ATLAS Group Meeting

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Introduction

Topics Covered Today

- Control Region (CR) and Validation Region (VR) signal contamination study
  - Defining different cuts and regions to study
  - Calculating Data Yields and percentage of Signal Contamination of different cuts and regions
- Tight Photon ID Analysis
  - Look at distributions of photons that pass/fail the tight ID in our medium subsection.

Regions and cuts

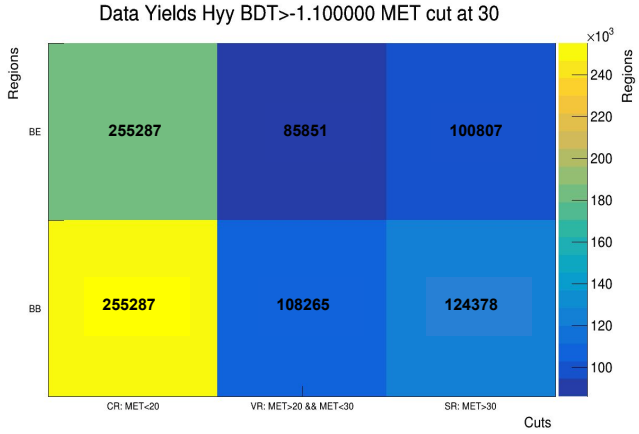
- Basic cuts
  - (Hcand_M>60 && Hcand_M<160) && abs(dEta_ph)>0.1 ---> then decided to drop high Hcand_M cut
- BDT cuts
  - (BDT_score > 0.0) vs (BDT_score > 0.8)
  - cut on the "bdtscore_Hino_Hyy" variable for signals with Hyy in the final state and "bdtscore_Hino_Zee" with Zee in the final state.
- CR (control region)
  - background-enriched region with negligible signal contamination
  - MET < 20
  - signal = ph1_t > 0 && ph2_t > 0 (PosPos)
  - dat (background) = ph1_t > 0 && ph2_t > 0 (PosPos)
- VR (validation region)
  - background and signal levels are predicted, but which are not used in the fit to constrain parameters
  - (MET > 20 && MET < 30) vs (MET > 20 && MET < 35) ----> then decide to use 30 as MET cut
  - signal = ph1_t > 0 && ph2_t > 0 (PosPos)
  - dat (background) = ph1_t < 0 && ph2_t < 0 (NegNeg)
- SR (signal region)
  - signal-enriched region that drives the signal extraction but adds negligible constraints on the background parameters.
  - (MET > 30) vs (MET > 35)
  - signal = ph1_t > 0 && ph2_t > 0 (PosPos)
  - dat (background) = ph1_t < 0 && ph2_t < 0 (NegNeg)
- Using medium diphoton trigger. Each photon also passes the FCLoose isolation working point (WP) and has maxEcell energy> 10GeV

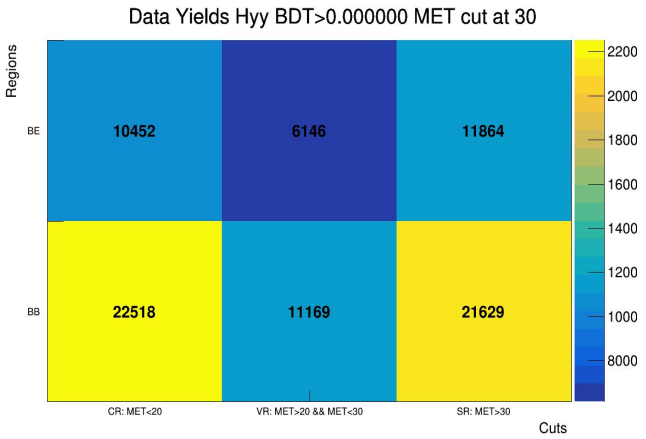
Signal Contamination

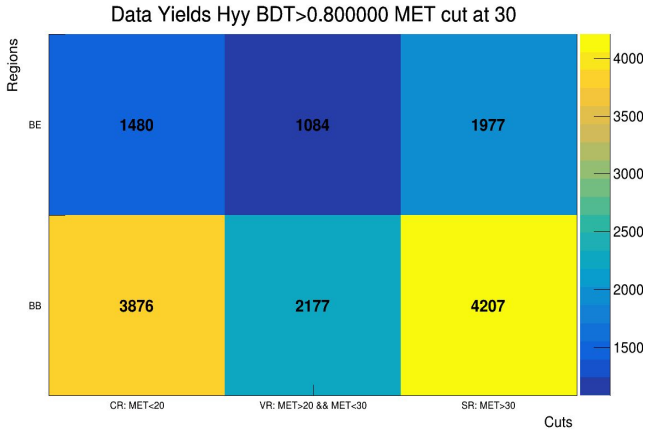
Calculating percentage of Signal Contamination of different areas using MicroNTuples v6.0

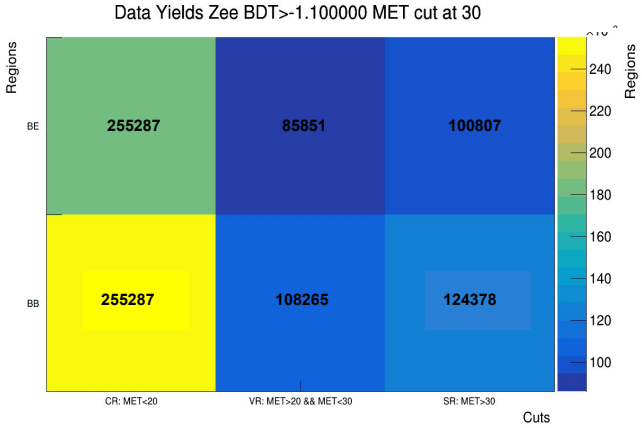
- Data (background)
  - data_97percent.root file.
- Signal
  - Hino files of final states HyyHSM and ZeeZSM with 2ns and 10ns lifetime and 100 GeV to 800 GeV mass.
- Signal Contamination percentage = $100 \times \frac{SignalEvents}{DataEvents}$

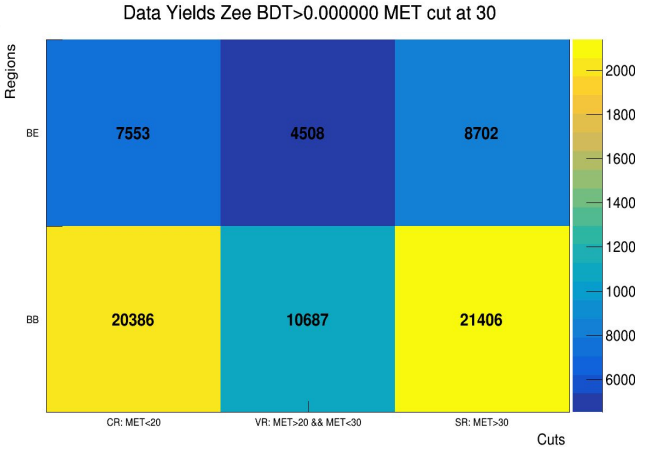
Data Yields with both Myy cuts (HCand_M>60 && HCand_M<160 GeV)

