Study of muon isolation at L1 using calorimeter information

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on behalf of FNAL/LPC upgrade team

L1 Upgrade Performance TF Meeting
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Use calorimeter isolation to Level-1 muon

Steps to simulate muon isolation at L1:

- Step1: Read L1 muon and L1 UCT15 12x12 region within $\Delta R=0.2$. Define isolation = 12x12 region E_T

  (See Dave Evan's slide from last week for UCT tower definition)

- Step 2: Use last week's agreed-upon working point
  - relIso = isolation / L1 muon p_T
  - If relIso < 0.5 then μ is isolated

Sample for rate study

/Commissioning/Run2012C-v1/RAW

Good run JSON list at

/afs/cern.ch/user/b/battilan/public/forDave/
L1Trigger_Run2012C_JSON_202500-204000_vl.json

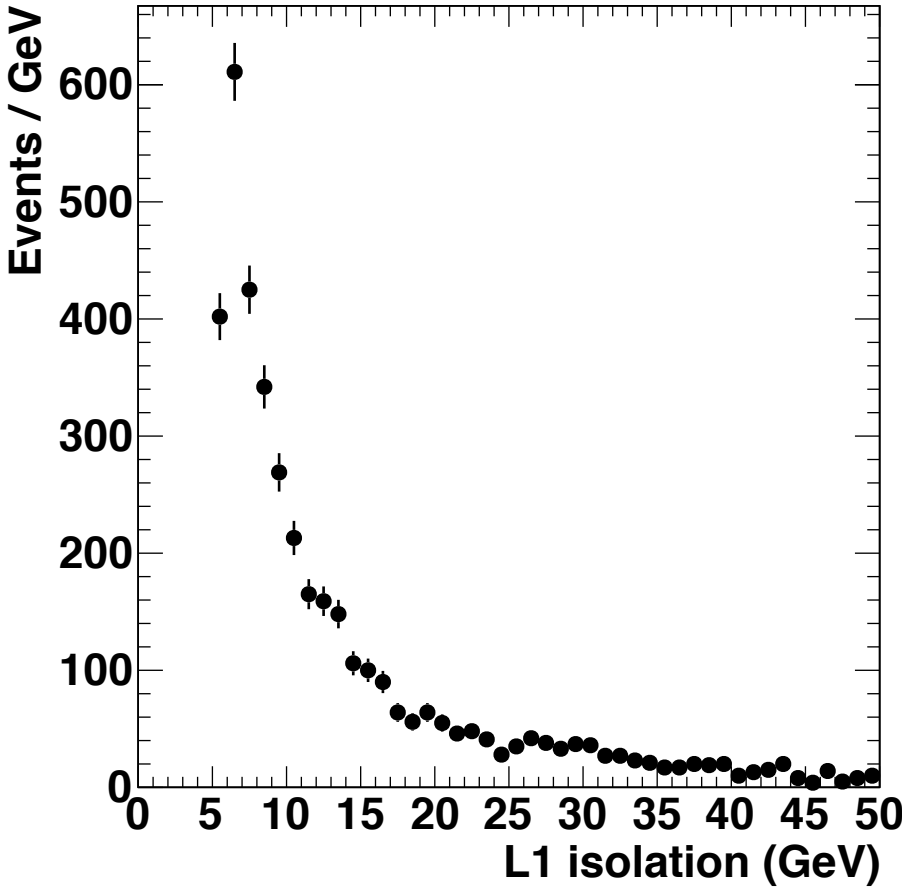
NB:

1.) There can be ≥1 L1 muon in the event, consider them all.

