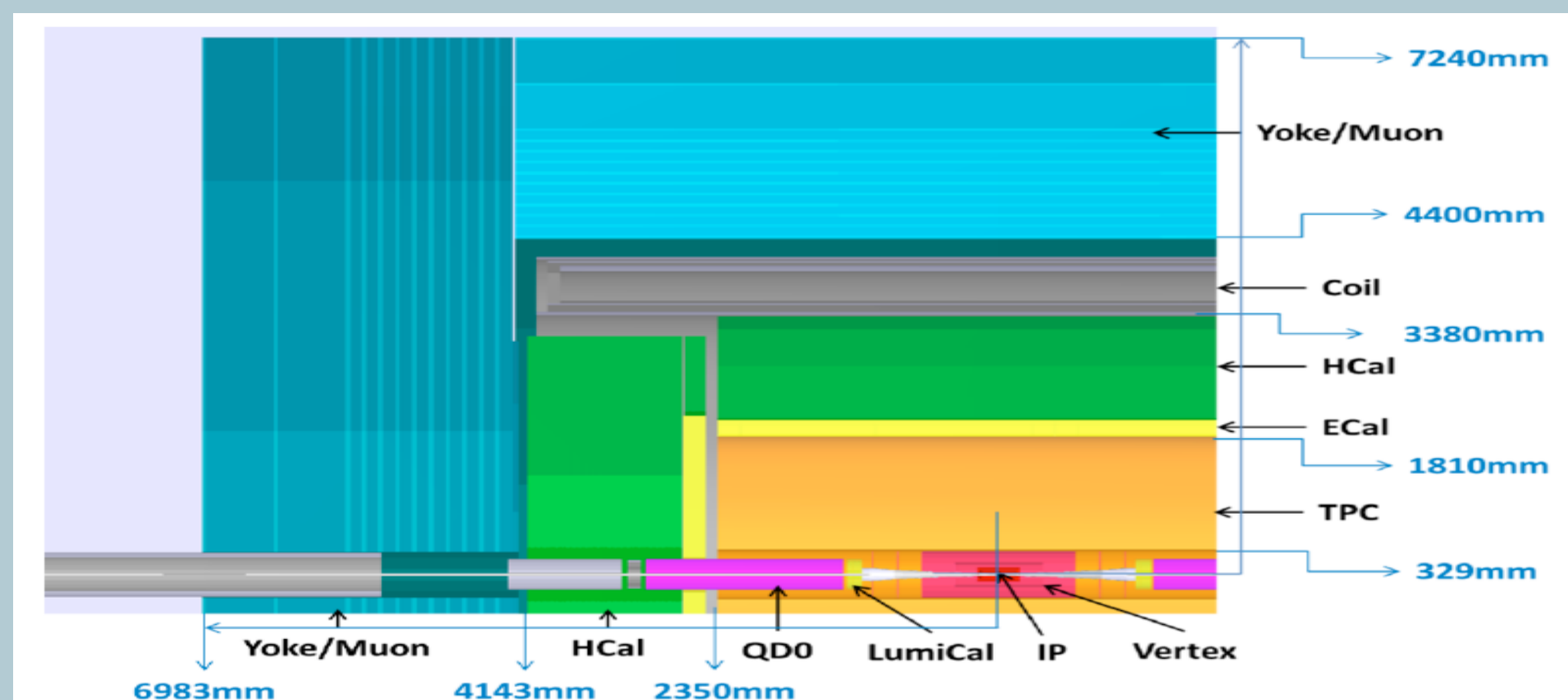


Measurement of $e^+e^- \rightarrow ZH(Z^*Z)$ Decay at CEPC

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Introduction

After the discovery of the Higgs particle, it is natural to measure its properties as precise as possible. The low Higgs mass of ~ 125 GeV makes possible a Circular Electron Positron Collider (CEPC) as a Higgs Factory, which has the advantage of higher luminosity to cost ratio and the potential to be upgraded to a proton-proton collider to reach unprecedented high energy and discover New Physics.



According to standard model, the branch ratio of higgs decay to ZZ^* is about 2.7%

Final state	bb	cc	gg	WW*	ZZ*	$\mu\mu$	$\tau\tau$	$\gamma\gamma$	Z γ
Branch ratio	57.8	2.7	8.6	21.6	2.7	0.02	6.4	0.23	0.16

The purpose of this analysis is to get the $\sigma(ZH) * Br(H \rightarrow ZZ^*)$, and measure the width of higgs.

