Jet Faking γ Background Estimation

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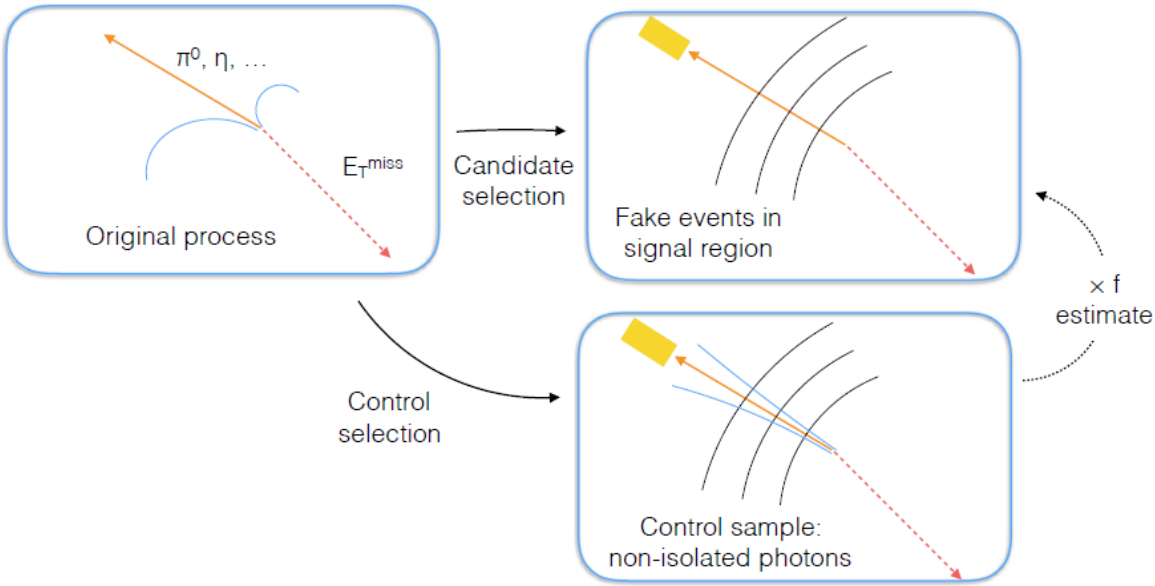
Jet Faking γ

- Data-driven strategy:
  - **Count number of "photon-like" jets** failing a loose isolation cut
  - **Multiply by a fake ratio** to get number of successful jet→photon fakes



$$f = \frac{N_{\text{iso}}(\text{EM Object})}{N_{\text{non-iso}}(\text{EM Object})}$$

QCD Fake Ratio Evaluation

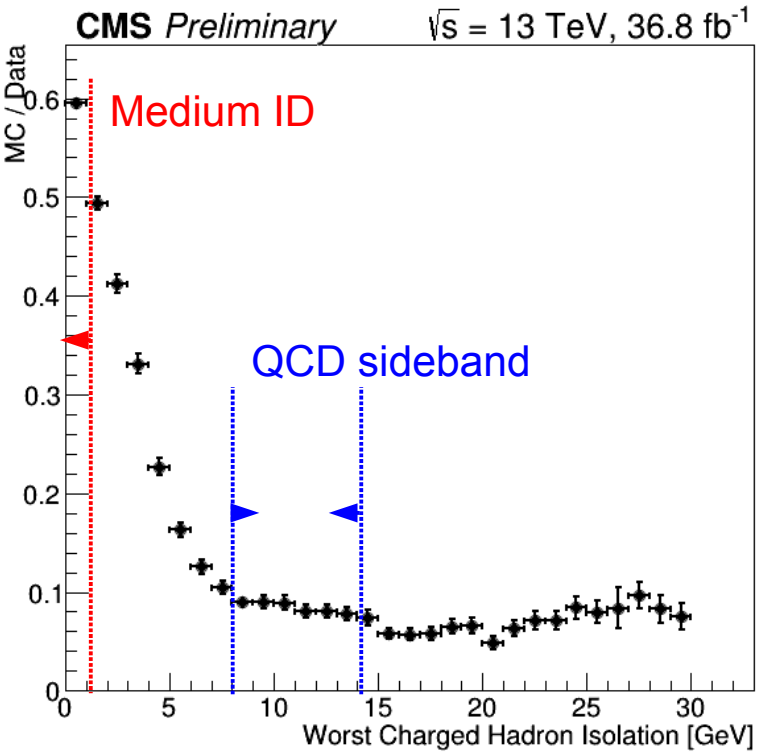
- Fake ratio **evaluated** in MET < 30 GeV **control region**
- **Numerator**: QCD *fake* events passing standard photon ID cuts, estimated using **template fit** of shower shape distribution in data (slides 4-7)