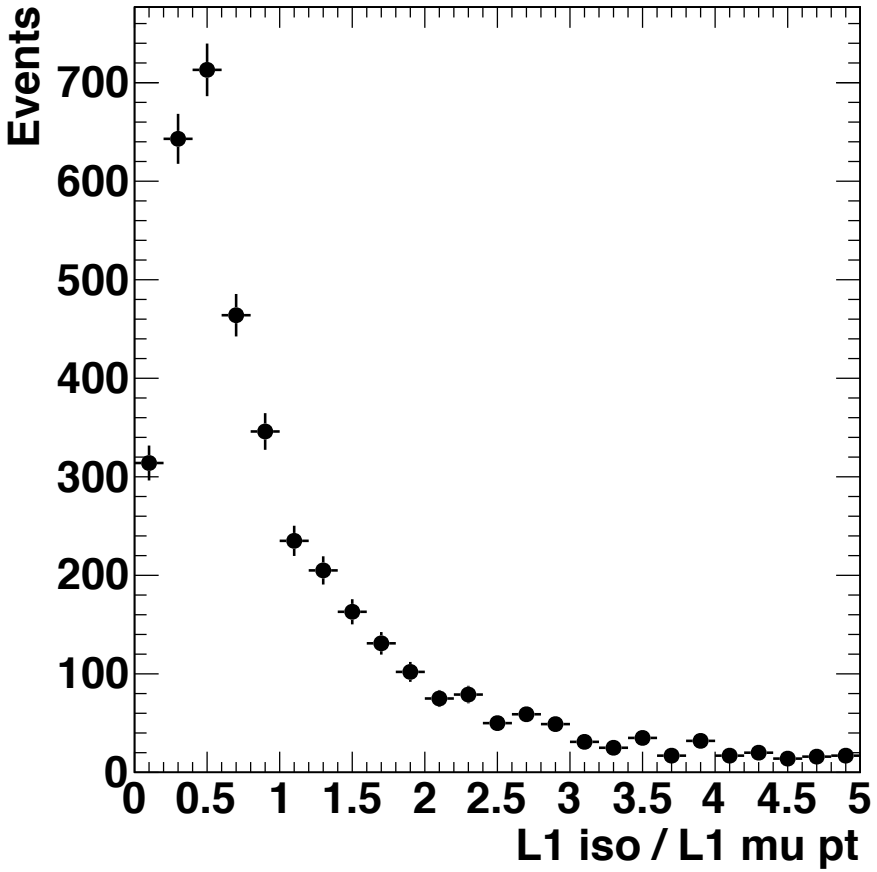
2.) Although not feasible to use reliso in Phase-I (only 2 bits available), today's study done using the above WP.

