CEPC ZH->mumuyy channel

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Outline

- available sample:
  - 3T fast simulation $\sqrt{s}$ =240GeV
    - ee->ZH->mumuyy signal 100K events
    - ee->mumu background ~26M events
    - ee->tautau background ~10M events

    Other background has been proved ignorable
  - 3.5T fast simulation $\sqrt{s}$ =240GeV
    - ee->ZH->mumuyy signal 100K events

    No background ready

	$\mu\mu$	$\tau\tau$	ZZ/WW	$Z+\nu$	W/Z+e
generated	26930165	10000000	1116511	219278	
$\mu\mu\gamma\gamma$ final state	1393678	6204	21507	923	0
Pass all selection	2704 (0.01%)	35 (0.0004%)	1	0	

3T background investigation

- Selection optimization in 3T
- Comparison of 3T and 3.5T signal

Selection

- $E_\gamma > 30GeV$
- $\left|cos\theta_\gamma\right| < 0.9$
- $10GeV < pT_{\gamma 1} < 73GeV$
- $30GeV < pT_{\gamma 2} < 100GeV$
- $110GeV < m_{\gamma\gamma} < 140GeV$
- $84GeV < M_{\gamma\gamma}^{recoil} < 103GeV$
- $125GeV < E_{\gamma\gamma} < 143GeV$
- $\min\{\left|cos\theta_{\gamma l}\right|\} < 0.9$

1. cut1: the energy, E_γ, of each photon exceeds 35 GeV;
2. cut2: the cosine of the polar angle of each photon is restricted to be $|cos\theta| < 0.9$;
3. cut3: the transverse energy, 20 (30 for $\tau^+\tau^-$)GeV $< P_{T\gamma 1} < 93$ GeV and 30 (36 for $\tau^+\tau^-$) GeV $< P_{T\gamma 2} <$ 100 GeV;
4. cut4: the recoil mass of two-photon is restricted to be in the region 86 GeV $< M_{recoil} <$ 100 GeV;
5. cut5: the energy of the two-photon system is between 136 (130 for $\tau^+\tau^-$)GeV$< E_{\gamma\gamma} <$ 148 GeV
6. cut6: the smallest angel between photon and the final state lepton $|\cos\theta_{\gamma l}| < 0.9$.

Previously Wang Feng's cut
sqrt(s) = 250GeV

Cut flow

	signal		mumu bkg	
generated	100000		26930165	
mumuyy	138039	138.039%	1393678	5.175%
E_y>35GeV	100602	72.879%	149107	10.699%
|Costheta_y|<0.9	83759	83.258%	58507	39.238%
20<pT_y1<93	83754	99.994%	56509	96.585%
30<pT_y2<100	83523	99.724%	48591	85.988%
110<m_yy<140	81624	97.726%	16814	34.603%
86<recoM_yy<100	71416	87.494%	3174	18.877%
136<En_yy<148	71409	99.990%	3048	96.030%
min|costheta_yl|<0.9	71248	99.775%	2704	88.714%
		71.248%		0.010%
weight to 5ab-1	55.431		2677.23	

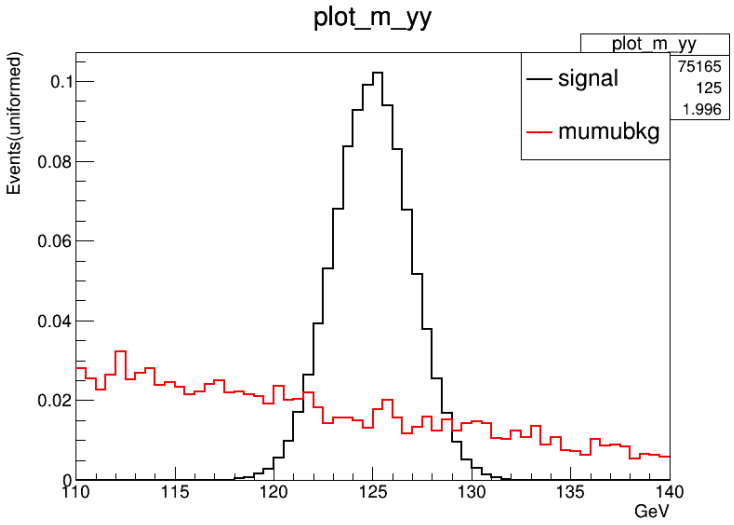
$$\sigma = \frac{S}{\sqrt{S+B}} = 1.05$$

