

Status report

May 13, 2021

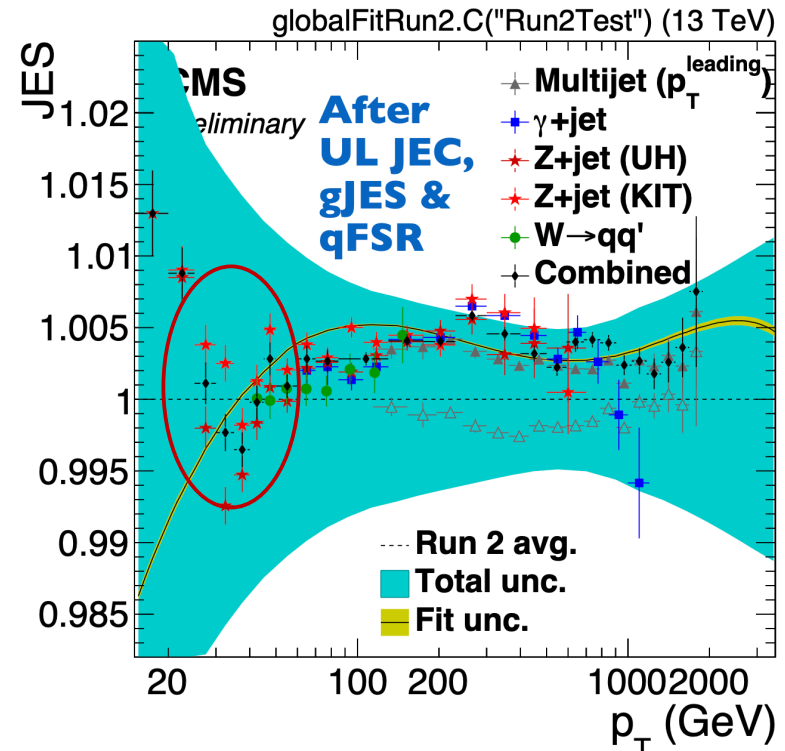
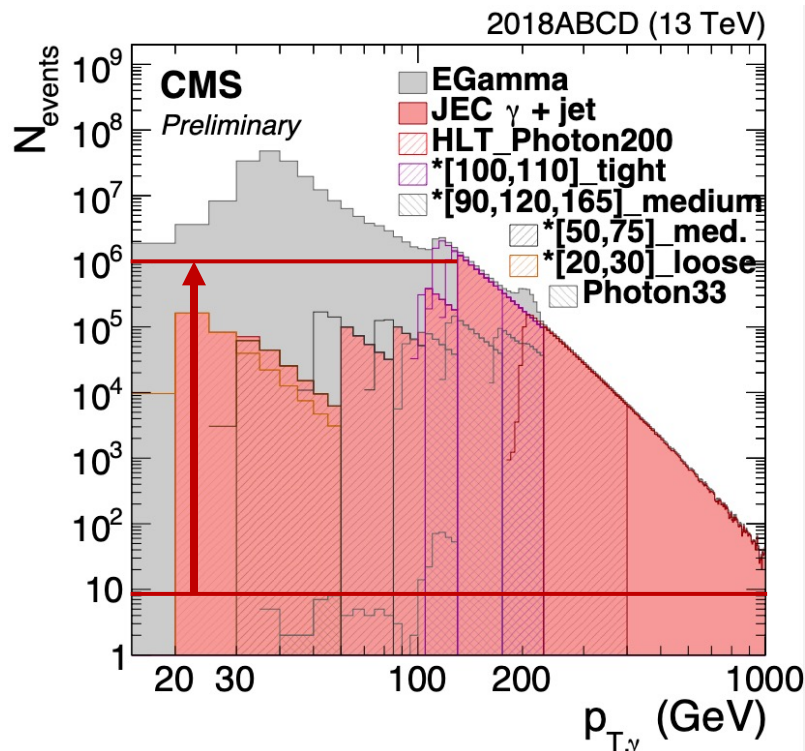
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HYU / IP2I

