Higgs mass measurement and $\gamma^{(*)}\gamma^{(*)}$ backgrounds

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Introduction

- Want to study $\gamma^{(*)}\gamma^{(*)} \rightarrow$ hadrons effect on Higgs mass measurement
- How sever the backgrounds are for Warm?
- How much difference do we see between Cold and Warm?
- Compare the results with European study

Contents of this talk

- We are doing the followings

1. Analysis overflow and 5C kinematical fit
2. Lesson from Higgs mass measurements with no $\gamma^{(*)}\gamma^{(*)}$ suppression
3. $\gamma^{(*)}\gamma^{(*)} \rightarrow$ hadrons suppression and European results
4. Our results

Analysis assumption

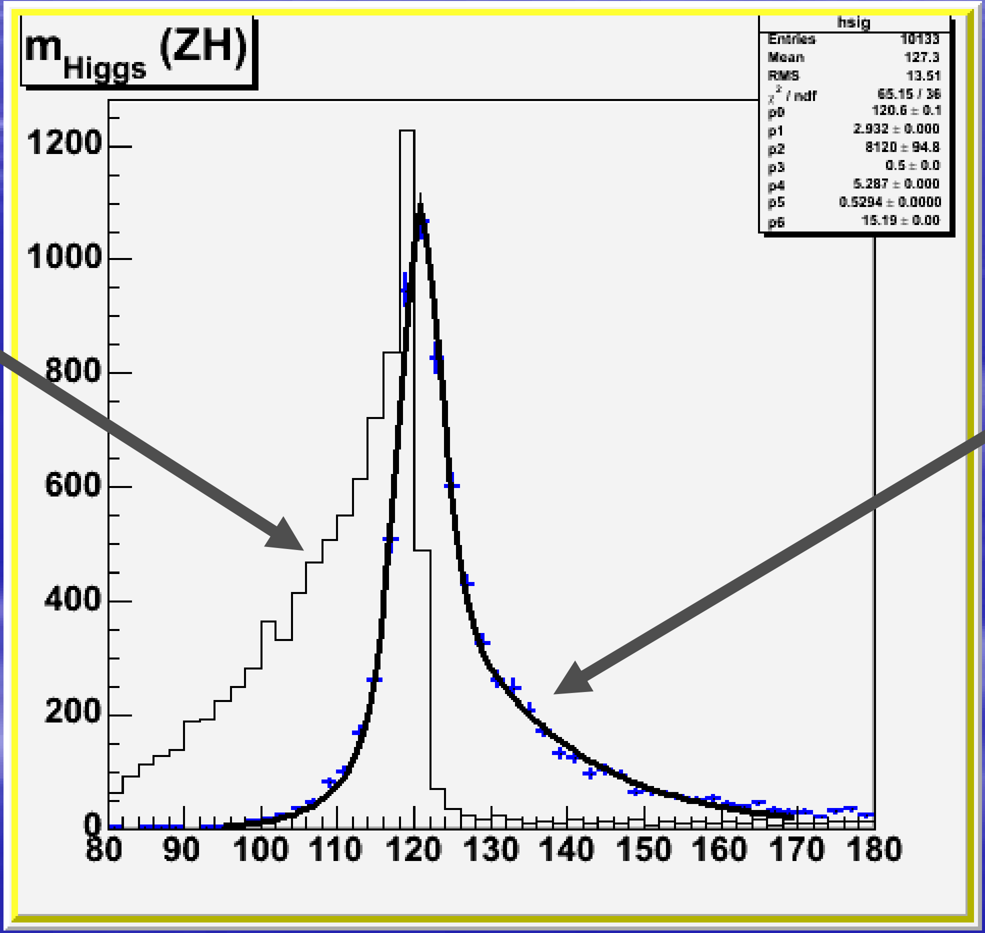
- Use $e^+e^- \rightarrow ZH \rightarrow qqbb$ at E_{cm}=500GeV.
- Use $\gamma^{(*)}\gamma^{(*)} \rightarrow$ hadrons provided by Tim to overlay on signal and background events.
- Only $e^+e^- \rightarrow ZH \rightarrow qqqq$ process is taken into account as backgrounds.
- Use fast detector simulation (SDMar01).

