Photon reconstruction and identification in heavy ion collisions with the CMS detector

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on behalf of the CMS collaboration

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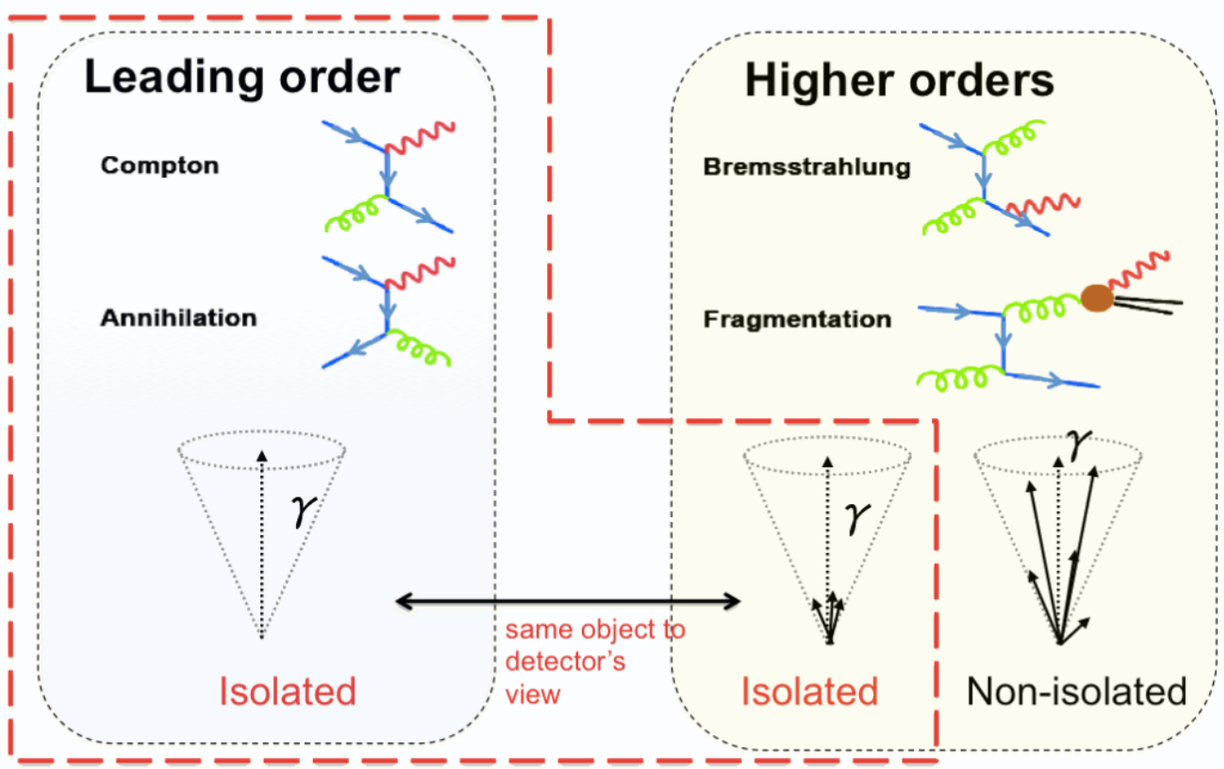
Introduction