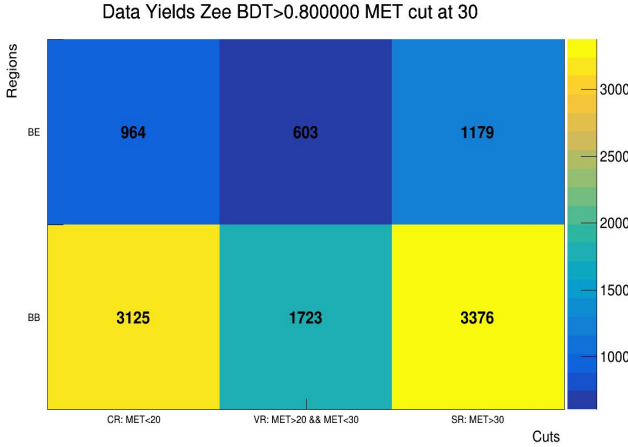




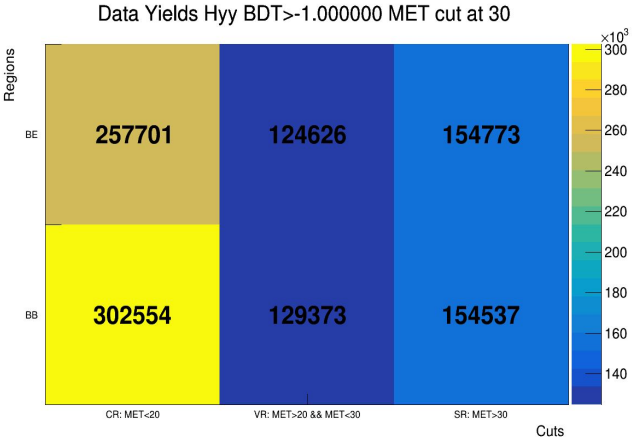


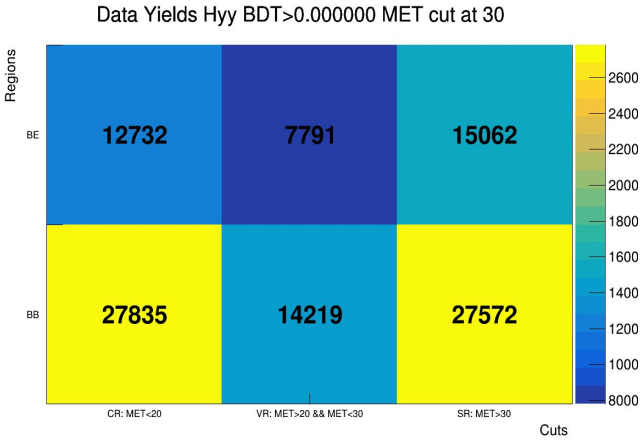


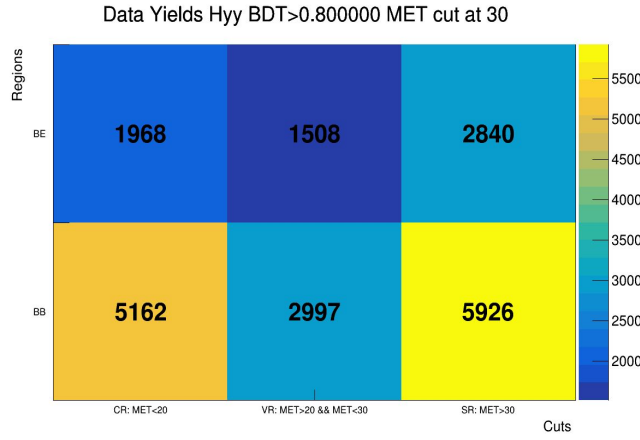


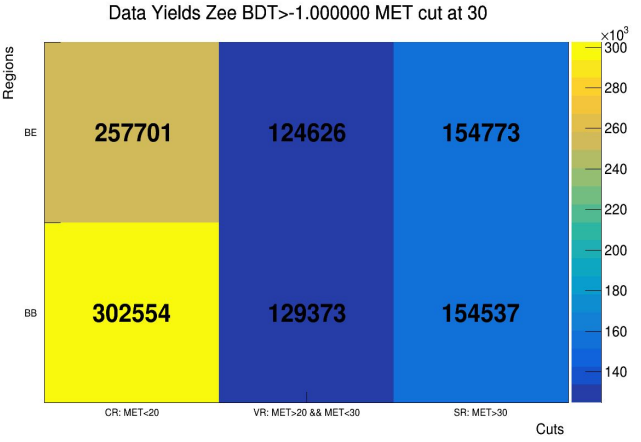


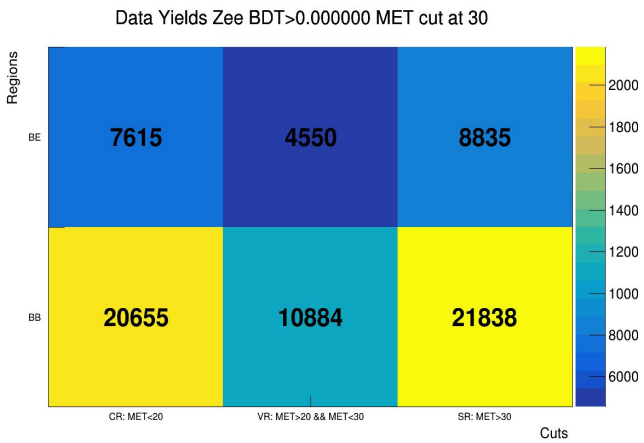
Data Yields dropping upper Myy cut (only HCand_M>60 GeV)

