Tight Muon Reconstruction Efficiency (Slide 7 corrected)

Sept 30, 2019

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From Sept 25 EW/Onia Meeting

- Check the dR selection for ID efficiency calculation.

- Study the efficiency/scale factors' centrality dependence.

Progresses

- Looked into dR distribution, observed similar distribution with Qipeng's study.
  - Efficiency is lowered by ~5-7% (barrel: ~5%, endcap ~7%)
  - Looked into truth efficiency to use as a reference
    - Truth efficiencies are under 70% for both upsilon & J/psi. low efficiency region at $1.2 < |eta| < 2$
    - No obvious dependence on charges/centrality.
    - Checked distribution of distances between a pair of tracks those are possibly from the same parent.
- Produced data distribution as a function of FCal, written codes for reweighting MC, yet to run since we're now unsure about our MC.
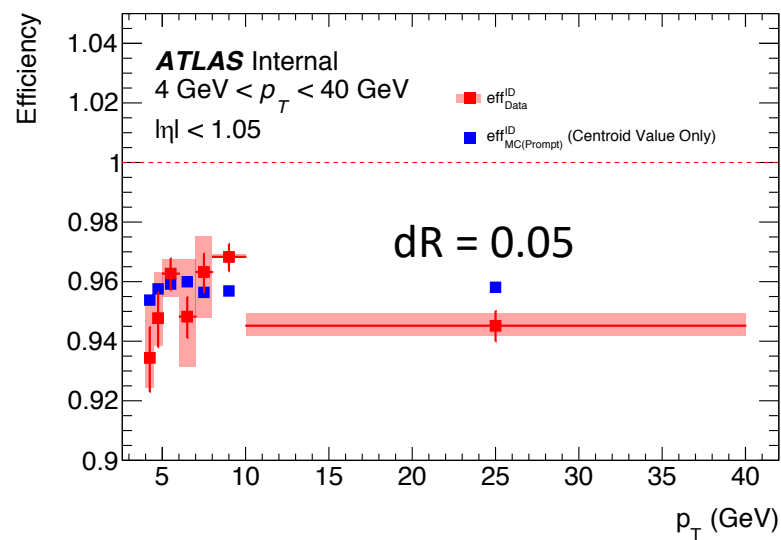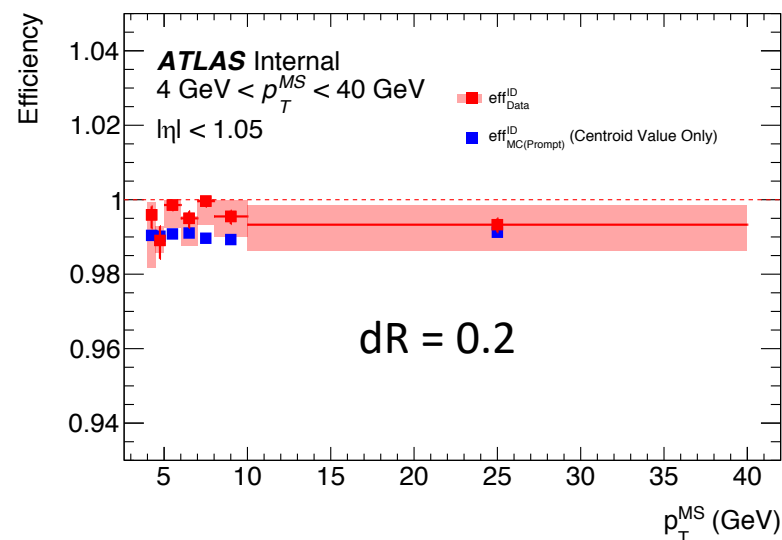
mindR in ID in Prompt J/psi MC
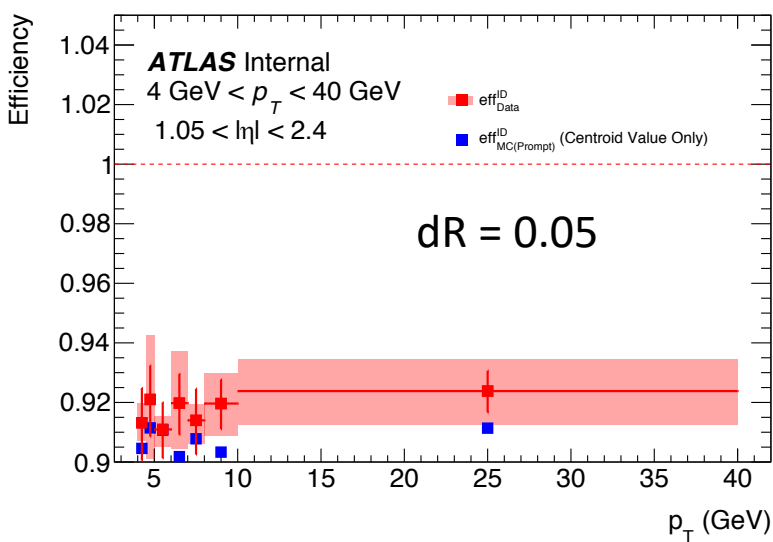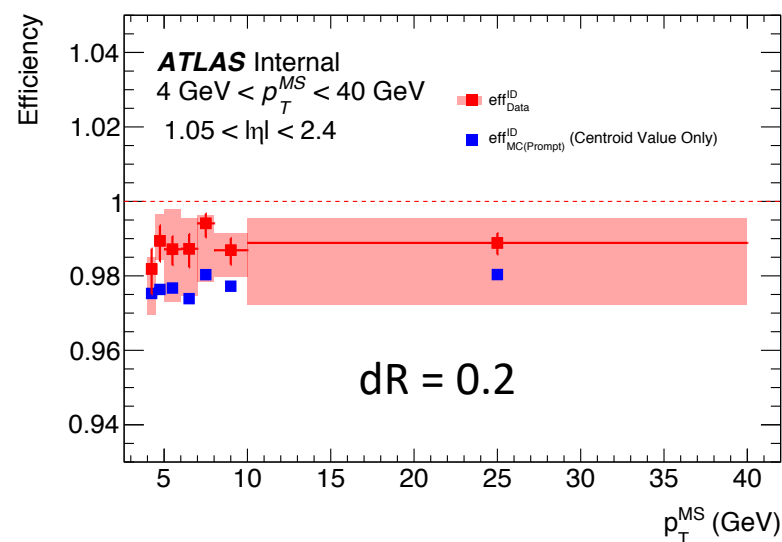
mindR in ID in Data

