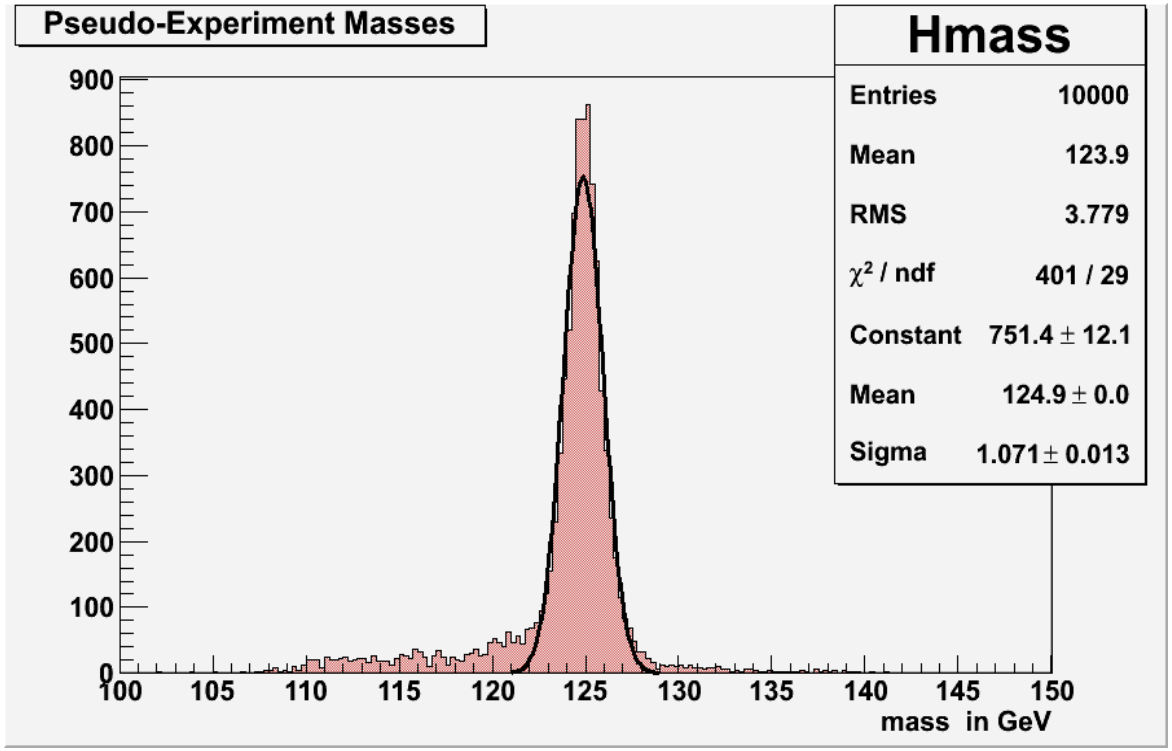
Systematic Uncertainties

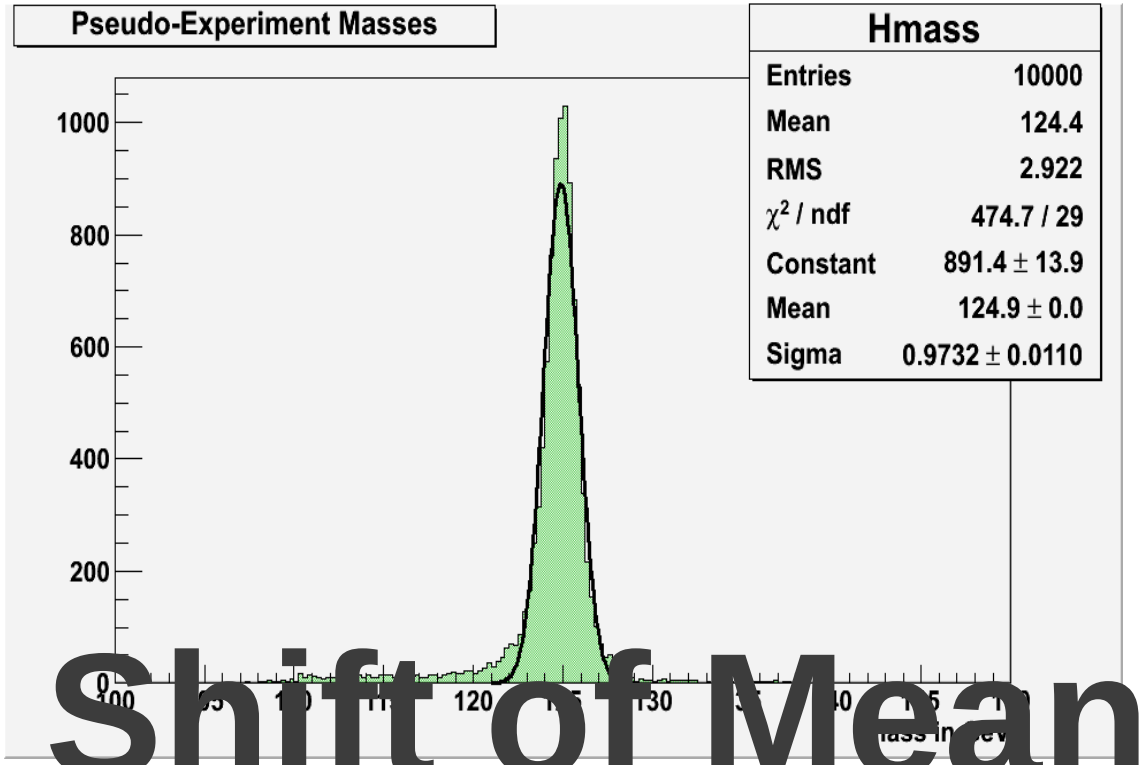
- Calculated the fraction of signal [$n_{sig}/(n_{sig}+n_{bkg})$] in the mass range 100 GeV to 150 GeV → It came out to be 0.39
- Plotted ZZ invariant mass
- Doubled the background and Halved the background : Plotted the ZZ invariant mass for both cases
- Does the mass peak shift ?



