



Primary Vertex Efficiency Measurement on 7TeV Data

Kevin Burkett, [Yanyan Gao](#) (Fermilab)
Geng-yuang Jeng (UC Riverside)

Tracking POG Meeting, May 3rd, 2010

Outline

- Introduction
- Split Method Description
- MC-Truth Method Description
- Results on MinBias Data with No PileUp at 7 TeV
 - Release: CMSSW 357 with 1cm clustering in z
 - MinBias MC: /MinBias/Spring10-START3X_V26A_357ReReco-v3/GEN-SIM-RECO
 - MinBias Data: /MinimumBias/Commissioning10-Apr20ReReco-v1/RECO
- Summary and Plans

Introduction

- **Primary Vertex Efficiency**
 - Given a set of tracks which should form a reconstructed vertex, how often do we reconstruct it with the reconstructed positions within a given acceptance level to the assumed values
 - It depends strongly on the number of tracks in the cluster
 - The turn-on curve is important for physics with low track multiplicity
 - It is sensitive to the denominator definition
- **Data-driven split-method to measure the PV efficiency**
 - *as a function of **number of tracks in the cluster***
 - This method is cross-checked with the “MC truth method” on MC data

Split Method Description

- **Asymmetrical Track Splitting:**
 - Sort the tracks in the first “offlinePrimaryVertices” according to p_T
 - The sorted tracks are then split asymmetrically into two sets, with 2/3 assigned to “tag track sets” and the other 1/3 to “probe track sets”
- **Vertex Fitting**
 - Fit the tag and probe track sets independently with the same “offlinePrimaryVertices” and saved as tag and probe vertex collections
- **PV Efficiency Analyzing**
 - Given a good tag vertex found, how often do we find a good tag vertex
 - **A good tag or probe vertex** is defined as being real and matched in z to the original vertex: $|z(\text{split})-z(\text{org})|/\sigma_z < 5$, σ_z :quadrature sum of both vertex errors

PV Efficiency Analyzing in Split-Method

- **Event Selections**

- Original vertex tracksSize > 6 and ndof > 6
- The average track weight > 0.75 (see backup slide 12)
- Exactly one cluster is found for tag and probe track sets

- **Number of Tracks**

- Number of tracks in the probe cluster with 3 pt cuts (0, 0.5, 0.9 GeV)

