Electron ID SF's with 2025 Data using 2024 MC

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Datasets

- 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-**X**J-MLL-50-PTLL-**XXX**to**XXX**_TuneCP5_-13p6TeV_amcatnloFXFX-pythia8
  - Where **XXX**to**XXX**: 40-100-200-400-600 with 1J and 2J
  - Global tags:
    - RunIII2024Summer24: 150X_mcRun3_2024_realistic_v2

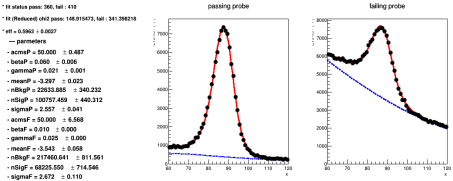
Selections

- 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.

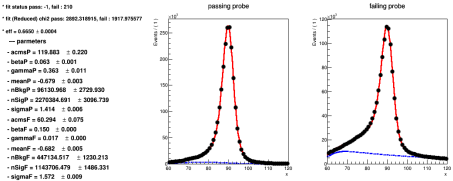
2025 nominal fits: Tight WP

All fits can be found here: (link)

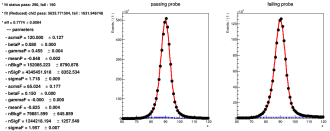
-2.50<η<-2.00, 10<p_t<20



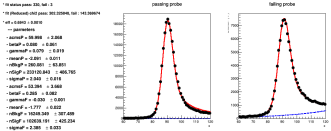
0.00<η<0.80, 20<p_t<35



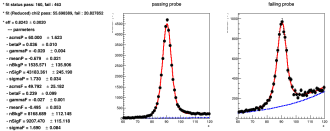
-1.44<η<-0.80, 35<p_t<50



2.00<η<2.50, 50<p_t<70



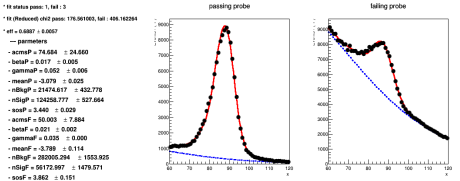
1.57<η<2.00, 70<p_t<100



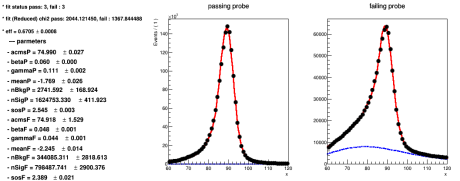
2025 altSigFit: Tight WP

All fits can be found here: (link)

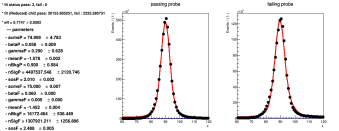
-2.00<η<-1.57, 10<p_t<20



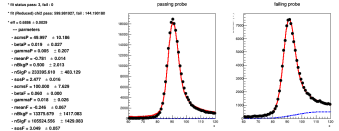
0.80<η<1.44, 20<p_t<35



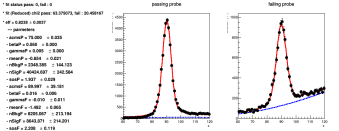
-1.44<η<-0.80, 35<p_t<50



2.00<η<2.50, 50<p_t<70



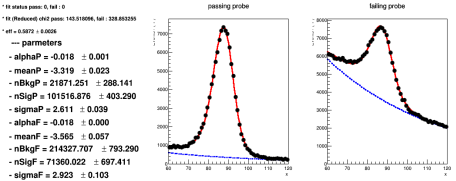
-2.00<η<-1.57, 70<p_t<100



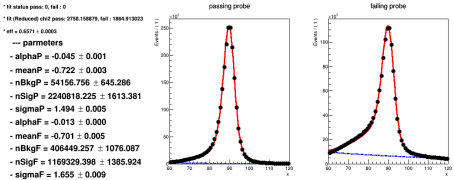
2025 altBkgFit: Tight WP

All fits can be found here: (link)