Default BKG

Double BKG

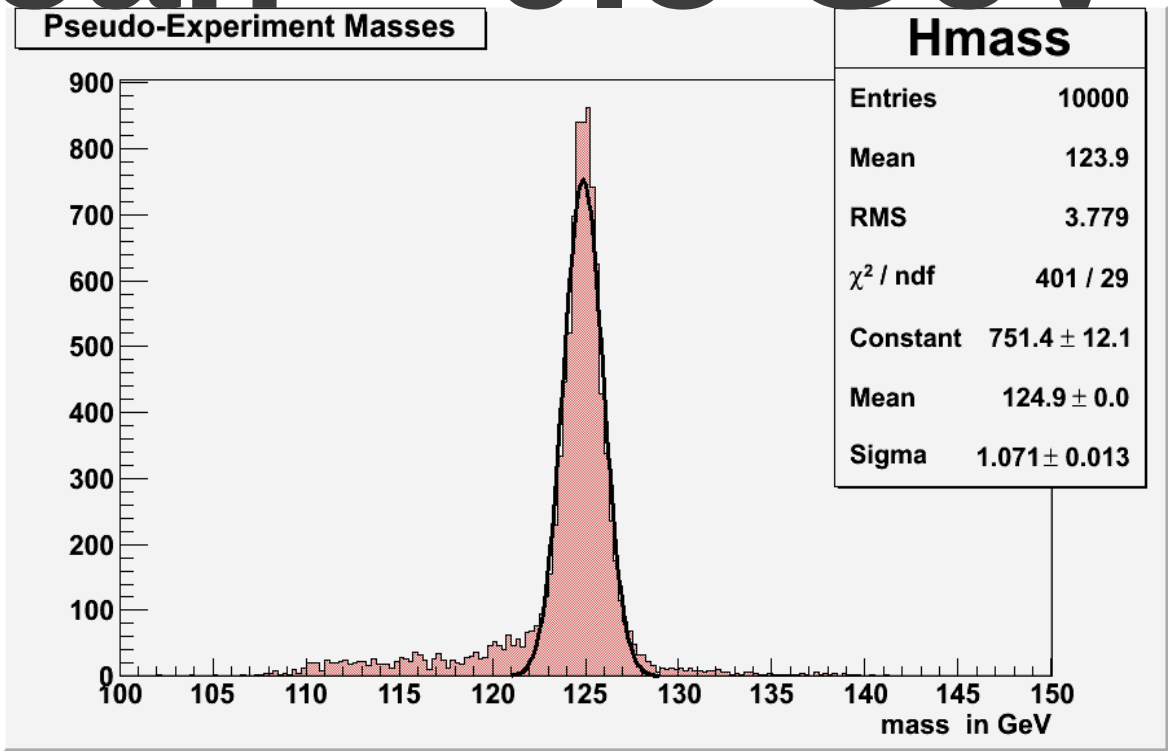


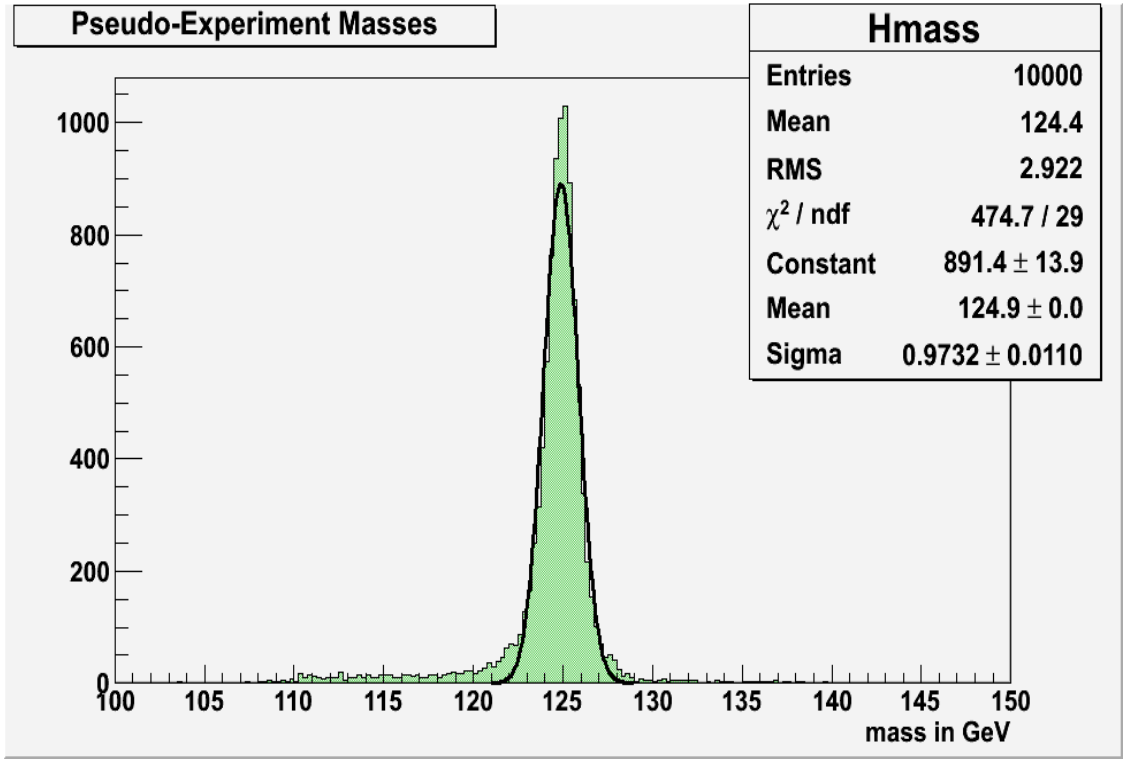


Default BKG

Shift of Mean = 0.5 GeV