- **Denominator at each nTrack bin**

- Number of events with at least one good tag vertex

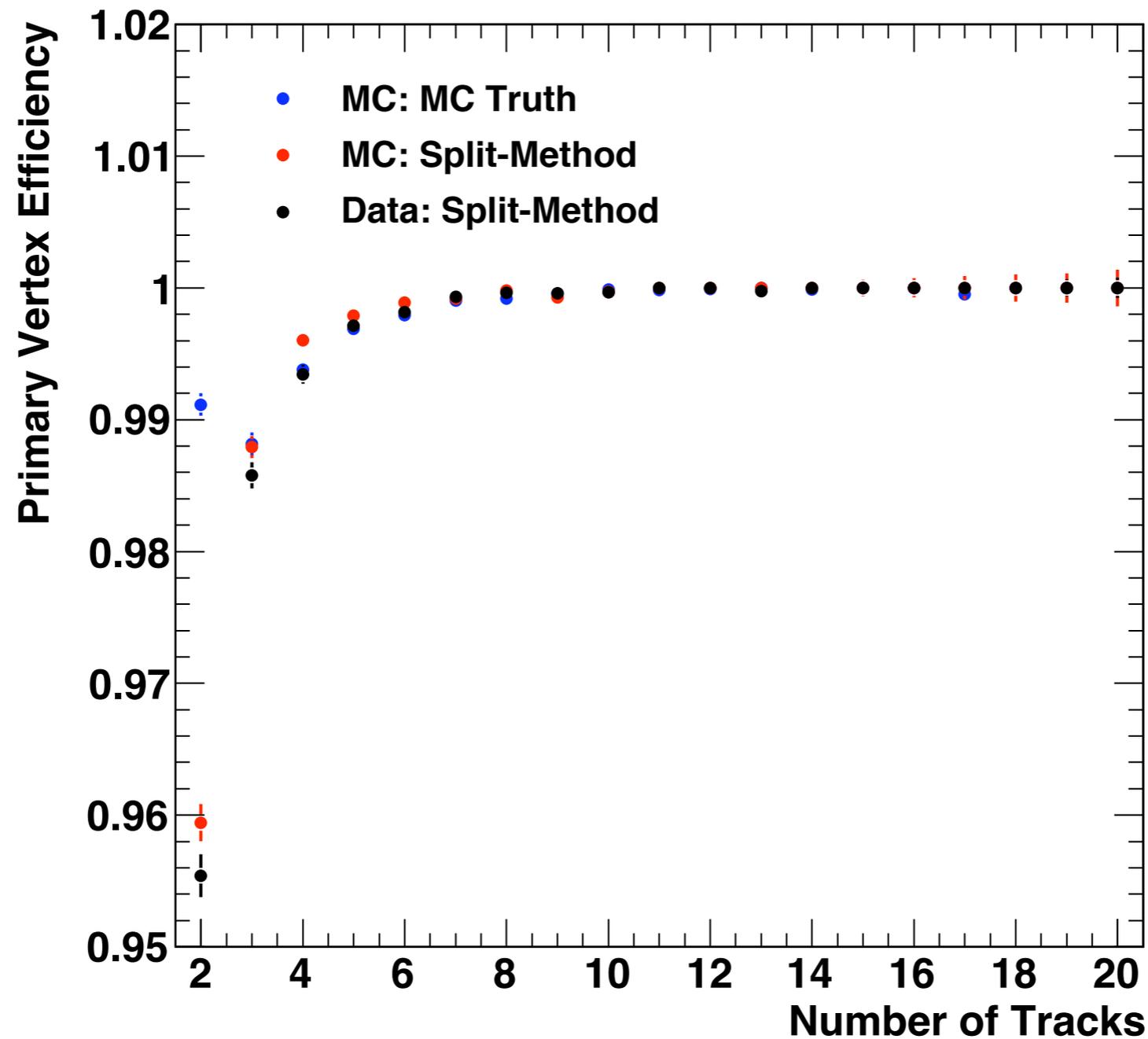
- **Numerator at each nTrack bin**

- Number of events with at least one probe vertex

PV Efficiency Analyzing in MC Truth Method

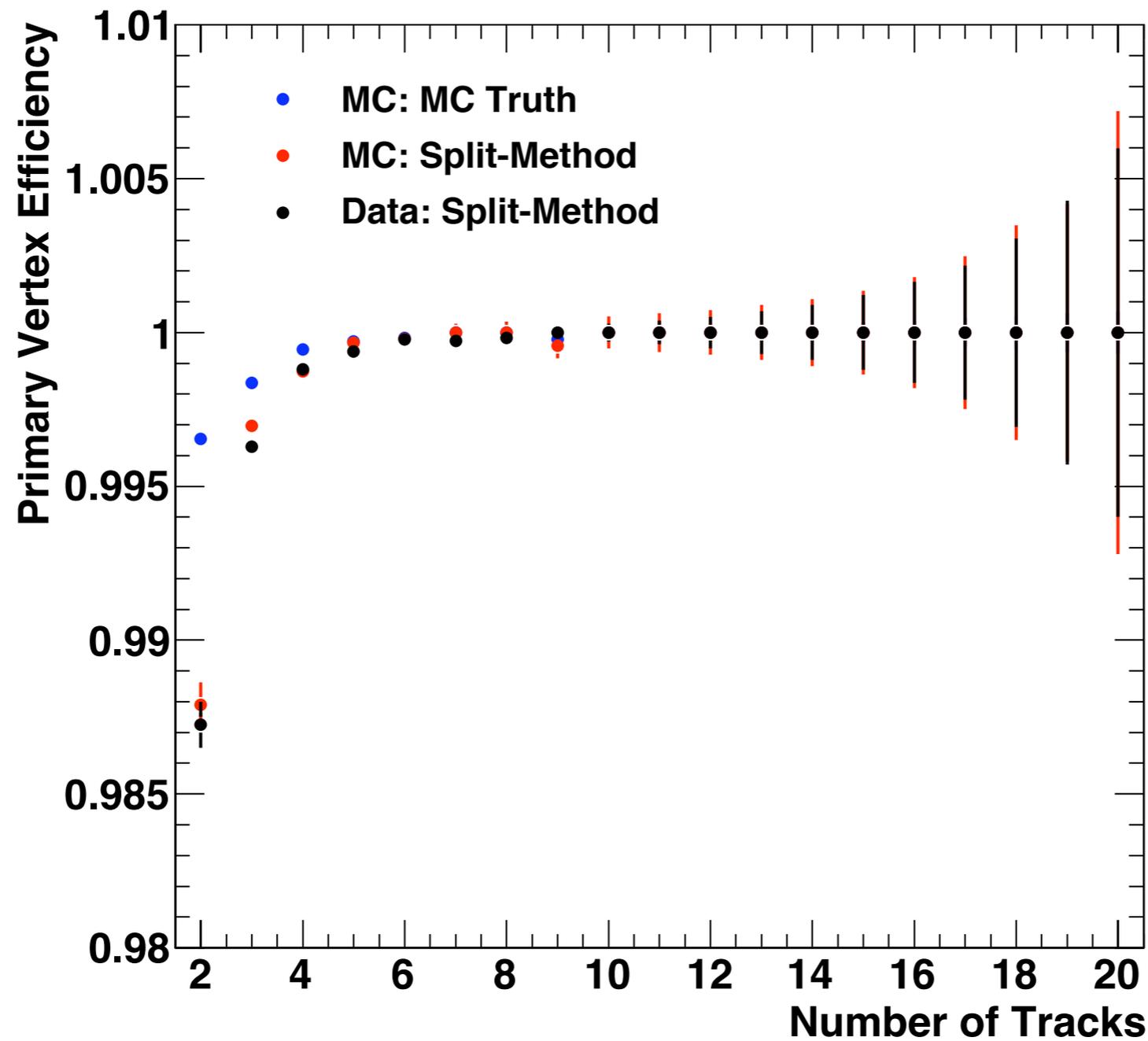
- **Number of Tracks**
 - Number of reco tracks passing the trackFilter and clustered in Z.
 - These tracks are required to be associated to the TrackingParticles, using "TrackAssociatorByHitsRecoDenom"
 - Additional pT cuts are studied (0.5 and 0.9 GeV)
- **Denominator at each nTrack bin**
 - All events
- **Numerator at each nTrack bin**
 - The events that have at least one real vertex reconstructed, and the leading vertex position in z is within 5 sigma from the simulated value

