



ULB

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Update: Synchronization, MC BKG

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Framework Synchronization



Framework Synchronization

- Checking **eeee channel** with Alexis and Bennett
- One significant **bug** (factor **10x**):

```
1 | root [14] Events->Draw("event", "(Muon_pt.size(>1.0)||Electron_pt.size(>1.0))&&(HLT_Ele27_WPTight_Gsf||HLT_IsoMu24)")
2 | (Long64_t)384
```

vs

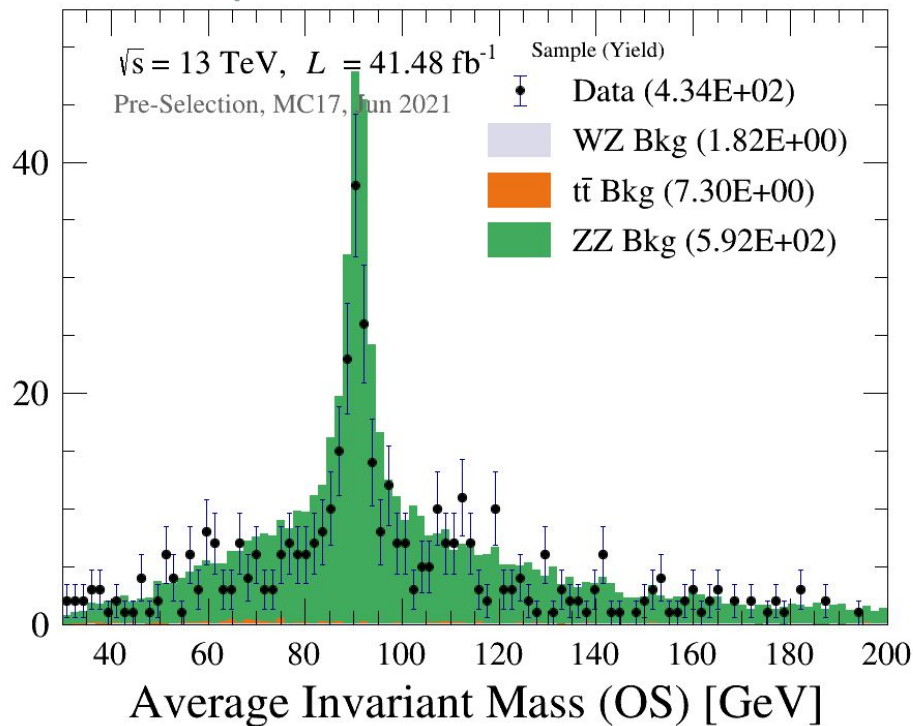
```
1 | root [15] Events->Draw("event", "(Muon_pt.size(>1.0))&&(HLT_Ele27_WPTight_Gsf||HLT_IsoMu24)")
2 | (Long64_t)3930
```

- **17/660** PU only events → MET Filters
- **2/660** ULB only events → events with **> 4 lep**
- All **synced up!**
- **NEXT**: repeat for **data**, more **MC**, **other channels**

Updating BKG plots

- Still seeing **disagreement**
 - ↳ **No lepton scale-factors**
 - ↳ **No bkg uncertainty**
 - ↳ **Missing data file?**
- Next:
 - ↳ **Double check data**
 - ↳ **Define a dedicated MC x-check region**
specifically for Data-MC comparison