Redlines are not fit
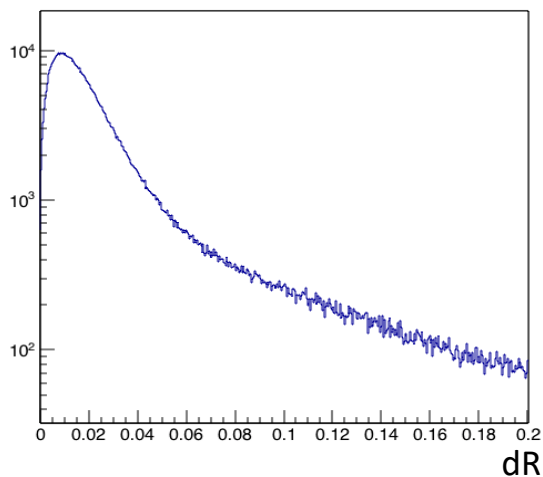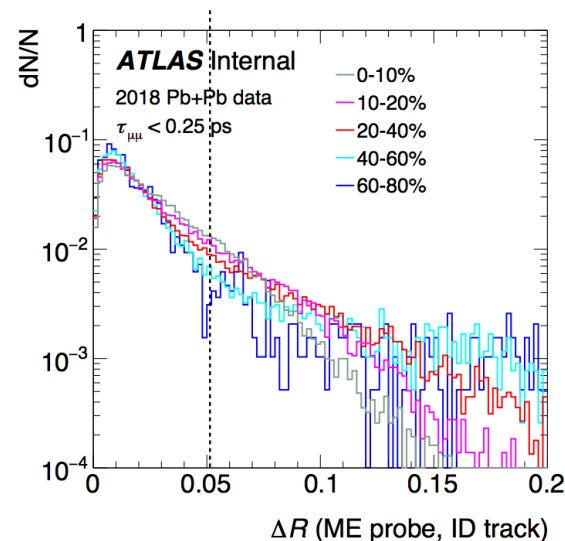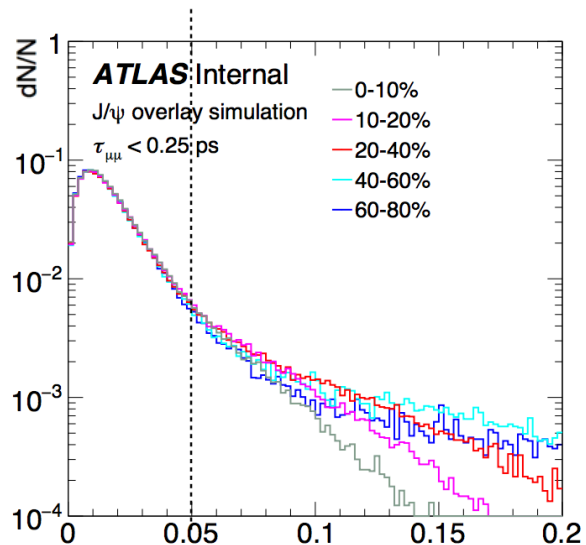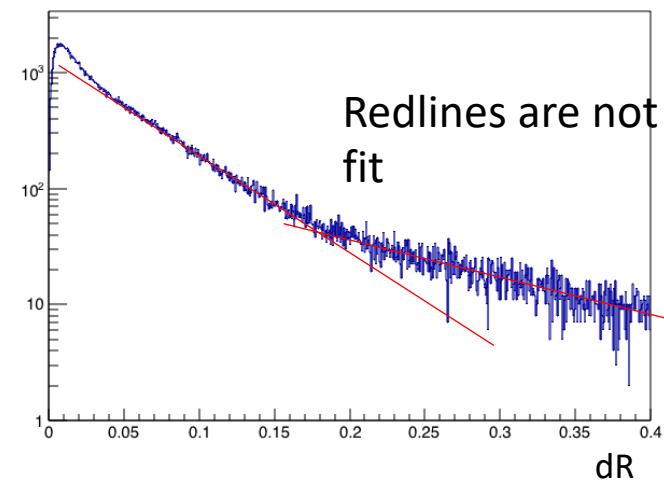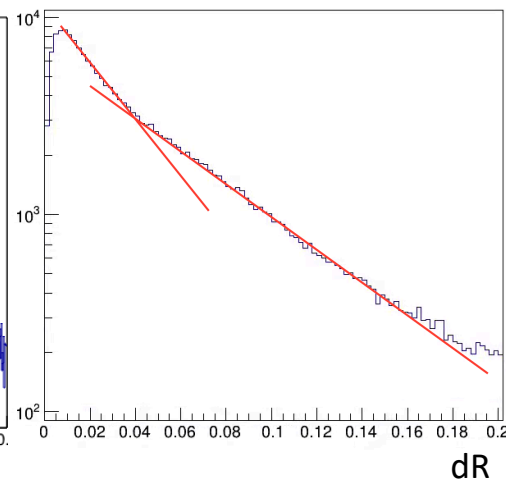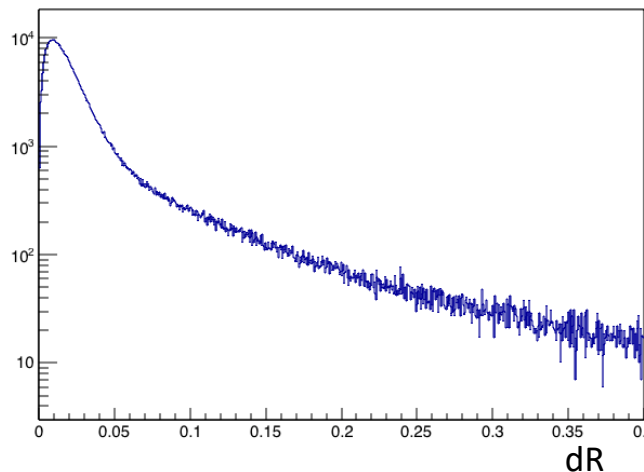
- Top 3 graphs, our data & MC using tight muons (integrated over centrality)
- Bottom 2 graphs, Qipeng's slides using medium muons
- Qualitatively similar.