- **CMS collected PbPb 5 TeV data with ~400 μb^{-1} in LHC Run2**

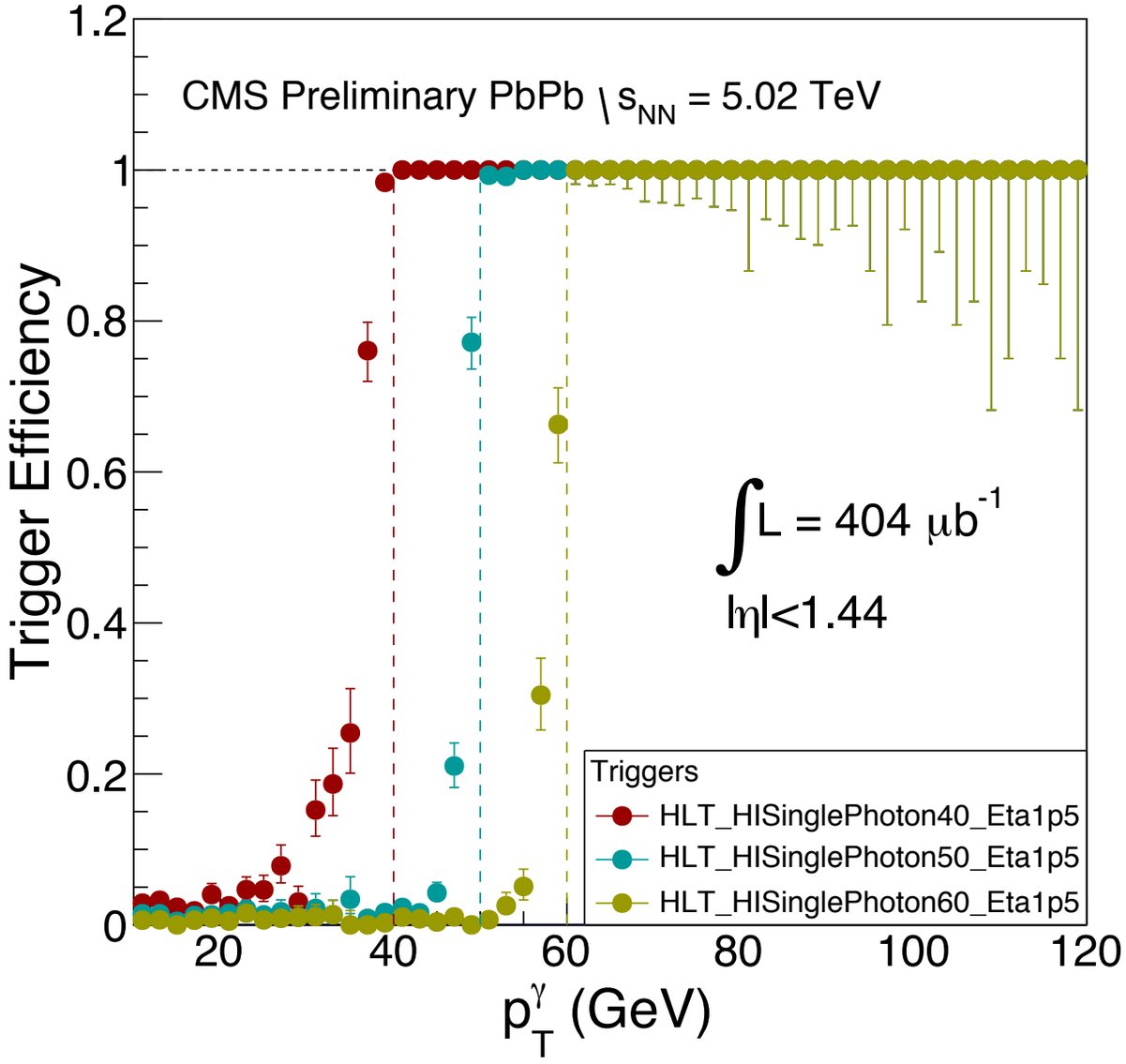
- **Why Isolated photons?**
  - Prompt photons as well as W and Z bosons are **NOT modified** by the strongly interacting medium produced in heavy ion collisions
  - Photons which have small energy around it in R = 0.4 cone are defined as Isolated photons