PV Efficiency vs Number of Tracks with no Pt Cut



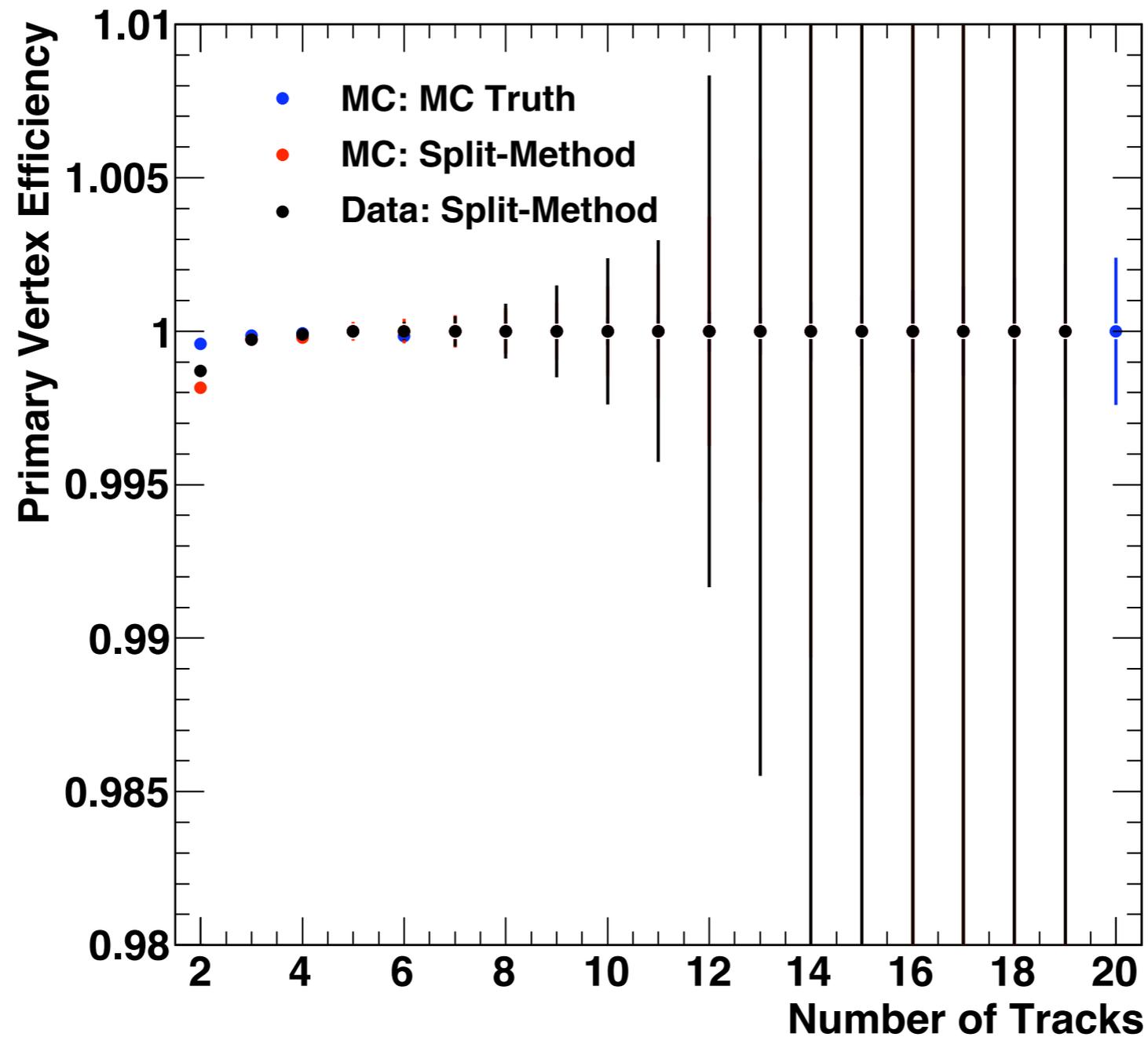
- The results with split-method applied to data and MC agree
- The difference between MC Truth and Split Method on MC is because the low weight tracks are not split according to 1:2 (backup slide 13)

PV Efficiency vs Number of Tracks with $P_t > 0.5 \text{ GeV}$



- The results with split-method applied to data and MC agree
- The results of all methods are within 0.1%
- We propose to use this results as the one to report in the PAS

PV Efficiency vs Number of Tracks with $P_t > 0.9 \text{ GeV}$



- The results with split-method applied to data and MC agree
- The results of all methods are within 0.1%