Event selection

- Force into four jets using Durham algorithm.
- Jets to form Higgs mass satisfy b-jet tagging.
- We require four-momentum conservation and constrain one of the two dijet masses to be m_Z=91.2GeV (**5C-fit**). One of the six possible jet pairings, the one minimizing χ^2 of the fit is chosen.
- Etc….

5C Kinematical fit

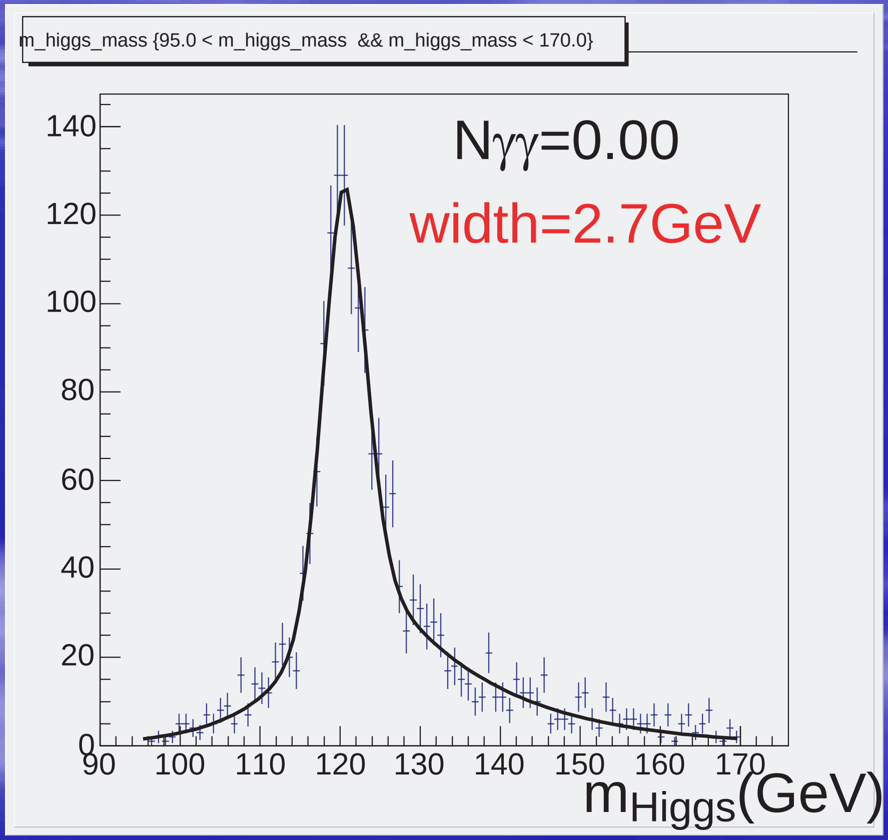
Raw mass

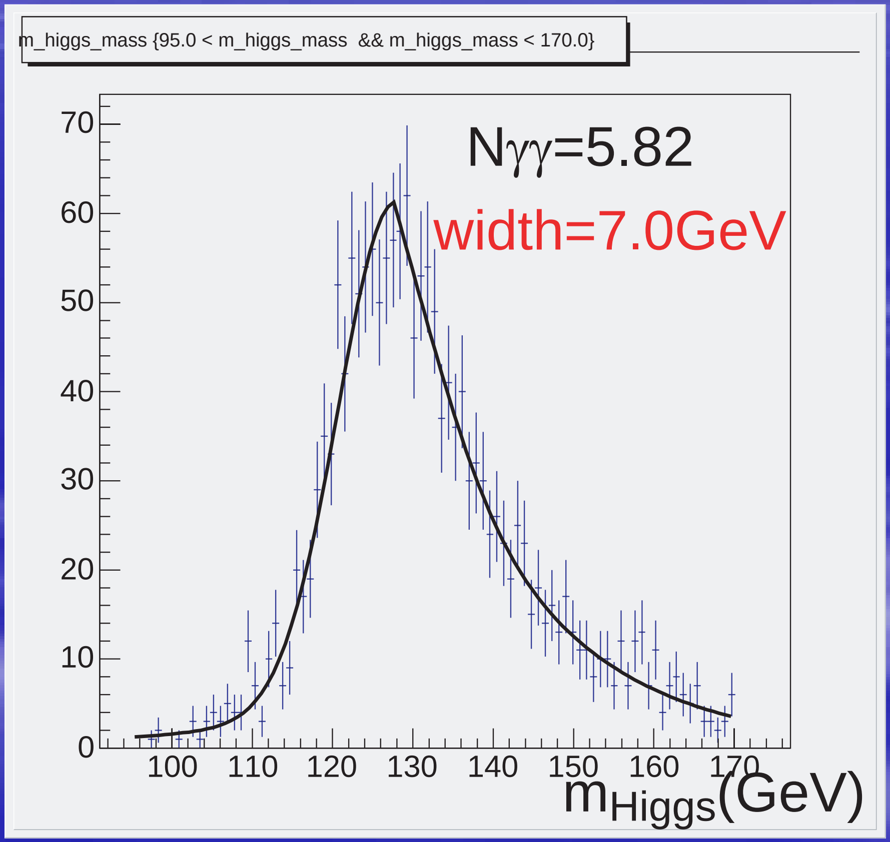


Fitted mass

The code is provided by courtesy of European colleagues.