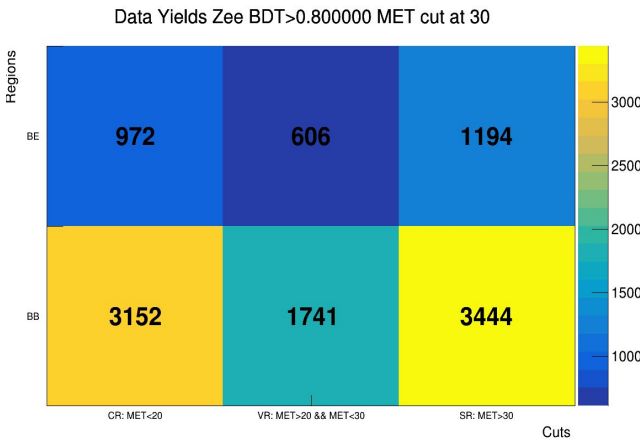




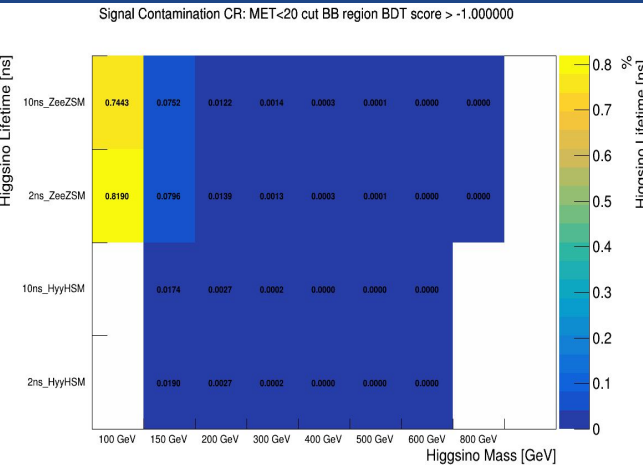


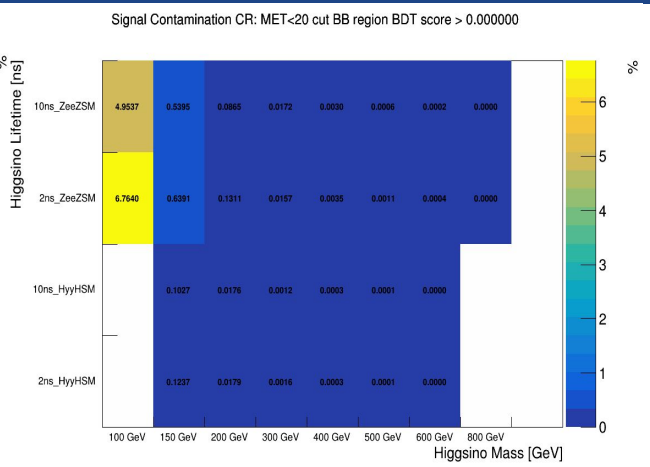


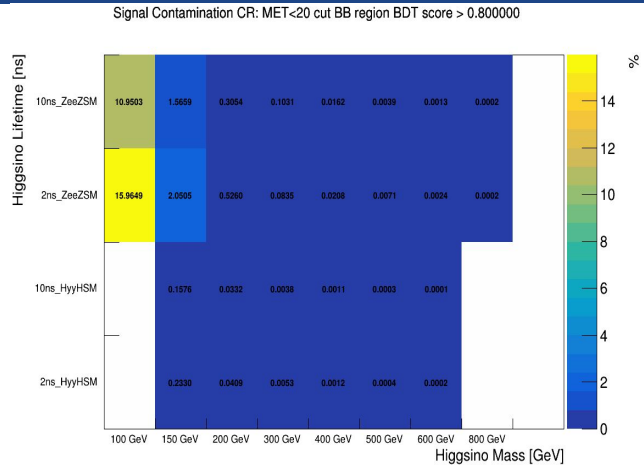


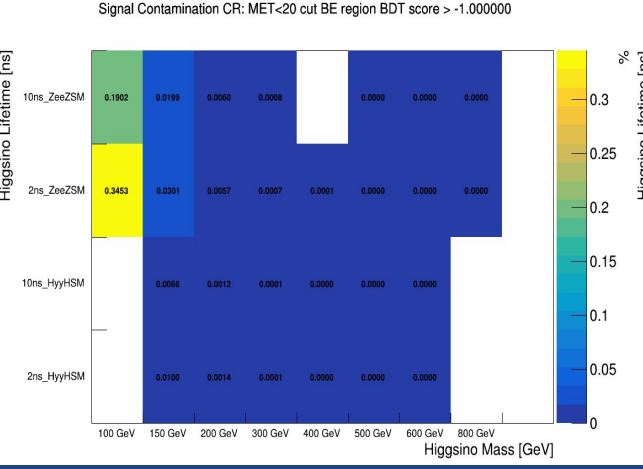


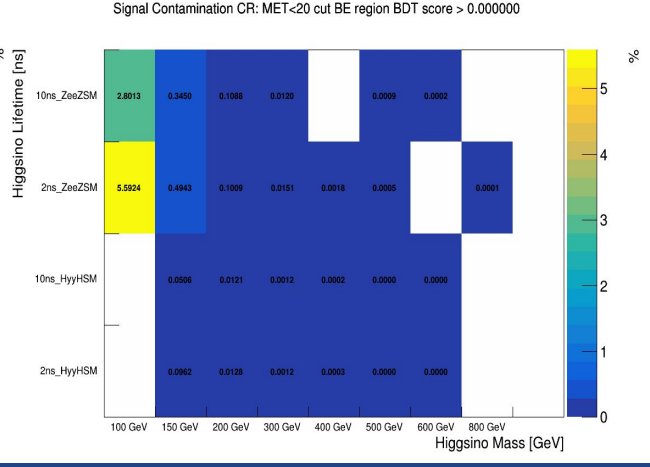
Signal Contamination for Control Region in Barrel-Barrel and Barrel-EndCap