HLT_Photon30EB Preparation

Motivation

- New HLT path for γ +jets JES study is needed in low p_T region
- Increase statistics with higher purity
 - Existing paths for low p_T are containing endcap region
 - Focusing on barrel photon with TightIso/ID criteria
- It would put valuable inputs for the combination with Z+jet for JES study



Comparison for Run2 UL, not final version

HLT_Photon30EB Preparation

Motivation

- Purer single photon HLT path with a lower prescale to gain more statistics

Preparing new HLT path

- Starting from existing path: HLT_Photon110EB_TightID_TightIso_v2
- To: HLT_Photon**30**EB_TightID_TightIso_v2

Path detail	110EB (Before)	30EB (After)
L1Seed	hltL1sSingleEG40to50 (L1_SingleEG40er2p5 L1_SingleEG42er2p5 L1_SingleEG45er2p5 L1_SingleEG60)	hltL1sSingleIsoEG28er1p5 (L1_SingleIsoEG28er1p5) for barrel Comments: lower the Threshold?
Prescaler	hltPrePhoton110EBTightID_TightIso	hltPrePhoton 30 EBTightID_TightIso
Reco sequence	HLTPhoton110EBTightID_TightIsoSqeunce (hltEG110EBTightID_TightIso*Filter: In Et: etcutEB = 110, etcut EE = 9999999)	HLTPhoton 30 EBTightID_TightIsoSqeunce (hltEG 30 EBTightID_TightIso*Filter: In Et: etcutEB = 30 , etcut EE = 9999999)

*X = {Et, ClusterShape, HE, R9, Ecallso, Hcallso, TrackIso}

HLT_Photon30EB Rate measurement

HLT Rate Measurement

- Followed the latest recommendation on STEAM ([twiki](#))
- Release: CMSSW_12_3_0 (V76) ([twiki](#)) GT: auto:run3_hlt (currently [123X_dataRun3_HLT_v5](#))
- Datasets: **EphemeralZeroBias**{1-8} 2018D run 323755 ([files](#),[info](#))
 - HLTPhysics dataset is not compatible with the GRun Menu releases after V55 ([twiki](#))
 - Due to L1 seed renaming, the L1T needs to be re-emulated
- Command line:

```
hltGetConfiguration /users/jichoi/GRunCopy/12_3_0_V76/V12
--globaltag auto:run3_hlt --data --full --offline --prescale 2.0e34+ZB+HLTPhysics --output no-output
--max-events -1 --era Run2_2018 --l1 L1Menu_Collisions2022_v1_0_0.xml
--customise HLTrigger/Configuration/customizeHLTforCMSSW.customiseFor2018Input
- --prescale: 2.0e34+ZB+HLTPhysics (OMS)
- --l1: L1Skim files were re-emulated using L1Menu\_Collisions2022\_v1\_0\_0
- --customise: running over 2018 data in 11_1+, this is mandatory (twiki)
```

Following the STEAM workflow

- Got the rates by merging and scaling
 - Requirements: Average instant lumi / target lumi / *HLT prescale
 - 1.385 / 2.0 / 224496 (used value in [twiki](#))

Path	Total Count	Total Rate (Hz)	Pure Count	Pure Rate (Hz)
HLT_Photon30EB_TightID_TightIso_v	3636	1486.53	3245	1326.68

HLT_Photon30EB Rate measurement

Prescaling Strategy

- Expected rate at low and high luminosity

Path	Total Rate (Hz)
HLT_Photon30EB_TightID_TightIso_v	1486.53
Prescale by 15 (< 1.0e34)	99.1
Prescale by 150 (~ 2.0e34)	9.91