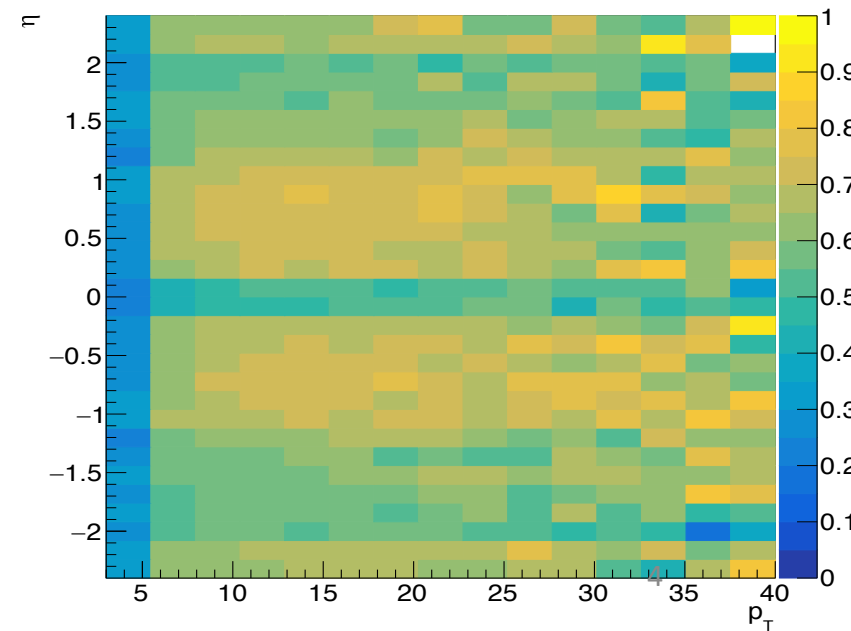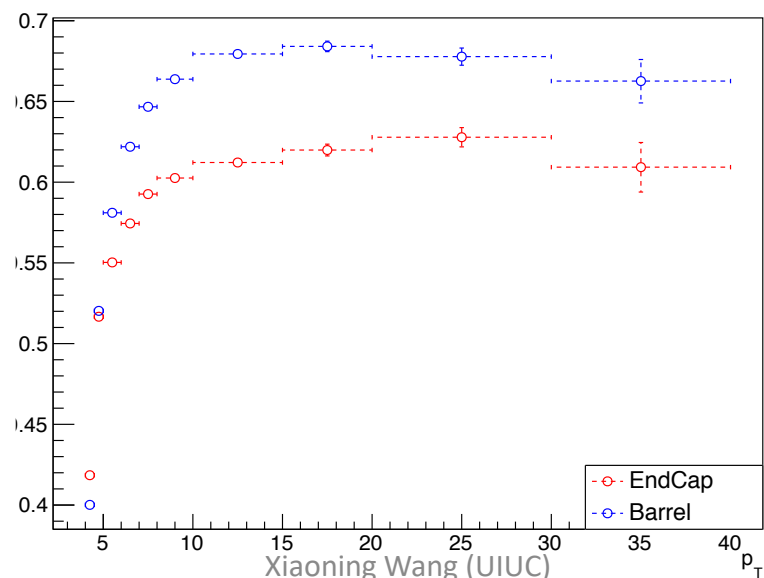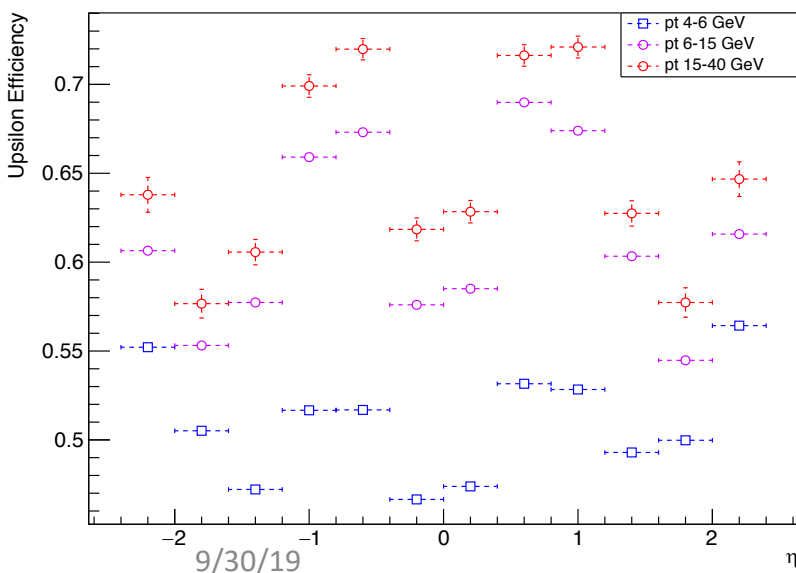