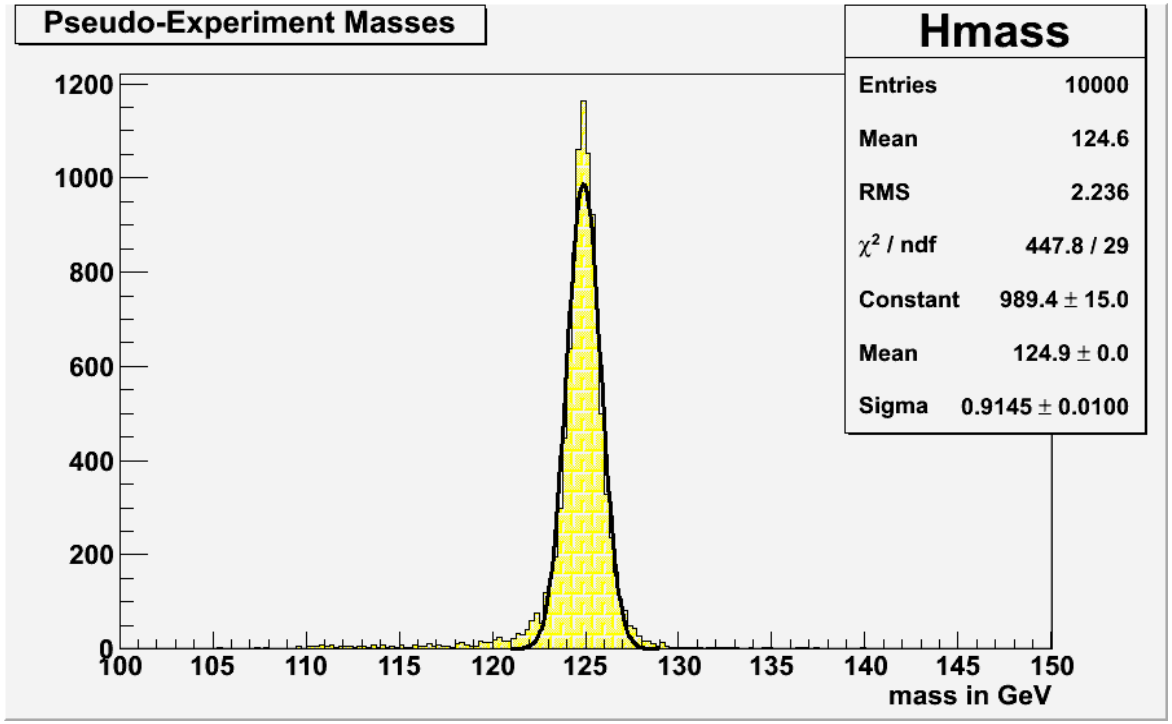
Double BKG

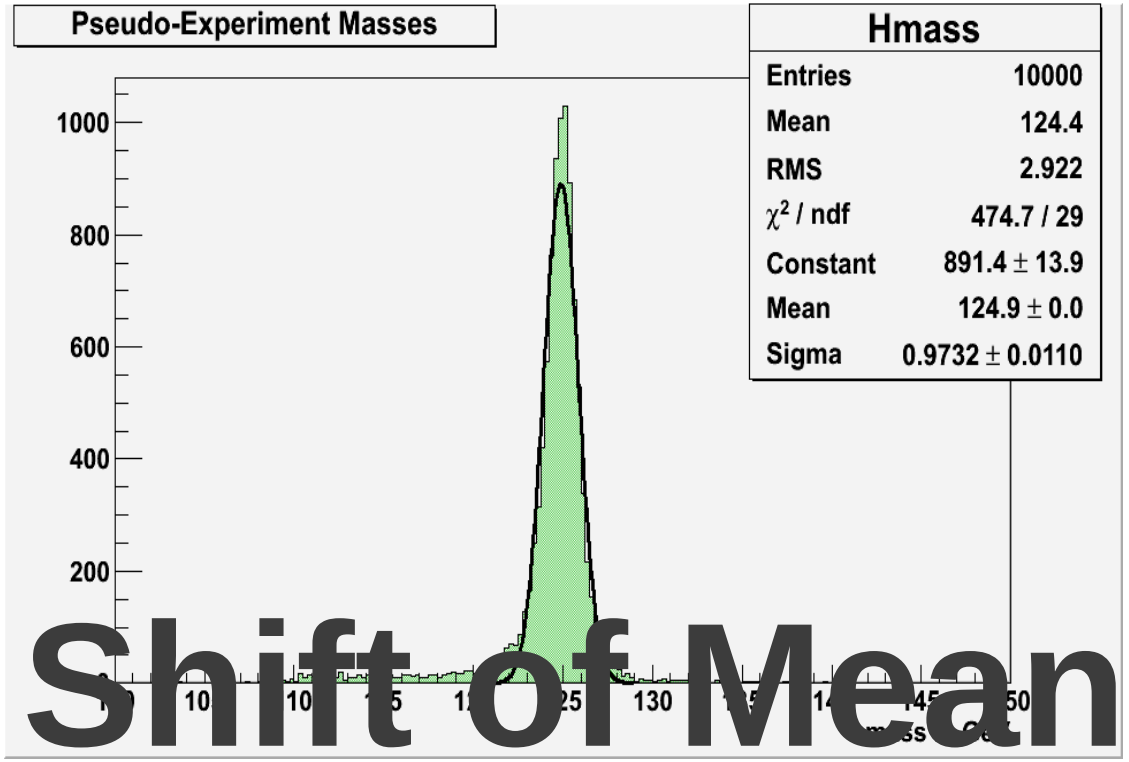




Default BKG

Half BKG