Summary and Plans

- Summary

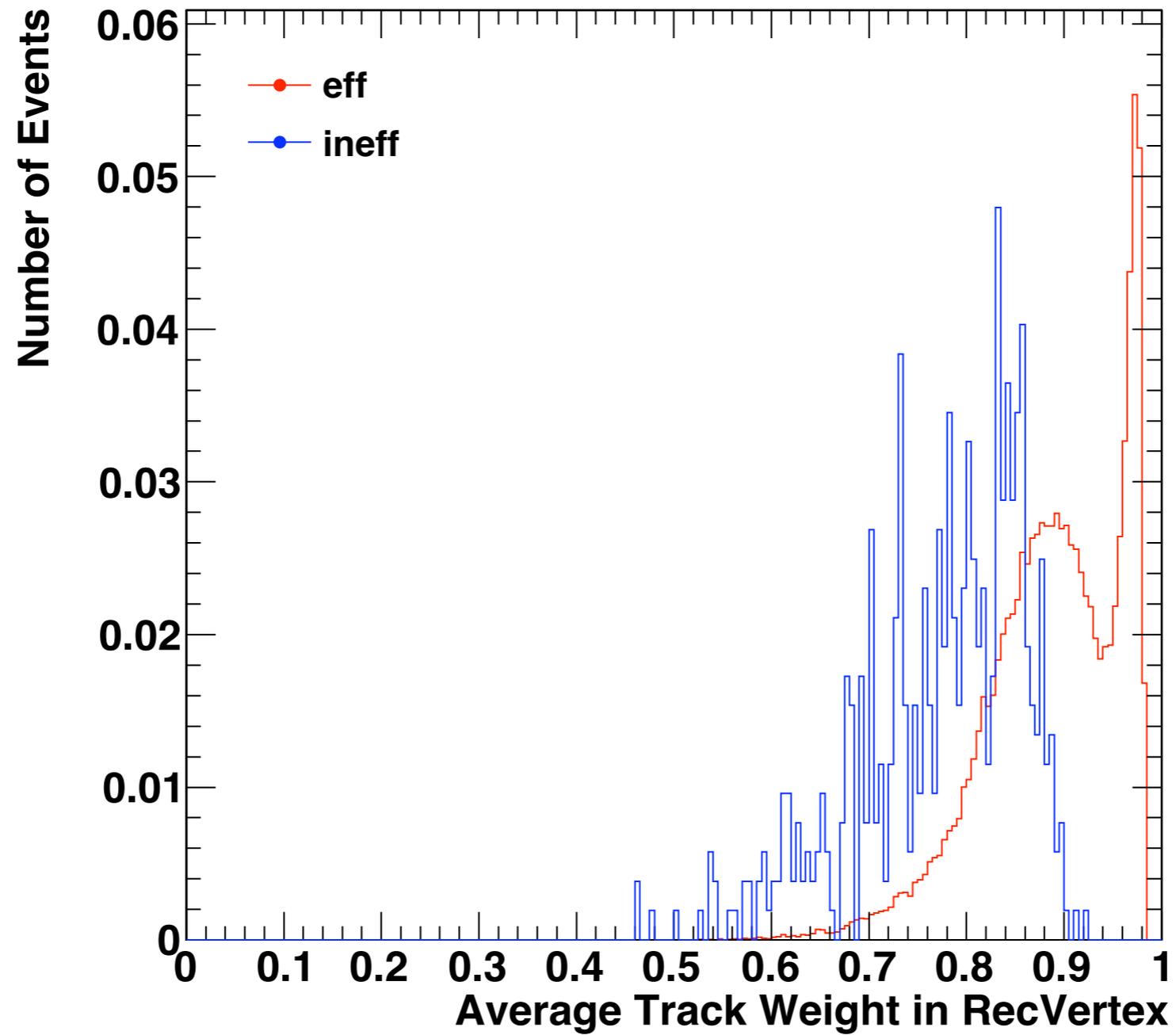
- We introduced a data-driven way to measure primary vertex efficiency
- The method was cross-checked with the MC truth method on the MinBias MC at 7 TeV. A small difference is observed at $nTrack = 2$ bin because the low weight ($< 1E-10$) tracks are not split efficiently
- The split method is applied on the data and the results agree with the results on MC sample
- The PV efficiency is measured to $> 99.5\%$ once the number of tracks with $pT > 0.5\text{GeV}$ exceeds 2

- Plans

- Check the method on the PileUp MCs
- Implement the fake rate measurement similarly

Backup Slides

Average Track Weight Selection Cut



Effect of Low Weight Tracks

If only splitting the tracks with weight $> 1E-10$ in the original vertex