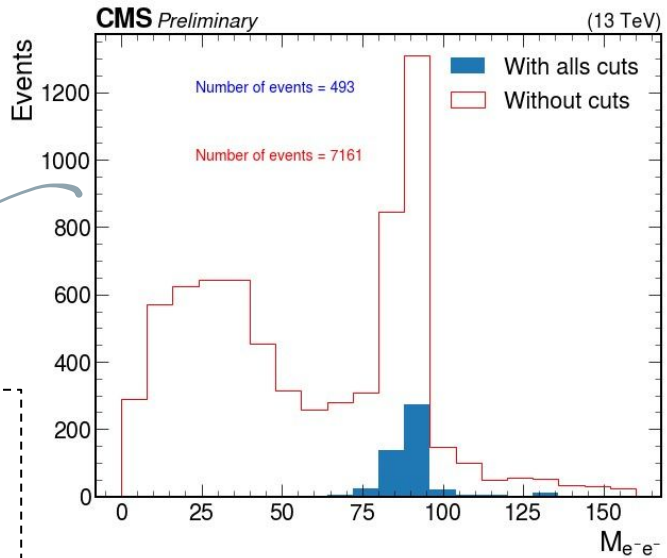
Events



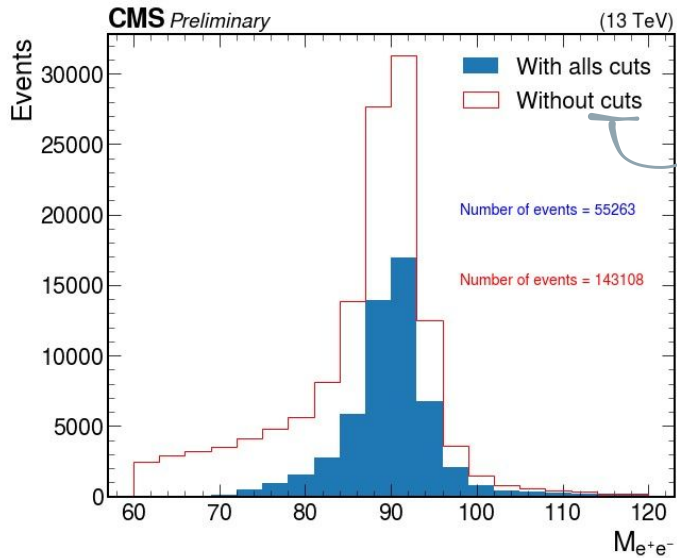
Blind!

Summer Student - Matheus

- He'll be working on the **charge misID** correction
- Officially **starts** on Mon **July 5th** - **some progress** already



From
dedicated
Drell-Yan
MC sample
















electron ID
Iso, etc.

Next Steps



Next Steps - checklist

- **Next** steps:

- ↳ Run on more **MC background** samples  → 
- ↳ **Produce** more **signal** mass points  → 
- ↳ **Synchronize** SW Frameworks  → 
- ↳ Finalize **MC background** estimate (UL2017)  → 
- ↳ **Data driven backgrounds** - charge misID, etc.  → 
- ↳ **First pass of** statistical setup in **Combine** 
- ↳ **Explore** new **variables, cuts** on MC 
- + optimize 

Next Steps - checklist


- **Next** steps:
 - ↳ Finalize **trigger** strategy + check **efficiency**
 - ↳ Finalize **selection** and **optimization**
 - ↳ Apply all **scale factors**
 - ↳ **Final background** estimation **CR+VR** and plots
 - ↳ **Unblind** 10% or 20% of **SR**
 - ↳ **Run** analysis on **2016** and **2018**
 - ↳ **Finalize statistical** analysis + **Combine** setup





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Useful stuff:

12.9 fb-1 [PAS](#) 

35.9 fb-1 [CADI](#) 

ATLAS (36.1 fb-1) [Paper](#) 