The $Br(H \rightarrow ZZ^*) = \frac{N_{signal}}{N_{Z(H \rightarrow ZZ^*)}} = \frac{N_{signal}}{N_{total} Br(Z \rightarrow A) Br(Z \rightarrow B) Br(Z^* \rightarrow C) \epsilon^2}$, in order to calculate the branch ratio, we should analyze the branch ratio of each final state.

The main final state are listed below:

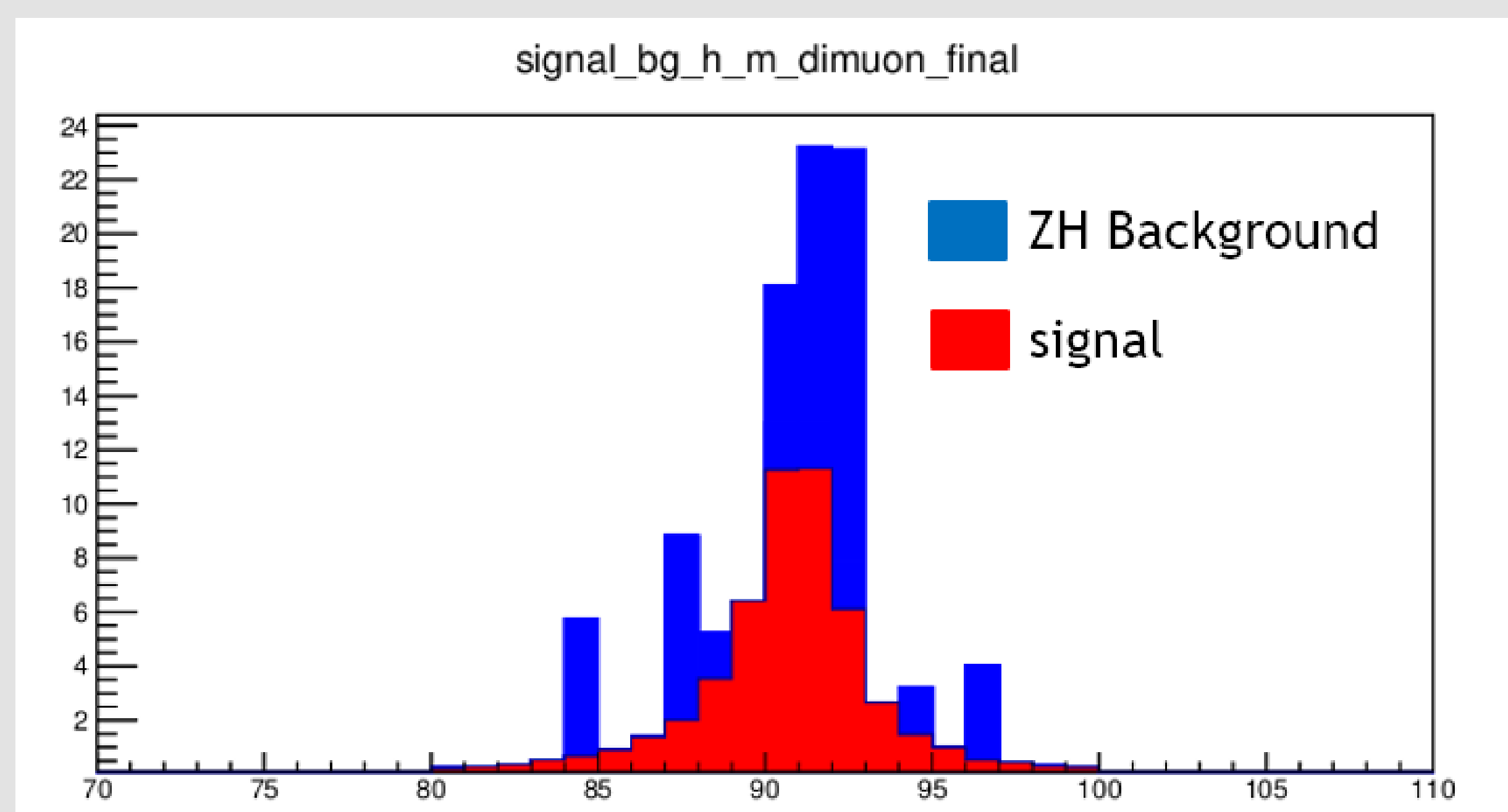
Z	ZZ*			
e^+e^-	vvjj	jjvv		
$\mu^+\mu^-$	vvjj	jjvv		jjjj
vv	e^+e^-jj	$jj e^+e^-$	$\mu^+\mu^-jj$	$jj\mu^+\mu^-$
jj	e^+e^-vv	$vv e^+e^-$	$\mu^+\mu^-vv$	$vv\mu^+\mu^-$

