

Electron ID SF's with 2025 Data using 2024 MC

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- ▶ Data (2025, NanoAODv15): EGamma (0, 1, 2, 3) and Runs (C, D, E, F, G)
- ▶ MC (NanoAODv15):
 - ▶ 10 to 100 GeV bins:
DYto2E-2Jets_Bin-MLL-50_TuneCP5_13p6TeV_amcatnloFXFX-pythia8
 - ▶ 100 GeV onward bins: DYto2L-2Jets_Bin-**XJ**-MLL-50-PTLL-**XXXtoXXX**_TuneCP5_-13p6TeV_amcatnloFXFX-pythia8
 - ▶ Where **XXXtoXXX**: 40-100-200-400-600 with 1J and 2J
 - ▶ Global tags:
 - ▶ RunIII2024Summer24: 150X_mcRun3_2024_realistic_v2

- ▶ Tag and probe:
 - ▶ Tag electron passing the OR of the following three triggers:
 - ▶ HLT_Ele32_WPTight_Gsf
 - ▶ HLT_Ele115_CaloIdVT_GsfTrkIdT
 - ▶ HLT_Photon200
 - ▶ Tag electron passing cut based tight ID
 - ▶ Tag $p_t > 35$ GeV, $|\eta| < 2.5$ (opposite charge with probe electron).
 - ▶ Probe $p_t > 10$ GeV and $|\eta| < 2.5$
 - ▶ $\Delta R > 0.1$
- ▶ Binning: Finer bins and particularly more bins at high pt.
 - ▶ p_t : [10, 20, 35, 50, 70, 100] & [100, 200, 300, 500, 700, 1000]
 - ▶ η : [-2.5, -2.0, -1.566, -1.4442, -0.8, 0.0, 0.8, 1.4442, 1.566, 2.0, 2.5]
- ▶ Systematics considered: altSigFit & altBkgFit.

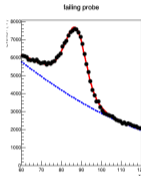
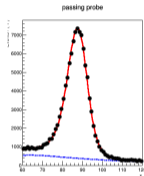
2025 nominal fits: Tight WP

All fits can be found here: [\(link\)](#)

$-2.50 < \eta < -2.00$, $10 < p_t < 20$

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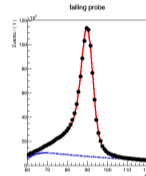
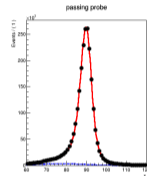
* fit status pass: 360, fail : 410
* fit (Reduced) chi2 pass: 146.015473, fail : 341.388218
* eff = 0.5963 ± 0.0027
-- parameters
- acmsF = 50.000 ± 0.487
- betaF = 0.060 ± 0.006
- gammaF = 0.021 ± 0.001
- meanF = -3.287 ± 0.023
- nSigF = 22633.885 ± 340.232
- nSigP = 100757.459 ± 440.312
- sigmaF = 2.557 ± 0.041
- acmsF = 50.000 ± 0.568
- betaF = 0.010 ± 0.000
- gammaF = 0.025 ± 0.030
- meanF = -3.543 ± 0.058
- nSigF = 21740.641 ± 811.561
- nSigP = 68225.650 ± 714.546
- sigmaF = 2.672 ± 0.110
    
```



$0.00 < \eta < 0.80$, $20 < p_t < 35$

```

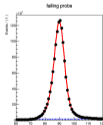
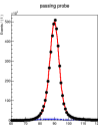
* fit status pass: -1, fail : 210
* fit (Reduced) chi2 pass: 2682.216915, fail : 1917.879577
* eff = 0.6650 ± 0.0054
-- parameters
- acmsF = 119.883 ± 0.220
- betaF = 0.063 ± 0.001
- gammaF = 0.363 ± 0.011
- meanF = -0.679 ± 0.003
- nSigF = 96130.968 ± 2729.930
- nSigP = 2270384.691 ± 3096.739
- sigmaF = 1.414 ± 0.006
- acmsF = 60.294 ± 0.075
- betaF = 0.150 ± 0.000
- gammaF = 0.017 ± 0.000
- meanF = -0.682 ± 0.005
- nSigF = 447134.517 ± 1230.213
- nSigP = 1143706.479 ± 1486.331
- sigmaF = 1.572 ± 0.009
    