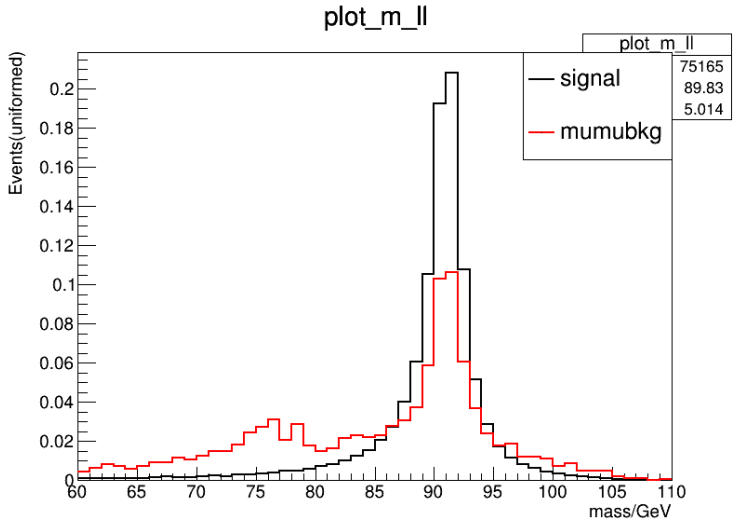
Channel	Generate	cut1	cut2	cut3	cut4	cut5	cut6
$\mu^+\mu^- H\_aa$	Efficiency	100%	91.56%	72.28%	55.42%	54.21%	42.17%
$\mu^+\mu^- H\_aa$	83	83	76	60	46	45	35
$\mu^+\mu^- aa$	1135659	214725	66703	23786	6427	1887	1026