Isolation

Absolute isolation

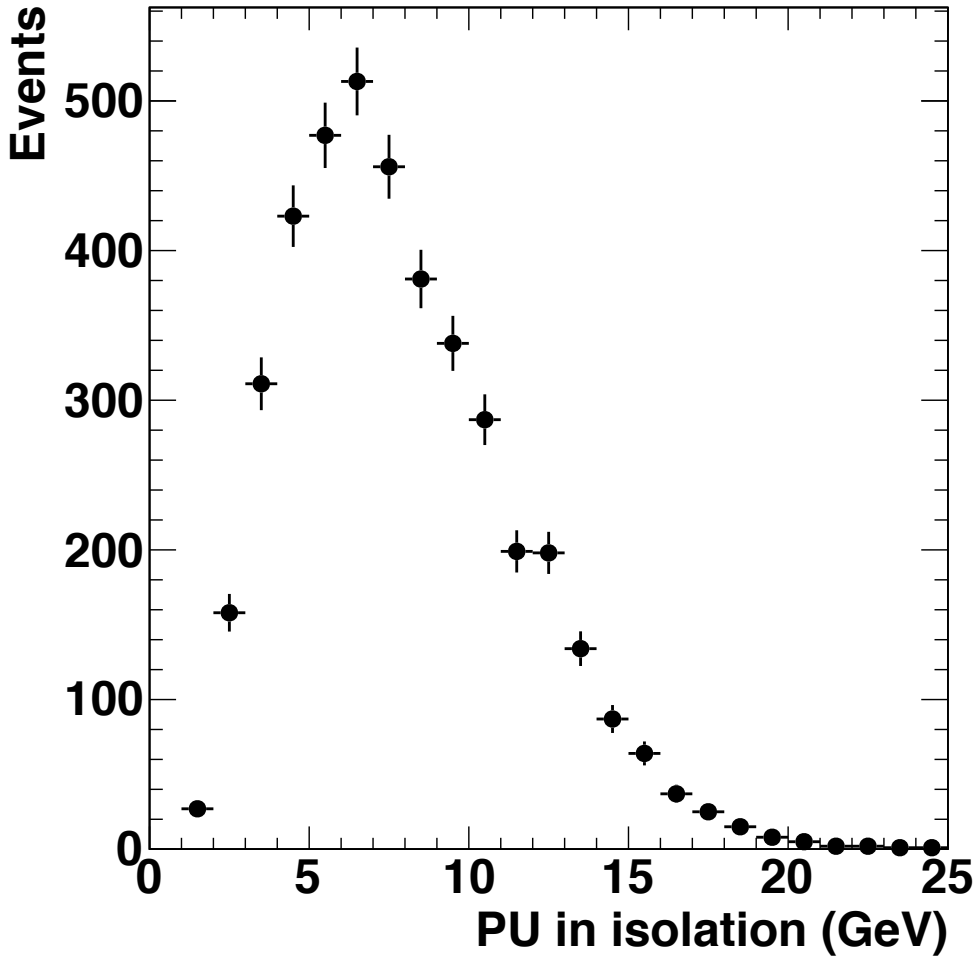


Relative isolation



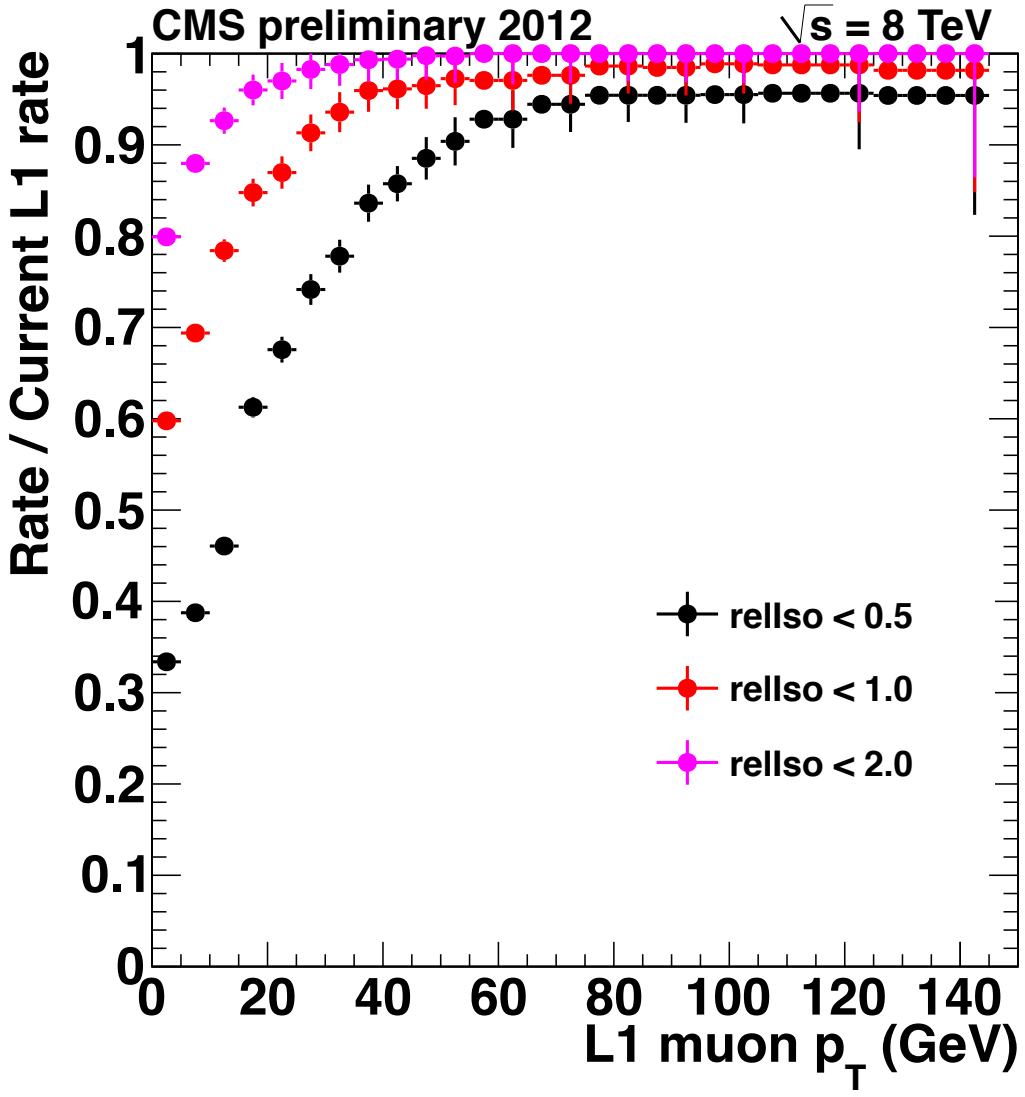
No pileup subtraction applied for today's study

Pileup contribution to isolation



- No simple way to compute nPileup in RAW data
- No pileup subtraction applied for today's study

Muon Level-1 rate drop after isolation



- The current working point is about the right level of aggressiveness
- The rate is cumulative
- L1IsoMu12 can give a factor of 2.5 reduction