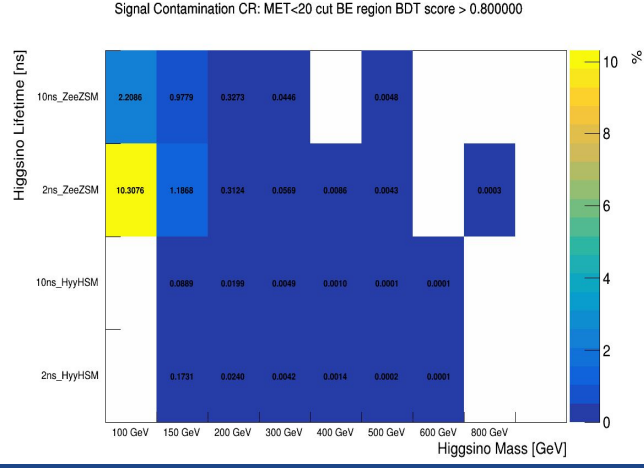




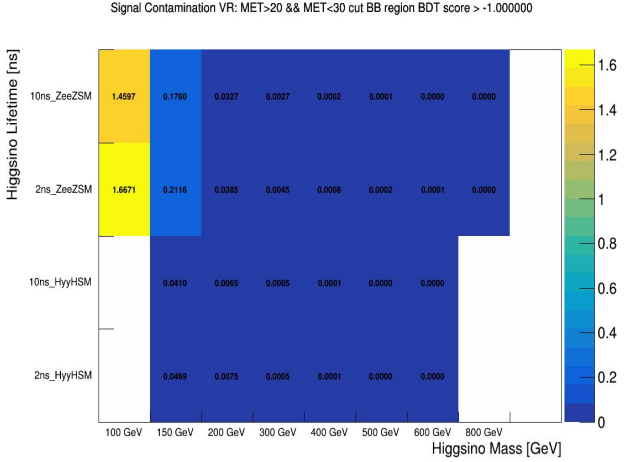


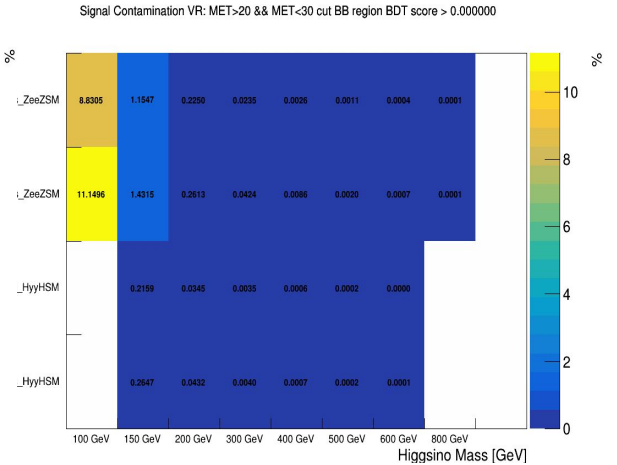


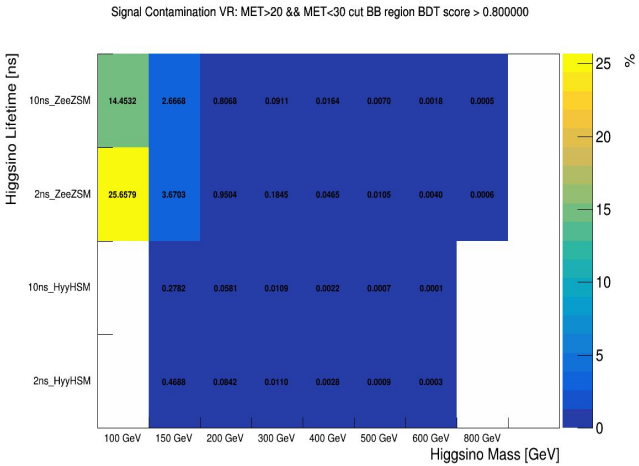


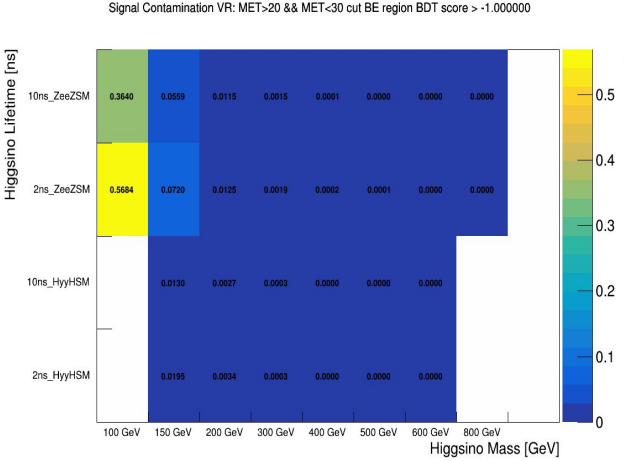


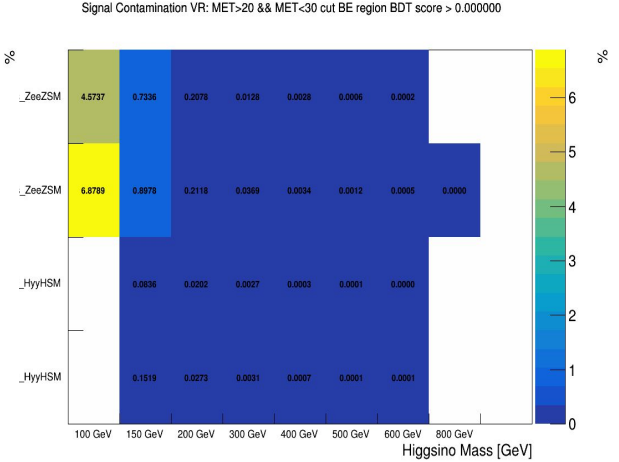
Signal Contamination for Validation Region in Barrel-Barrel and Barrel-EndCap