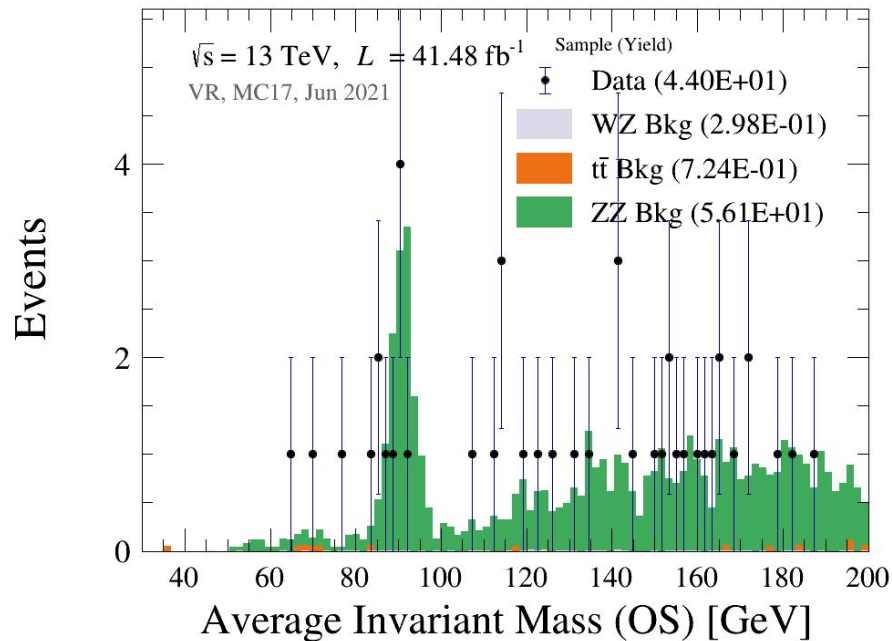
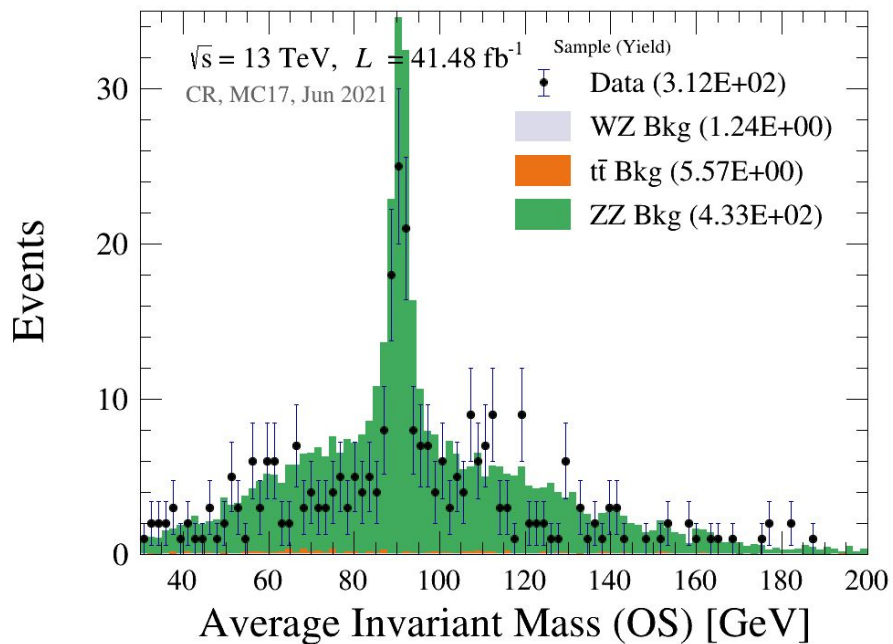
HppHmmLep [GitLab repository](#) 