  Real photon template: γ+jets MC

  Fake photon template: QCD sideband in data
- **Denominator**: QCD events failing loose photon ID selection, still passing loose isolation cuts ×5
  - Require $\sigma i\eta i\eta > 0.0104$ to remove real photon contribution (slide 8)

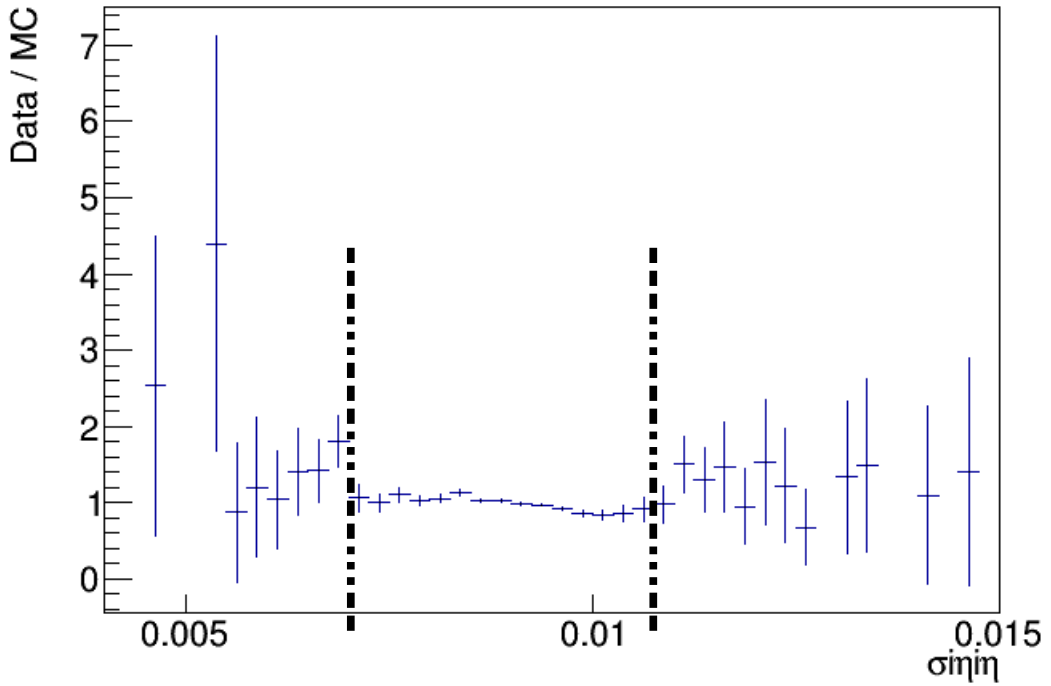
Numerator Template Definitions

- **Real photon template** for numerator is taken from γ+jets MC
  - Reco. photon matched to gen photon within ΔR < 0.1
- **Fake photon template** is taken from a real-photon-suppressed **sideband** in data
- Real photon contamination flattens out starting at 8 GeV
- **Sideband definition**: 8 GeV < rho-corrected Worst Charged Hadron Isolation < 14 GeV
- Must subtract remaining real photon contamination from sideband, estimated using γ+jets MC
  - Fake Template Cleaning (slide 6)