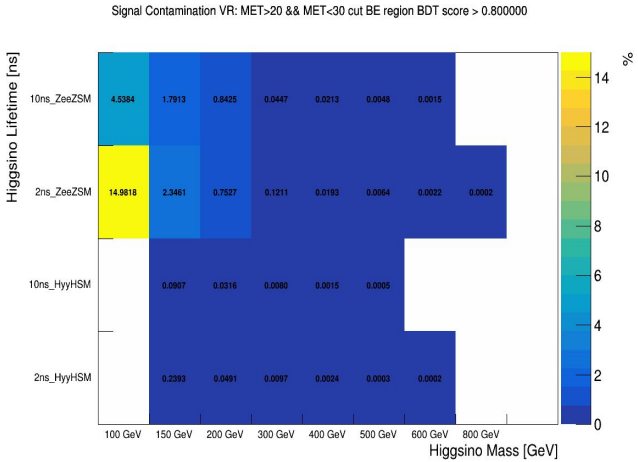




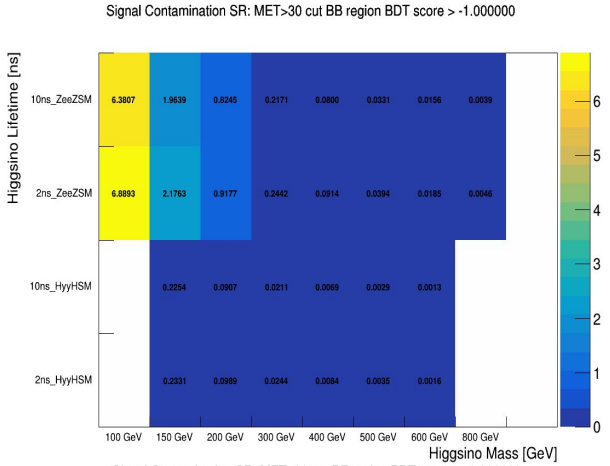


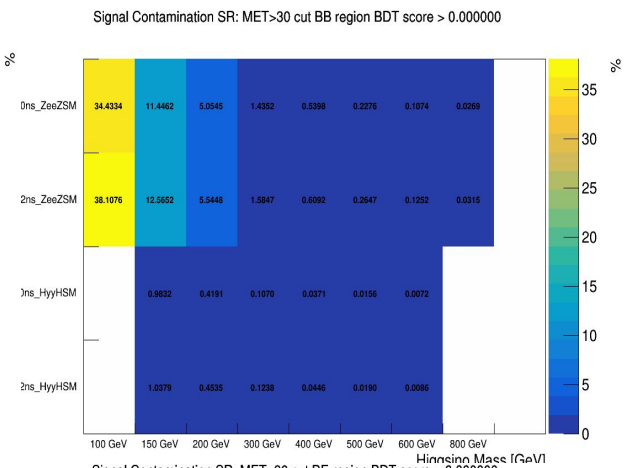


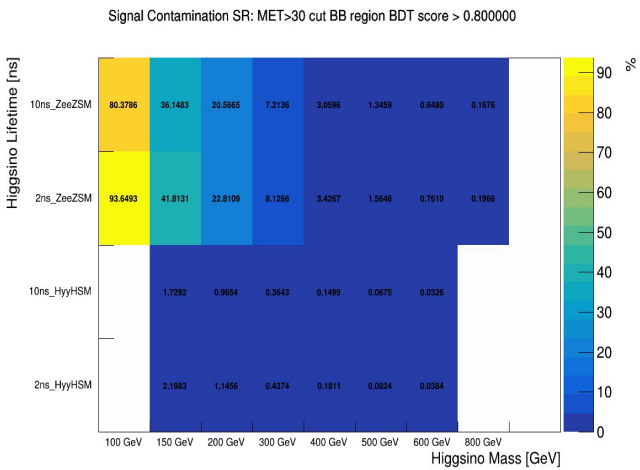


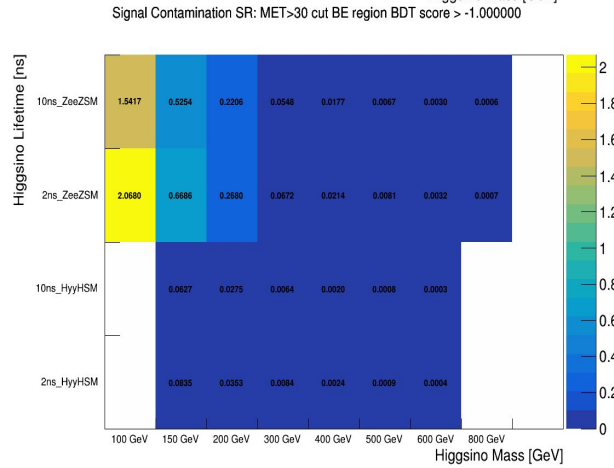


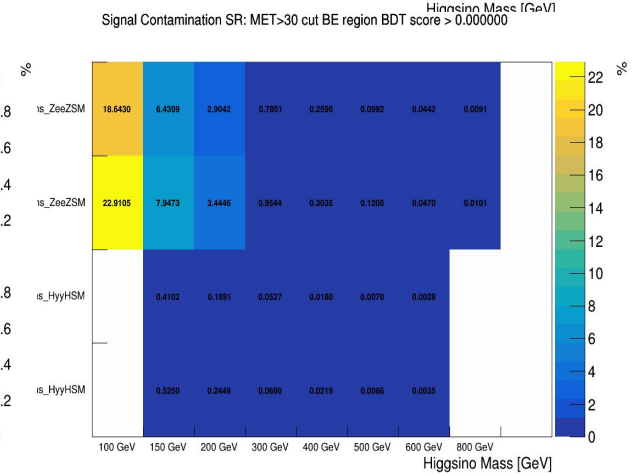
Signal Contamination for Signal Region in Barrel-Barrel and Barrel-EndCap

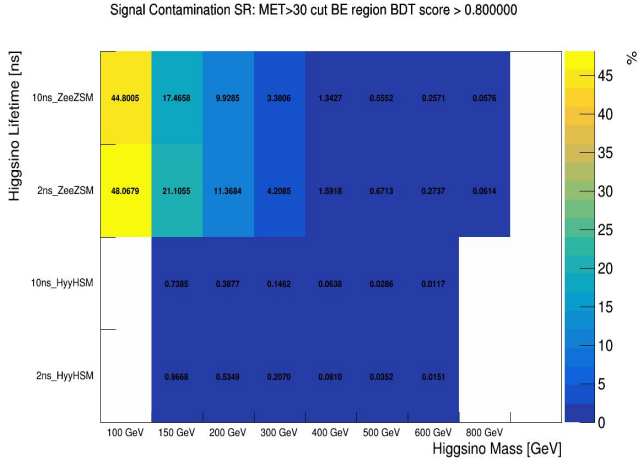












Tight Photon ID

- Look at distributions of photons that pass/fail the tight ID in our medium subsection.
  - For each photon (isTight vs !isTight): leading/subleading pt, eta, E, maxEcell_E, timing, pointing (ph1_z)
  - For event-level variables ((ph1_isTight && ph2_isTight) vs (!ph1_isTight || !ph2_isTight)): vertexing, MET, Hcand_pt, Hcand_M, dEta_ph, dPhi_ph
  - all in Control Region: MET_met < 20

Conclusions & Next Steps

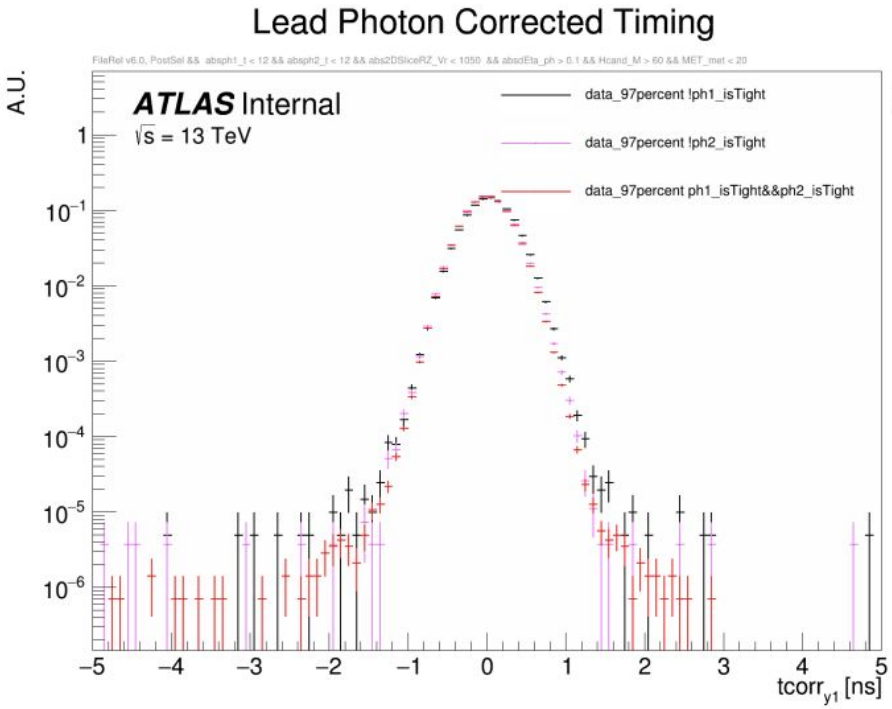
Conclusions

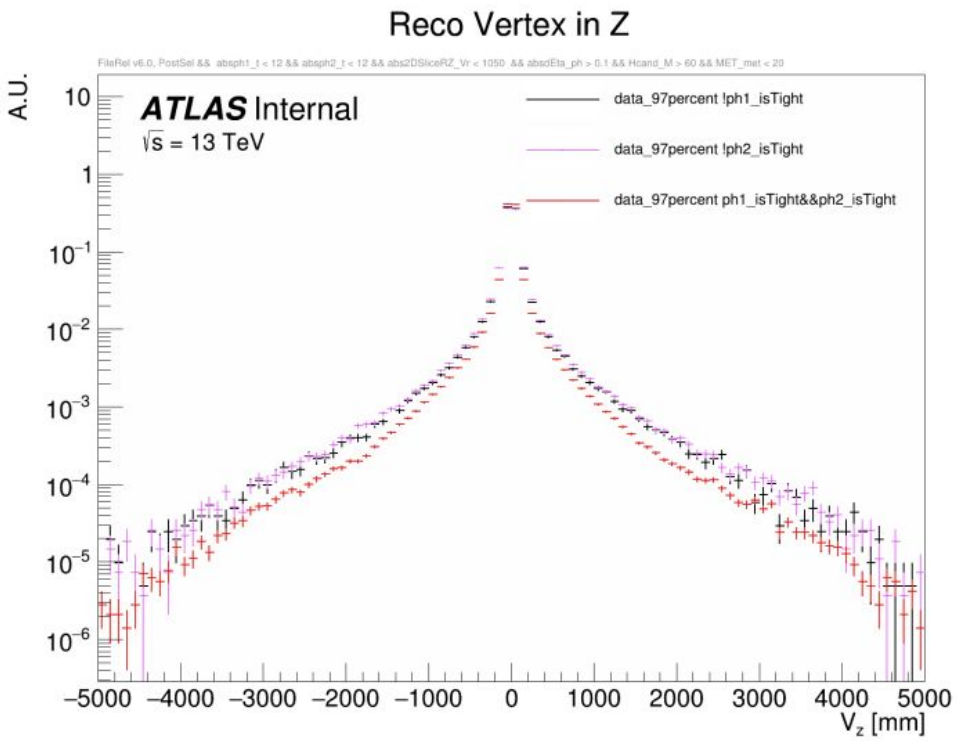
- The precise value of BDT score cut has a significant impact on our signal contamination in both the CR and VR. The higher the BDT score cut, the higher the signal contamination.
- We must weight the pro's and con's concerning the MET cut dividing our VR and SR
  - A 30 GeV cut has higher signal contamination than a 35 GeV cut. A 35 GeV cut provides similar levels of background statistics between the VR and SR
  - So far decided to use 30 Gev and drop high Myy cut

