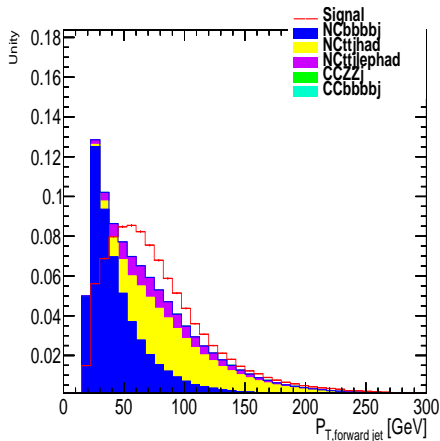
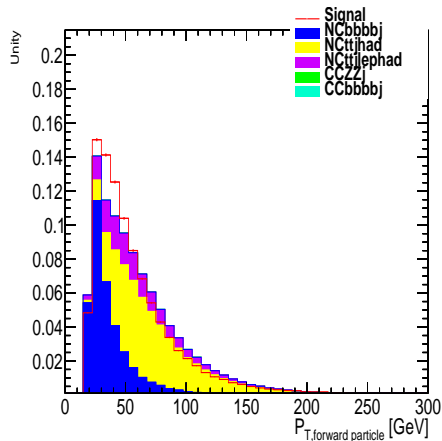
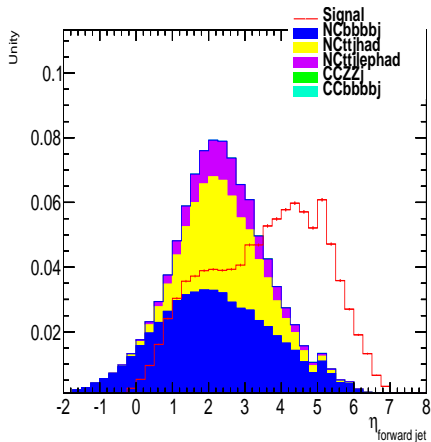
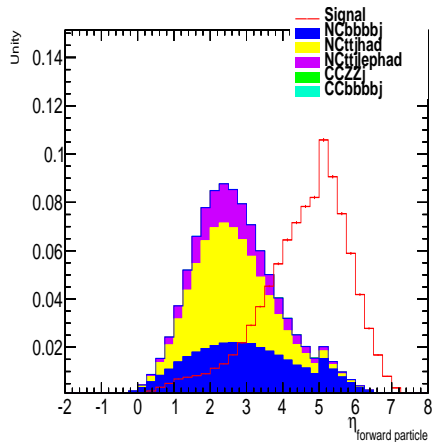


- Double Higgs production in 4b final states in 50 TeV proton and 60 GeV electron collision at FCC-he
- Using MG5 + pythia-pgs + delphes
- Modified CMS Delphes Card: forward jet  $|\eta| < 7$ , bTag  $|\eta| < 5$
- Comparing "particle" and "detector" level distributions and cut-flows
- Cut-flows:
  - No Cut
  - $p_T > 20$  GeV, 4b + 1 jet
  - $\eta_{fwd-jet} > 3.8$
  - $MET > 30$ ,  $\Delta\phi_{MET-ljet} > 0.4$ ,  $\Delta\phi_{MET-subldjet} > 0.4$
  - $90 < M_{ij} < 125$
  - Lepton rejection  $p_T > 10$  GeV
  - $M_{4b} > 250$  GeV
- $L = 10 \text{ ab}^{-1}$

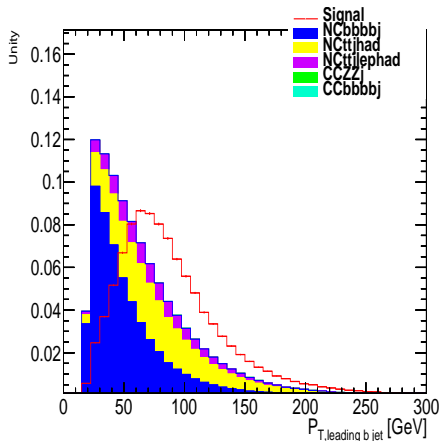
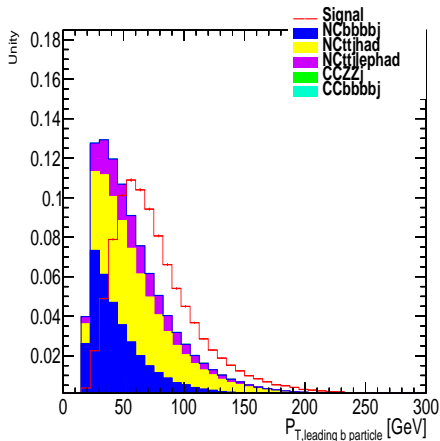
## forward jet:



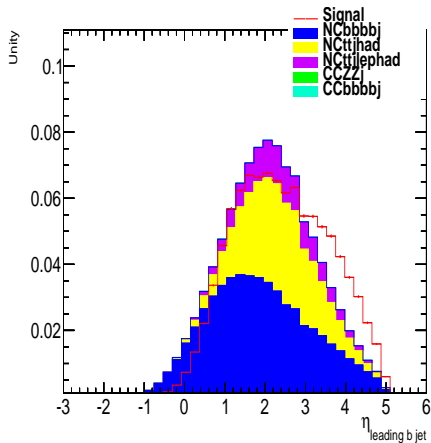
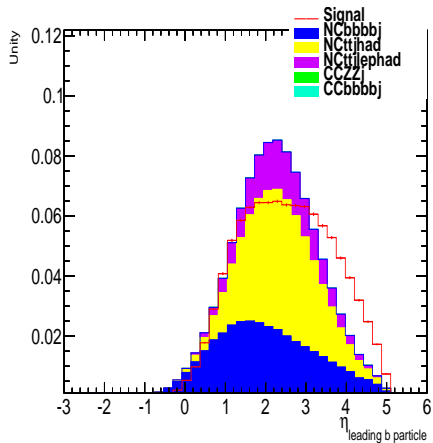
## forward jet:



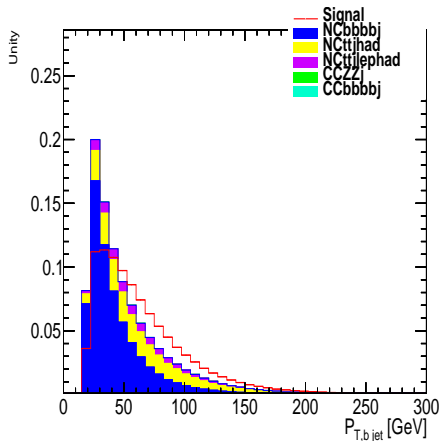
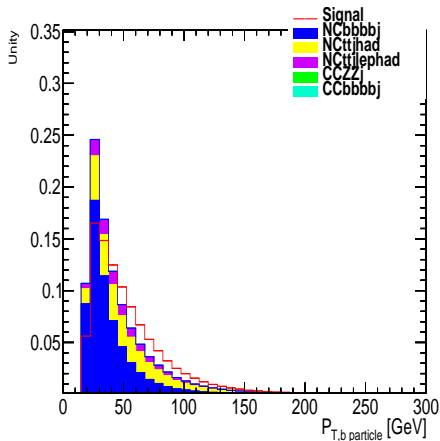
# b jet:



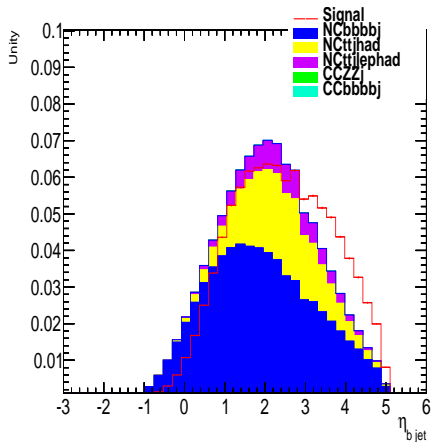
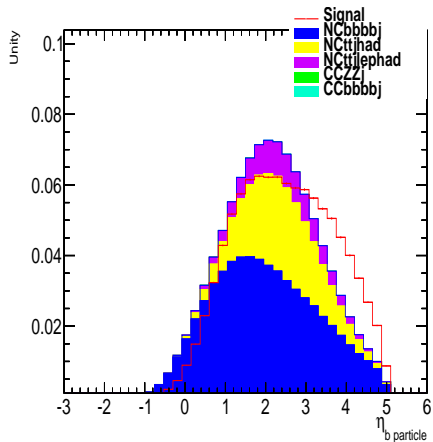
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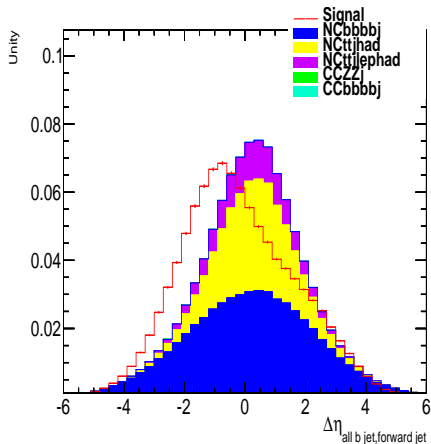
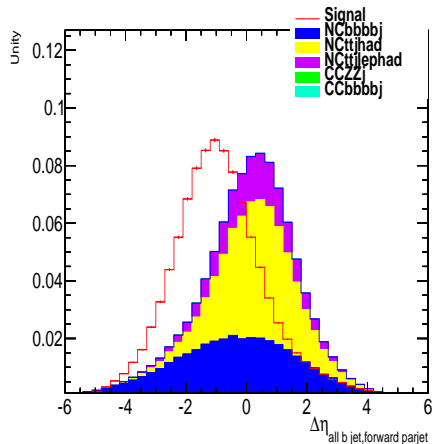


# b jet:

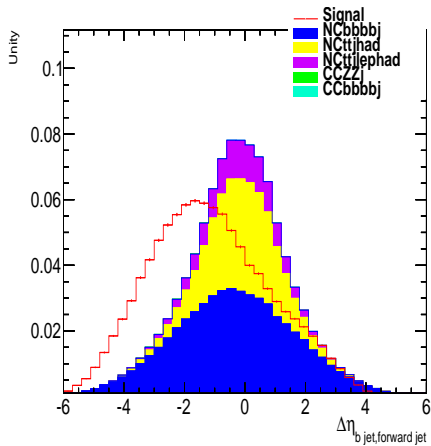
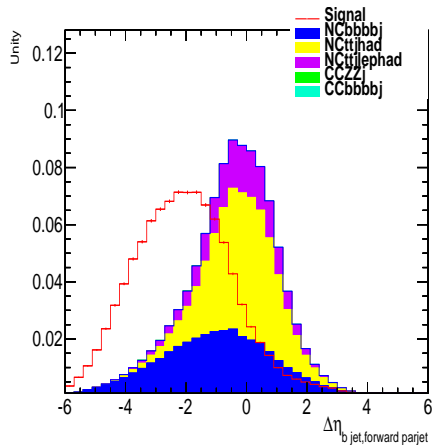


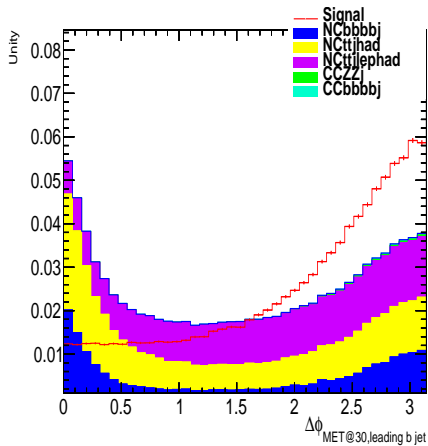
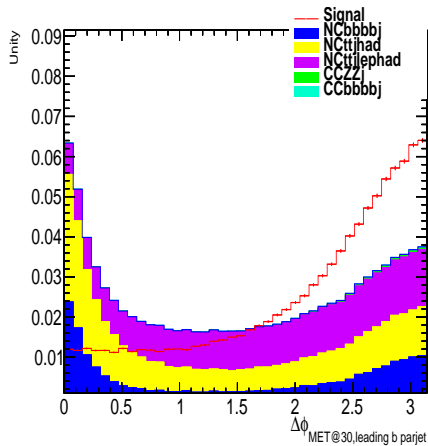
# b jet:

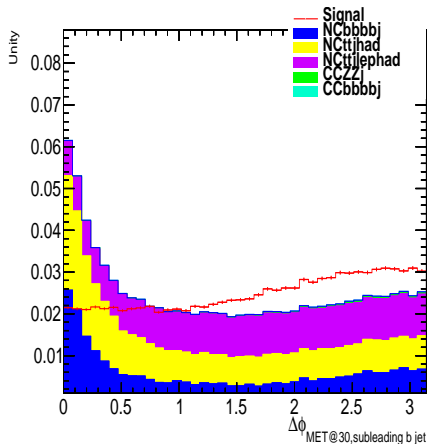
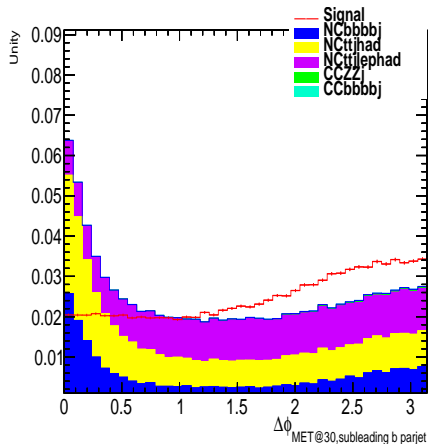


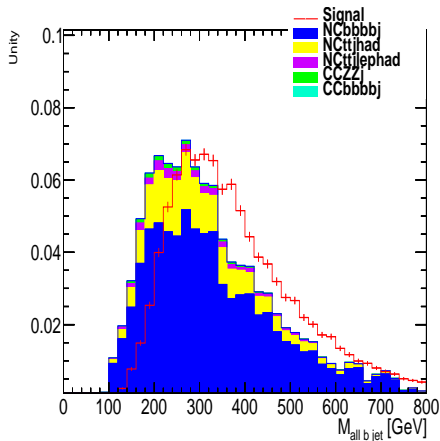
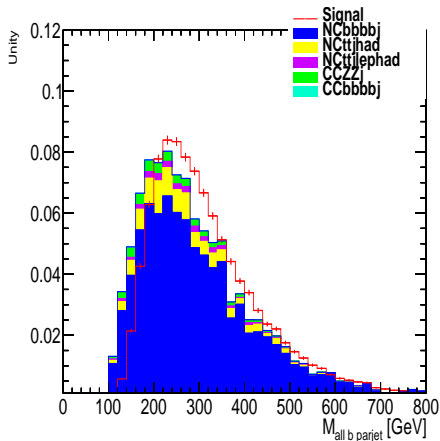
$\Delta\eta:$ 

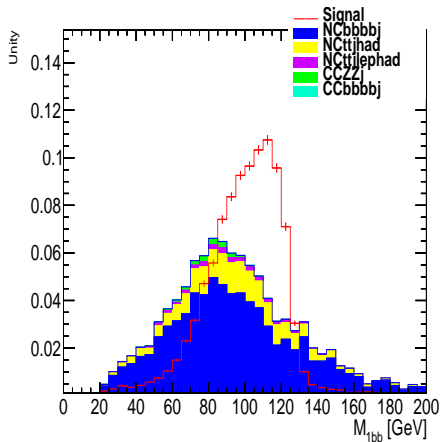
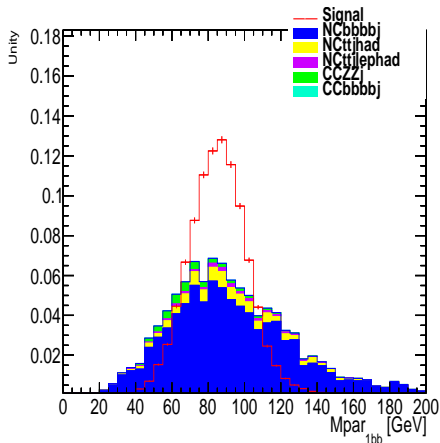