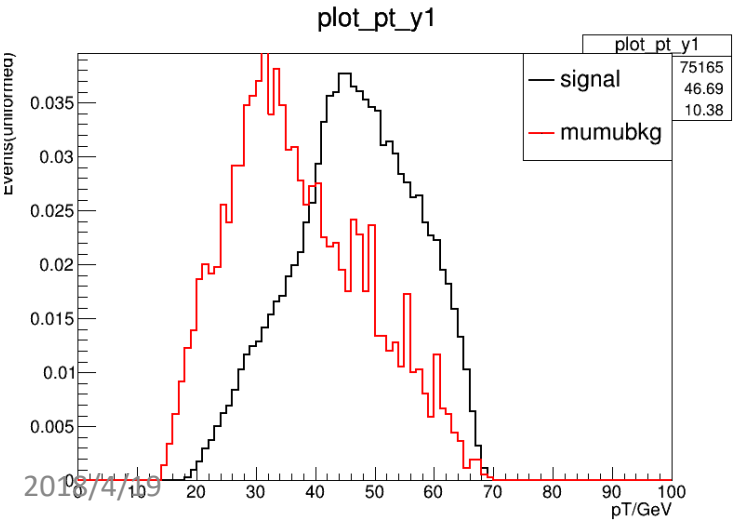
$$\sigma = 1.07$$

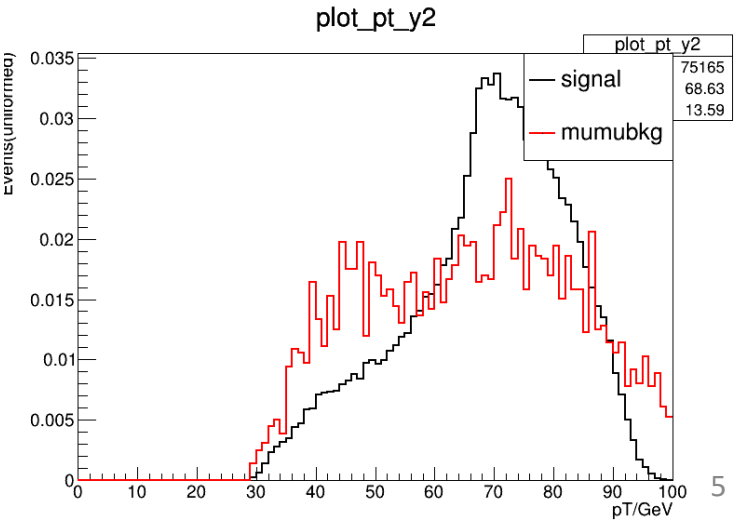
Previously Wang Feng's results

Distribution





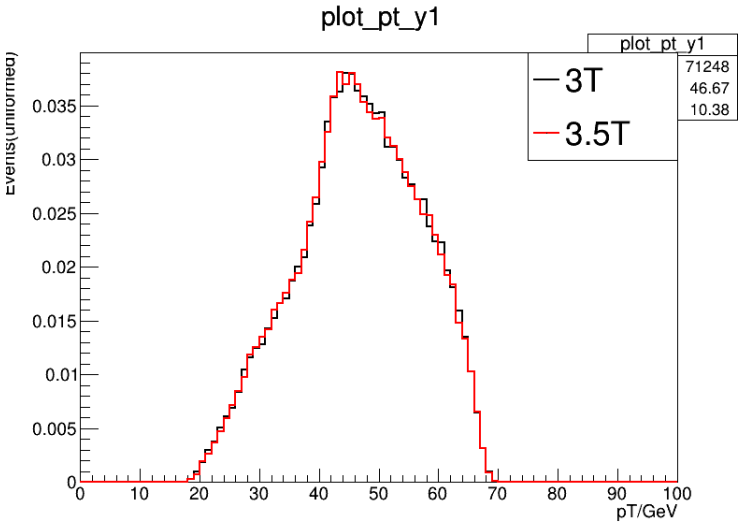


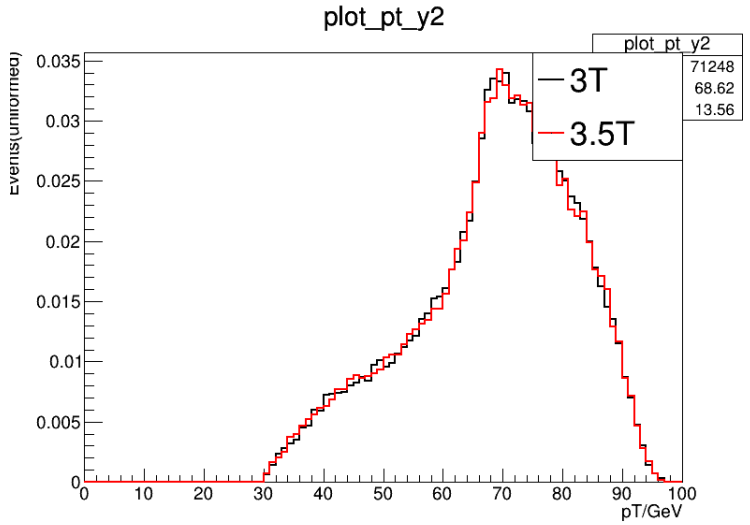


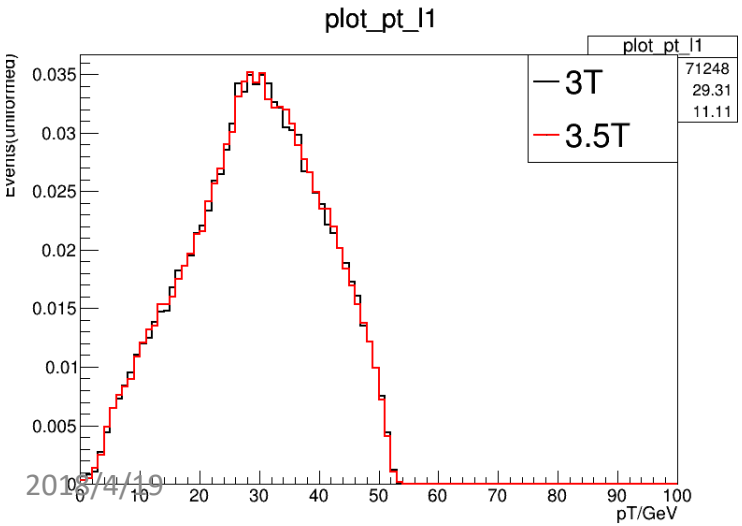
Comparison between 3T and 3.5T

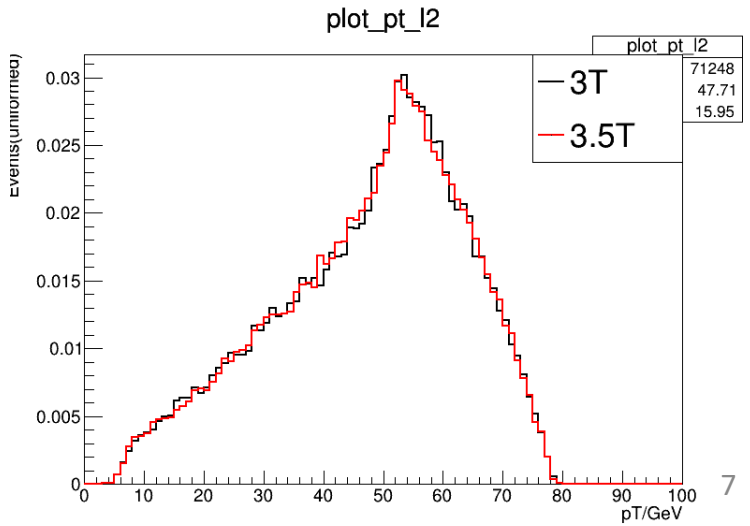
	3.5T signal		3T signal	
generated	100000		100000	
mumuyy	138616	138.616%	138039	138.039%
E_y>30GeV	100623	72.591%	100602	72.879%
|Costheta_y|<0.9	83832	83.313%	83759	83.258%
10<pT_y1<73	83828	99.995%	83754	99.994%
30<pT_y2<100	83604	99.733%	83523	99.724%
110<m_yy<140	81598	97.601%	81624	97.726%
84<recoM_yy<103	71385	87.484%	71416	87.494%
125<En_yy<143	71378	99.990%	71409	99.990%
min|costheta_yl|<0.9	71209	99.763%	71248	99.775%
		71.209%		71.248%
weight to 5ab-1	55.4006		55.43094	

Comparison between 3T and 3.5T









Comparison between 3T and 3.5T