-2.50<η<-2.00, 10<p_t<20



-0.80<η<0.00, 20<p_t<35



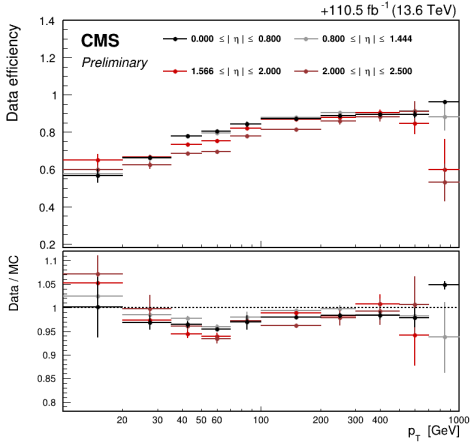
-1.44<η<-0.80, 35<p_t<50

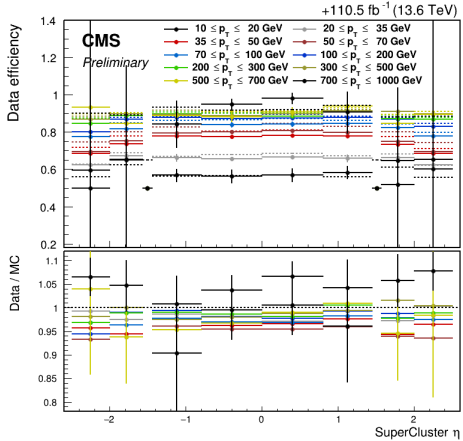
2.00<η<2.50, 50<p_t<70

1.57<η<2.00, 70<p_t<100

2025 Efficiencies & SF's: Tight WP

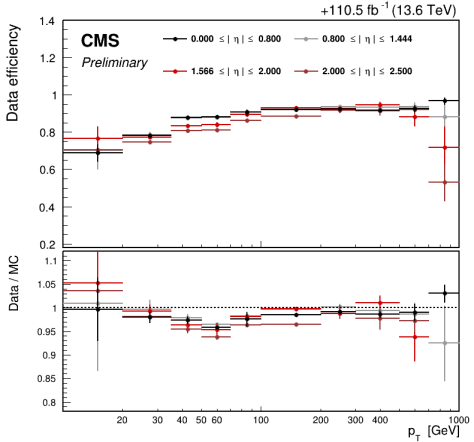
- Data efficiency is lower for pt bins at low pt.
- Limited statistics at high pt bins causing somewhat high uncertainty.

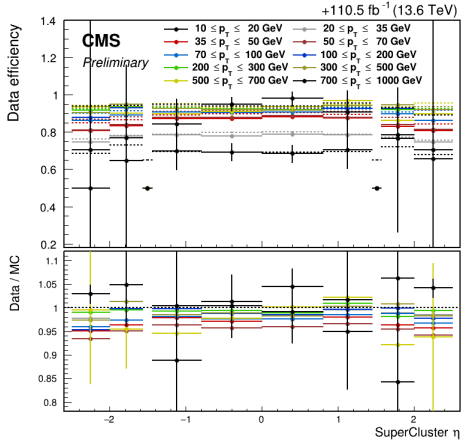




2025 Efficiencies & SF's: Medium WP

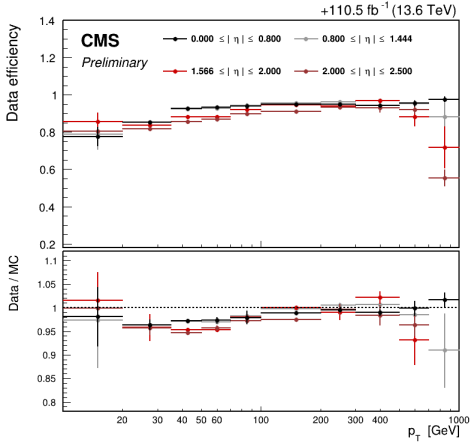
- For most bins, the data efficiency is higher compared to the Tight WP.