Samples used to compute efficiency

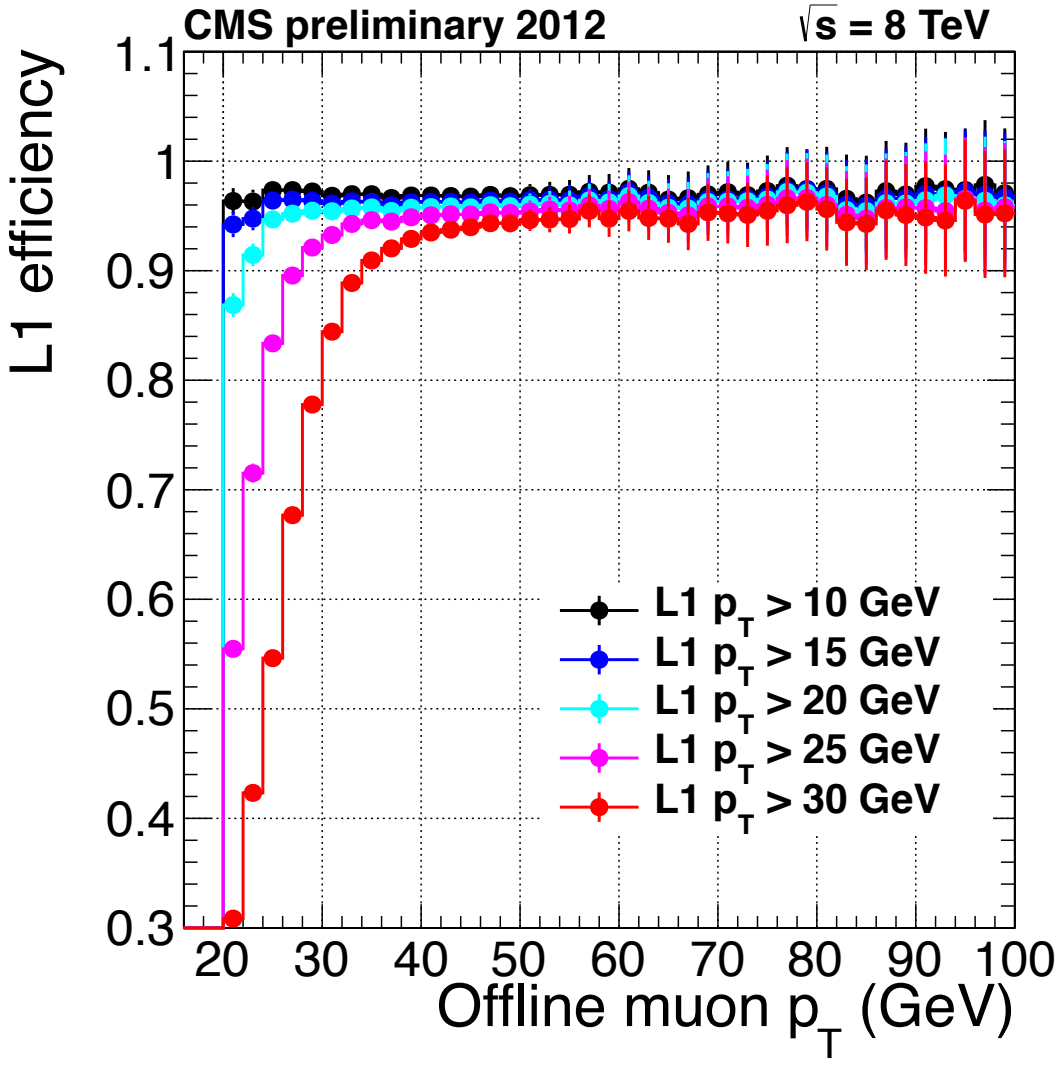
/SingleMu/Run2012C-ZMu-PromptSkim-v3/RAW-RECO

- Z→μμ in data in runs 2012 C
  - **Muon p_T > 20 GeV, $|\eta|$ <2.1**
  - **Z mass window:60-120 GeV**

- Require good quality criteria
  - **Reconstructed as a Global and Tracker Muon**
  - **≥10 tracker hits, ≥1 pixel hits (Tracker track)**
  - **≥2 muon hits of the Global track**
  - **χ2/ndf < 10 global fit**