Results

The cut flow table of uuHvvjj channel:

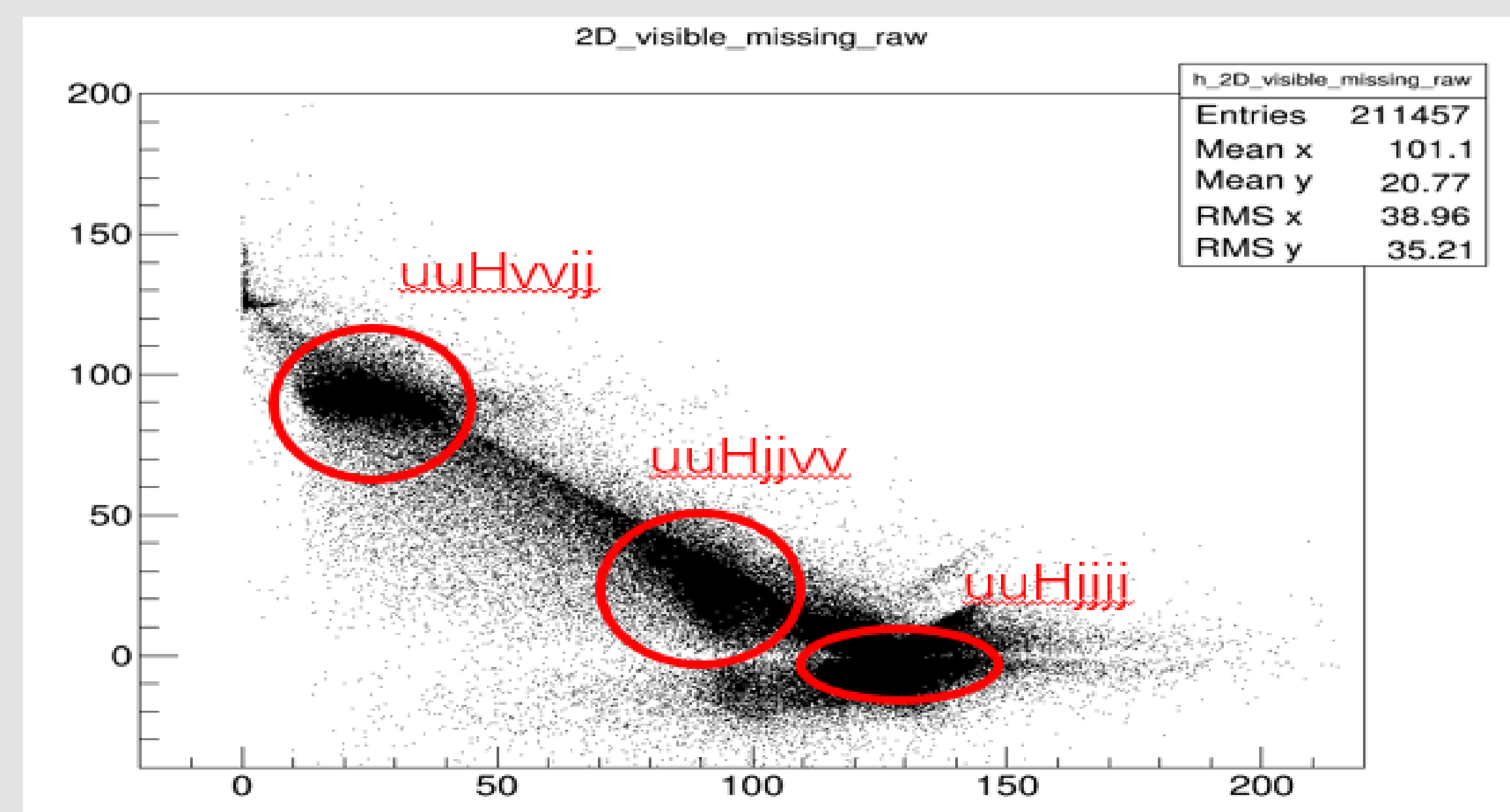
	Signal	ZH Background	Other Background
Missing mass > M(di-jets)	144	3257	2012382
$80 < M(\text{dimuon}) < 100$	132	2063	1265888
$120 < \text{RecM}(\text{dimuon}) < 135$	118	1783	63335
$N(\text{pfo}) > 15$	98	553	2477
$Pt(\text{total visible}) > 10$	93	502	814
Min angle > 0.3	87	455	589
Missing Mass & M(di-jets)	60	70	455
$Pt(\text{jet1}) > 3$ & $Pt(\text{jet2}) > 3$	54	55	13
$N(\text{lepton}) < 3$	52	55	12