→ For variations of prescale, we would like to have **linear** prescale

HLT_Photon30EB Efficiency Estimation

Sample

- /GJets_HT-40To100_TuneCP5_13TeV-madgraphMLM-pythia8/RunIISummer19UL18NanoAODv2-106X_upgrade2018_realistic_v15_L1v1-v1/NANOADSIM
- /QCD_HT50to100_TuneCP5_PSWeights_13TeV-madgraph-pythia8/RunIISummer20UL18NanoAODv9-106X_upgrade2018_realistic_v16_L1v1-v1/NANOADSIM
- Tested with some part of the samples

Retrieving Selections

- Naive estimation with selections as HLT
- From Soumya's [talk](#) in JetMET workshop
 - MET Filters ([twiki](#))
 - Photon selection
 - == one photon with $p_T > 30$ GeV & $|\eta| < 1.44$, TightID/Iso (CutBased ID (Fall17 V2))
 - Jet selection
 - $\geq$ one jet with $p_T > 40$ GeV $|\eta| < 2.5$, Tight JetID
 - Lepton Veto:
 - Any loose lepton (muon/electron) with $p_T > 10$ GeV

Comments: Jet p_T is too high

Comments: QCD is too small

Number of MC events	Without Selection	With Selection	Estimated Efficiency (%)
Gjets_HT-40To100	9331493	1512791	16
QCD_HT50to100	6057016	171	0.003

1/5000

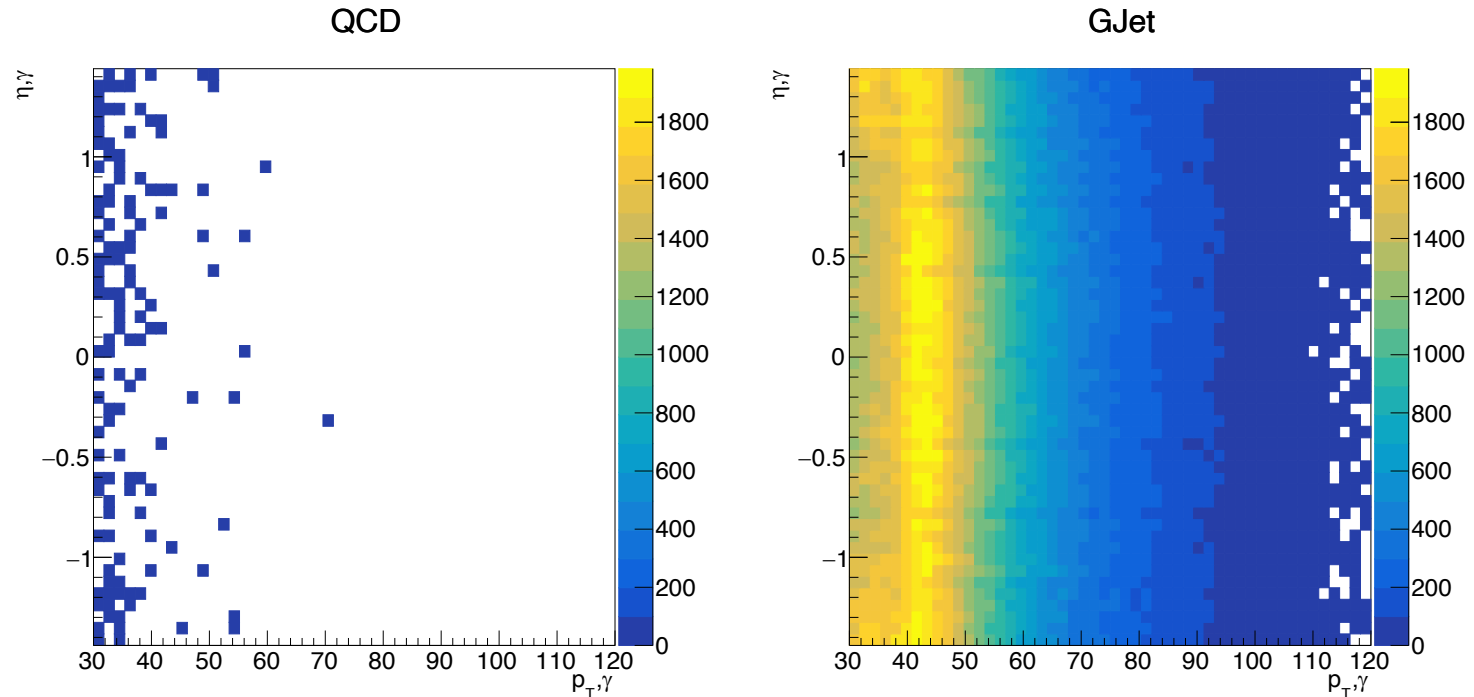
We are improving Photon ID at HLT which was not review since 2015