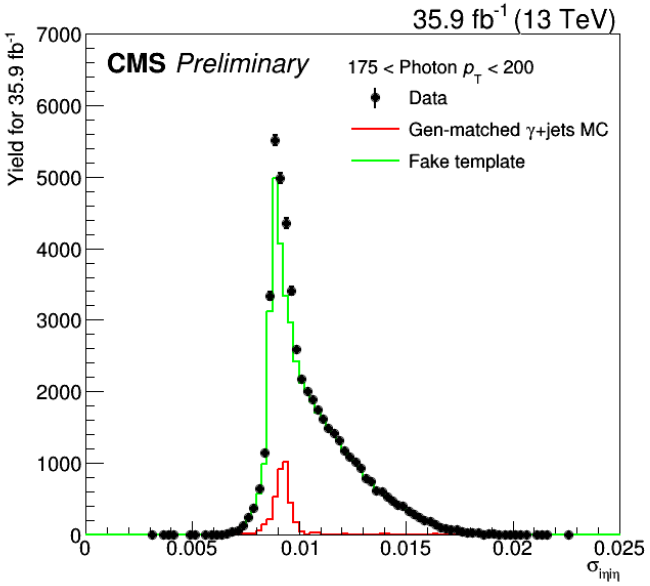


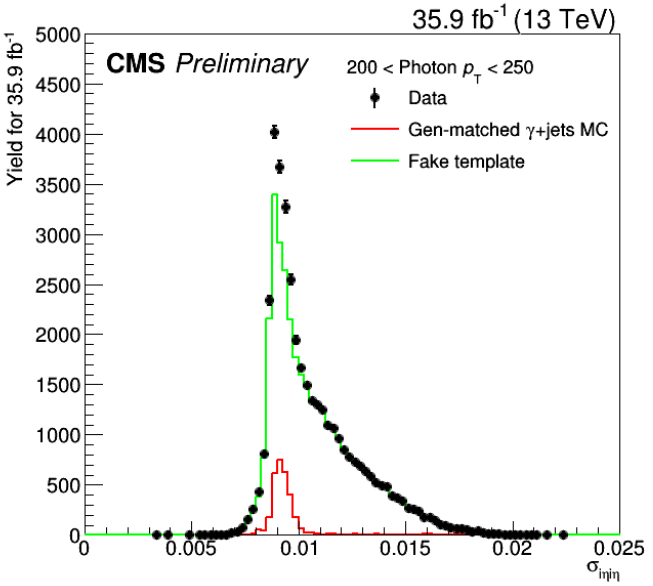
$\sigma_{i\eta i\eta}$ Reweighting

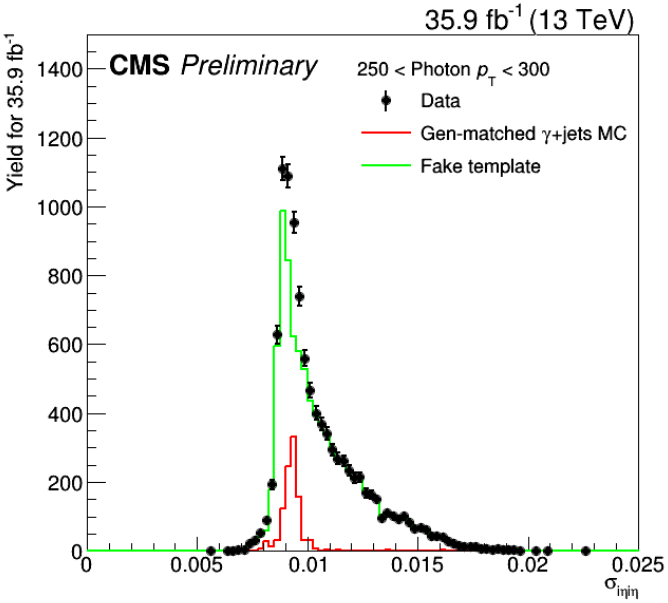
- There is some disagreement in photon $\sigma_{i\eta i\eta}$ distribution between MC and data
  - Derived reweighting factors using Z(ee) events
  - Used these weights in the interval 0.00700 to 0.01075; 1 outside
  - Applied during $\sigma_{i\eta i\eta}$ template fit for QCD fake ratio