Good JSON runs as mentioned previously

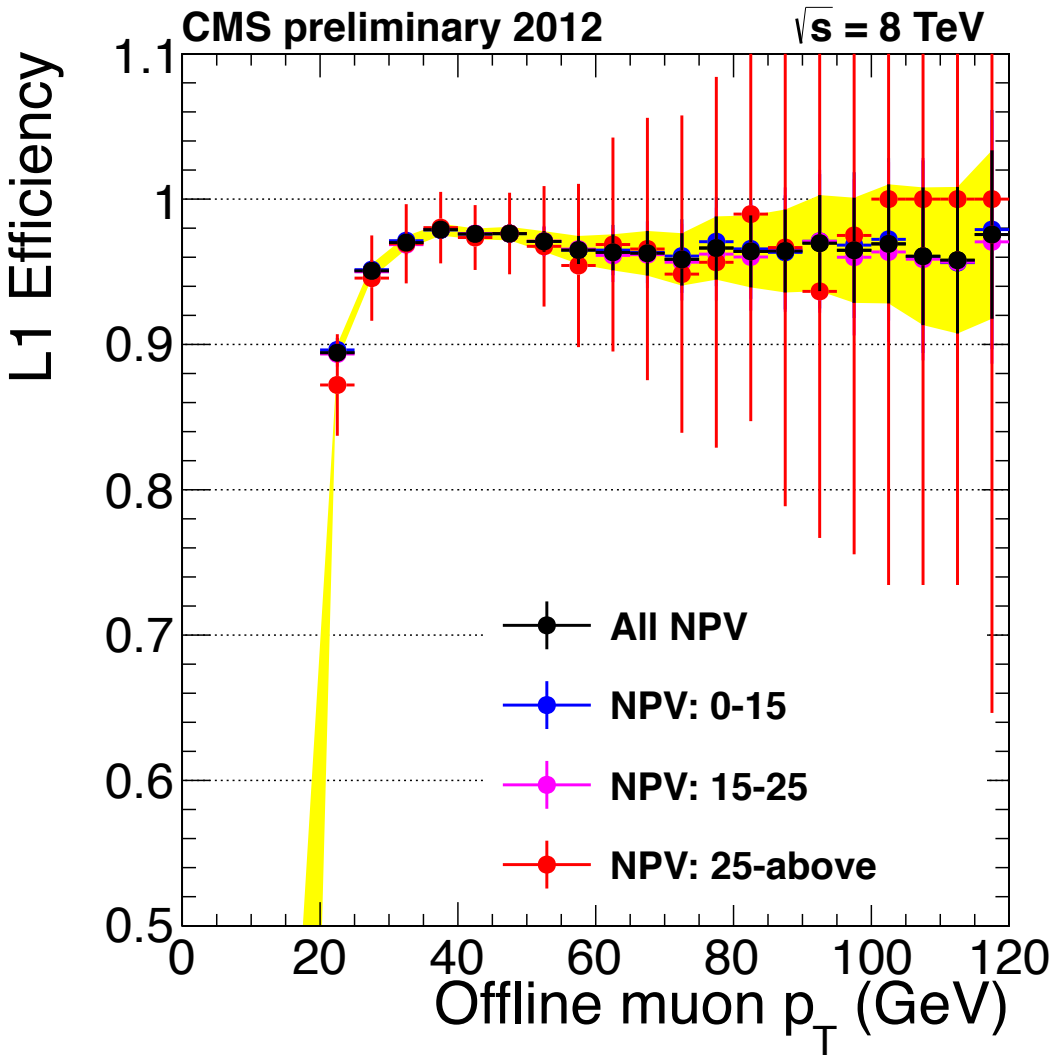
L1 turn-on curve



Denominator: Offline isolated muon which are matched in $\Delta R<0.3$ to a level-1 muon

Numerator: Same as above & passing L1 p_T threshold.