~1/5000 selected events will be QCD → High purity of the selection

HLT_Photon30EB Efficiency Estimation

Efficiency Estimation

- Naive estimation with selections as HLT



Number of MC events	Without Selection	With Selection	Estimated Efficiency (%)
Gjets_HT-40To100	9331493	1512791	16
QCD_HT50to100	6057016	171	0.003

→ More efficiencies on Gjets and better rejections on QCD are expected

- Purer single photon HLT path with a lower threshold is needed to gain more statistics in JES study
- HLT_Photon30EB_TightIso_TightID with rate $\sim 1.4\text{kHz}$ without prescale is ready: `/users/jichoi/GRuncoy/12_3_0_V76/V12/HLT_Photon30EB_TightID_TightIso_v2`, waiting for feedback from TSG
- More GJets efficiencies and better QCD rejections are expected
- We can expect to gain more statistics with the new path

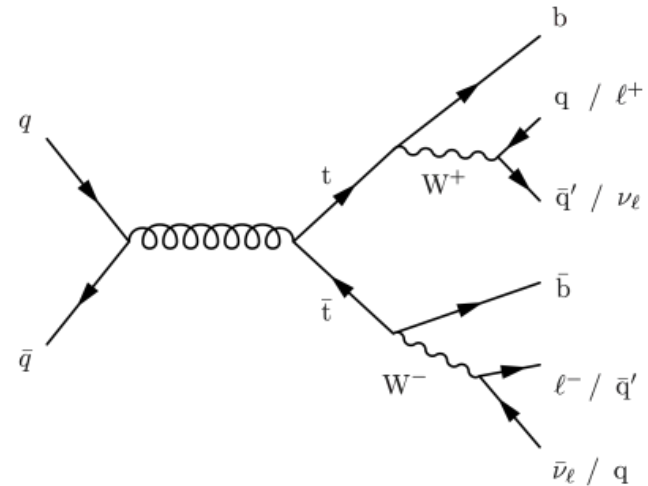
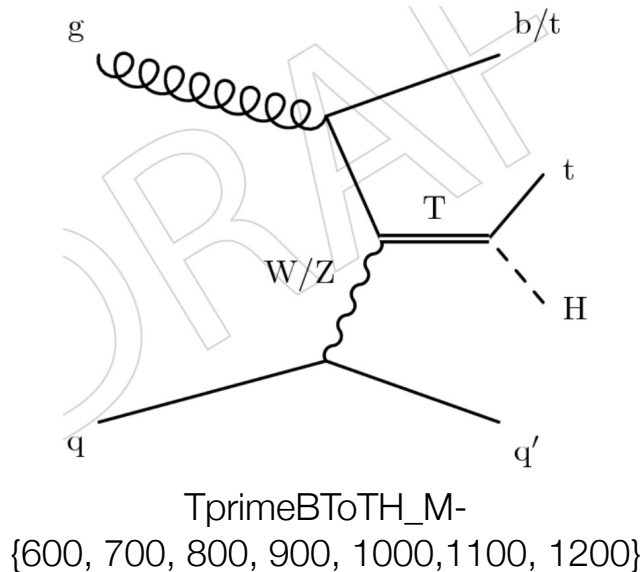
Thank you!