```



$-1.44 < \eta < -0.80$, $35 < p_t < 50$

```

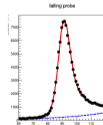
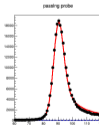
* fit status pass: 300, fail : 100
* fit (Reduced) chi2 pass: 3653.771704, fail : 1621.949458
* eff = 0.7776 ± 0.0084
-- parameters
- acmsF = 100.000 ± 0.137
- betaF = 0.088 ± 0.003
- gammaF = 0.480 ± 0.004
- meanF = 0.688 ± 0.002
- nSigF = 153083.222 ± 8790.676
- nSigP = 434540.916 ± 8922.034
- sigmaF = 1.718 ± 0.006
- acmsF = 63.024 ± 0.177
- betaF = 0.130 ± 0.000
- gammaF = 0.400 ± 0.003
- meanF = 0.805 ± 0.004
- nSigF = 79871.090 ± 640.809
- nSigP = 128422.104 ± 1027.548
- sigmaF = 1.987 ± 0.007
    
```



$2.00 < \eta < 2.50$, $50 < p_t < 70$

```

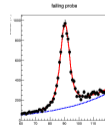
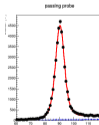
* fit status pass: 330, fail : 3
* fit (Reduced) chi2 pass: 502.202948, fail : 141.266074
* eff = 0.8890 ± 0.0010
-- parameters
- acmsF = 10.868 ± 0.008
- betaF = 0.086 ± 0.001
- gammaF = 0.070 ± 0.019
- meanF = 0.891 ± 0.011
- nSigF = 280.811 ± 13.801
- nSigP = 233120.843 ± 466.765
- sigmaF = 0.240 ± 0.016
- acmsF = 13.394 ± 0.068
- betaF = 0.235 ± 0.002
- gammaF = 0.030 ± 0.001
- meanF = -1.777 ± 0.022
- nSigF = 10308.549 ± 387.409
- nSigP = 103036.191 ± 405.234
- sigmaF = 2.380 ± 0.023
    
```



$1.57 < \eta < 2.00$, $70 < p_t < 100$

```

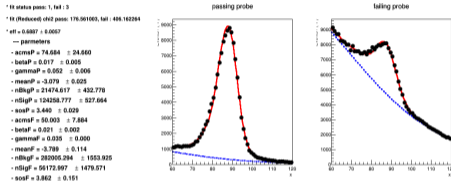
* fit status pass: 180, fail : 443
* fit (Reduced) chi2 pass: 35.696394, fail : 20.807993
* eff = 0.8043 ± 0.0050
-- parameters
- acmsF = 90.000 ± 0.423
- betaF = 0.028 ± 0.004
- gammaF = 0.820 ± 0.004
- meanF = -0.819 ± 0.023
- nSigF = 1335.071 ± 131.908
- nSigP = 42483.361 ± 245.198
- sigmaF = 1.753 ± 0.004
- acmsF = 49.782 ± 26.182
- betaF = 0.229 ± 0.009
- gammaF = 0.007 ± 0.001
- meanF = -0.465 ± 0.033
- nSigF = 8166.889 ± 113.146
- nSigP = 3207.470 ± 145.118
- sigmaF = 1.680 ± 0.063
    
```



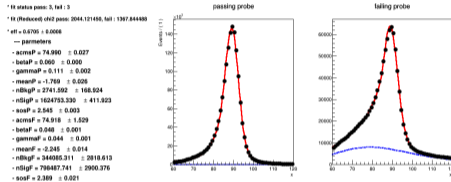
2025 altSigFit: Tight WP

All fits can be found here: [\(link\)](#)

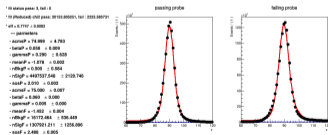
$-2.00 < \eta < -1.57, 10 < p_t < 20$



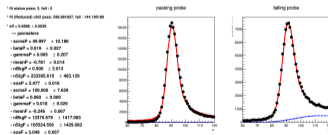
$0.80 < \eta < 1.44, 20 < p_t < 35$



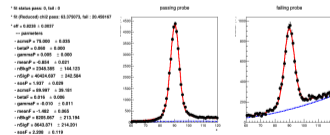
$-1.44 < \eta < -0.80, 35 < p_t < 50$



$2.00 < \eta < 2.50, 50 < p_t < 70$



$-2.00 < \eta < -1.57, 70 < p_t < 100$



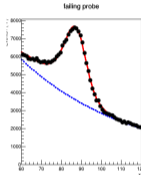
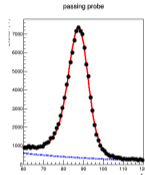
2025 altBkgFit: Tight WP

All fits can be found here: [\(link\)](#)

$-2.50 < \eta < -2.00$, $10 < p_t < 20$

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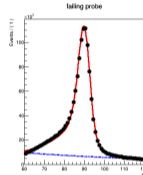
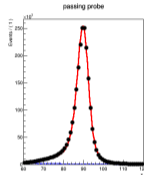
* fit status pass: 0, fail: 0
* fit (Reduced) chi2 pass: 143.510066, fail: 328.65235
* eff = 0.5872 ± 0.0006
--- parameters
- alphaP = -0.018 ± 0.001
- meanP = -3.319 ± 0.023
- nBkgP = 21871.251 ± 288.141
- nSigP = 101516.876 ± 403.290
- sigmaP = 2.611 ± 0.039
- alphaF = -0.018 ± 0.000
- meanF = -3.565 ± 0.057
- nBkgF = 214327.707 ± 793.290
- nSigF = 71360.022 ± 697.411
- sigmaF = 2.923 ± 0.103
    
```