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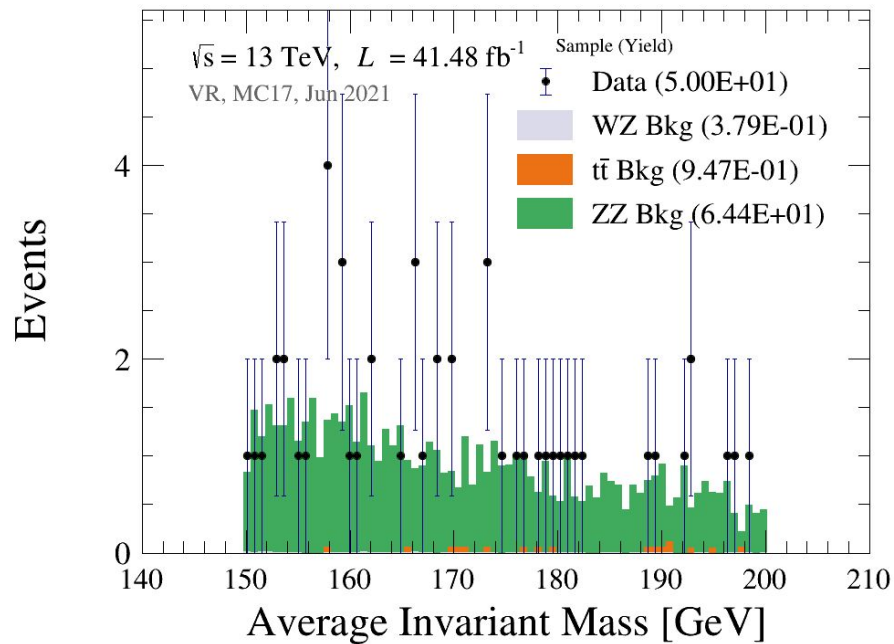
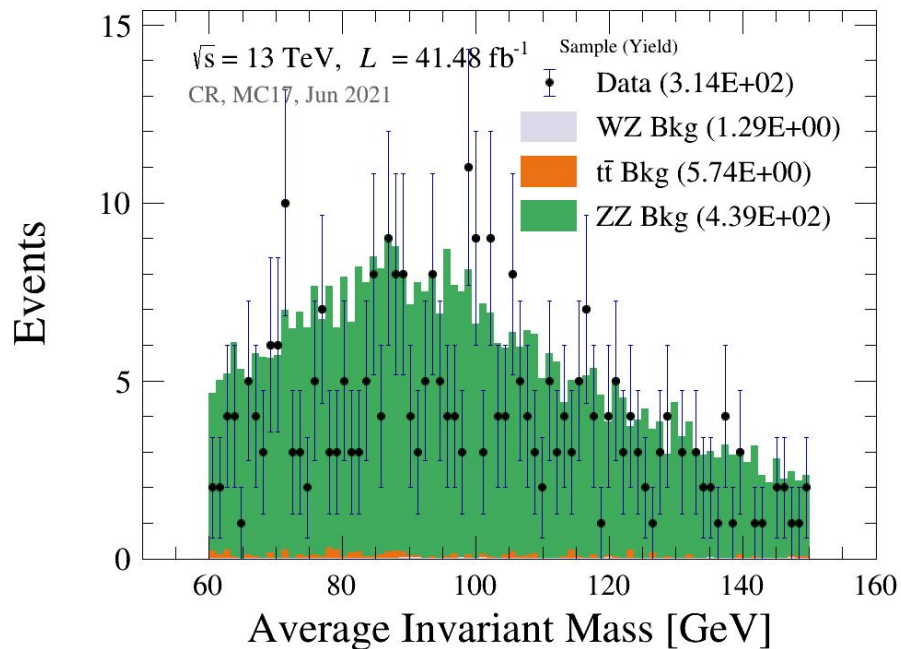
July 2021