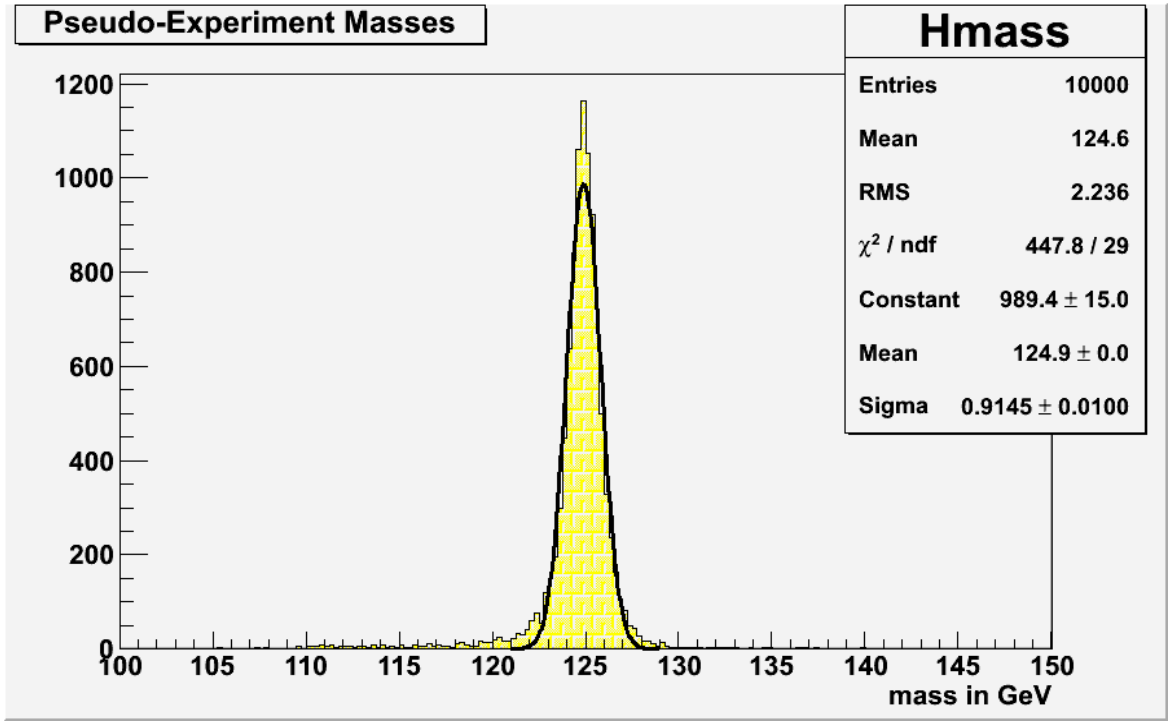




Default BKG

Shift of Mean = 0.2 GeV

Half BKG

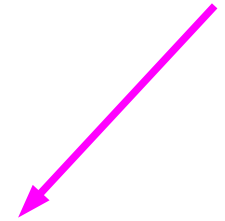


Average Shift of Mass Peak :