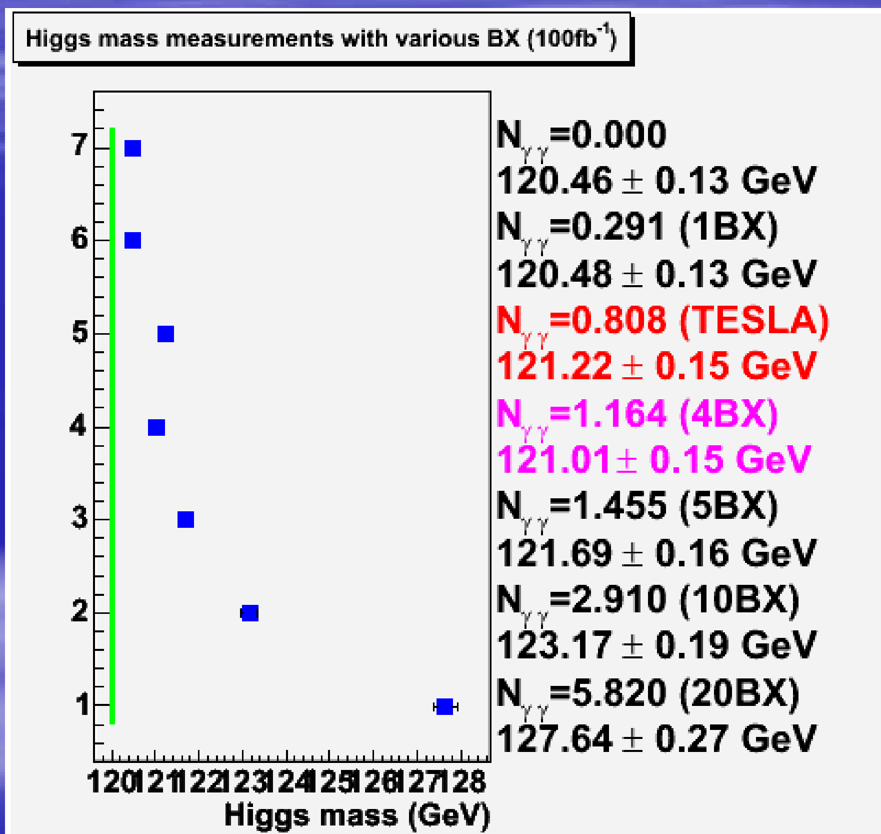
Reconstructed Higgs mass

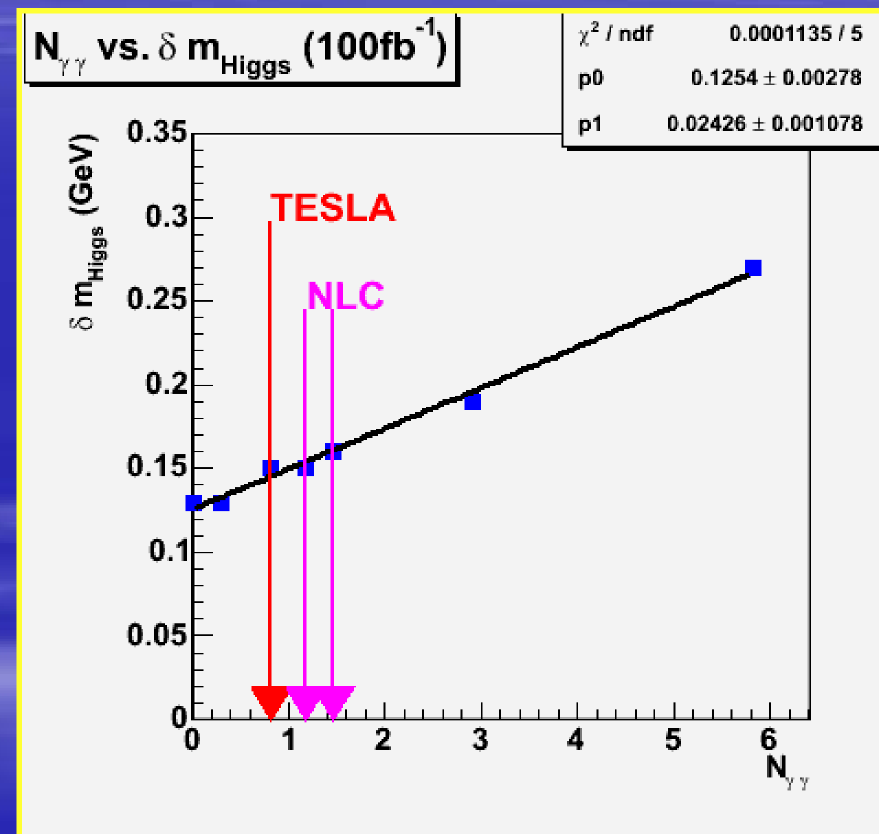




$100 fb^{-1}$

m_{Higgs} without $\gamma^{(*)}\gamma^{(*)}$ suppression



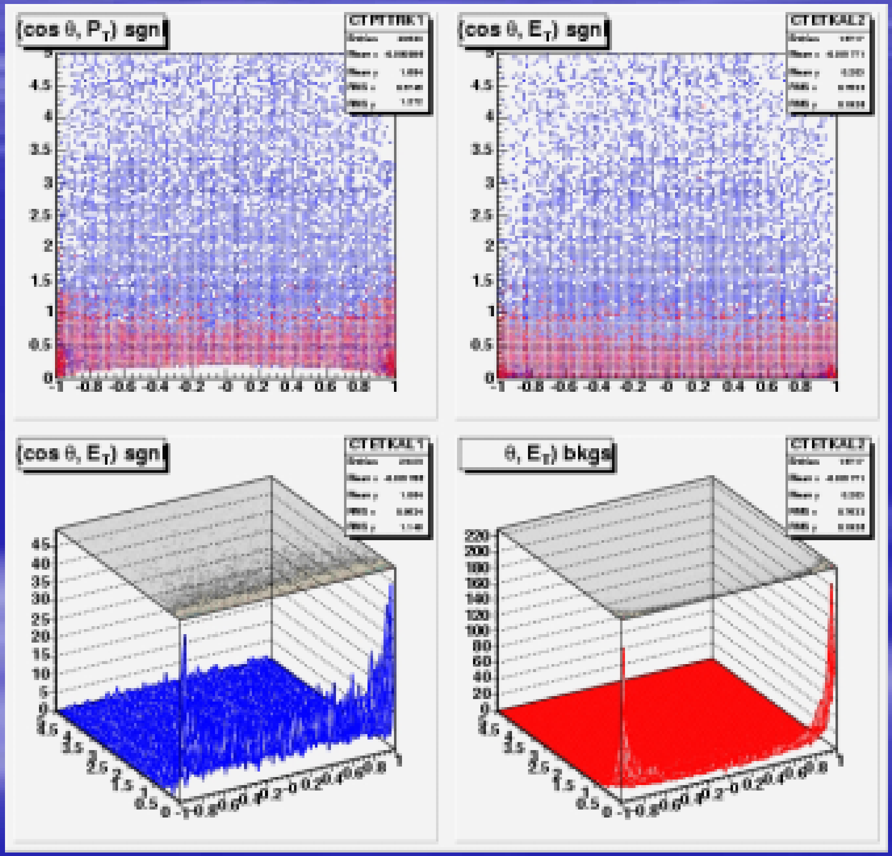


100fb^{-1}