NN From Scratch

Correlations between input features

- Motivation: Get "useful" input features for training NN
 - Jet components {pT, eta, energy, b-tag disc.} for first 5 leading jets (20 variables)
- Pandas python library for Pearson coefficient is available
 - If it is highly correlated (-1 or 1), drop it from input features

Samples



Selections

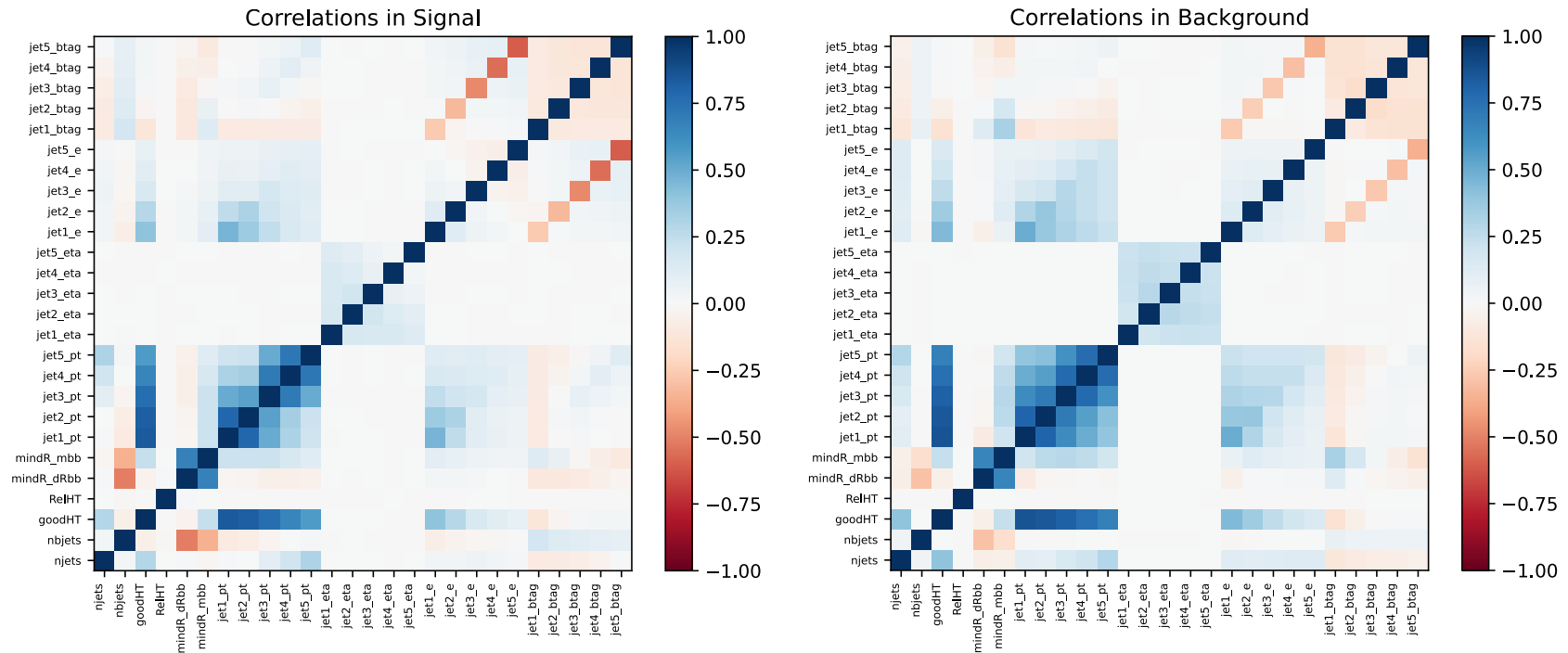
- $\text{HLT} + n_{\text{jets}} \geq 6 + n_{\text{bjets}} \geq 2$

NN From Scratch

Correlations between input features

- Motivation: Get "useful" input features for training NN
 - Jet components {pT, eta, energy, b-tag disc.} for first 5 leading jets (20 variables)
 - + nJets, nbJets, HT, RelHT, dRbb, mbb