$-0.80 < \eta < 0.00$, $20 < p_t < 35$

```

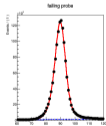
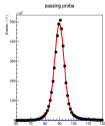
* fit status pass: 0, fail: 0
* fit (Reduced) chi2 pass: 2736.156878, fail: 1864.813023
* eff = 0.6571 ± 0.0003
--- parameters
- alphaP = -0.045 ± 0.001
- meanP = -0.722 ± 0.003
- nBkgP = 54156.756 ± 645.286
- nSigP = 2240818.225 ± 1613.381
- sigmaP = 1.494 ± 0.005
- alphaF = -0.013 ± 0.000
- meanF = -0.701 ± 0.005
- nBkgF = 406449.257 ± 1076.087
- nSigF = 1169329.398 ± 1385.924
- sigmaF = 1.655 ± 0.009
    
```



$-1.44 < \eta < -0.80$, $35 < p_t < 50$

```

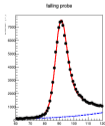
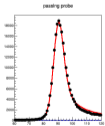
* fit status pass: 0, fail: 0
* fit (Reduced) chi2 pass: 1051.105996, fail: 1051.002002
* eff = 0.7009 ± 0.0002
--- parameters
- alphaP = -0.009 ± 0.001
- meanP = -0.913 ± 0.002
- nBkgP = 22970.447 ± 471.196
- nSigP = 4470519.027 ± 2161.859
- sigmaP = 1.894 ± 0.003
- alphaF = 0.012 ± 0.000
- meanF = -0.850 ± 0.004
- nBkgF = 60887.511 ± 463.700
- nSigF = 1255211.106 ± 1183.811
- sigmaF = 2.032 ± 0.007
    
```



$2.00 < \eta < 2.50$, $50 < p_t < 70$

```

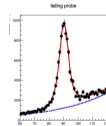
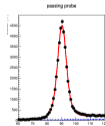
* fit status pass: 0, fail: 0
* fit (Reduced) chi2 pass: 291.280586, fail: 108.189994
* eff = 0.6002 ± 0.0009
--- parameters
- alphaP = -0.067 ± 0.018
- meanP = -2.092 ± 0.011
- nBkgP = 224.891 ± 57.732
- nSigP = 233160.307 ± 486.083
- sigmaP = 2.041 ± 0.016
- alphaF = 0.030 ± 0.001
- meanF = -1.776 ± 0.022
- nBkgF = 16213.472 ± 278.396
- nSigF = 102684.658 ± 405.625
- sigmaF = 2.387 ± 0.033
    
```