Next Steps

- Start working on Tight Photon ID Analysis

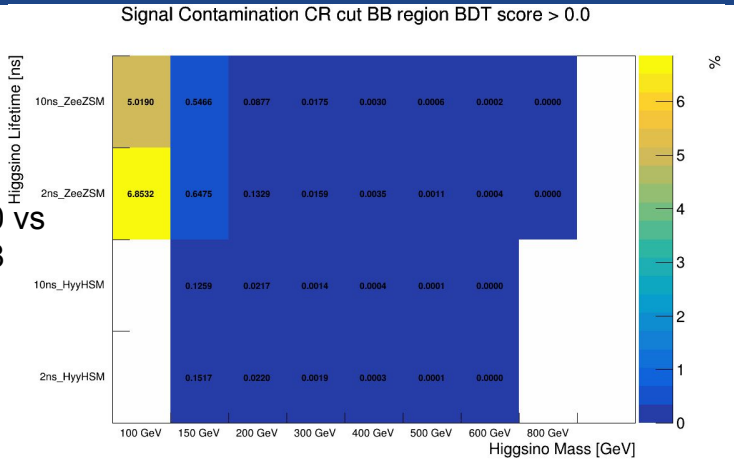
Tight Photon ID

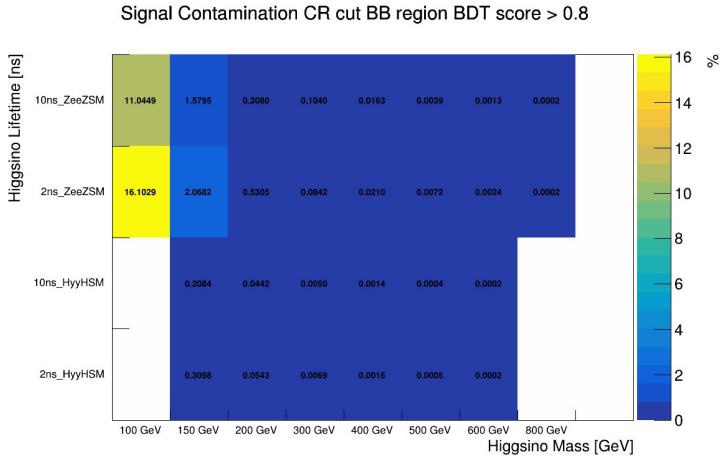


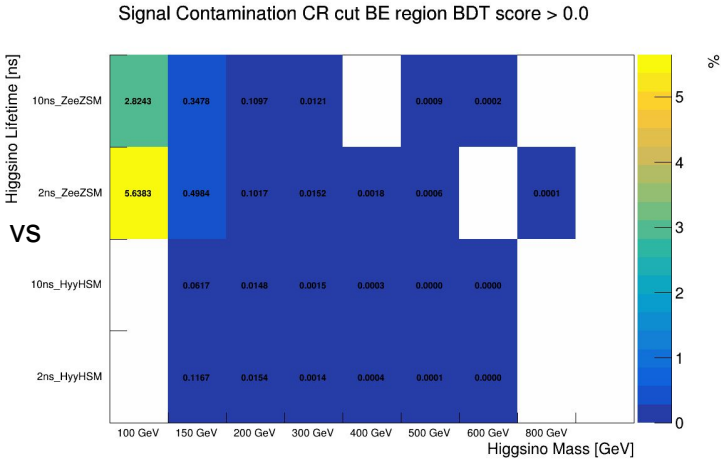


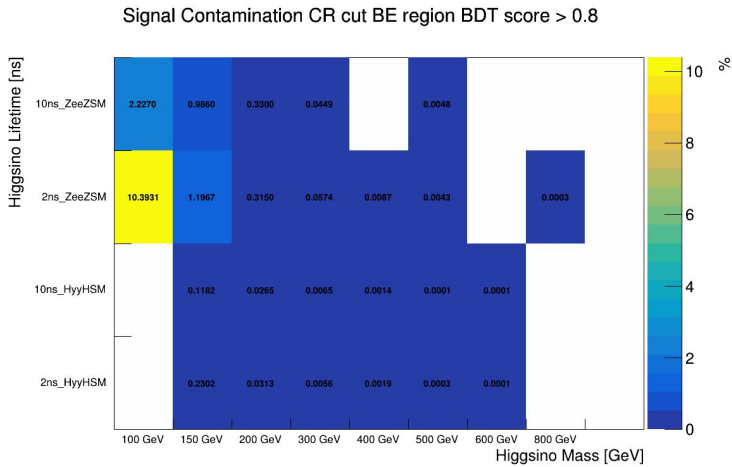
Signal Contamination for Control Region

- CR in Barrel-Barrel above BDT_score of 0.0 vs above BDT_score of 0.8
- Control region stays at same cut (MET<20)
- CR in Barrel-Endcap above BDT_score of 0.0 vs above BDT_score of 0.8