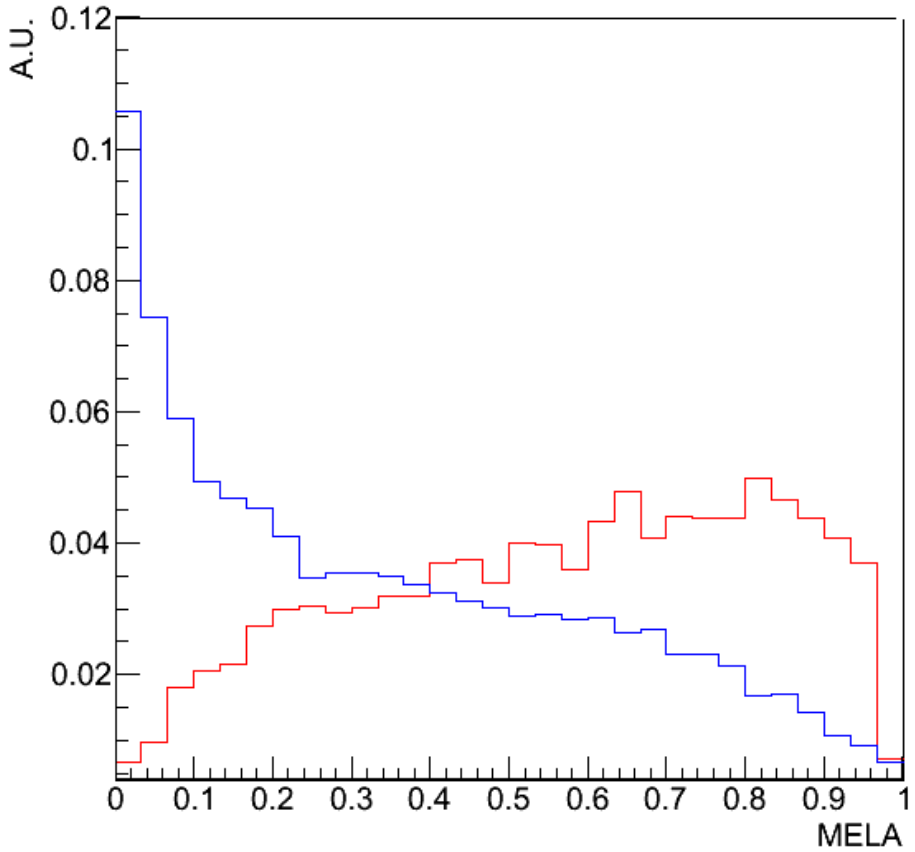
$(0.2+0.5)/2 = 0.35$ GeV

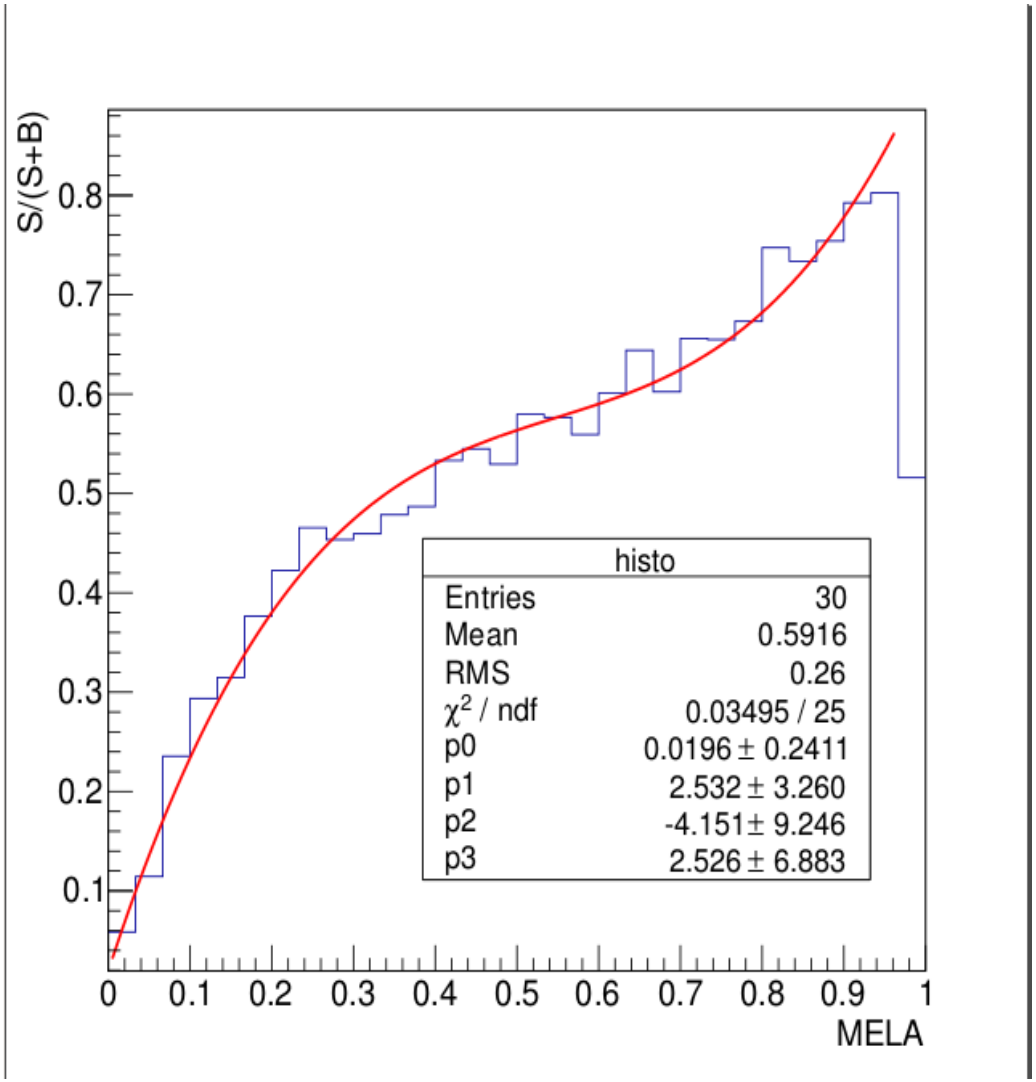
Average Shift of Mass Peak :

(0.2+0.5)/2 = 0.35 GeV



Systematic Uncertainty


A.U.
0.12
0.1
0.08
0.06
0.04
0.02
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
MELA

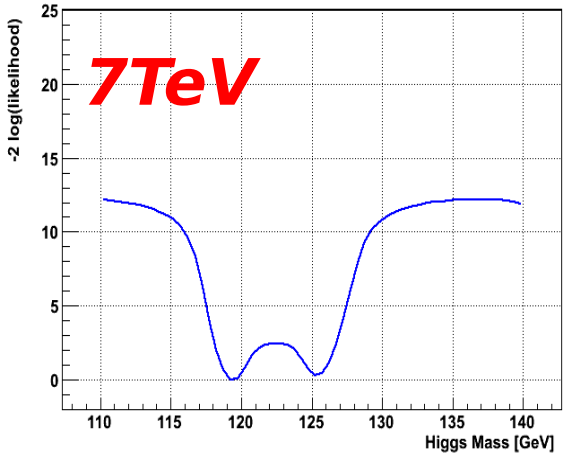

S/(S+B)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
MELA
histo
Entries 30
Mean 0.5916
RMS 0.26
χ² / ndf 0.03495 / 25
p0 0.0196 ± 0.2411
p1 2.532 ± 3.260
p2 -4.151 ± 9.246
p3 2.526 ± 6.883