$\gamma^{(*)}\gamma^{(*)}$ effect on Higgs mass

- $\gamma^{(*)}\gamma^{(*)} \rightarrow$hadrons results in widening reconstructed Higgs mass distribution.
  1. 5~8ns time separation is need to equivalent to TESLA.
  2. About 2X worse measurement error for 20BX compared to no $\gamma^{(*)}\gamma^{(*)} \rightarrow$hadrons.
- We need to suppress $\gamma^{(*)}\gamma^{(*)} \rightarrow$hadrons.

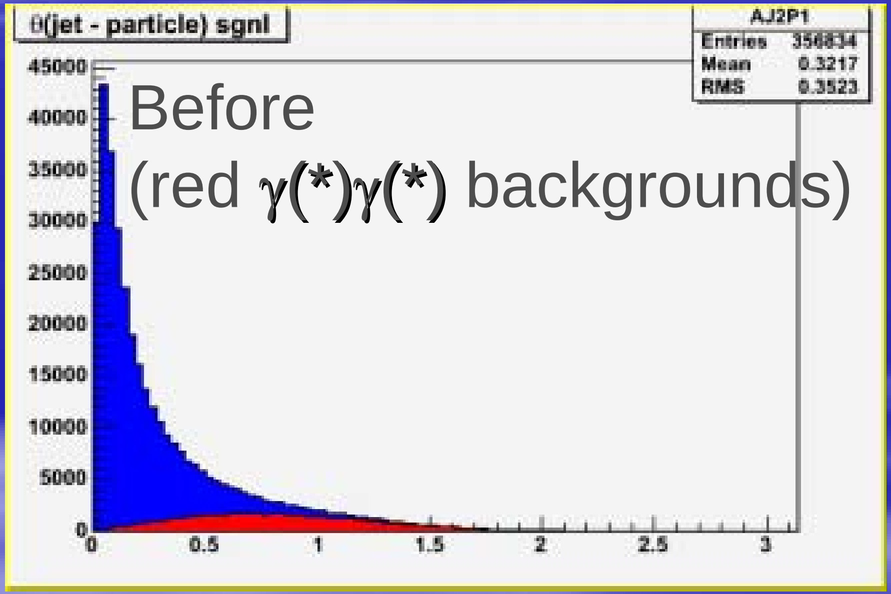
Possible cut to suppress $\gamma^{(*)}\gamma^{(*)}$ backgrounds