$1.57 < \eta < 2.00$, $70 < p_t < 100$

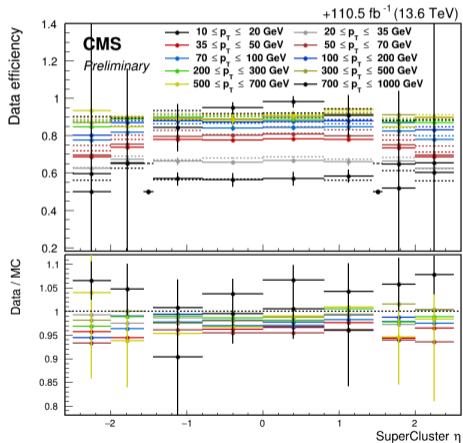
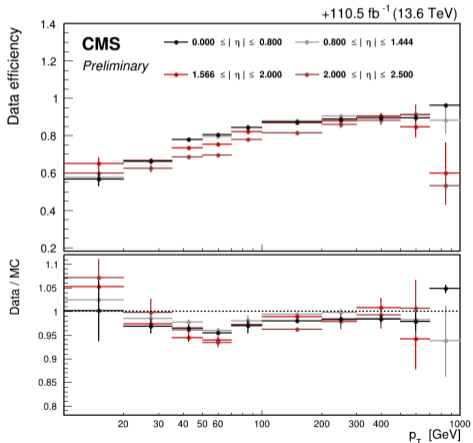
```

* fit status pass: 0, fail: 0
* fit (Reduced) chi2 pass: 53.759095, fail: 20.969791
* eff = 0.8047 ± 0.0002
--- parameters
- alphaP = 0.029 ± 0.004
- meanP = -0.879 ± 0.021
- nBkgP = 1397.569 ± 127.648
- nSigP = 43233.798 ± 241.268
- sigmaP = 1.742 ± 0.034
- alphaF = 0.027 ± 0.001
- meanF = -0.494 ± 0.050
- nBkgF = 8166.270 ± 136.396
- nSigF = 9207.226 ± 140.164
- sigmaF = 1.691 ± 0.099
    
```



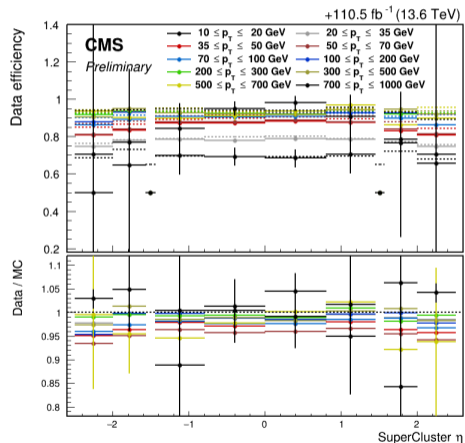
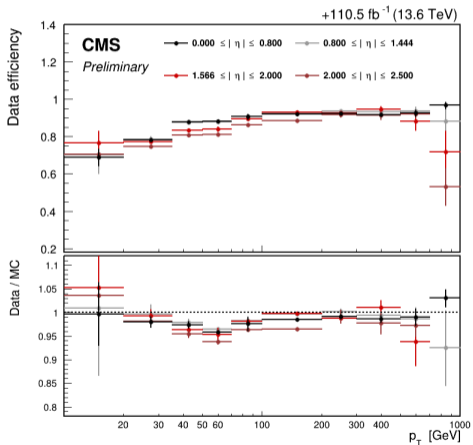
2025 Efficiencies & SF's: Tight WP

- ▶ Data efficiency is lower for pt bins at low pt.
- ▶ Limited statistics at high pt bins causing somewhat high uncertainty.



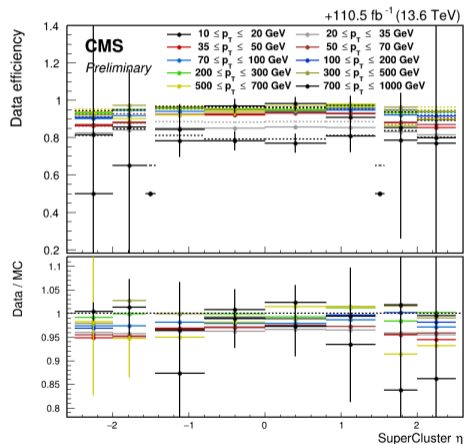
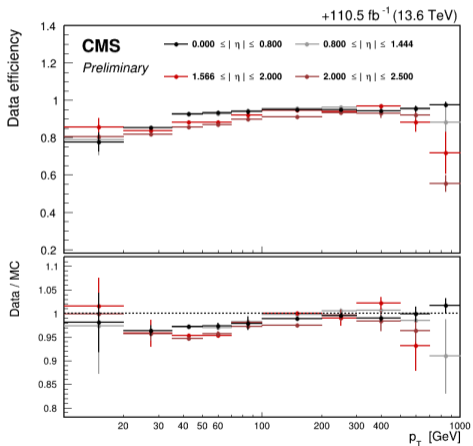
2025 Efficiencies & SF's: Medium WP

- For most bins, the data efficiency is higher compared to the Tight WP.