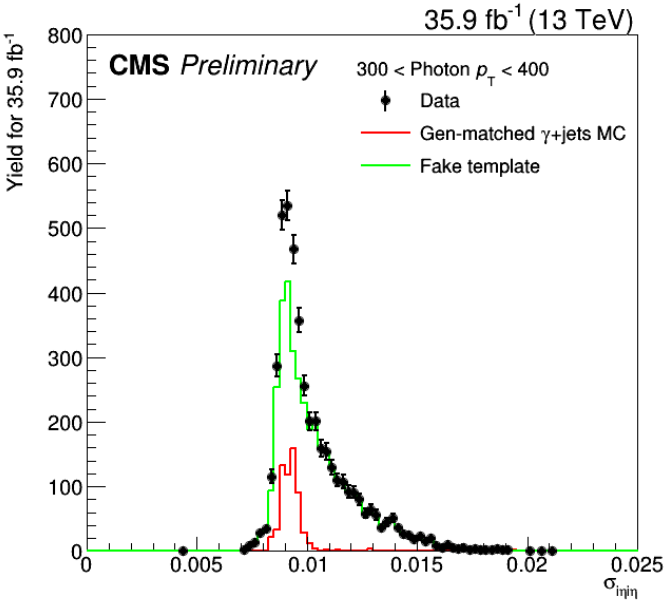


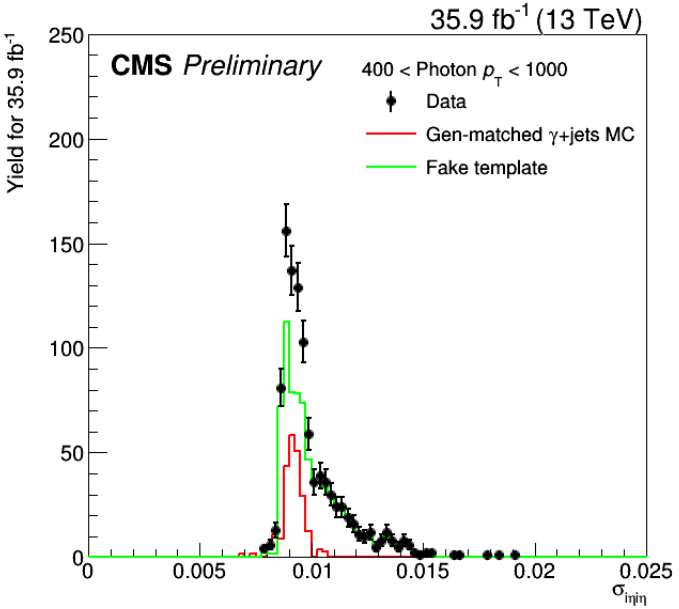
Fake Template Cleaning



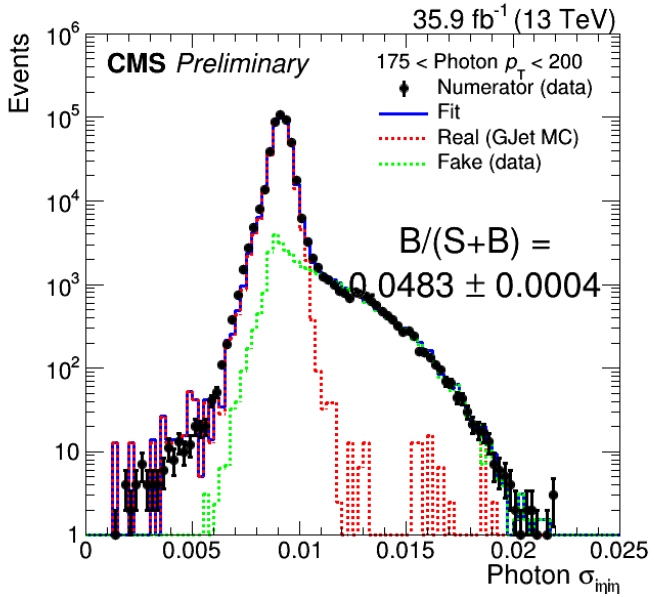


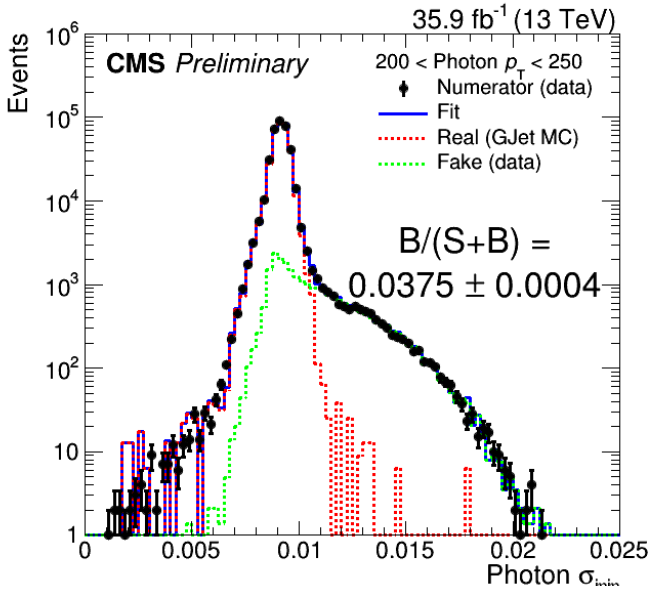