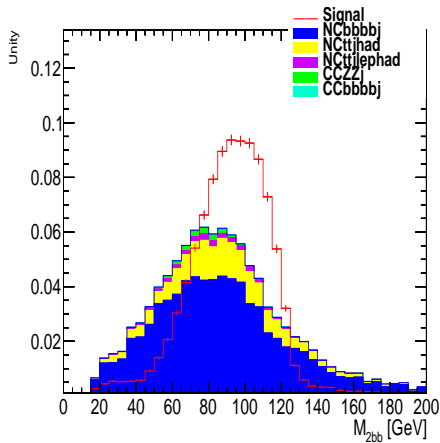
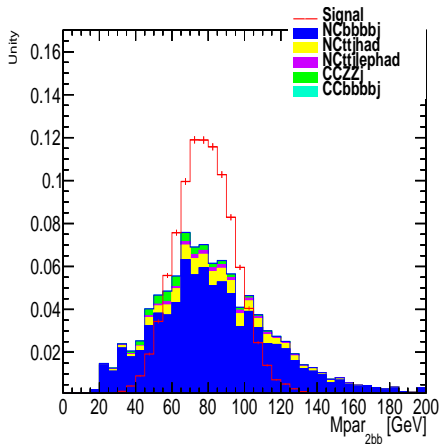
$\Delta\eta:$ 

$\Delta\Phi$ :

$\Delta\eta$ :



$M_{ij}$ :

$M_{ij}$ :

# Cut flows: particle

Samples	signal	ccbbbj	ccbbjjj	ncbbbj
01 INIT	$2.36e+03 \pm 4.82$	$8.19e+03 \pm 11.8$	$6.44e+06 \pm 9.3e+03$	$4.27e+06 \pm 6.32e+03$
02 4b1j	$496 \pm 2.21$	$154 \pm 1.62$	$1.72e+03 \pm 152$	$3.8e+04 \pm 596$
03 forward3.8	$321 \pm 1.78$	$12.7 \pm 0.465$	$161 \pm 46.5$	$4.73e+03 \pm 210$
04 METdphib1b2	$218 \pm 1.47$	$10.8 \pm 0.429$	$134 \pm 42.5$	$776 \pm 85.2$
05 M1M2	$21 \pm 0.455$	$0.836 \pm 0.119$	$26.9 \pm 19$	$37.4 \pm 18.7$
06 LepRej	$21 \pm 0.455$	$0.836 \pm 0.119$	$26.9 \pm 19$	$0 \pm 0$
07 M4b	$14.4 \pm 0.376$	$0.495 \pm 0.0919$	$13.4 \pm 13.4$	$0 \pm 0$
ncbbjjj	ccttjhad	ccttjlephad	ncttjhad	ncttjlephad
$2.46e+08 \pm 4.26e+05$	$3.26e+03 \pm 4.71$	$1.22e+03 \pm 1.77$	$1.37e+06 \pm 1.97e+03$	$4.86e+05 \pm 70$
$6.26e+04 \pm 6.79e+03$	$2.35 \pm 0.126$	$0.699 \pm 0.0422$	$2.22e+03 \pm 79.5$	$635 \pm 25.3$
$1.1e+04 \pm 2.85e+03$	$0.36 \pm 0.0495$	$0.0969 \pm 0.0157$	$234 \pm 25.8$	$91.1 \pm 9.6$
$2.21e+03 \pm 1.28e+03$	$0.265 \pm 0.0424$	$0.079 \pm 0.0142$	$74 \pm 14.5$	$53.6 \pm 7.37$
$736 \pm 736$	$0.0204 \pm 0.0118$	$0.0051 \pm 0.00361$	$8.54 \pm 4.93$	$2.02 \pm 1.43$
$736 \pm 736$	$0.0204 \pm 0.0118$	$0.0051 \pm 0.00361$	$0 \pm 0$	$0 \pm 0$
$736 \pm 736$	$0.0136 \pm 0.00961$	$0.0051 \pm 0.00361$	$0 \pm 0$	$0 \pm 0$
cczzj	nczzj	Total bkg	S/Sqrt(S+B)	
$7.36e+03 \pm 10.6$	$165 \pm 0.238$	$2.59e+08 \pm 4.26e+05$	0.147	
$979 \pm 3.88$	$17.9 \pm 0.0785$	$1.06e+05 \pm 6.82e+03$	1.52	
$567 \pm 2.95$	$4 \pm 0.0371$	$1.68e+04 \pm 2.86e+03$	2.45	
$449 \pm 2.63$	$0.959 \pm 0.0182$	$3.71e+03 \pm 1.28e+03$	3.48	
$32 \pm 0.7$	$0.0705 \pm 0.00492$	$844 \pm 737$	0.715	
$32 \pm 0.7$	$0.0272 \pm 0.00306$	$796 \pm 737$	0.735	
$11 \pm 0.412$	$0.00756 \pm 0.00161$	$761 \pm 736$	0.517	