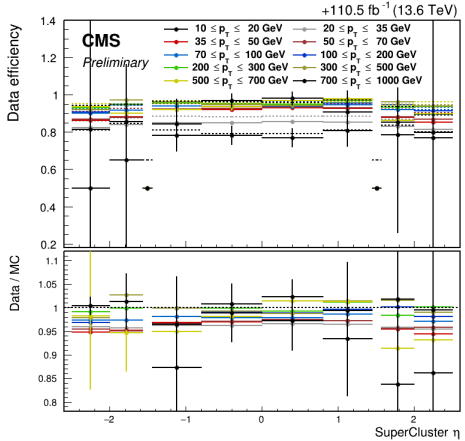




2025 Efficiencies & SF's: Loose WP

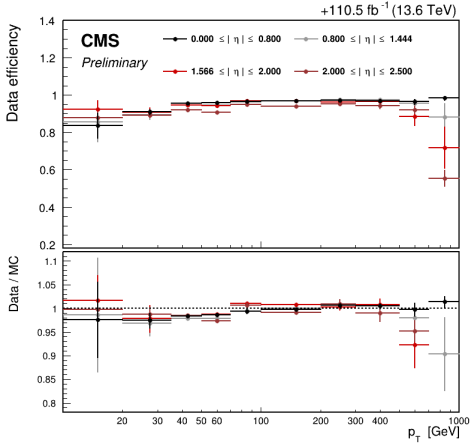
- The SF is closer to unity compared to the Tight & Medium WP's.

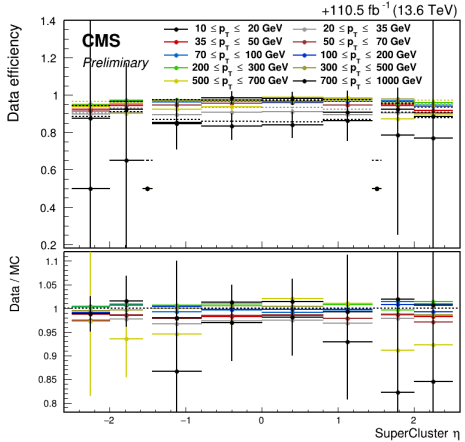




2025 Efficiencies & SF's: Veto

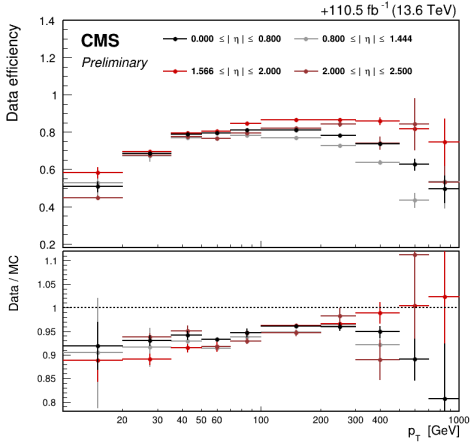
- SF closer to 1 for most of the bins other than > 500 GeV.

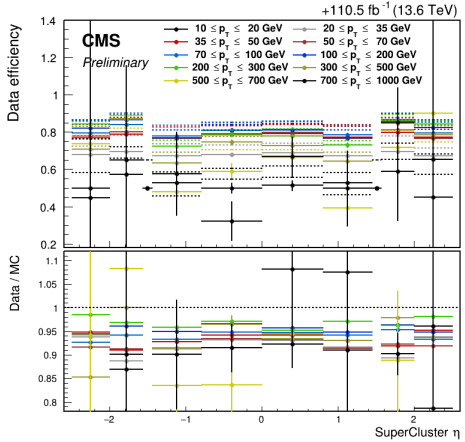




2025 Efficiencies & SF's: MVAIso-WP80

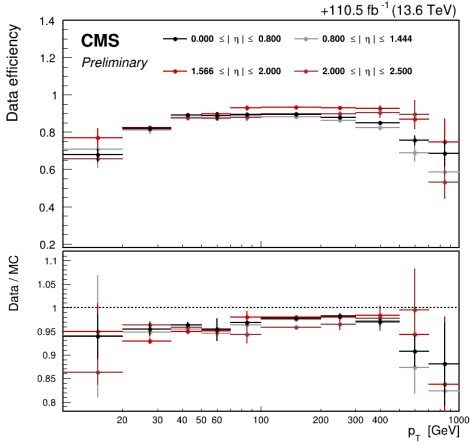
- Data efficiency is much lower at low pt bins (similar trend as in 2024).