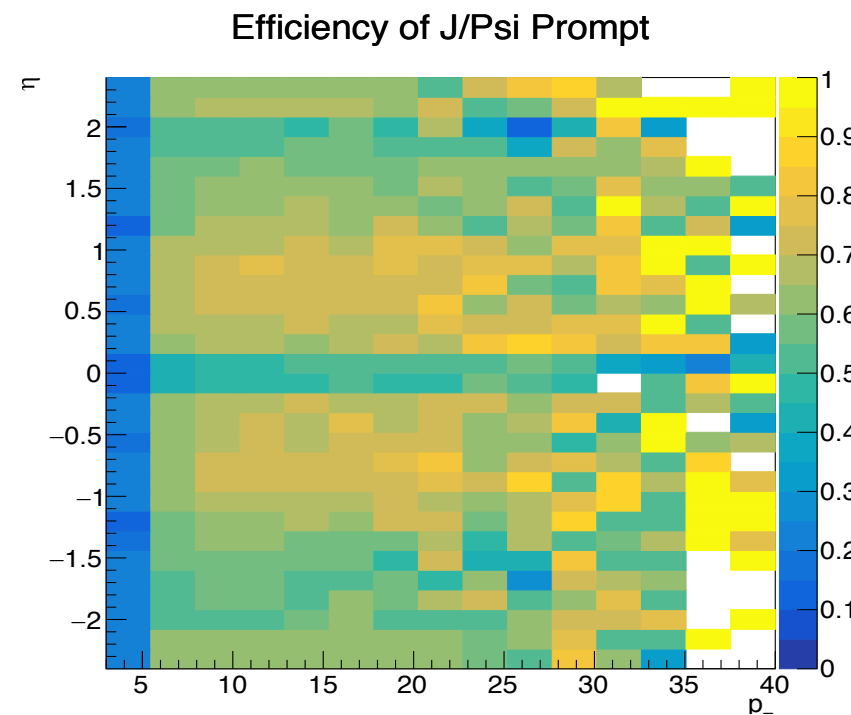# Comparison of Using different dR selection