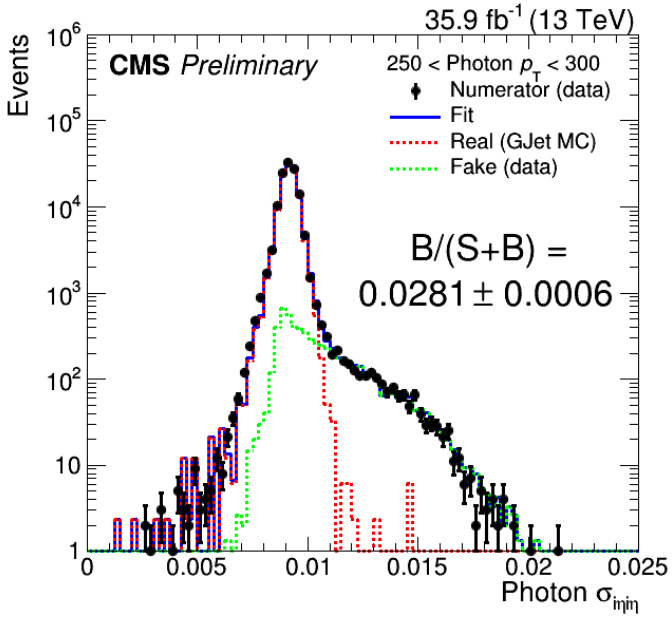


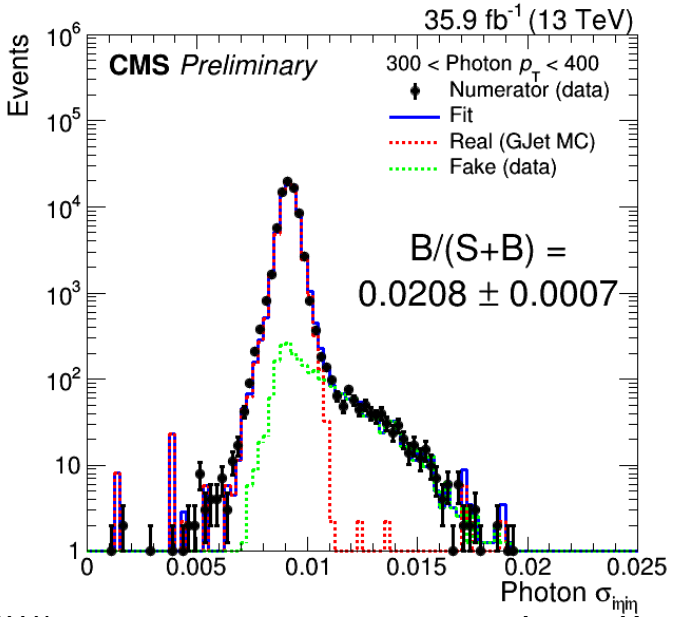


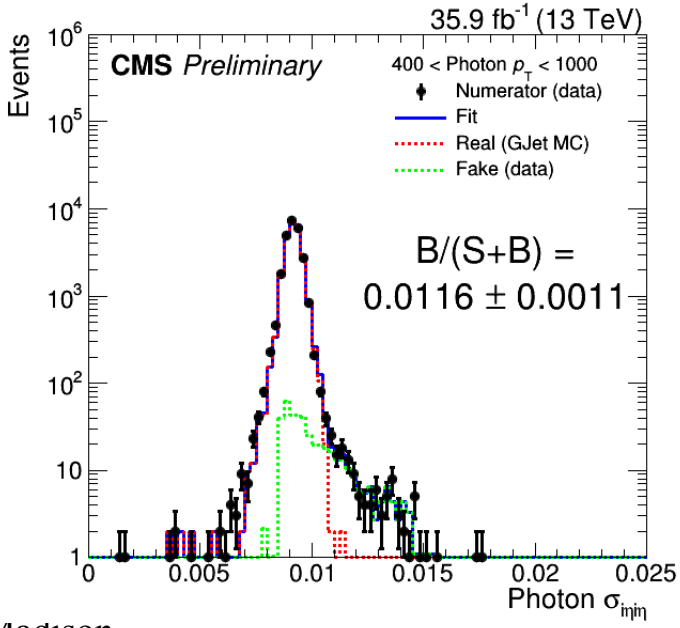
Numerator Template Fits



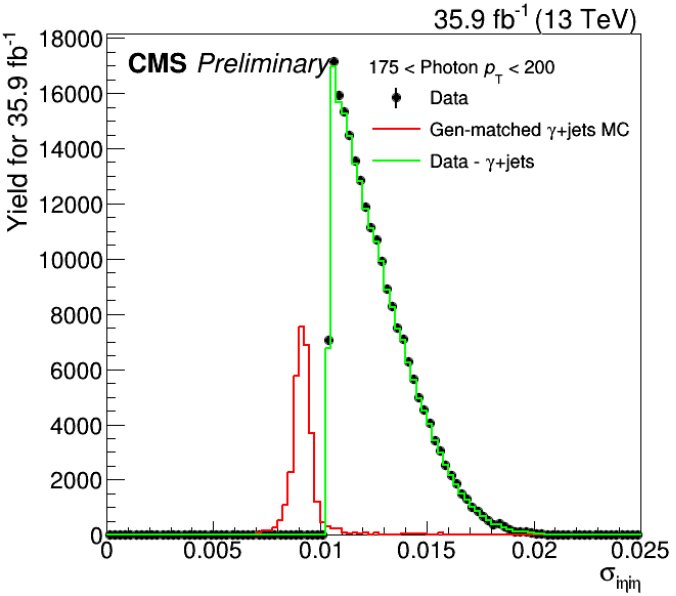


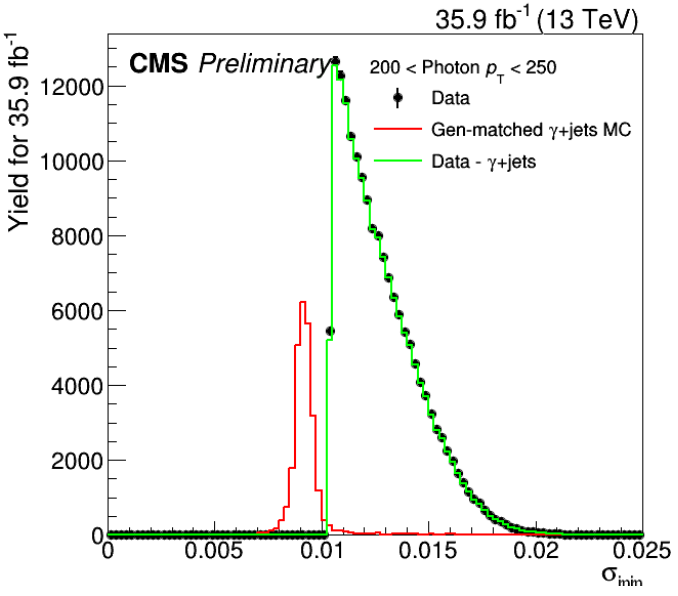