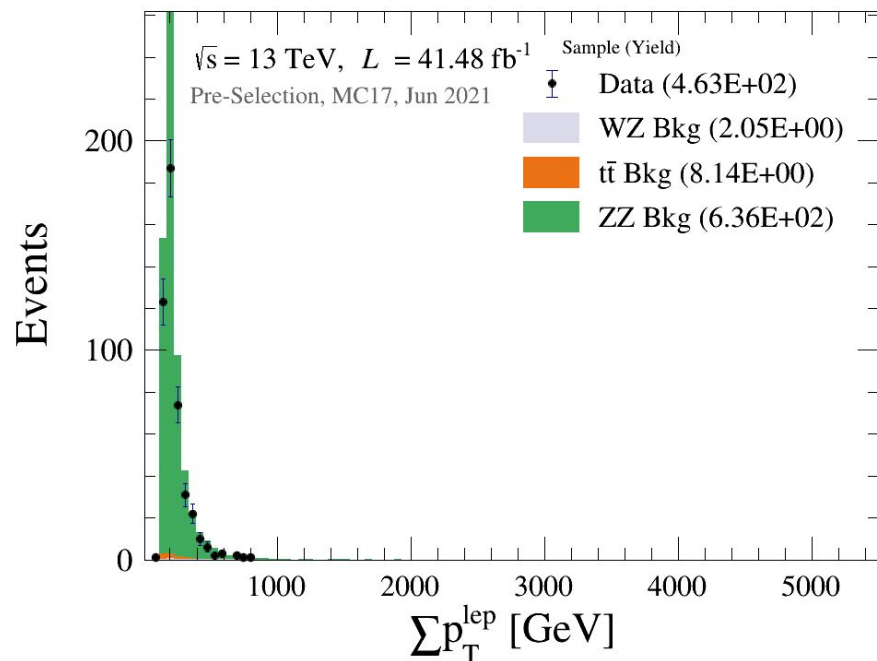
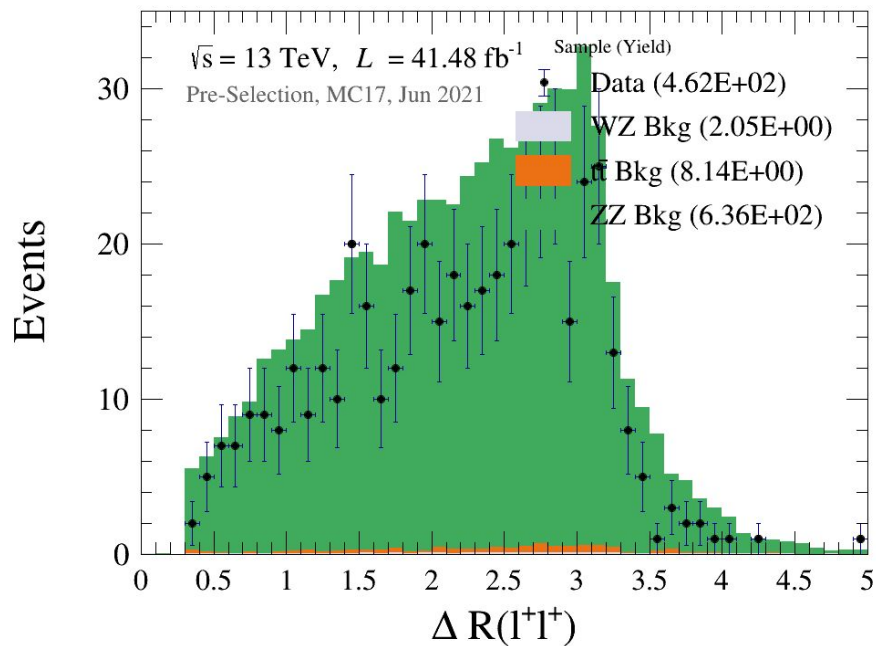
More plots