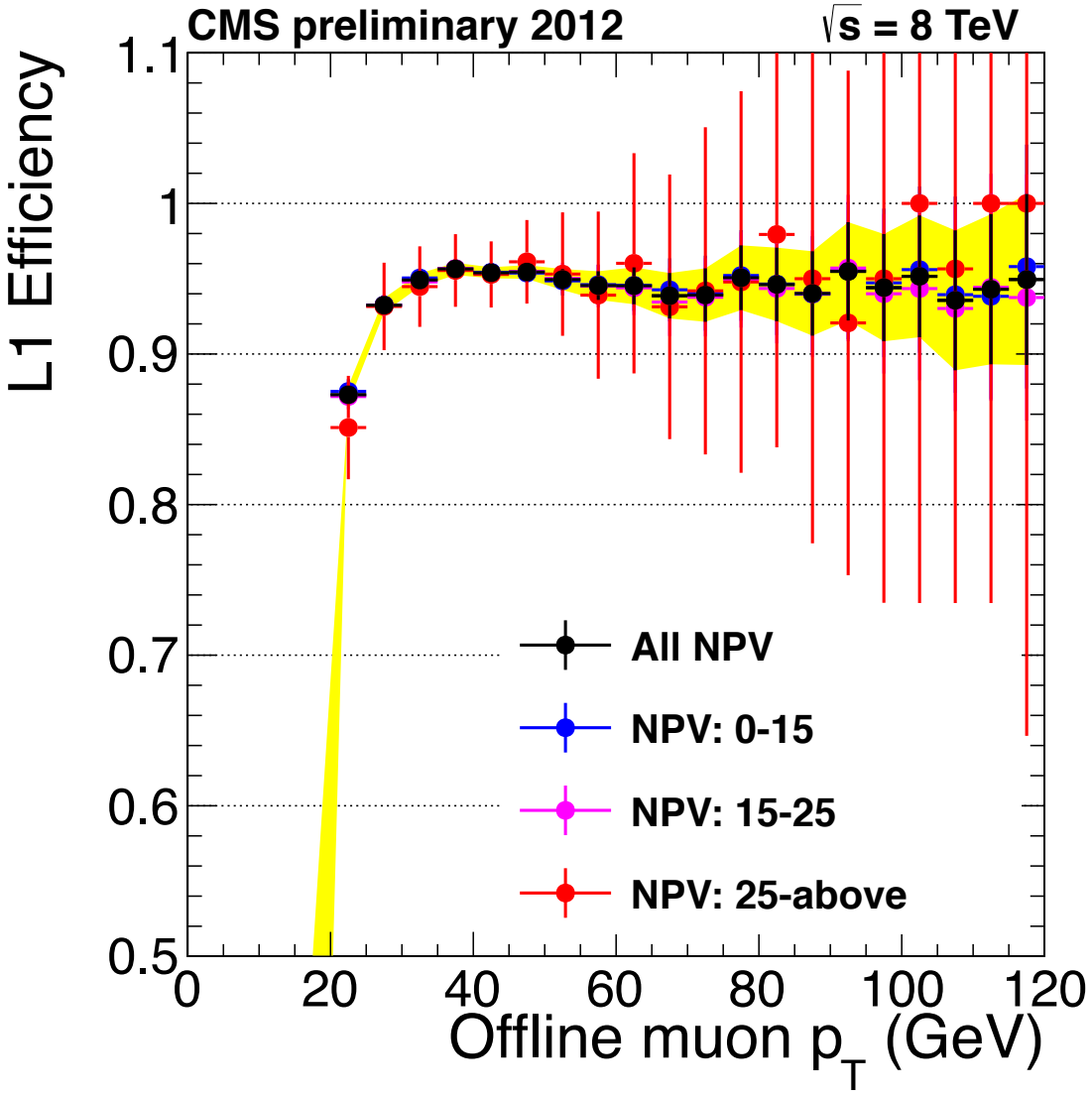
L1 (pure) isolation efficiency



Denominator: Good offline muon matched to L1 muon.

Numerator: Same as above & requiring isolation at Level-1 (no cut on L1 p_T)