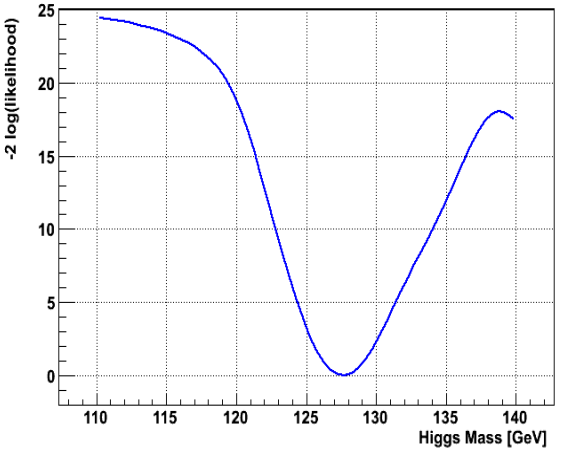
DATA

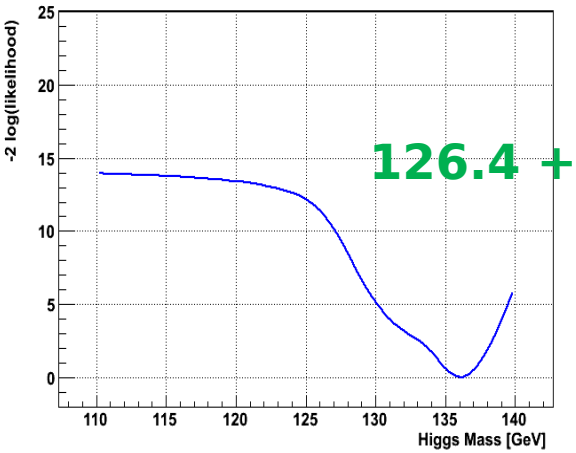
4mu

2e2mu

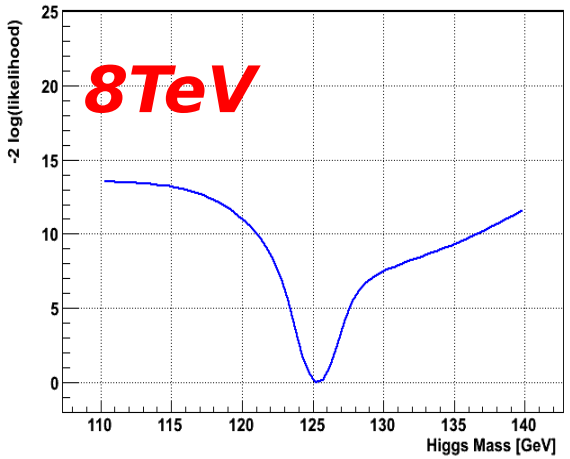
4e

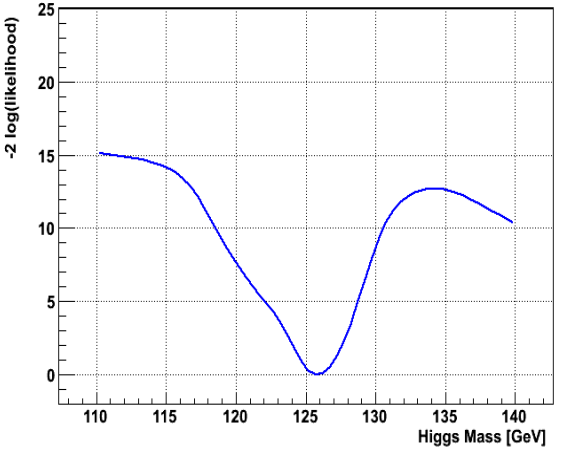


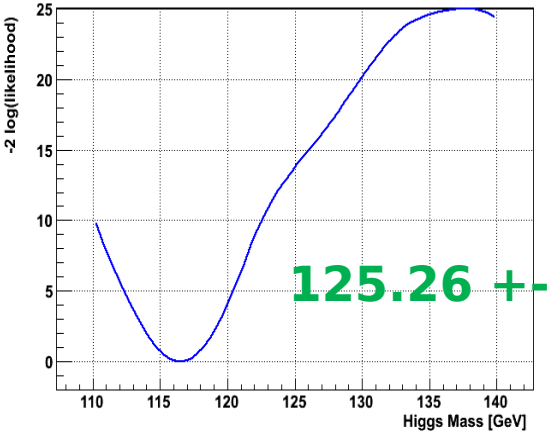




126.4 +- 1.2 GeV







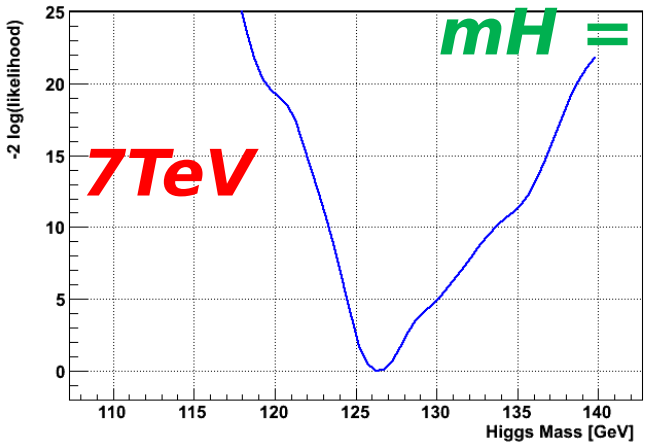
125.26 +- 0.99 GeV