More plots

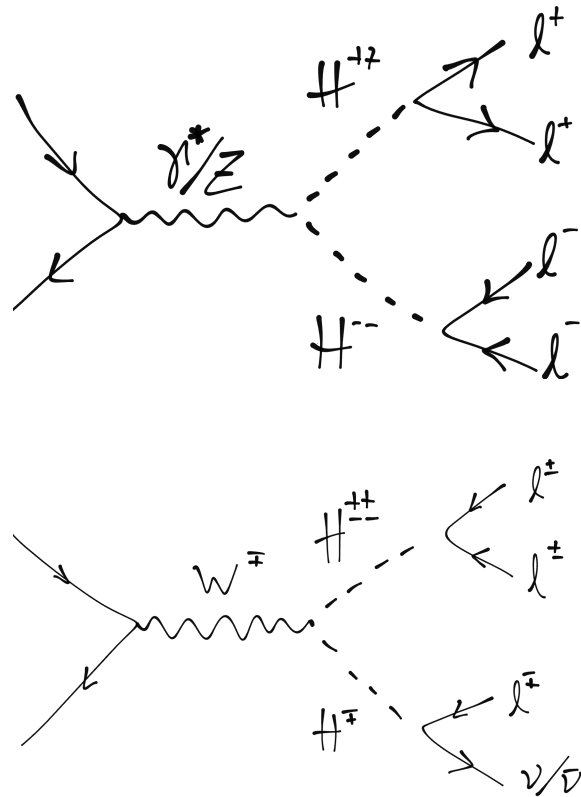


More plots

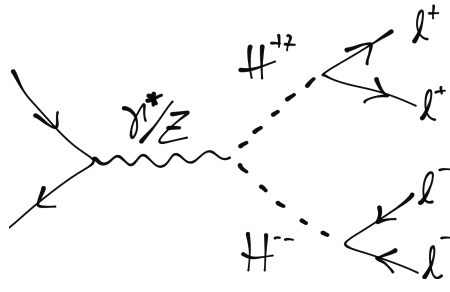


Current Results

- [CMS-PAS-HIG-16-036](#) (12.9 fb^{-1})
 - **Draft** of update: [CMS-AN-17-100](#) (35.9 fb^{-1})
 - ↳ **Archived** since 2018
 - By **Devin N. Taylor** (UC Davis)
- [ATLAS Paper](#) (36.1 fb^{-1})
 - CERN-EP-2017-198; arXiv:1710.09748
 - *Only targets pair-production

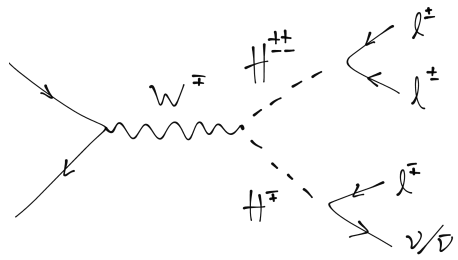


Status - channels





	ee	eμ	μμ	ττ	τε	τμ
ee	Green	Green	Green	Red	Red	Red
eμ	Green	Green	Green	Red	Red	Red
μμ	Green	Green	Green	Red	Red	Red
ττ	Red	Red	Red	Red	Red	Red
τε	Red	Red	Red	Red	Red	Red
τμ	Red	Red	Red	Red	Red	Red

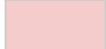
	e	μ	τ
ee	Yellow	Yellow	Red
eμ	Yellow	Yellow	Red
μμ	Yellow	Yellow	Red
ττ	Red	Red	Red
τε	Red	Red	Red
τμ	Red	Red	Red



	eν	μν	τν
ee	Yellow	Yellow	Red
eμ	Yellow	Yellow	Red
μμ	Yellow	Yellow	Red
ττ	Red	Red	Red
τε	Red	Red	Red
τμ	Red	Red	Red