L1 efficiency: L1IsoMu12



A few % drop compared to pure isolation efficiency

Plots with higher L1 threshold are in the backup

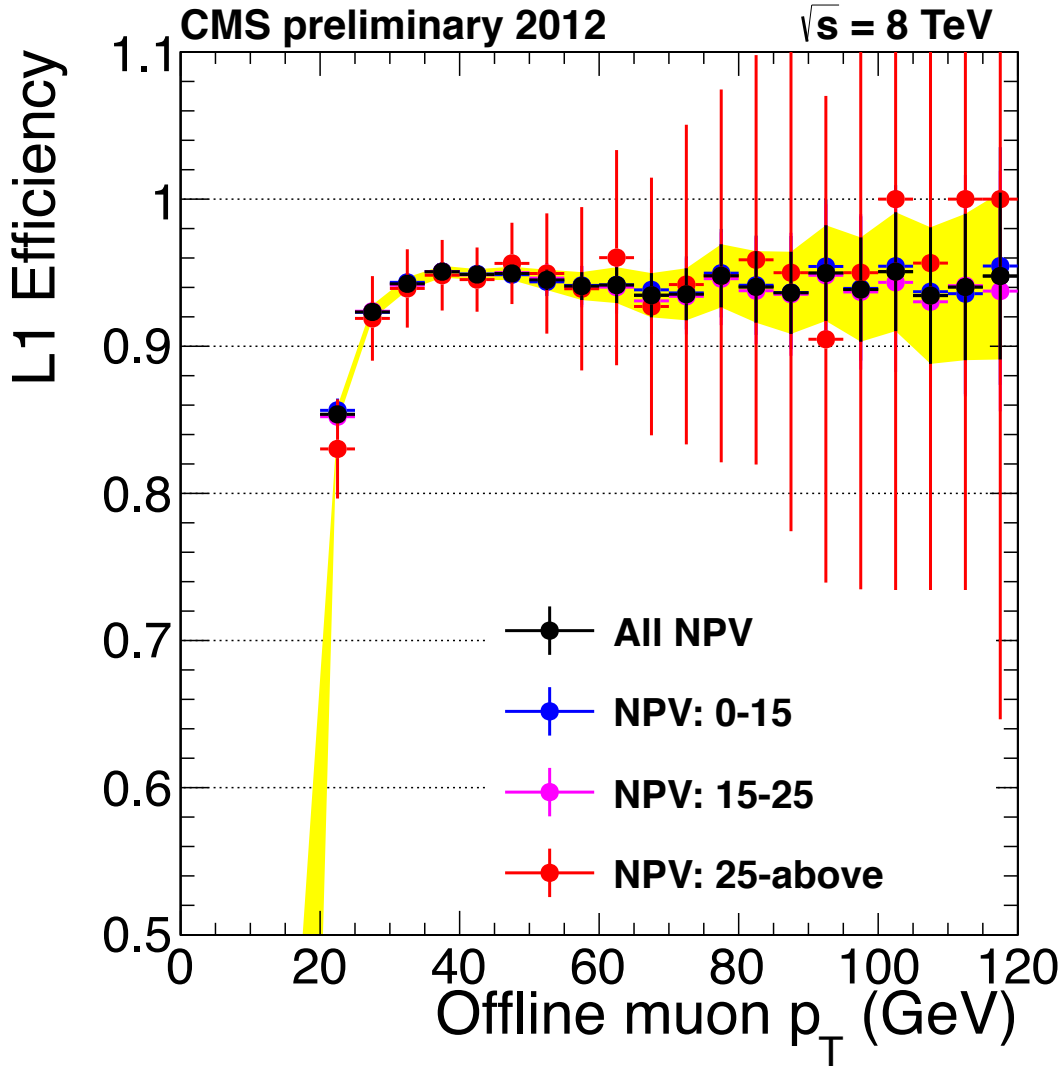
Summary

- Following last week's agreed-upon operating point for muon isolation, have computed
  - Rate reduction as a function of L1 threshold
  - Turn on curves for several L1 thresholds and NPV
  - Efficiency for several L1 thresholds and NPV
- Code to generate trees and for making plots shown in previous slides is located at