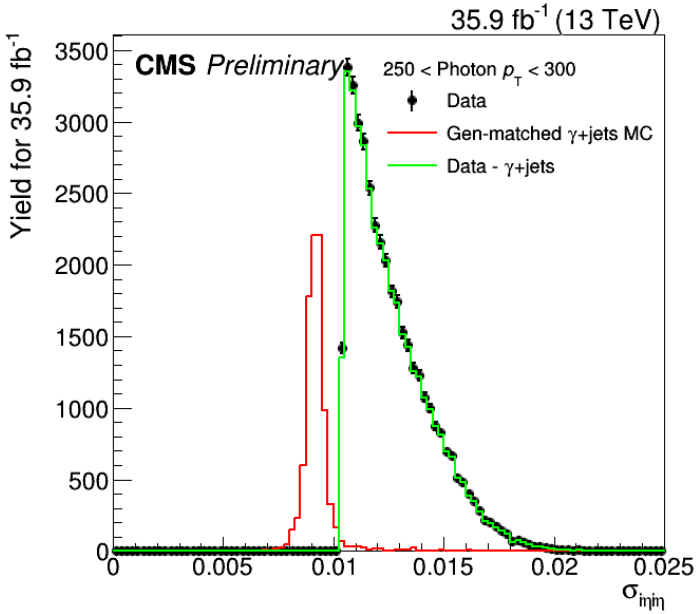


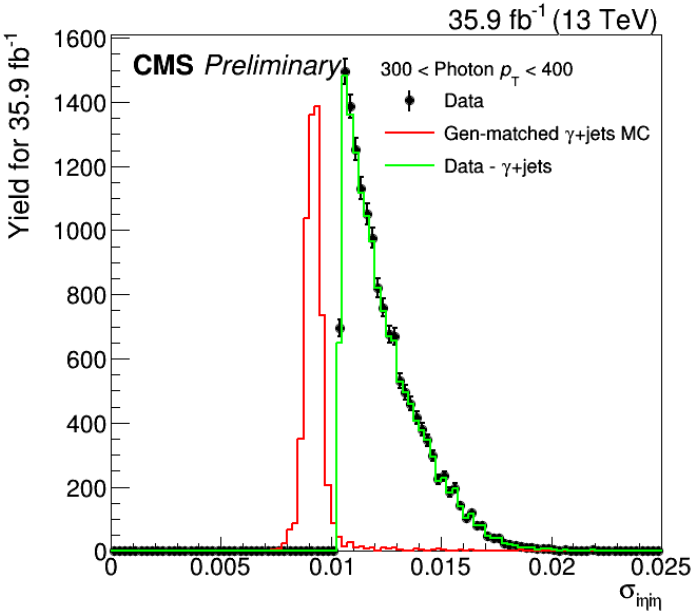


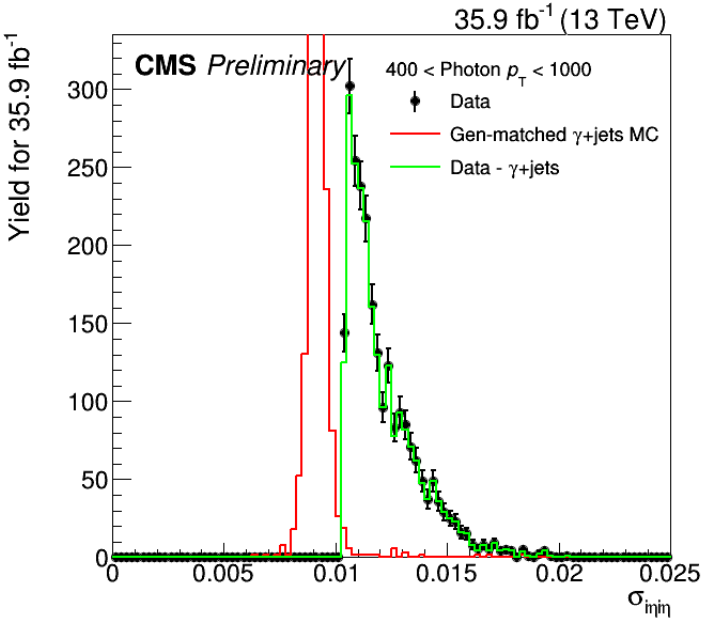
Denominator Purity





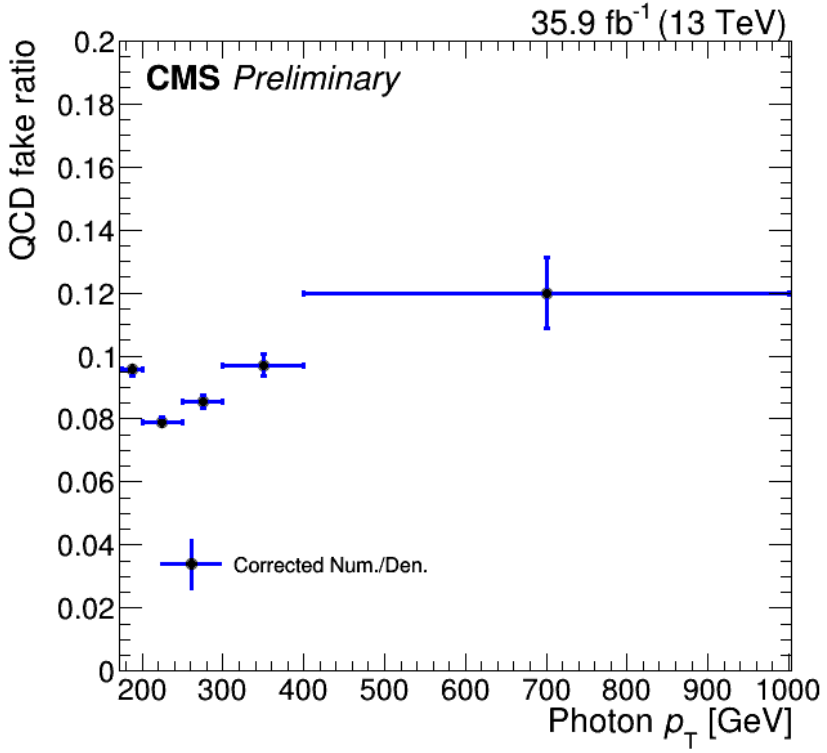




