Data-MC matching

Yang Tianyi

Data-MC matching check

- Both OS2l+6b and SS2l channels *ttHH* analysis has two leptons in the final state.
- The checking is based on the 2l topology.
- This initial data-MC checking uses 2μ samples @Run2023D.
- Further study of data-MC matching on the full running period and all flavours di-leptonic final state will be presented soon.

Data

- Checking begin with only di-muon channel for simplicity
 - Muon0 and Muon1 primary datasets contain all the single muon and double muon triggered events.
 - Other primary datasets MuonEG and EGamma0/1 will be considered later for 2e and $e\mu$ channels.
 - Currently no double counting of events exists.
- Using Run2023D era for the checking
 - Luminosity: **9.451 fb**⁻¹

MC samples

- Drell-Yan: XS: 6221.3 pb
 - DYto2L-4Jets_MLL-50_TuneCP5_13p6TeV_madgraphMLM-pythia8
- *tt***DL**: XS * branching ratio: 96.9 pb
 - TTto2L2Nu_TuneCP5_13p6TeV_powheg-pythia8
- WW: XS: 173.4 pb
 - WWto2L2Nu_TuneCP5_13p6TeV_powheg-pythia8, branching ratio: 21.57% * 21.57%
- WZ: XS: 54.3 pb
 - WZto2L2Q_TuneCP5_13p6TeV_powheg-pythia8, branching ratio: 67.41% * 6.729%
- **ZZ**: XS: **16.7 pb**
 - ZZto2L2Q_TuneCP5_13p6TeV_powheg-pythia8, branching ratio: 6.729% * 69.91% * 2
 - ZZto2L2Nu_TuneCP5_13p6TeV_powheg-pythia8, branching ratio: 6.729% * 20.00% * 2

Object and event preselection

- Muon requirement:
 - Tight ID
 - Tight Iso (*I*_{0.4} < 0.15)
 - + Kinematic cut: $p_T > 35 {\rm GeV}$, $|\eta| < 2.4$
- Events required:
 - Select events with exactly 2 muons.

MC normalization and cut scheme

- genWeight applied for generator level nominal weights.
- Total evens is normalized to the luminosity before preselection:

 $w_{lumi} = \frac{\text{lumi} \times \text{cross} - \text{section}}{\sum \text{genWeight}}$

• The scale factors of muon is applied to weighted events after preselection.

•
$$SF_{tight ID} = \frac{\epsilon_{data}(tight ID)}{\epsilon_{MC}(tight ID)}$$
, $\epsilon(tight ID) = \frac{tight ID muons}{tracked muons}$
• $SF_{tight ISO} = \frac{\epsilon_{data}(tight ISO)}{\epsilon_{MC}(tight ISO)}$, $\epsilon(tight ISO) = \frac{tight ID \& tight ISO muons}{tight IDmuons}$

- Scale factors in
 - *p*_T bin [30, 40, 50, 60, 120, inf]
 - η bin [-2.4, -2.1, -1.6, -1.2, -0.9, -0.3, -0.2, 0.2, 0.3, 0.9, 1.2, 1.6, 2.1, 2.4]

Data-MC matching plot

Linear scale

Log scale



- The central bin has some overshooting. Maybe some additional factors not considered.
- The gap between DY and data outside the central bin is mostly filled by $t\bar{t}$.
- Diboson almost has no contribution.

Without SF applied

Linear scale



Log scale



- There is not much difference without SF applied.
- The style with ratio plots is under-tuning now. Original style code:

https://github.com/monttj/usercode/blob/master/MuonAnalyzer/test/paperPlots/plots.C

Samples moving to our server

- Samples on KNU:
 - /u/user/tiyang/dataset/cms/store/data Run2023C Run2022C(downloading)
 - /u/user/tiyang/dataset/cms/store/mc
 Run3Summer23BPixNanoAODv12(2023D) ttbar diboson
- Samples on lxplus:
 - /eos/home-t/tiyang/CMS/cms/store/data/ Run2023D
 - /eos/home-t/tiyang/CMS/cms/store/mc/
 Run3Summer23BPixNanoAODv12(2023D) Drell-Yan
- Currently I am downloading dataset to the htop now.:
 - /data1/common/NanoAOD/data/
 - /data1/common/NanoAOD/mc/

EPR

- EPR task: updating the quality control (QC) data of GEM ME0 components to the GEM database.
- GEM database takes XML format of QC run. My current work is preparing XML format data from other format QC run records.
- The task starts with the external frame with the help of Luigi Longo.
- **Register ME0 parts** Dashboard GE1/1 GE1/1 Parts parts GE1/1 Chambers GE1/1 SuperChambers Readout board (1) GEM foil (1) GE1/1 SuperChambers (status) GE1/1 QC 🕇 Add new + Add new GE1/1 Operations GE2/1 Drift board (1) GE2/1 Parts GE2/1 Chambers Add nev GE2/1 Modules GE2/1 QC GEM External Frame (1) ME0 ME0 Parts + Add new + Add new ME0 Modules ME0 Stacks OptoHybrid (426) ME0 Comp. Plots ME0 Modules Plots P5 RUN Config VFAT3 (413) Hardware Locator

GEM Electronic Board (30)

GEM Internal Frame (1)

GEM VTRxPlus (425)

External frame QC

- The external frame separates the drift and read-out PCBs. Internal is the foil. Grooves on the external frame are to hold sealing O-rings.
- Uniform thickness, suitable groove width and depth, smooth surface with polyurethane coating without flaws are needed.
- The thickness, groove width and depth of 41 point with ~10 cm distance.



Next

- With the permission of Stefano, I can upload the XML files onto the GEM database.
- Now, I am looking at the converting of the QC data for readout and drift PCB.