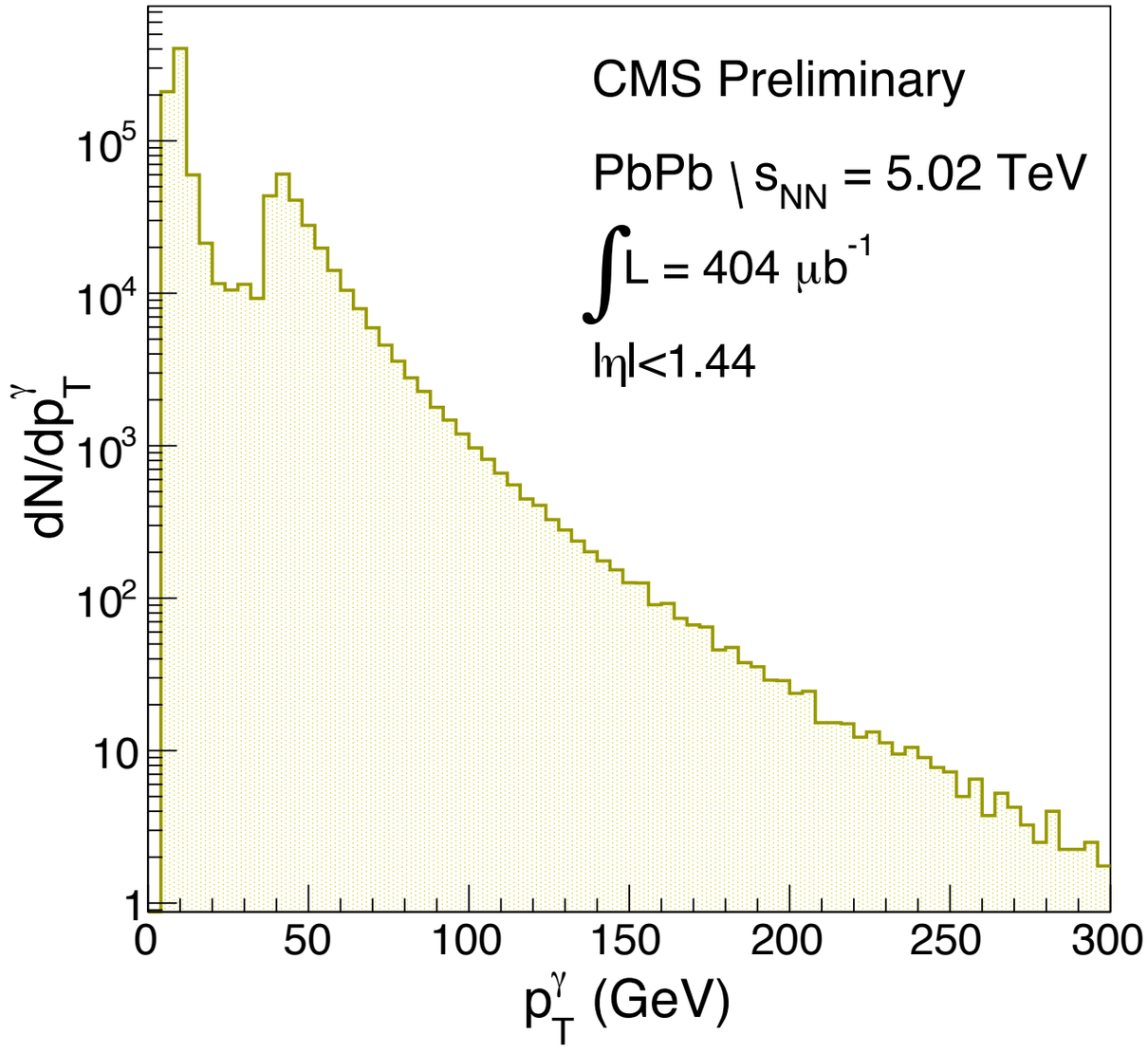


  - **Isolated photons** contain most of prompt photons and part of fragmentation photons

- **Photon observables and efficiencies depend on centrality, which is defined by the impact parameter b**