Barrel

End Cap

Use Truth Efficiency as a reference?

Efficiency of J/Psi Prompt

Efficiency of Upsilon
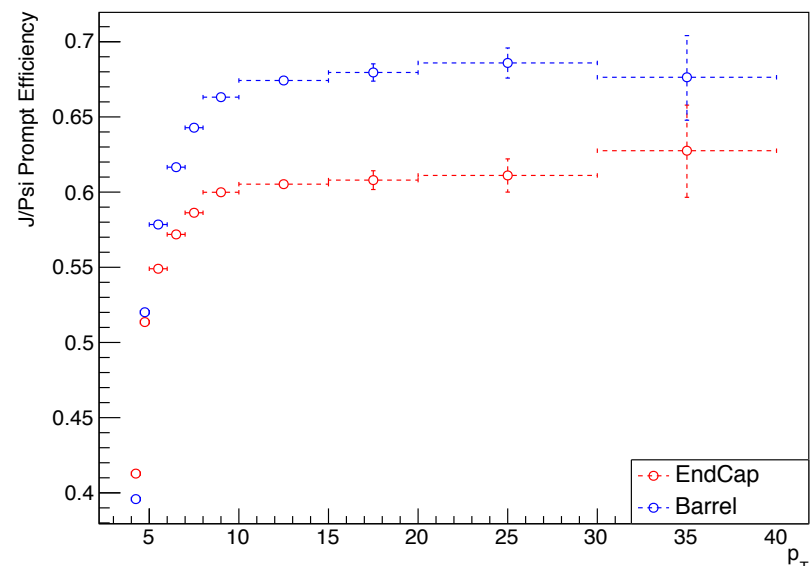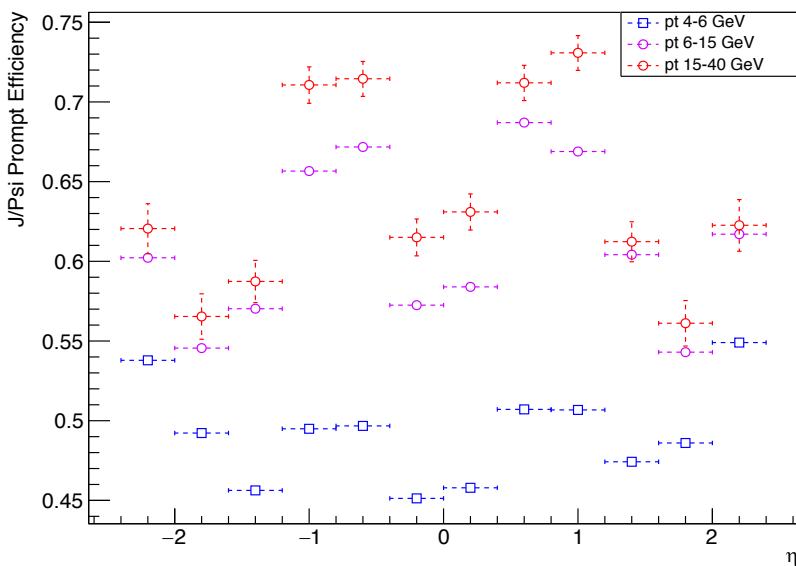
9/30/19