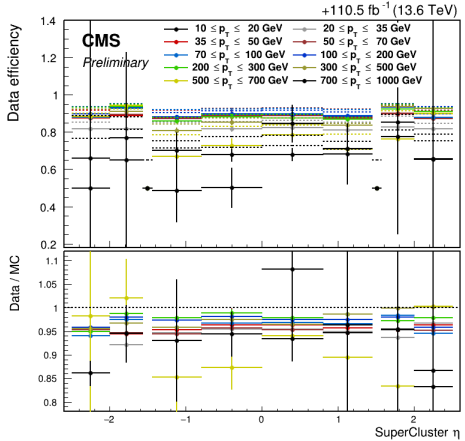




2025 Efficiencies & SF's: MVAIso-WP90

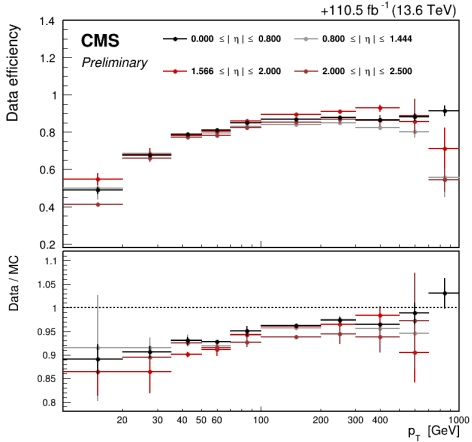
- A slightly higher data efficiency at low pt bins compared to MVAIso-WP80.

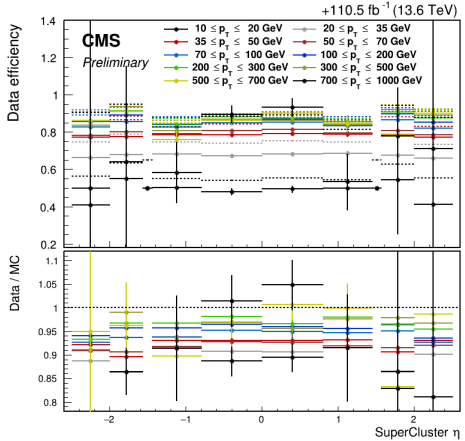




2025 Efficiencies & SF's: MVANoIso-WP80

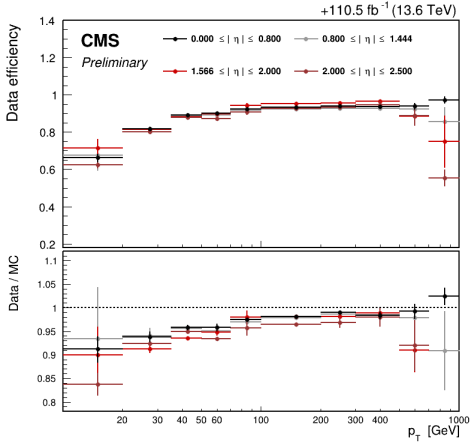
- Similar to what was observed in 2024, data efficiency is much lower at low pt bins.

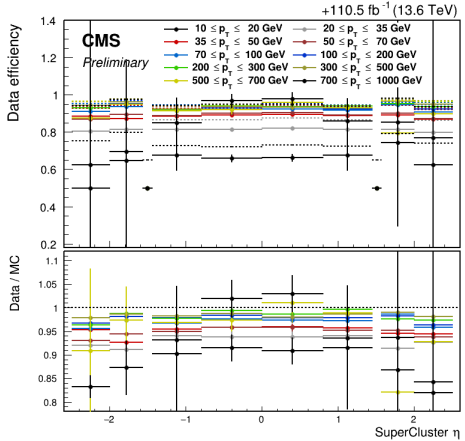




2025 Efficiencies & SF's: MVANoIso-WP90

- 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, hight 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. Assing 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.