Final distribution of dimuon invariant mass

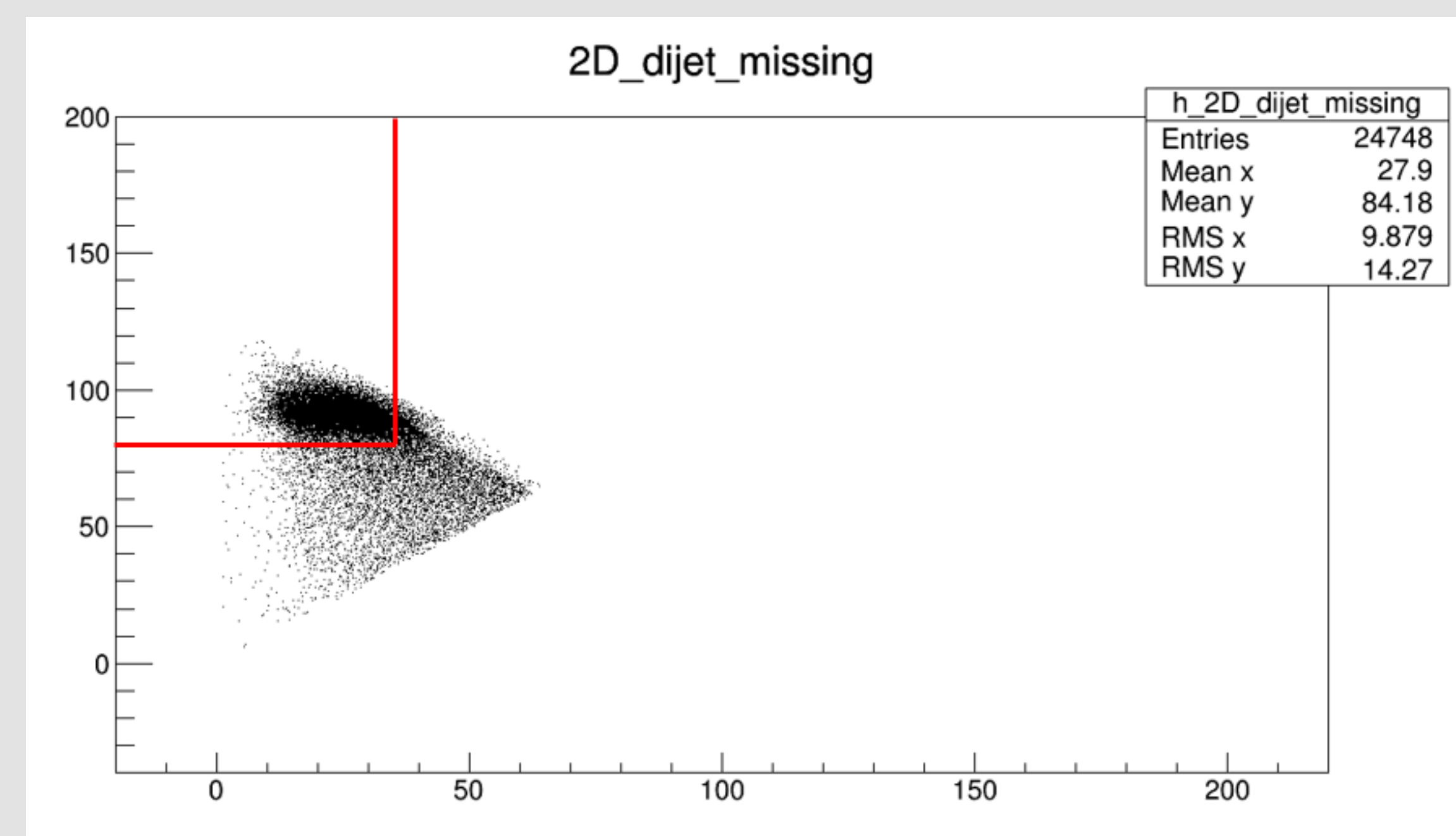


Methodology

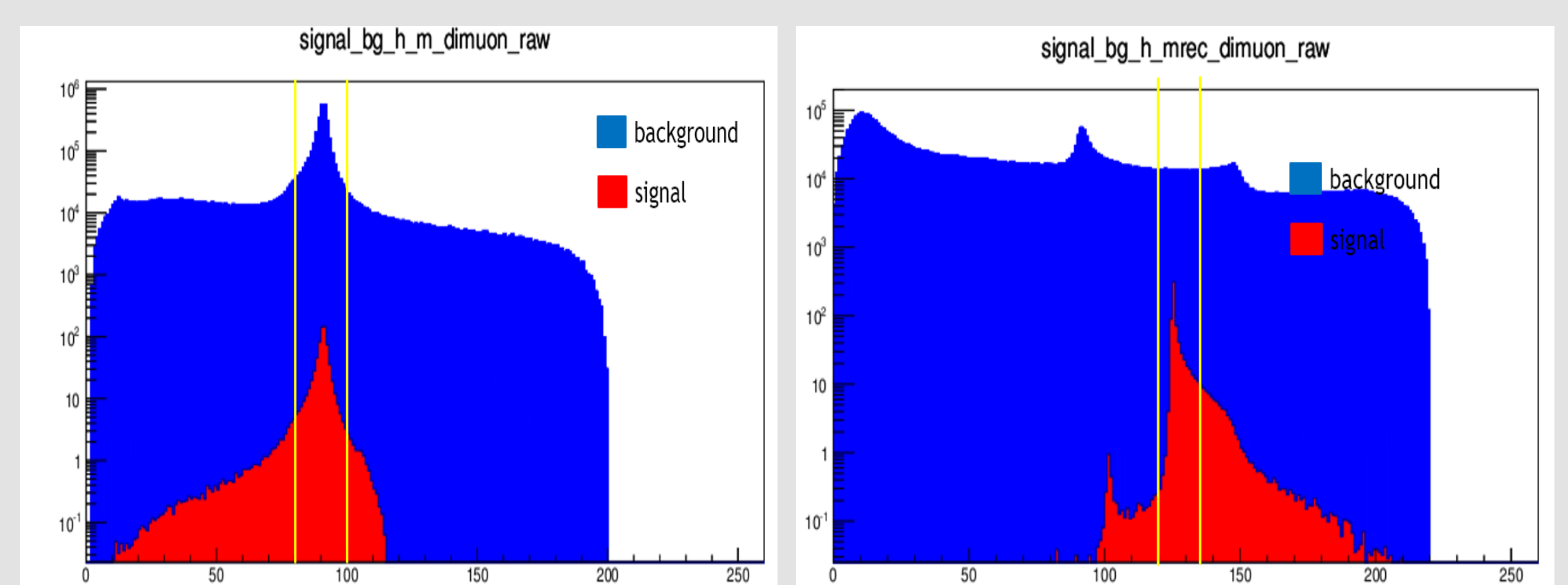
For uuHZZ channel, we can see from the 2D missing mass and invariant mass diagram, there are three main final states, uuHvvjj, uuHjjv, and uuHjjj.



We chose different cuts to separate those states, for example, the uuHvvjj channel we chose di-jets invariant mass < 35GeV and missing mass > 80GeV



Then we chose other cuts to reduce the background. The results are shown in the result part.



$80 < M(\text{dimuon}) < 100$

$120 < \text{RecM}(\text{dimuon}) < 135$

Plan

Analyze other channel
Calculate the combined branch ratio of higgs $\rightarrow ZZ^*$

Acknowledgements

[1] Yuqian Wei, The simulation study on measurement of branching ratio of Higgs boson decay to ZZ^* at CEPC[D]. Beijing: IHEP, 2017