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- Truth efficiency follows a reasonable trend as a function of pT.
- Have low efficiency regions around 1.2<|eta|<2, this is also seen in T&P method.
- Separating charges & different centrality does not show obvious differences. (see backup slides)
- Major sources of inefficiency come from truth muons with no reco muons closer than dR=2, so the selection of matching dR threshold is not the reason for overall low efficiency. (see below)
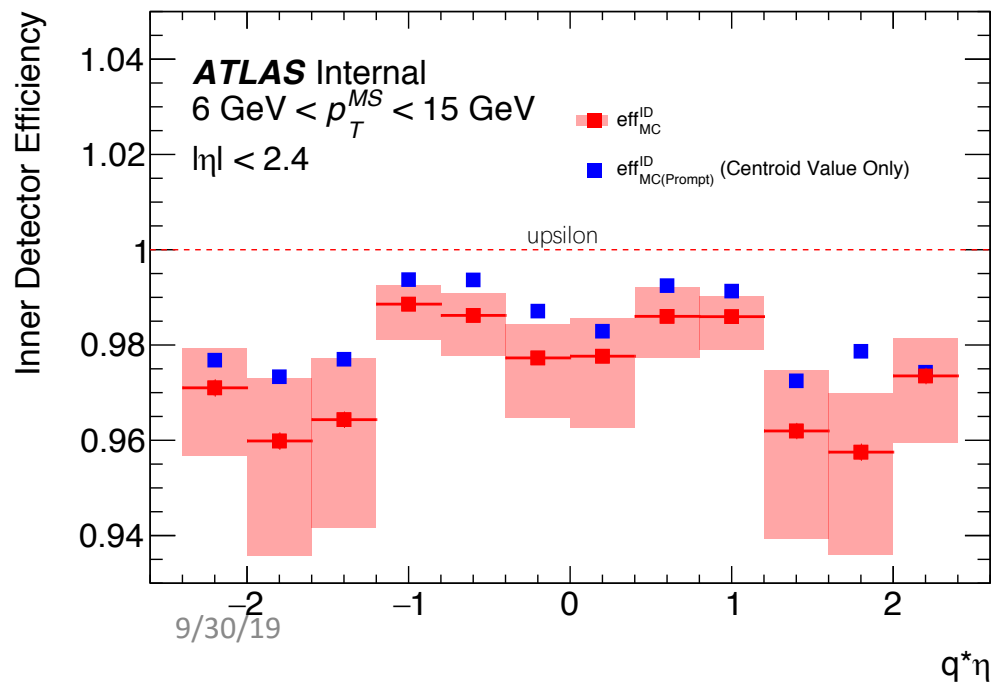
Prompt J/Psi minimum dR of Reco Muons from Truth Muons histogram
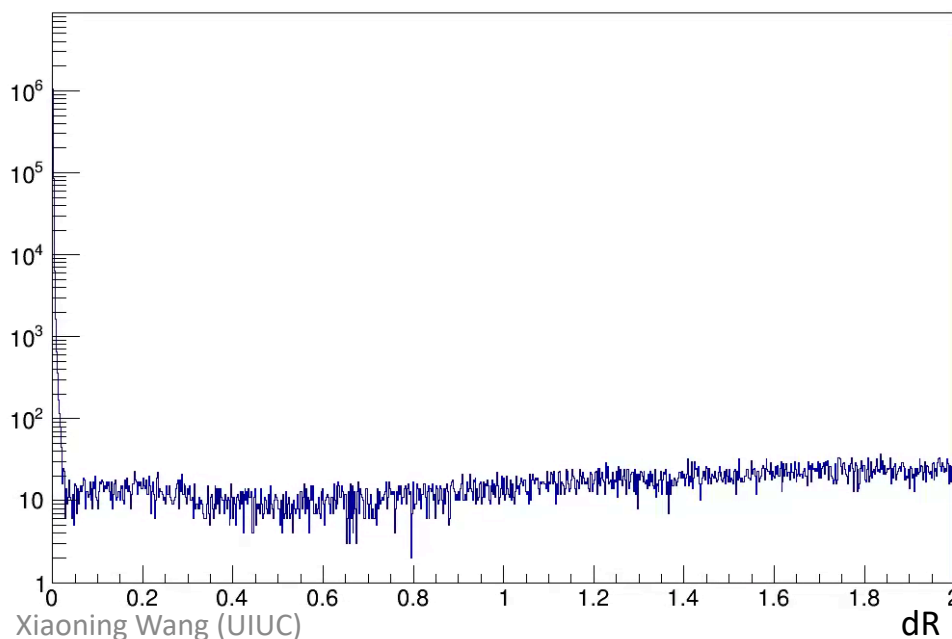
This is the peak for truth muons with no reco muons closer than dR = 2. This peak doesn't go away with increasing pT.