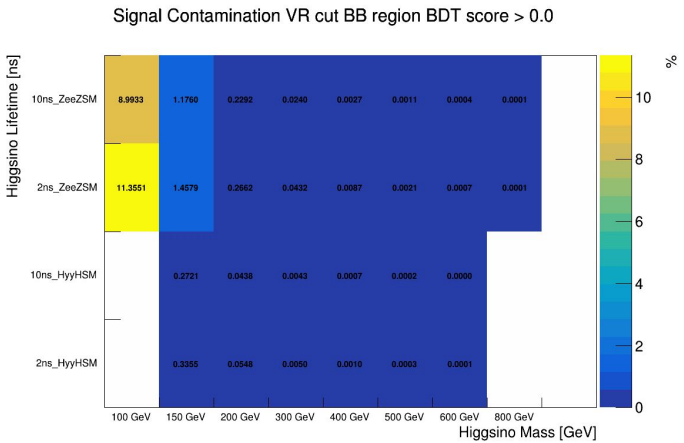


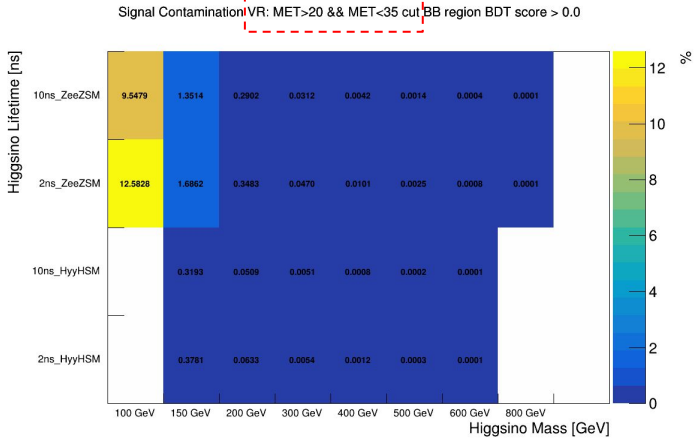




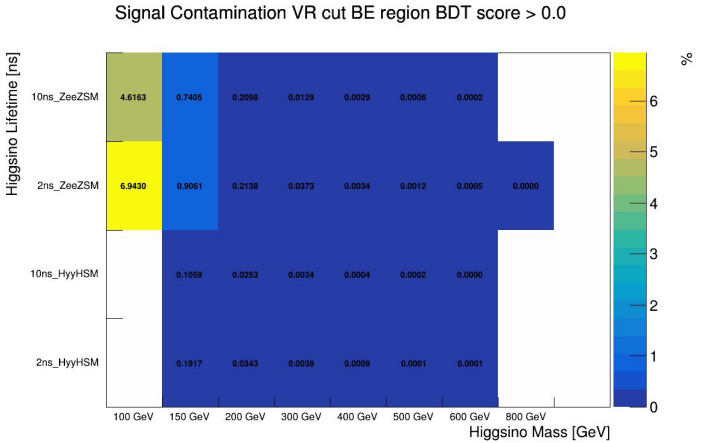
Signal Contamination for Validation Region using BDT_score >0.0

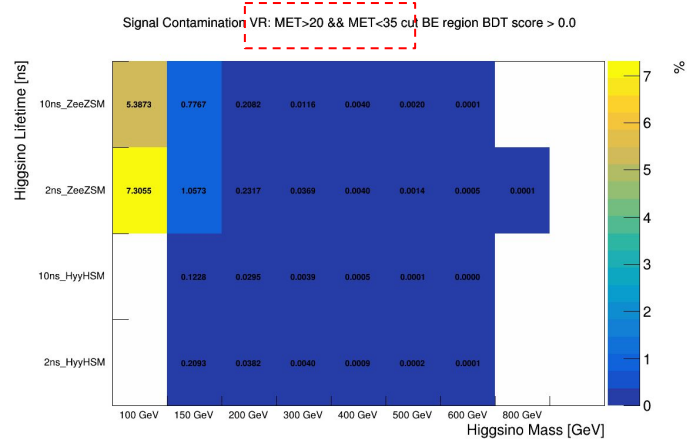
- Tight VR (MET 20-30) vs Loose (MET 20-35) in Barrel-Barrel above BDT_score of 0.0





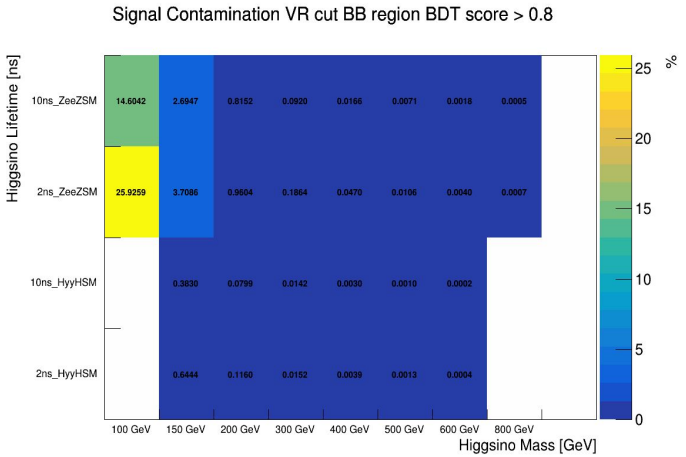
- Tight VR (MET 20-30) vs Loose (MET 20-35) in Barrel-Endcap above BDT_score of 0.0

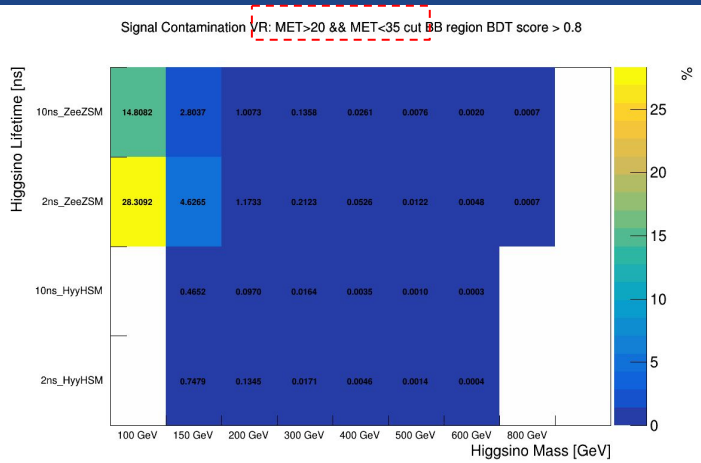




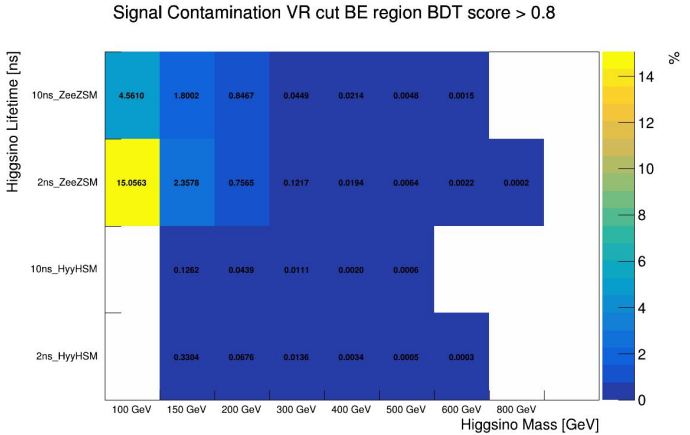
Signal Contamination for Validation Region using BDT_score >0.8

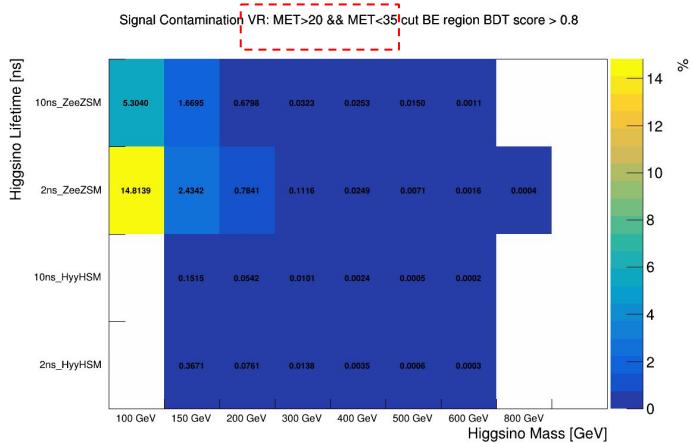
- Tight VR (MET 20-30) vs Loose (MET 20-35) in Barrel-Barrel above BDT_score of 0.8