UserCode/kalanand/Upgrade/

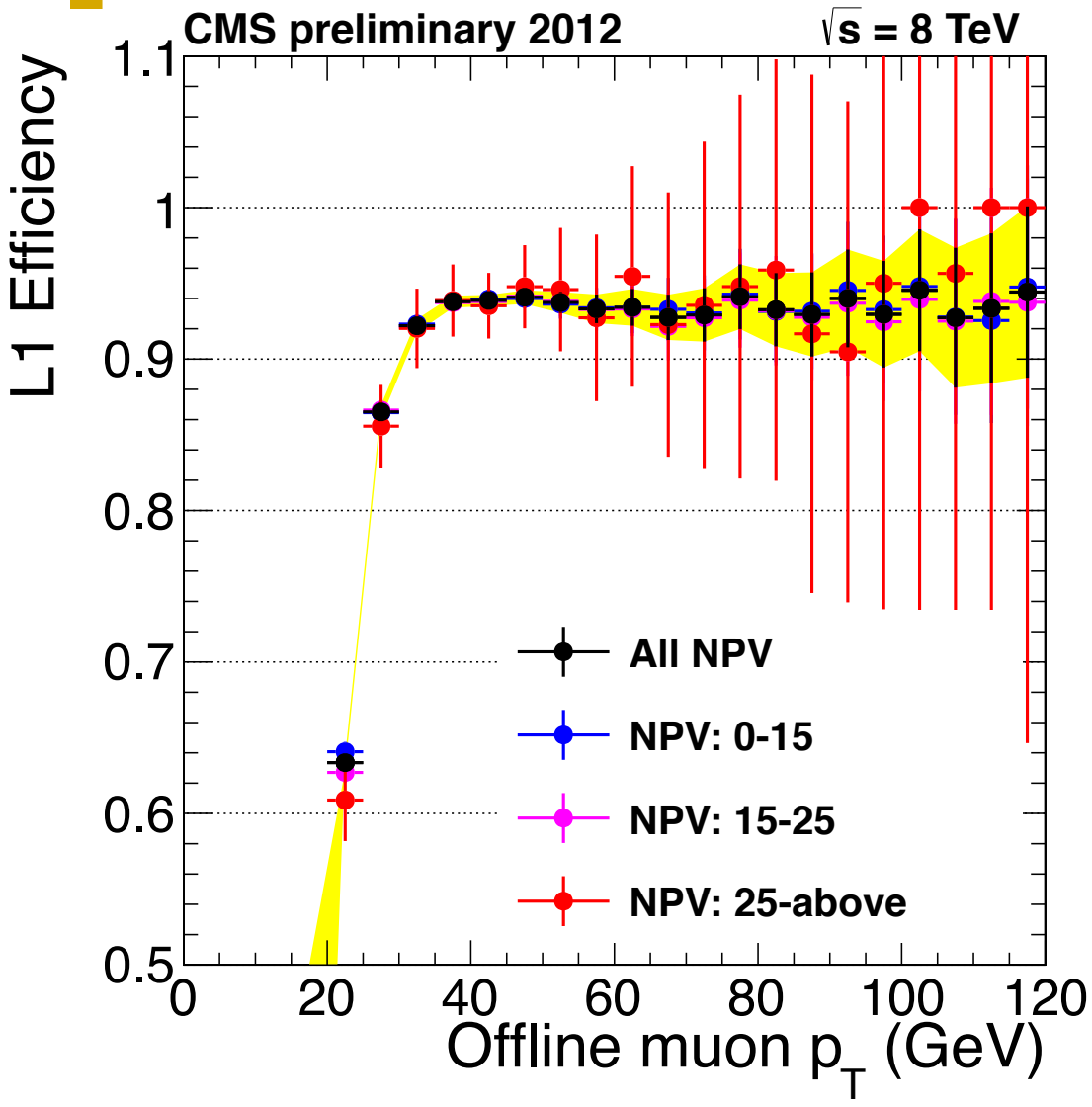
BACKUP SLIDES

L1 efficiency: L1IsoMu18

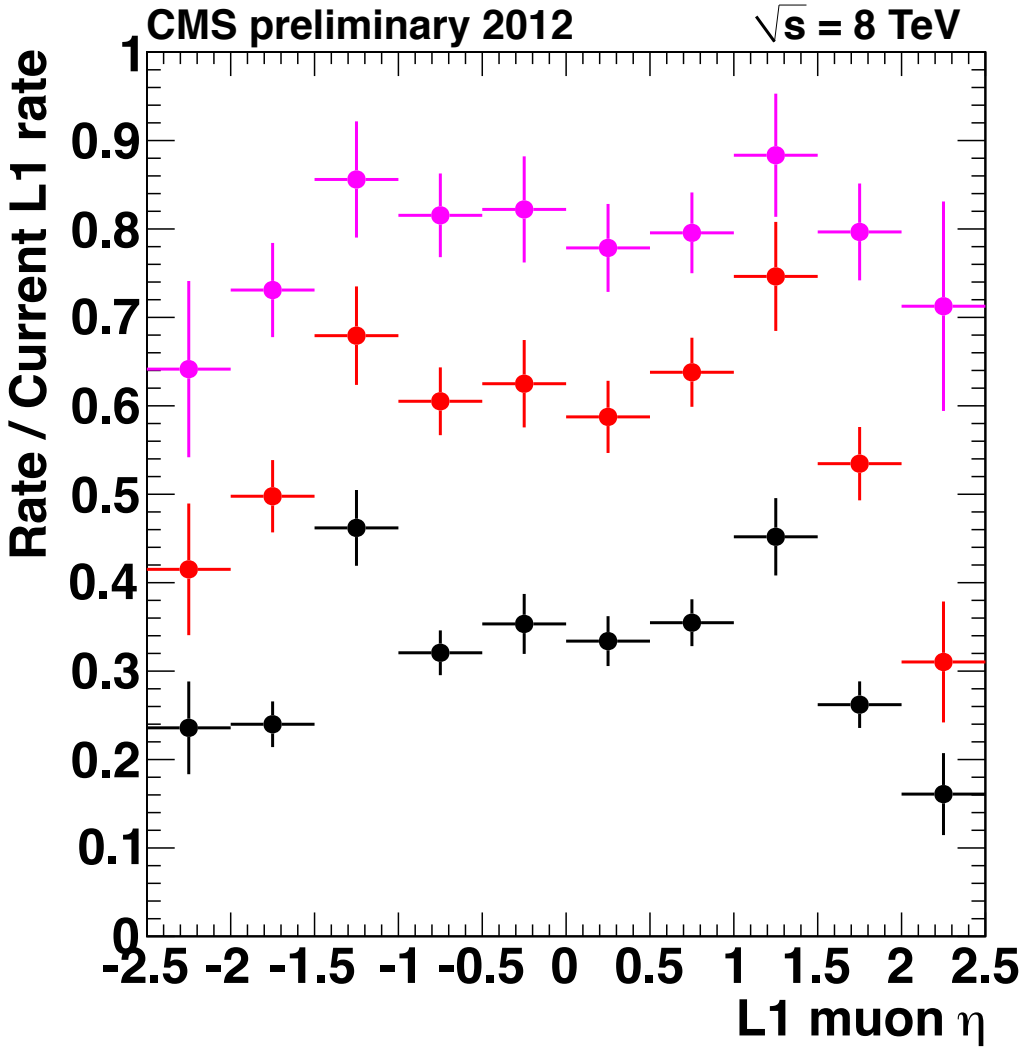


A few % further drop compared to L1IsoMu12 in the first bin

L1 efficiency: L1IsoMu24



Muon Level-1 rate drop after isolation vs η



- No p_T cut applied

L1 efficiency: L1IsoMu12 as a function of η