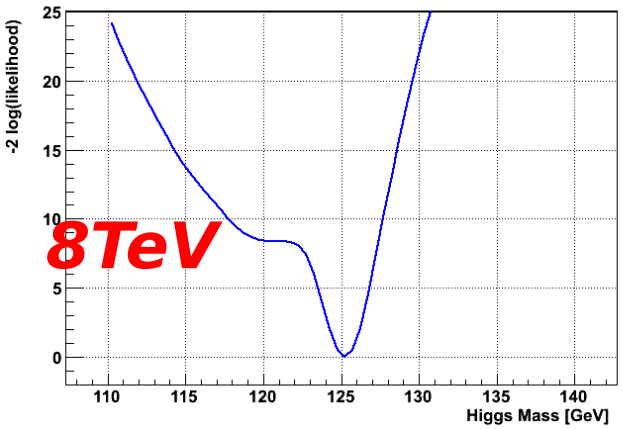
125.38 +- 0.80 GeV

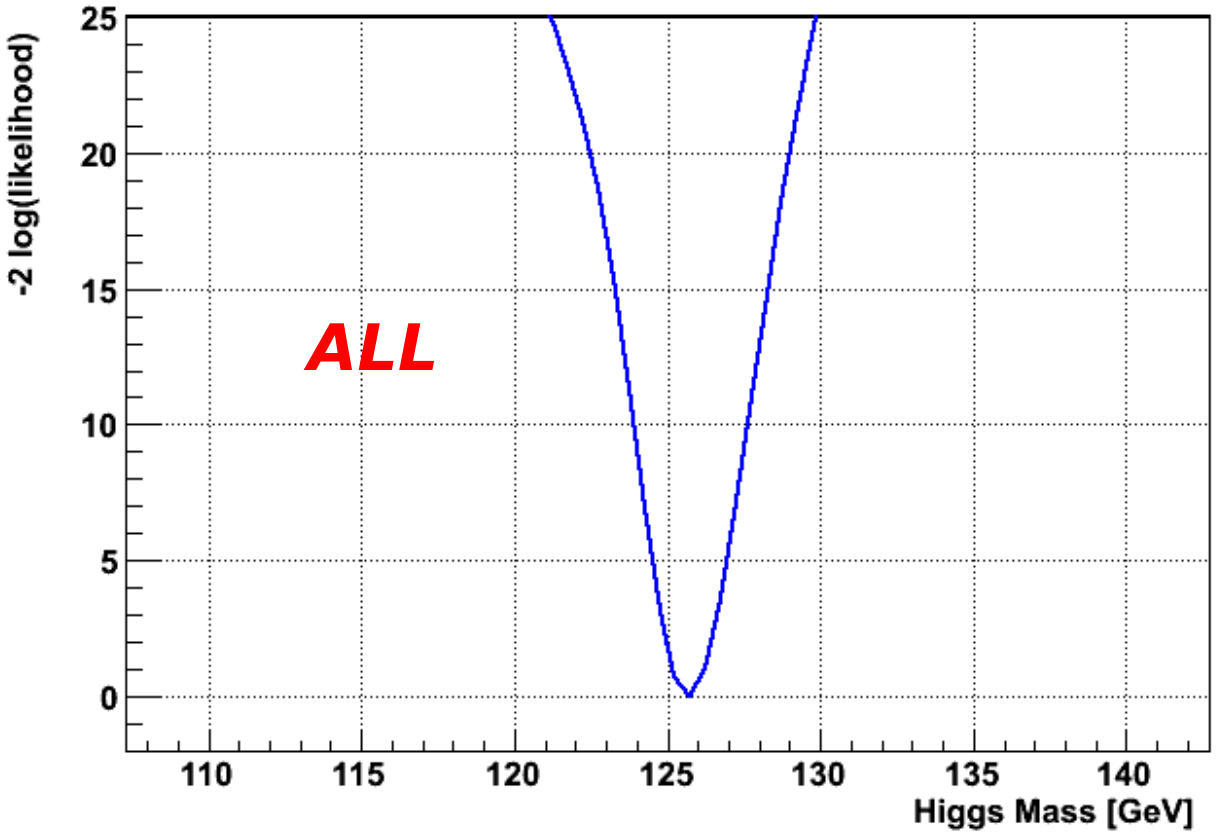
126.6 +- 1.2 GeV

116.6 +- 2.2 GeV

Result


mH = 125.70 +- 0.69 (stat) +- 0.35 (syst) GeV
7TeV
-2 log(likelihood)
Higgs Mass [GeV]


8TeV
-2 log(likelihood)
Higgs Mass [GeV]


ALL
-2 log(likelihood)
Higgs Mass [GeV]

Thank You