currently working on → 

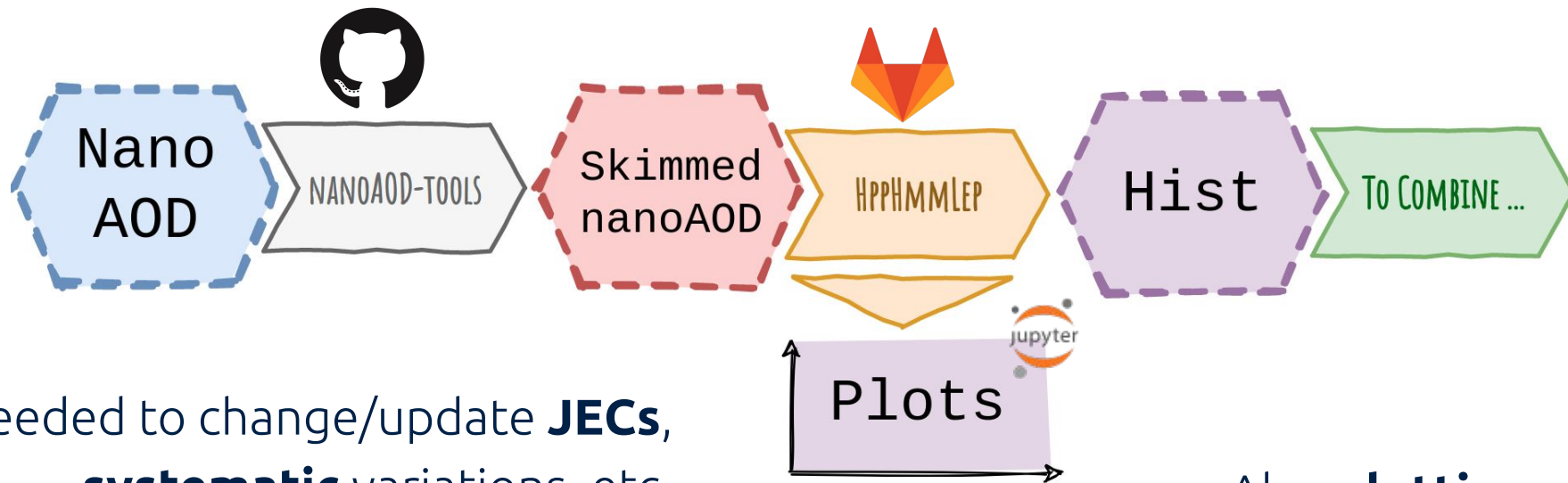
potential addition → 

no plan to add → 

Status - software

- **Software framework**

Object & Event **Selection**,
weighting, etc.



Needed to change/update **JECs**,
systematic variations, etc.
+ some **initial cuts**

Also **plotting**

Status - selections

- **Work in progress:** Selections

ELECTRONS

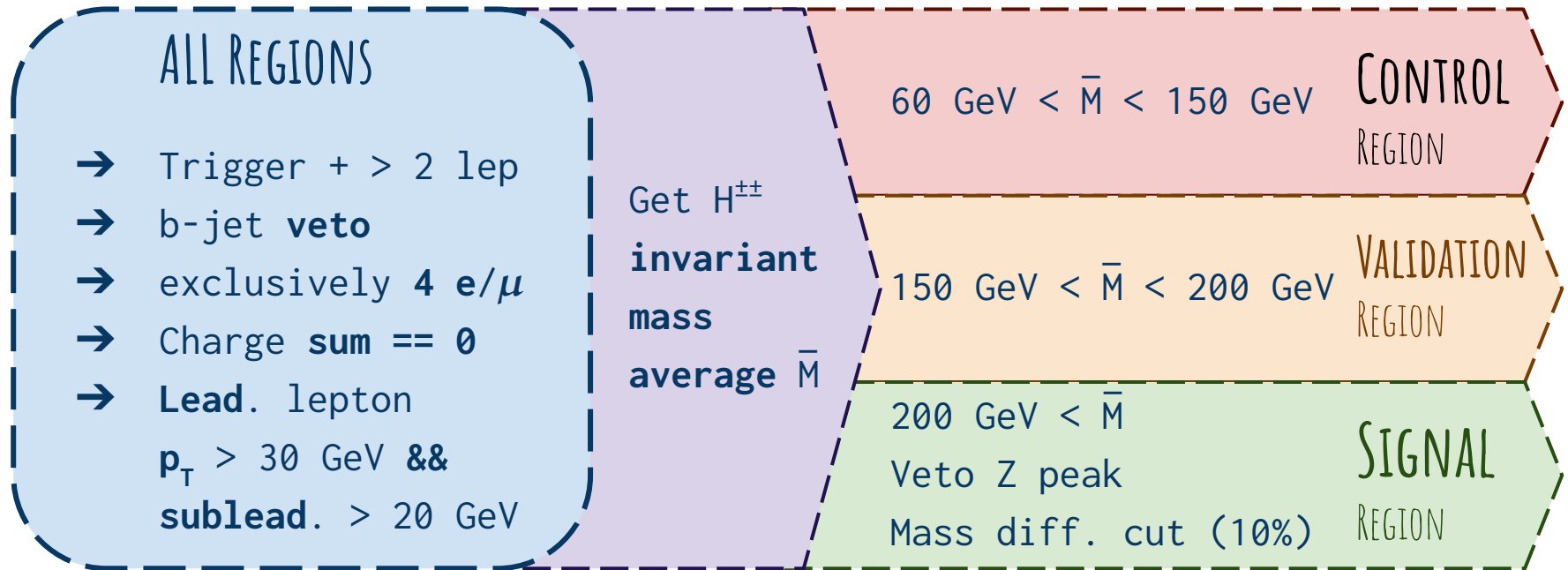
- $p_T > 20 \text{ GeV}$
- $|\eta| < 2.5$
- **Iso:** cutBasedHEEP
- $d_{xy} < 0.05$
- $d_z < 0.1$