Distribution of distances between a pair of tracks those are possibly from the same parent

Distribution of dR between 2 ID Tracks Potentially from the Same Parent in Prompt J/Ψ

J/Psi ID

Distribution of dR between 2 ID Tracks Potentially from the Same Parent in Upsilon
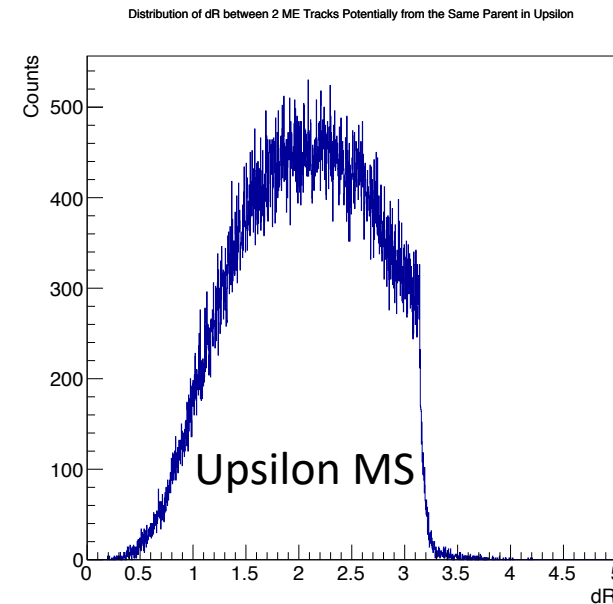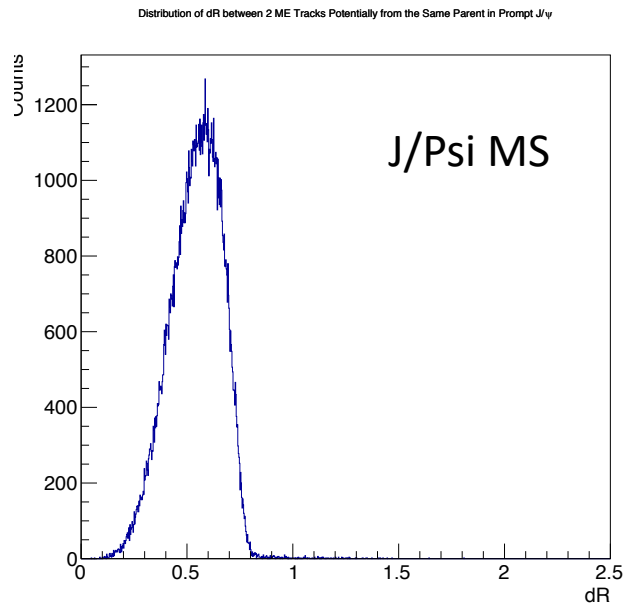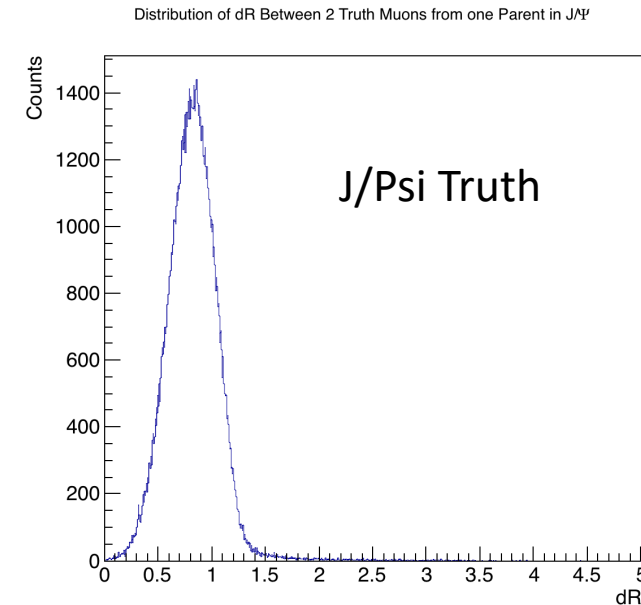
Upsilon ID