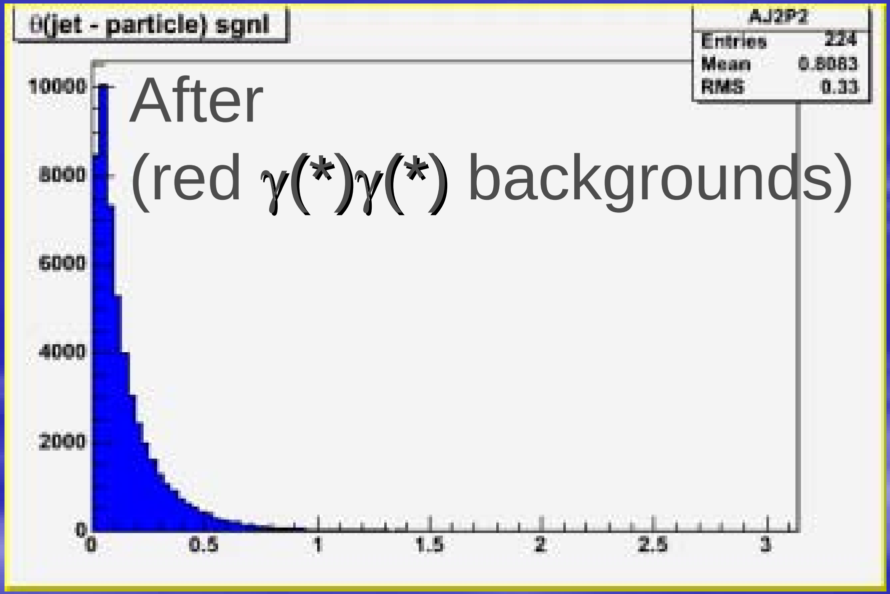


- European colleague already studied to suppress $\gamma^{(*)}\gamma^{(*)}$ backgrounds and they found P_T cut is very useful.
- After P_T >1.0GeV requirement, most of $\gamma^{(*)}\gamma^{(*)}$ backgrounds are gone.

$\gamma^{(*)}\gamma^{(*)}$ background suppresion

Angle between jet-axis and particles

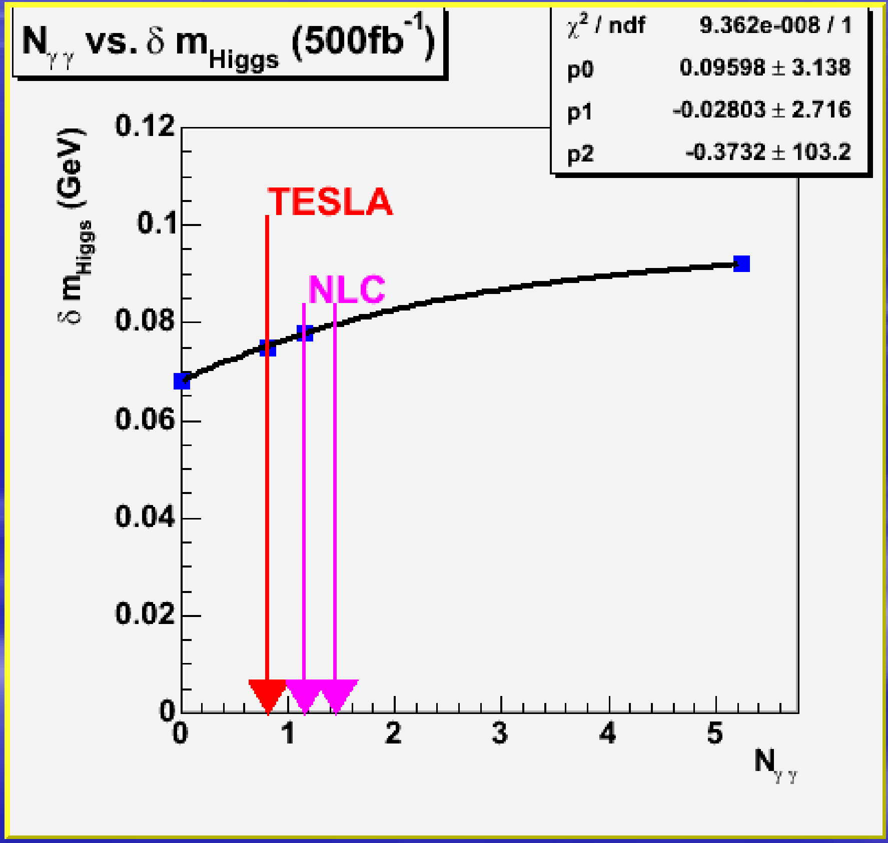




Not same number of events…

European results ($500fb^{-1}$)

$N_{\gamma\gamma}$ → hadrons	δm_{Higgs} (MeV)	δm_{Higgs}/ $\delta m_{Higgs}(0)$
0.0	68	-
TESLA	75	1.10
4BX	78	1.15
18BX	92	1.35