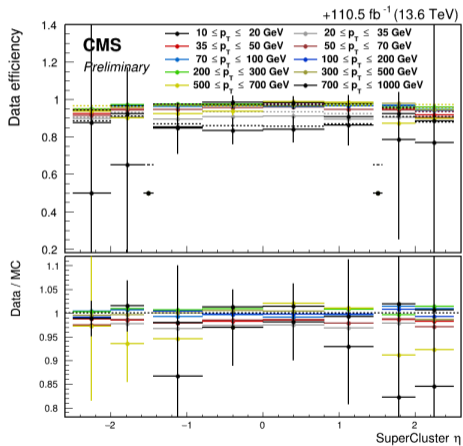
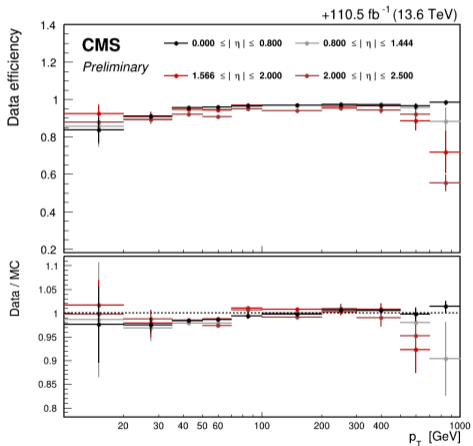
2025 Efficiencies & SF's: Loose WP

- The SF is closer to unity compared to the Tight & Medium WP's.



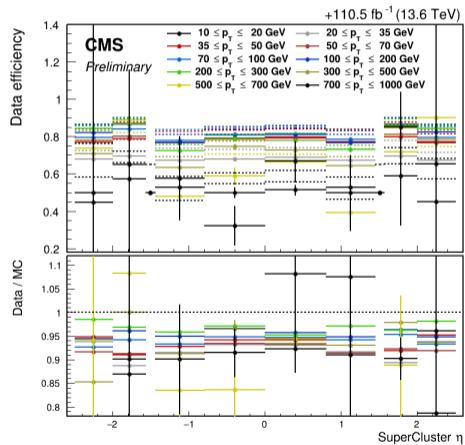
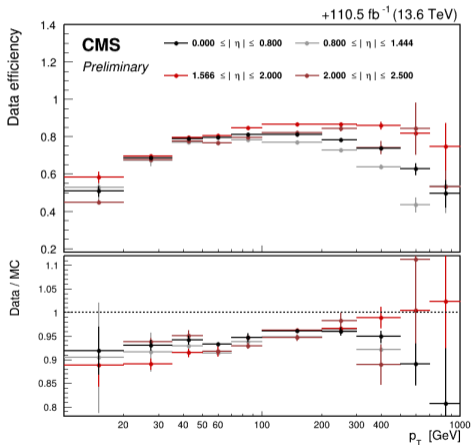
2025 Efficiencies & SF's: Veto

- SF closer to 1 for most of the bins other than > 500 GeV.



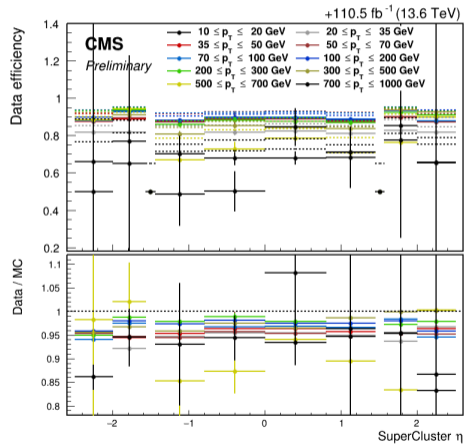
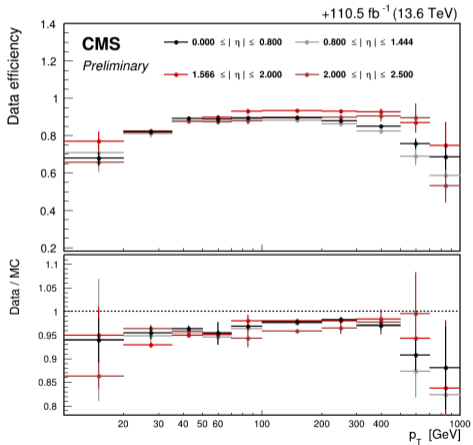
2025 Efficiencies & SF's: MVAIso-WP80

- Data efficiency is much lower at low pt bins (similar trend as in 2024).