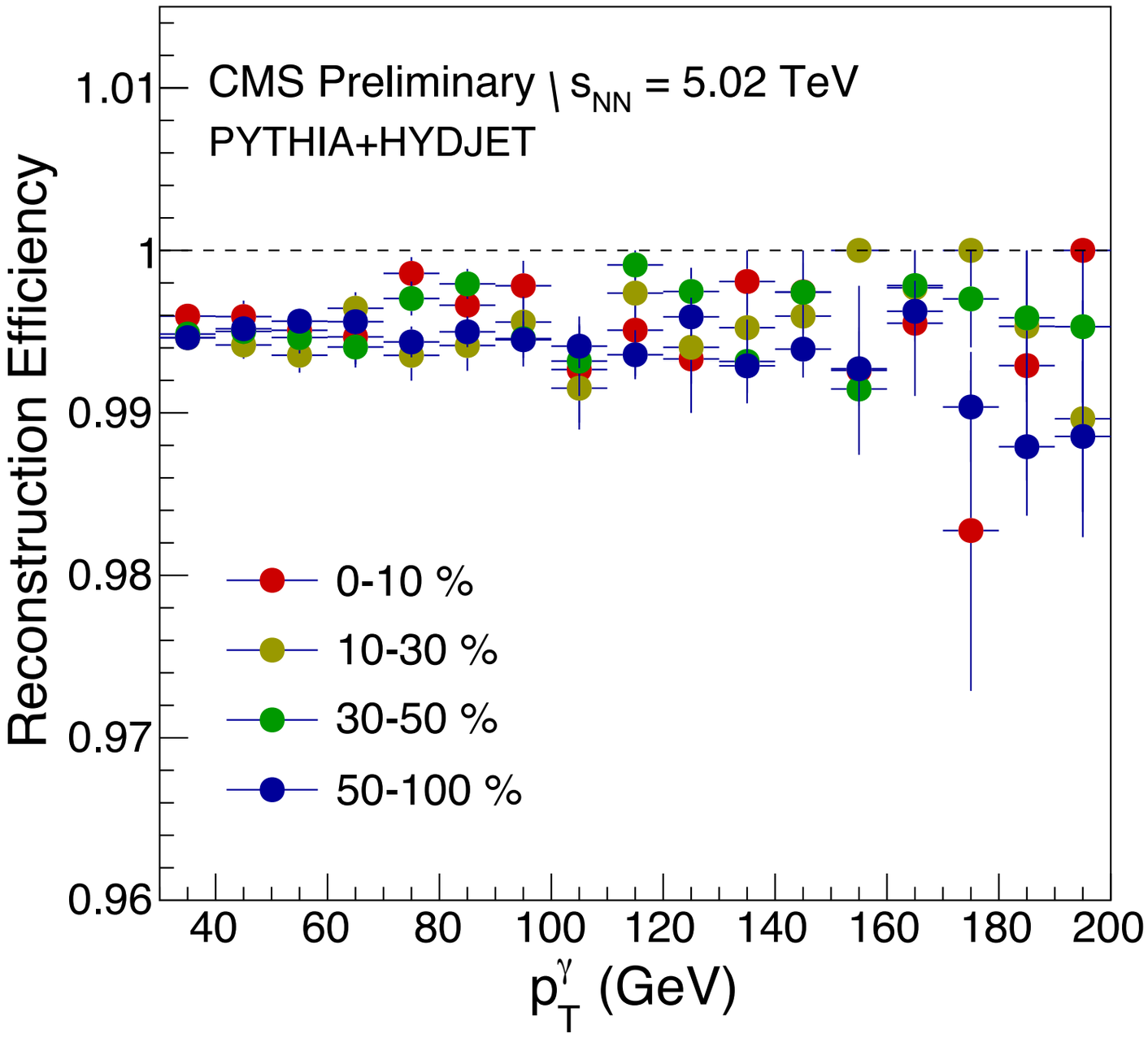
Trigger Efficiency





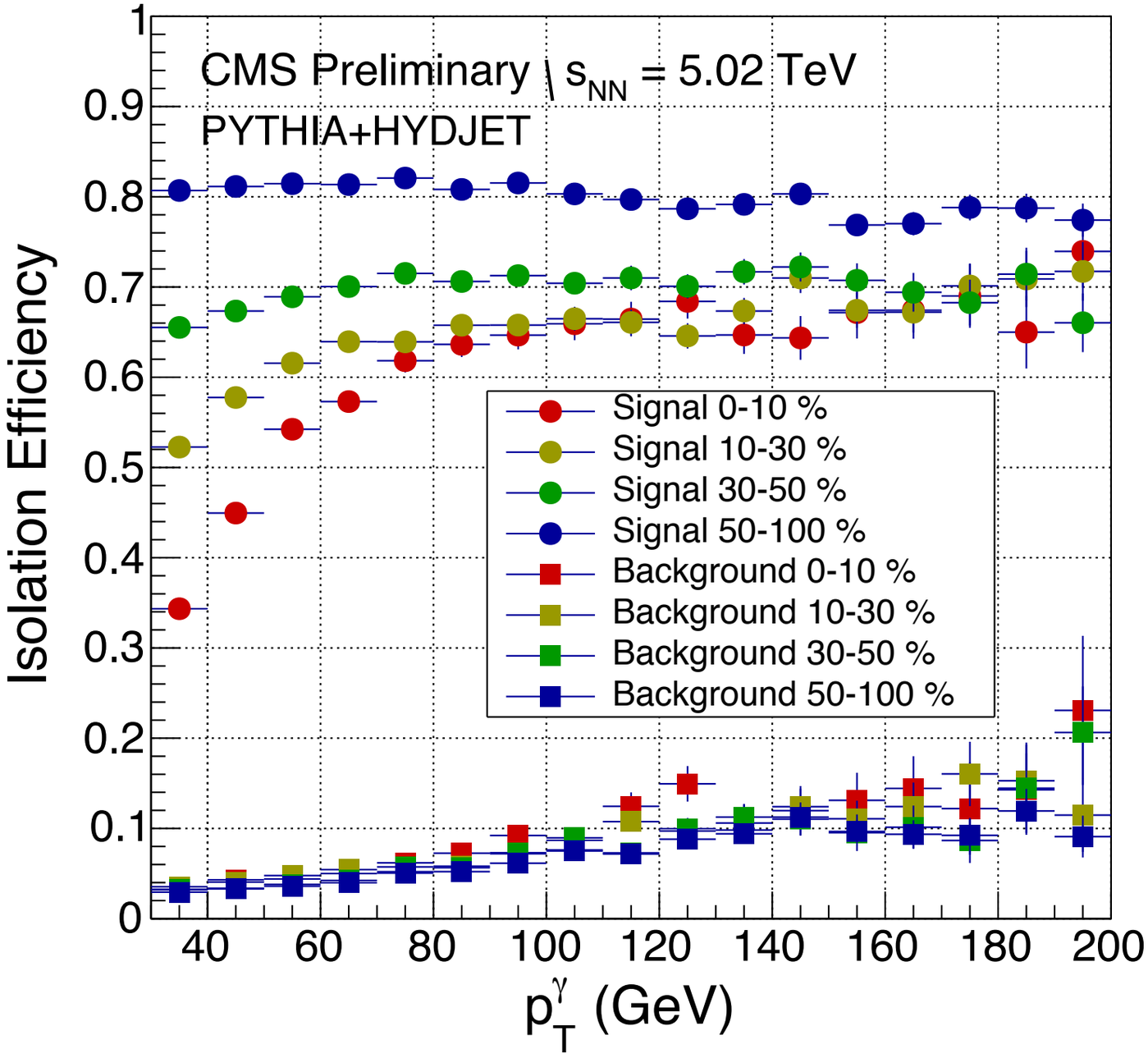
- **All trigger efficiencies are over 99 % for each threshold**
- **All reconstructed photon spectra as a function of p_T have been measured without isolation condition**

Reconstruction Efficiency



- **There is no centrality dependence**
- **Reconstruction efficiency is over 98 % in all centrality and p_T region**