MUONS

- $p_T > 20 \text{ GeV}$
- $|\eta| < 2.4$
- **ID:** mediumID
- $d_{xy} < 0.2$
- $d_z < 0.5$
- $tkRelIso/p_T < 0.4$

Status - selections

● Work in progress: Cuts



Triggers

- **Work in progress:** Trigger list

OR OF:

- 'HLT_Ele27_WPTight_Gsf',
- 'HLT_IsoMu24',
- 'HLT_Ele23_Ele12_CaloIdL_TrackIdL_IsoVL_DZ',
- 'HLT_Mu17_TrkIsoVVL_Mu8_TrkIsoVVL_DZ',
- 'HLT_Mu8_TrkIsoVVL_Ele23_CaloIdL_TrackIdL_IsoVL_DZ',
- 'HLT_Mu23_TrkIsoVVL_Ele12_CaloIdL_TrackIdL_IsoVL_DZ'

Data Samples List

- **2016 NANO AOD not yet ready**

2017 & 2018:

/DoubleMuon/Run2017*-UL2017_MiniAODv1_NanoAODv2-v1/NANO AOD

/DoubleMuon/Run2018*-UL2018_MiniAODv1_NanoAODv2-v2/NANO AOD

/DoubleEG/Run2017*-UL2017_MiniAODv1_NanoAODv2-v1/NANO AOD

/EGamma/Run2018*-UL2018_MiniAODv1_NanoAODv2-v1/NANO AOD

/MuonEG/Run2017*-UL2017_MiniAODv1_NanoAODv2-v1/NANO AOD

/MuonEG/Run2018*-UL2018_MiniAODv1_NanoAODv2-v1/NANO AOD

MC Samples List

NANOADSIM's :

```
/WZTo3LNu_mllmin01_NNPFD31_TuneCP5_13TeV_powheg_pythia8/RunIISummer20UL17NanoAODv2-106X_mc2017_realistic_v8-v1  
/DYJetsToLL_M-50_TuneCP5_13TeV-amcatnloFXFX-pythia8/RunIISummer19UL17NanoAODv2-106X_mc2017_realistic_v8-v1  
/TTTo2L2Nu_TuneCP5_13TeV_powheg-pythia8/RunIISummer19UL17NanoAODv2-106X_mc2017_realistic_v8-v1  
/WWTo2L2Nu_TuneCP5_DoubleScattering_13TeV-pythia8/RunIISummer19UL17NanoAODv2-106X_mc2017_realistic_v8-v1  
/TTJetsToLNu_TuneCP5_13TeV-amcatnloFXFX-madspin-pythia8/RunIISummer19UL17NanoAODv2-106X_mc2017_realistic_v8-v1  
/TT_Mtt-1000toInf_TuneCP5_13TeV_powheg-pythia8/RunIISummer19UL17NanoAODv2-106X_mc2017_realistic_v8-v1  
/TT_Mtt-700to1000_TuneCP5_13TeV_powheg-pythia8/RunIISummer19UL17NanoAODv2-106X_mc2017_realistic_v8-v1  
/ST_tW_antitop_5f_NoFullyHadronicDecays_TuneCP5_13TeV_powheg-pythia8/RunIISummer19UL17NanoAODv2-106X_mc2017_realistic_v8-v1  
/ST_tW_top_5f_NoFullyHadronicDecays_TuneCP5_13TeV_powheg-pythia8/RunIISummer19UL17NanoAODv2-106X_mc2017_realistic_v8-v1
```

Homebrew NANOAD's :

```
/pnfs/iihe/cms/store/user/lathomas/ZZTo4L_M-1toInf_TuneCP5_13TeV_powheg_pythia8/NANOADStep_UL17/210212_190310
```