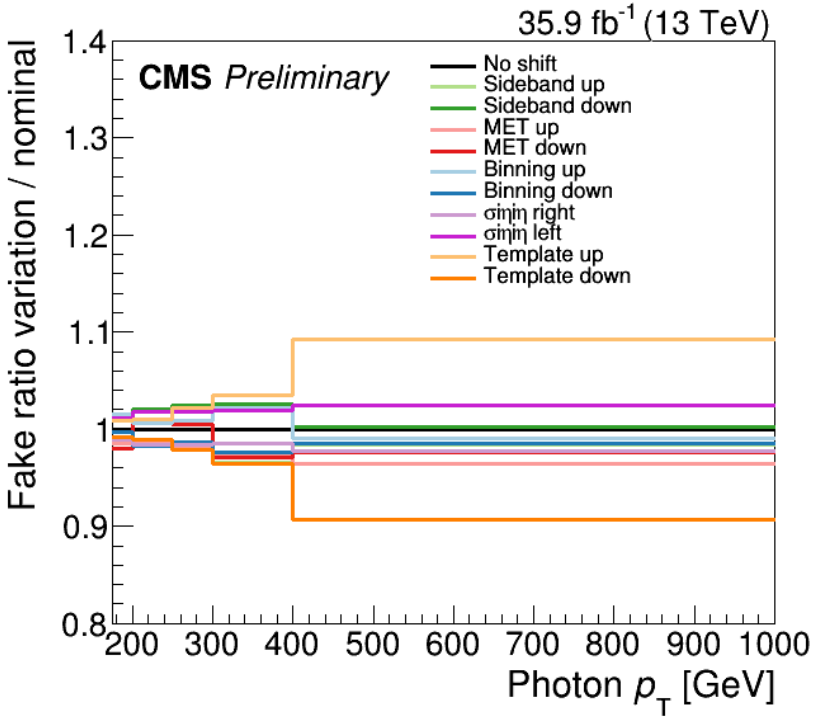


QCD Fake Ratio

- Fake ratio in each photon p_T bin



- Percentage shifts in fake ratio obtained by shifting selection criteria



- Finally, events passing denominator cuts are selected from our main signal and control regions, and the number of these events is multiplied by the QCD fake ratio to obtain the estimated jet faking photon contribution

jet→γ estimate in SR:
61.9 ± 2.6 events