Distribution of dR Between 2 Truth Muons from one Parent in J/Ψ

J/Psi Truth

Distribution of dR between 2 ME Tracks Potentially from the Same Parent in Prompt J/ψ

J/Psi MS

Distribution of dR between 2 ME Tracks Potentially from the Same Parent in Upsilon

Upsilon MS

- Looped over tracks (ID or MS or Truth muons) in each event, and for J/Psi, plotted the dR between all pairs with an invariant mass in the range of 3.3-3.5 GeV (peak of mass histogram at around 3.4 GeV), or 9.25-9.55 GeV for upsilon (peak of mass histogram at around 9.4 GeV).

What have been checked

- Distribution of pT, eta, FCal for Truth muons without a dR-matched Reco Muon in J/Psi (see Slide 4)

- In J/Psi data, 99.54% of events have 1 pair of truth muons, others have 2 or 3 pairs. Looking only at the 1 pair events:

  - About 5% of truth muons pairs do not have correct invariant mass, and the pairs with "wrong" invariant mass all have smaller mass.

Distribution of Invariant Mass for Truth Muons without Mass-matched Muon
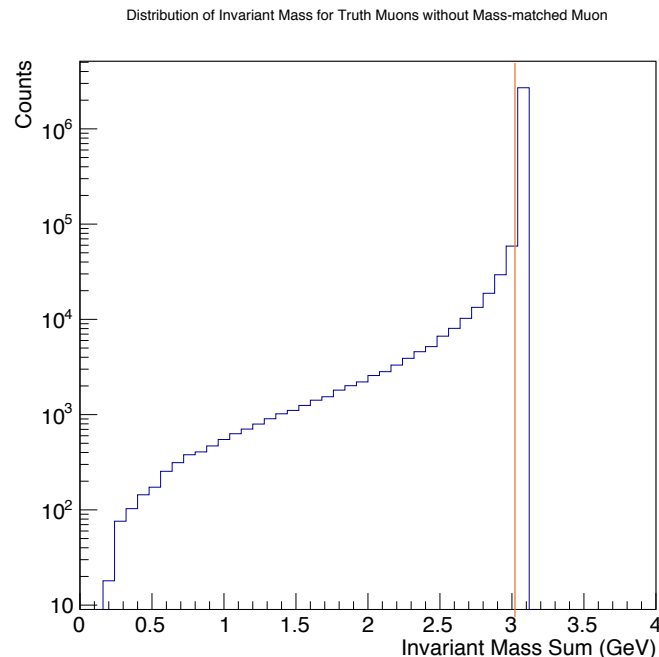
- In the pt and eta range we're interested in, 46.6% truth muons do not have reco muons closer than dR =2.
- Of the 46.6%, ~~85%~~ are lost in pairs, other pairs lost only one muons.

  56.1% Previously I only limited pT and eta on either of the tracks with dR >2, thus overcounting the numerator.

- If the missing reconstructed muons are uncorrelated, given 46.6% lost rate on each muon, would expected 46.6%x46.6% muons to be lost in pair, which is 21.7% of total number of truth muons, and 46.6% of lost muons.
- In MC-prompt JPsi we saw 26.1% of total muons lost in pair, which is 56.1% of lost muons.

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Efficiency versus FCal in Data (ID: dR = 0.2, MS: dR = 0.01)