# Cut flows: Detector

Samples	signal	ccbbbj	ccbbjjj	ncbbbj
01 INIT	$2.36e+03 \pm 4.82$	$8.19e+03 \pm 11.8$	$6.44e+06 \pm 9.3e+03$	$4.27e+06 \pm 6.32e+03$
02 4b1j	$252 \pm 1.58$	$145 \pm 1.57$	$3.37e+03 \pm 213$	$2.98e+04 \pm 528$
03 forward3.8	$182 \pm 1.34$	$13.8 \pm 0.485$	$376 \pm 71$	$5.66e+03 \pm 230$
04 METdphib1b2	$126 \pm 1.11$	$12.2 \pm 0.456$	$295 \pm 63$	$654 \pm 78.2$
05 M1M2	$46.9 \pm 0.679$	$0.819 \pm 0.118$	$0 \pm 0$	$56.1 \pm 22.9$
06 LepRej	$46.9 \pm 0.679$	$0.819 \pm 0.118$	$0 \pm 0$	$0 \pm 0$
07 M4b	$43.7 \pm 0.656$	$0.546 \pm 0.0965$	$0 \pm 0$	$0 \pm 0$
ncbbjjj	ccttjhad	ccttjlephad	ncttjhad	ncttjlephad
$2.46e+08 \pm 4.26e+05$	$3.26e+03 \pm 4.71$	$1.22e+03 \pm 1.77$	$1.37e+06 \pm 1.97e+03$	$4.86e+05 \pm 70$
$1e+05 \pm 8.59e+03$	$17.3 \pm 0.343$	$3.42 \pm 0.0933$	$7.36e+03 \pm 145$	$1.24e+03 \pm 35$
$2.5e+04 \pm 4.29e+03$	$2.02 \pm 0.117$	$0.405 \pm 0.0322$	$948 \pm 52$	$217 \pm 14.8$
$2.95e+03 \pm 1.47e+03$	$1.75 \pm 0.109$	$0.357 \pm 0.0302$	$256 \pm 27$	$142 \pm 12$
$0 \pm 0$	$0.17 \pm 0.034$	$0.023 \pm 0.00765$	$37 \pm 10.3$	$13.2 \pm 3.65$
$0 \pm 0$	$0.17 \pm 0.034$	$0.0204 \pm 0.00721$	$5.7 \pm 4.03$	$1.01 \pm 1.01$
$0 \pm 0$	$0.136 \pm 0.0304$	$0.0153 \pm 0.00625$	$0 \pm 0$	$0 \pm 0$
cczzj	nczzj	Total bkg	S/Sqrt(S+B)	
$7.36e+03 \pm 10.6$	$165 \pm 0.238$	$2.59e+08 \pm 4.26e+05$	0.147	
$655 \pm 3.17$	$12.4 \pm 0.0652$	$1.43e+05 \pm 8.61e+03$	0.667	
$393 \pm 2.46$	$2.67 \pm 0.0303$	$3.27e+04 \pm 4.3e+03$	1.01	
$312 \pm 2.19$	$0.548 \pm 0.0137$	$4.62e+03 \pm 1.48e+03$	1.83	
$15.2 \pm 0.483$	$0.0309 \pm 0.00326$	$123 \pm 25.4$	3.6	
$15.2 \pm 0.483$	$0.00894 \pm 0.00175$	$22.9 \pm 4.18$	5.61	
$8.33 \pm 0.357$	$0.00516 \pm 0.00133$	$9.03 \pm 0.372$	6.02	



# New Physics:

$$V = \frac{1}{2} M_h^2 h^2 + \lambda \lambda_{SM} v h^3 + \frac{\bar{\lambda}}{4} h^4, \text{ where } \lambda_{SM} = \bar{\lambda} = M_h^2 / 2v^2 \approx 0.13$$

