CEPC HZZ Analysis Update

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Introduction

- > Cut-based only analysis
- > Will discuss the observables we have used so far

 $qqHZZ (Z \rightarrow \nu\nu, Z \ast \rightarrow \mu\mu)$

> Cut Flow Table

		Cut	Signal	ZH Background	2f Background	4f Background		
		Expected	20254	1140511	801811977	107203890		
		Pre-selection	826	30494	480828	515424		
		Signal or not	203	30291	480828	515424		
		$M_{missing} > M_{dimuon}$	94	3179	18606	40769		
		N(pfo)	84	2242	1212	12626		
		$M_{visible}$	76	1614	7	5138		
		$\cos \theta$	75	1498	7	3464		
		M_{dimuon}^{rec}	53	1102	0	1080		
		$P_{visible}$	53	985	0	1056		
		M_{dijet}	50	889	0	972		
		$E_{leading jet}$	50	867	0	716		
		$E_{subleading jet}$	49	852	0	603		
		$Angle_{\mu j}$	45	775	0	453		
		M_{dimuon}	41	653	0	430		
		$cos \theta_{visible}$	41	653	0	430		
		$M_{visible}^{rec}$	40	560	0	389		
		$Pt_{visible}$	40	528	0	376		
	This time	$not\mu^+\mu^-HZZ$	40	528	0	376		
		$not \nu \nu HZZ$	35	483	0	360		
	BDT optimized	$not\nu$	30	166	0	110		
	cut-based BDT	BDT	46	377	0	233		
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▶ 40 < N(pfo) < 95



Note:

1. all the plots are in log scale

2. Two cuts are applied to first supress the background

15<npfo<120 50<M(dijet)<130

➢ 75 < Di-jet mass < 110 GeV</p>



➢ 50 < Missing mass < 110 GeV</p>



➢ 15 < Di-muon mass < 55 GeV</p>



➤ 110 < Visible mass < 180 GeV, and not in [122, 128]</p>



Note: this plot is after all the cuts applied

➤ 160 < Di-muon recoil mass < 220 GeV, and not in [122, 128]</p>



 $qqHZZ (Z \rightarrow \nu\nu, Z \ast \rightarrow \mu\mu)$

➤ -0.9 < cos theta < 0.9</p>



➤ -0.9 < cos theta (visible) < 0.9</p>







➤ 10 < Pt visible < 60 GeV</p>



➢ 45 < Leading jet E < 85 GeV</p>



➢ 25 < Sub-leading jet E < 55 GeV</p>



➢ 60° < Dimuon-dijet angle < 170°</p>



Fitting Result

	Precision		
Cut	76.47%		
BDT	50.89%		
Mixed	54.19%		



$\mu\mu$ HZZ (vvjj)

Cut Flow Table

		Cut	Signal	ZH Background	2f Background	4f Background
		Expected	1000	1140511	801811977	107203890
		Pre-selection	616	30494	480828	515448
		Signal or not	211	30282	480828	515448
		$M_{missing} > M_{dijet}$	107	1608	115062	28809
		$M_{\mu^+\mu^-}$	95	725	73741	6830
		N(pfo)	92	295	24151	1620
		$E_{leading jet}, Pt_{leading jet}$	91	288	2799	1096
		$E_{subleading jet}, Pt_{subleading j}$	et 90	285	328	957
		M_{dimuon}^{rec}	87	245	44	263
		$Pt_{visible}$	83	228	7	76
		$M_{missing}$	82	227	7	74
		M_{dijet}	82	221	7	64
		$Angle_{\mu j}$	77	212	7	53
	This time	$not \; qqHZZ$	77	212	7	53
		not $\nu\nu HZZ$	67	167	7	52
	BDT optimized	not $\nu\nu HZZ$ 4	7	22	0	3
\sim	cut-based	BDT 6	6	36	14	11
	RDI					

μμΗΖΖ (ννjj)

➤ 3 < Leading jet Pt < 55</p>



Note: this plot is after all the cuts applied

μμΗΖΖ (ννjj)

➤ 1 < Sub-leading jet Pt</p>



Note: this plot is after all the cuts applied

 $\mu\mu HZZ \ (Z \rightarrow \nu\nu, Z \rightarrow jj)$

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Fittin	g Result	795 120 8.0 ∕ ∞100		5 Z	CEPC 2019 5.6 ab ⁻¹ , 240 GeV Z→μ⁺μ⁻, H→ZZ*→ννqq			
	Precision	ent	-		-			
Cut	23.48%	ы Ш 20	-		_			
BDT	15.10%	00	-		 CEPC Simulation 			
Mixed	16.89%	60	_	-	- S+B Fit			
		00	-					
		40	- ^	I	- ZH Background			
			-	1	-			
		20	- 1					
			-	IIIII				
		12	20 125	5 130	135 140			
					ινι _{μμ} [Gev]			

Status

- Finished two mmHZZ and two qqHZZ channels
- > Seperating vvHZZ into two channels is ongoing

Next to do

- Finish vvHZZ seperating
- Combined fitting