~2.0 for no $\gamma\gamma$ suppression

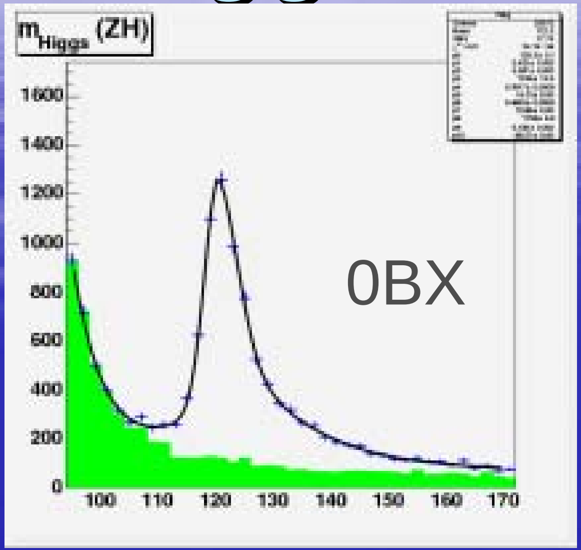
Higgs mass (European method)

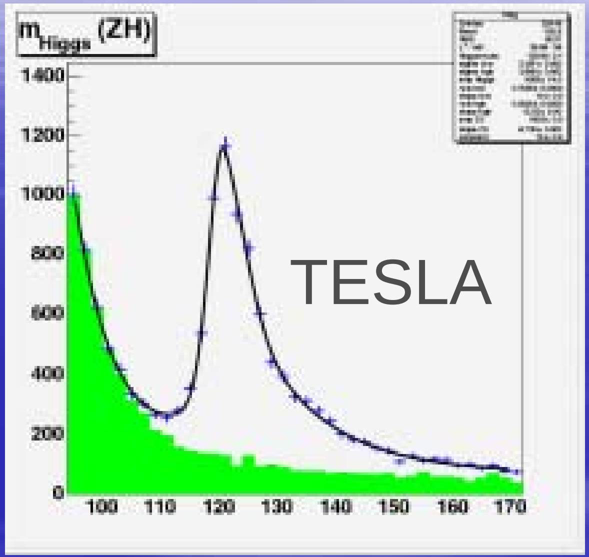
- P_T >1.0GeV requirement helps to suppress the $\gamma^{(*)}\gamma^{(*)}$ effect on Higgs mass measurement.
- But we still need 5~8ns time separation to match up Cold (TESLA) environment.
- The larger error with P_T >1.0GeV can be understood due to information loss of reconstructed jet energy.

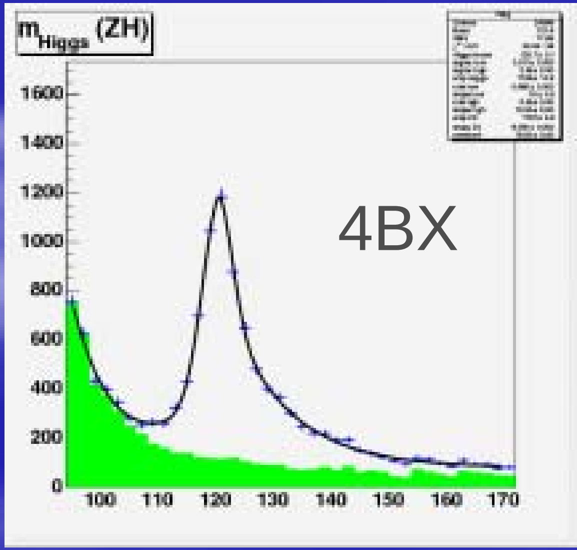
Our approach

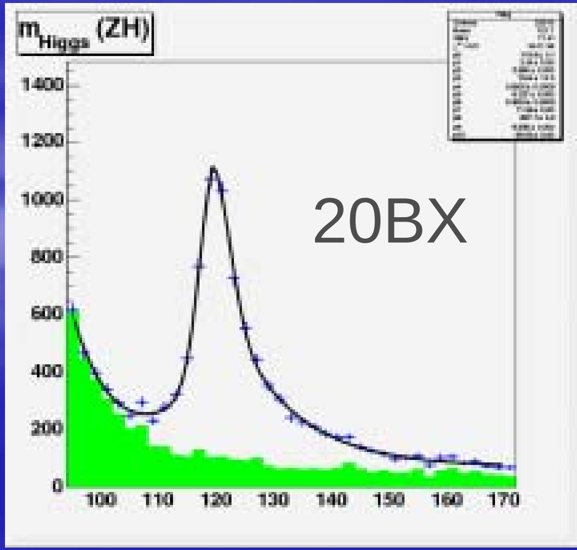
- We want to recover jet energy resolution to improve reconstructed Higgs mass resolution with P_T >1.0GeV.
- Since we use Linear Collider environment with which we know total four momentum of the reaction, we could recover the jet energy resolution.
- We already use this information (5C fit), but European colleague uses resolution function which is determined with "NO" P_T >1.0GeV requirement. → re-determine the function with the requirement.