Isolation Efficiency



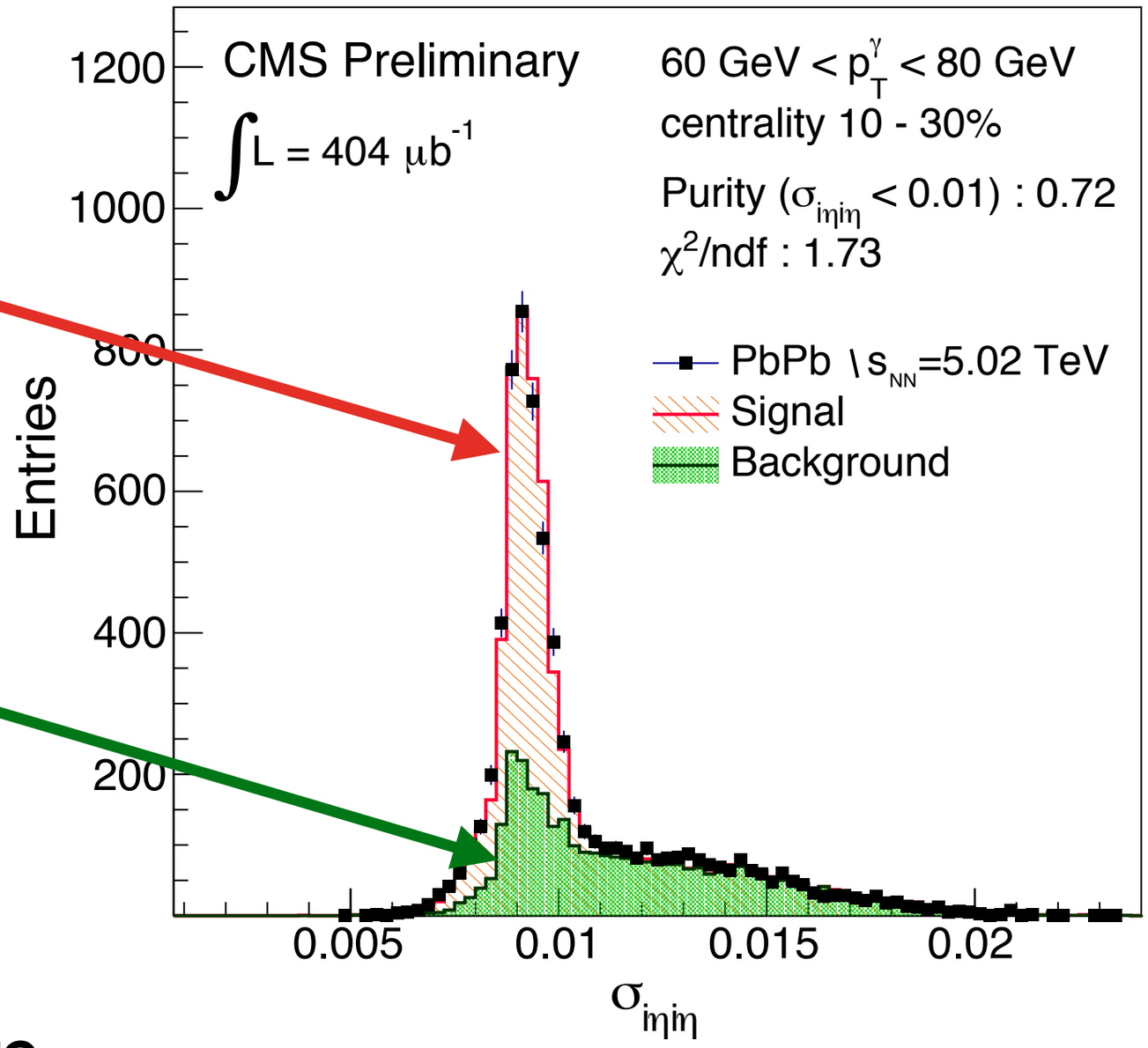
- **Numerator (Isolated photon selection)**
  - H/E < 0.1
  - sumIso < 1 GeV
  - $\sigma_{i\eta i\eta} < 0.1$
- **Denominator**
  - Signal :
    - 1) isolated prompt photon
    - 2) isolated fragmentation photon
  - Background :
    - 1) decay photons from neutral meson
    - 2) non-isolated prompt & fragmentation photon

- **Over 80 % of background photons are rejected by isolation condition**
- **Isolation efficiency for the signal decreases with increasing centrality and decreasing p_T**

Purity

- **Signal Pdf from MC**
  Isolated photon
  (prompt+fragmentation photon)
  : H/E < 0.1
  : [signal] sumIso<1 GeV

- **Background Pdf from DATA**
  mostly neutral meson
  (pi0, eta, …)
  : H/E < 0.1
  : [sideband] 10 <sumIso<20 GeV



- **Data are fit to the sum of the signal and background template in p_T and centrality bins**

$$\sigma^2_{i\eta i\eta} = \frac{\sum_i^{5\times5} w_i(\eta_i - \eta_{5\times5})^2}{\sum_i^{5\times5} w_i} \qquad w_i = \max(0, c + \ln\frac{E_i}{E_{5\times5}})$$

Summary

- **Reconstruction and identification of isolated photons have been developed in heavy ion collisions and provide good performances**
  - Trigger efficiency
  - Inclusive photon spectra
  - Reconstruction efficiency
  - Isolation efficiency
  - Purity

- **Many analyses related to isolated photons in heavy ion collisions are in progress**
  - Isolated photon R_{AA}
  - Isolated photon-jet correlation
  - Isolated photon-jet fragmentation function