Correlation matrices



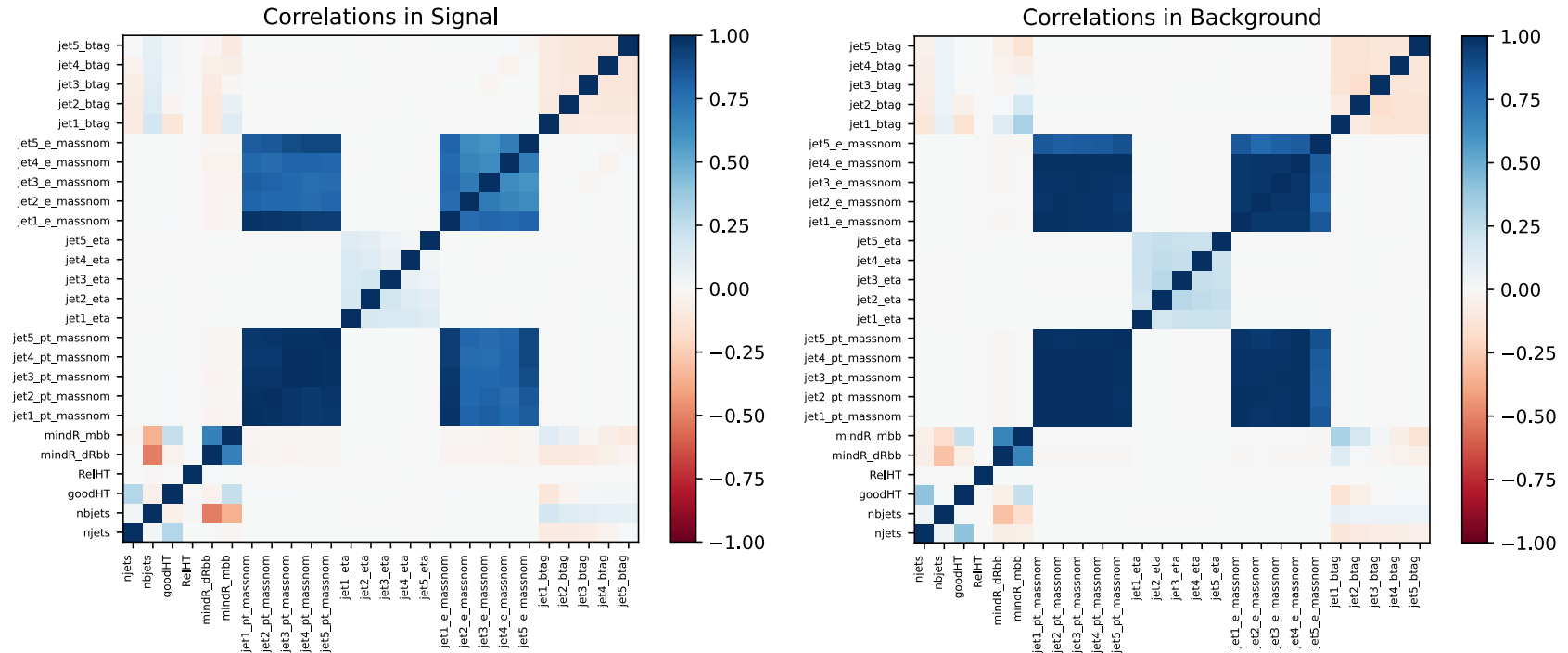
- Jet_pt and btag (DeepCSV) is highly correlated in signal

NN From Scratch

Correlations between input features

- Motivation: Get "useful" input features for training NN
 - Jet components {pT, eta, energy, b-tag disc.} for first 5 leading jets (20 variables)
 - + nJets, nbJets, HT, RelHT, dRbb, mbb
 - Mass independent variables (pT/mass, energy/mass)

Correlation matrices



- Mass independent variables are strongly correlated to themselves