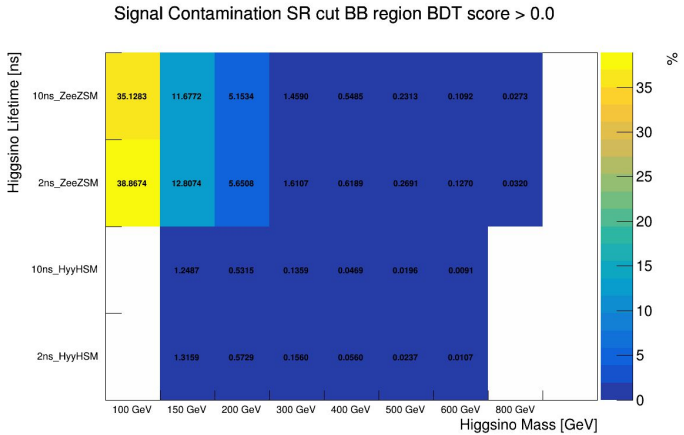
- Tight VR (MET 20-30) vs Loose (MET 20-35) in Barrel-Endcap above BDT_score of 0.8

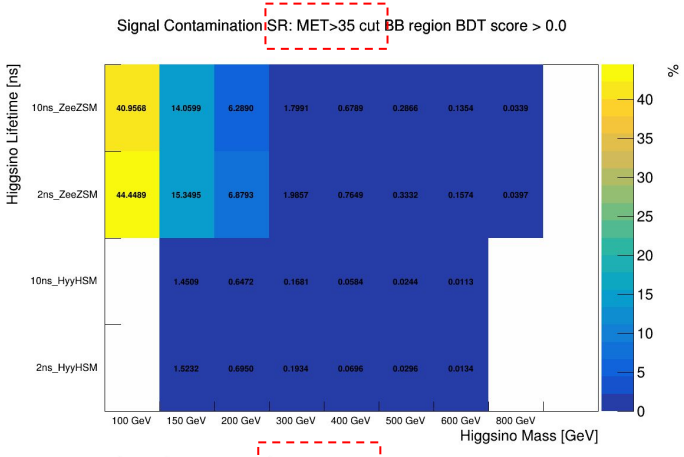




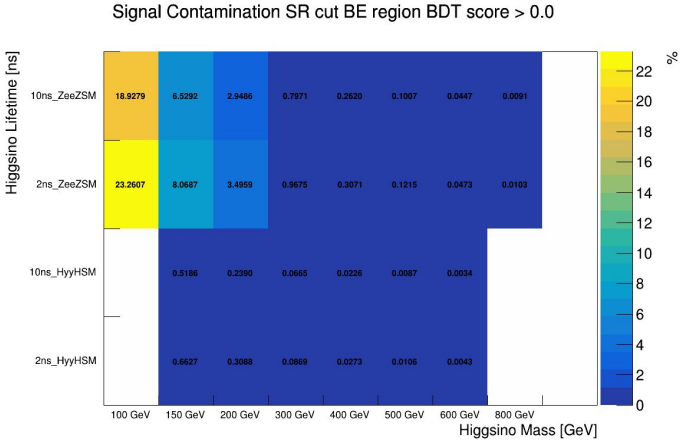
Signal Contamination for Signal Region using BDT_score >0.0

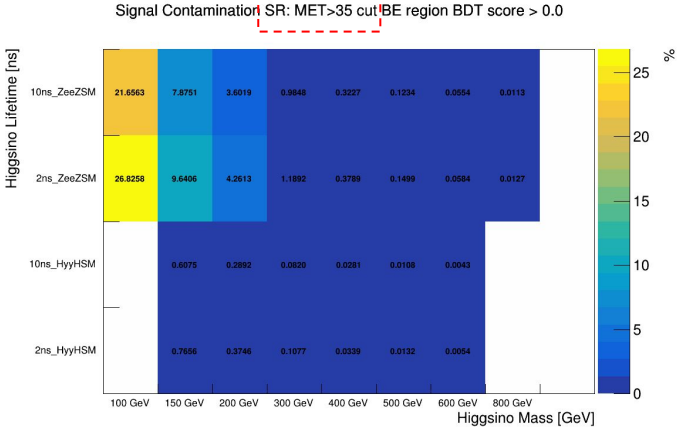
- SR as MET>30 vs SR as MET>35 in Barrel-Barrel above BDT_score of 0.0





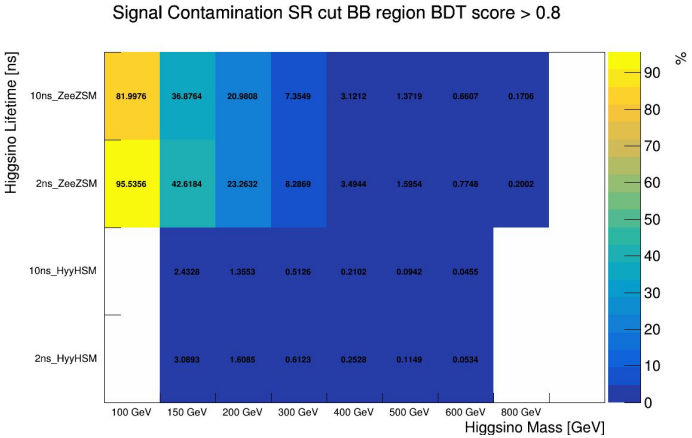
- SR as MET>30 vs SR as MET>35 in Barrel-Endcap above BDT_score of 0.0

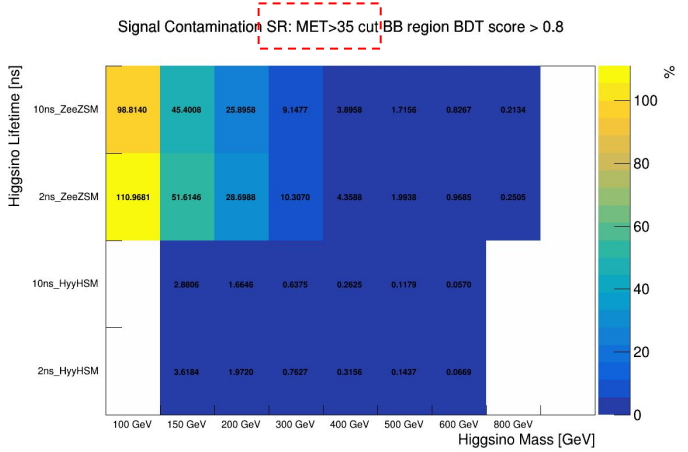




Signal Contamination for Signal Region using BDT_score >0.8

- SR as MET>30 vs SR as MET>35 in Barrel-Barrel above BDT_score of 0.8





- SR as MET>30 vs SR as MET>35 in Barrel-Endcap above BDT_score of 0.8