Higgs mass distribution



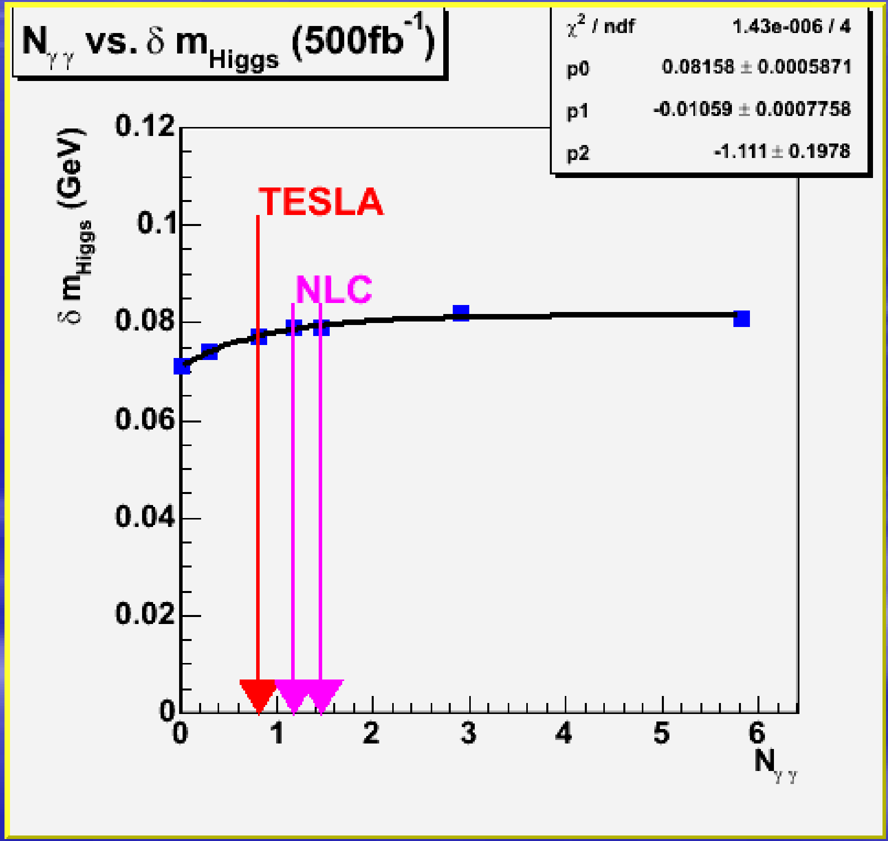






Our results (500fb^{-1})

$N_{\gamma\gamma}\rightarrow$hadrons	δm_{Higgs} (MeV)	δm_{Higgs}/ $\delta m_{Higgs}(0)$
0.0	71	
1BX	74	1.04
TESLA	77	1.08
4BX	79	1.11
5BX	79	1.11
10BX	82	1.15
20BX	81	1.14



Compared to European results

$N_{\gamma\gamma}$→hadrons	δm_{Higgs} (MeV) (European's)	δm_{Higgs} (MeV) (Ours)
0.0	68	71
TESLA	75	77
4BX	78	79
18/20BX	92	81

Summary

- Larger $\gamma\gamma$ backgrounds results in increasing error of Higgs mass measurement, so we need good time separation for warm environment.
- European colleague establishes efficient $\gamma\gamma$ backgrounds suppression, but it looks we still need good time separation.
- 5C-fit recovers the measurement accuracy with reasonable level compared to Cold environment even 20BX case.
- Our and European results are consistent (<10BX).