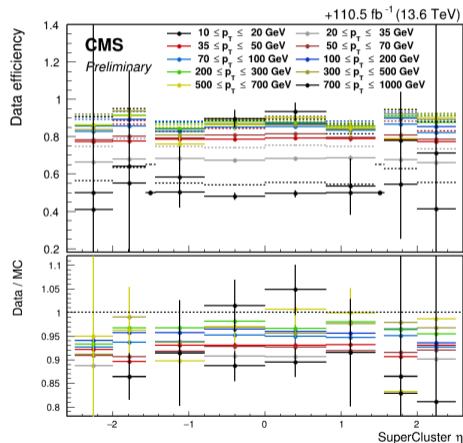
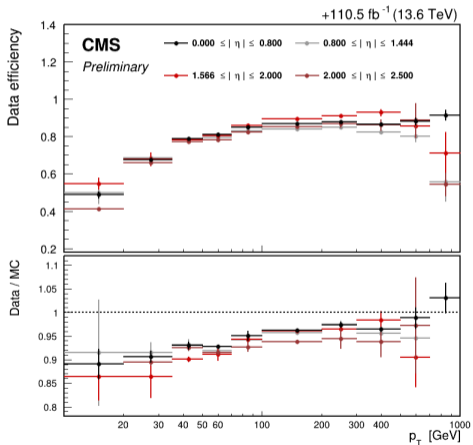
2025 Efficiencies & SF's: MVAIso-WP90

- ▶ A slightly higher data efficiency at low p_T bins compared to MVAIso-WP80.



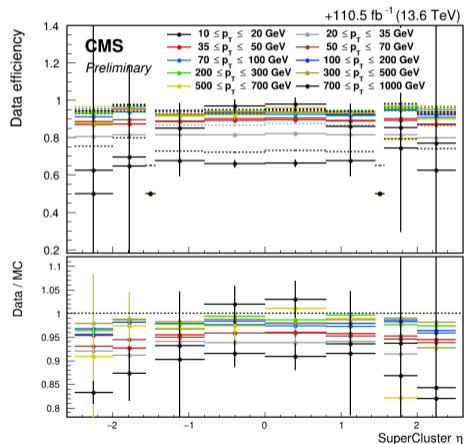
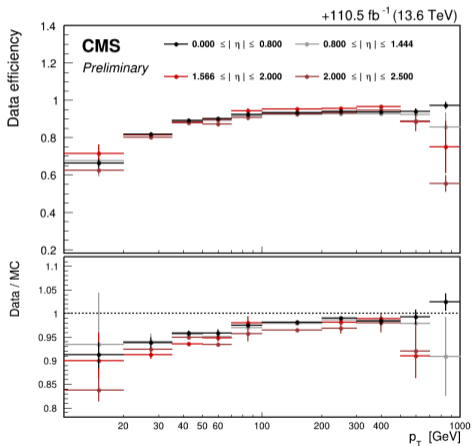
2025 Efficiencies & SF's: MVANoIso-WP80

- ▶ Similar to what was observed in 2024, data efficiency is much lower at low p_T bins.



2025 Efficiencies & SF's: MVANoIso-WP90

- Higher data efficiency at low pt bins compared to MVANoIso-WP80.



Summary

- ▶ Efficiencies and SF's has been evaluated using 2025 Data (Runs C, D, E, F, G).
- ▶ The same framework (pyRAT) has been employed to produce nTuples & histograms as in the 2024/(22+23, high p_T electron/photon ID) SF studies.
- ▶ For high- p_T bins, we propose to adopt the SF from the 200-300 GeV bin with an uncertainty that increases linearly up to 1 TeV, similar to what was done in 2024.
 - ▶ **Endcaps:** Use the SF from the p_T 200–300 GeV bin and apply it inclusively for $p_T > 200$ GeV. Assigning a conservative uncertainty of 3% at $p_T = 300$ GeV increasing linearly to 7.5% at 1 TeV.
 - ▶ **Barrel:** Use the SF from the p_T 300–500 GeV bin and apply it inclusively for $p_T > 300$ GeV. Assign a conservative uncertainty of 2% at $p_T = 300$ GeV increasing linearly to 5% at 1 TeV.
- ▶ Feedback is welcome.