Determination of reconstruction efficiency

Chatura Kuruppu[1]

[1]New Mexico State University, Las Cruces, NM 88003

September 24, 2025

Abstract

This document outlines the methodology for determining the dimuon reconstruction efficiency required for the Drell-Yan double-differential cross-section measurement. Efficiency correction factors are derived using Monte Carlo simulations and applied to experimental data. The efficiency ϵ is parameterized as a function of the kinematic variables, Feynman-x (x_F) and dimuon invariant mass (m). We detail the procedure for calculating the average efficiency $\langle\epsilon\rangle$ for each kinematic bin by applying a linear interpolation method to data events. The propagation of statistical uncertainties is rigorously derived, and the final correction factors, $1/\langle\epsilon\rangle$, are presented for different datasets and target configurations.

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1 Introduction

We report DY absolute double differntial cross-section for different Mass and x_F bins. It is necessary to correct the reconstruction efficiency for different x_F and Mass bins using Monte-Carlo events. In this study we first generate efficiency curves for different Mass and x_F bins and then calculate average efficiency $< \epsilon >$ using the methodology developped by Harsha and iterating through data (RS67, RS57-70) for each 2-dimensional bin range. Then the correction factor: $1/ < \epsilon >$ will be applied when calculating cross-section.

1.1 Dimuon Events Used

Following files were used to calculate kTracker efficiency for different Mass and x_F bins:

- Following Monte-Carlo files were used to generate efficiency curves for different Mass and x_F bins:
  - mc_drellyan_LH2_M027_S002_messy_occ_pTxFweight_v2.root
  - mc_drellyan_LH2_M027_S002_clean_occ_pTxFweight_v2.root
- Following data files were used to calculate average efficiency for different Mass and x_F bins:
  - R008_roadset67_0_2111v42_tmp_noPhys_noOcc.parquet
  - roadset57_70_R008_2111v42_tmp_noPhys.parquet

The reconstruction efficiency curves were generated for different Mass and x_F bins by taking the ratio:

$$Efficiency\ (\epsilon) = \frac{Number\ of\ messy\ dimuon\ events}{Number\ of\ clean\ dimuon\ events}$$

that passes all event selection cuts. This is calculated as a function of the D2 variable, binned in Feynman-x (x_F) and dimuon mass (m).

1.2 Bin ranges

This efficiency study is conducted by using the same bin ranges defined in Shivangi's cross-section script. Following bins widths are defined to calculate efficiency corrections.

- x_F bins: [0.0, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85]
- Mass bins: [4.2, 4.5, 4.8, 5.1, 5.4, 5.7, 6.0, 6.3, 6.6, 6.9, 7.5, 8.7]

1.3 Event Selection

Following event selection criteria applied to Monte-Carlo events mentioned in section. I am using the same event selection criteria defined by Hugo's analysis.

- Event selection applied to messy events:
  - Base cuts: chuckCutsPositive_2111v42_tmp && chuckCutsNegative_2111v42_tmp && chuckCutsDimuon_2111v42 && physicsCuts_noMassCut_2111v42_tmp && occCuts_2111v42 && DYCut_MC
  - xF cut
  - mass cut

- Event selection applied to clean events:
  - Base cuts: chuckCutsPositive_2111v42_tmp && chuckCutsNegative_2111v42_tmp && chuckCutsDimuon_2111v42 && physicsCuts_noMassCut_2111v42_tmp && DY-Cut_MC
  - xF cut
  - mass cut

1.4 Determination of Efficiency for a Dimuon Event

In order to determine efficiency for each dimuon event in data, I use the same methodology developped by Harsha.

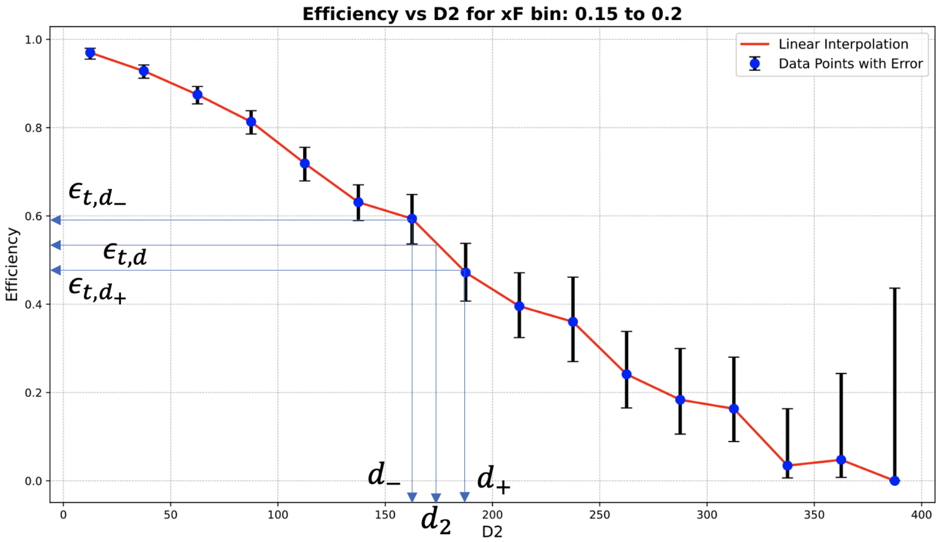


Figure 1: Determination of Efficiency and it's uncertainty

The given formula for the efficiency, denoted by ϵ_{t,d_2}, is a function of ϵ_{t,d_+}, ϵ_{t,d_-}, d_+, d_-, and d_2:

$$\epsilon_{t,d_2} = \epsilon_{t,d_-} - \frac{\epsilon_{t,d_+} - \epsilon_{t,d_-}}{d_+ - d_-}(d_2 - d_-)$$

Our goal is to find the uncertainty of ϵ_{t,d_2}, denoted as $\delta\epsilon_{t,d_2}$, assuming we know the uncertainties $\delta\epsilon_{t,d_+}$ and $\delta\epsilon_{t,d_-}$. The terms d_2, d_+, and d_- are treated as constants with no associated uncertainty.

1.4.1 Error Propagation Method

For a function of multiple variables, such as $\epsilon_{t,d_2}(\epsilon_{t,d_+}, \epsilon_{t,d_-})$, the general formula to propagate uncertainty (assuming the variables are uncorrelated) is:

$$(\delta\epsilon_{t,d_2})^2 = \left(\frac{\partial\epsilon_{t,d_2}}{\partial\epsilon_{t,d_+}}\right)^2 (\delta\epsilon_{t,d_+})^2 + \left(\frac{\partial\epsilon_{t,d_2}}{\partial\epsilon_{t,d_-}}\right)^2 (\delta\epsilon_{t,d_-})^2$$

1.4.2 Step-by-Step Derivation

To find the final uncertainty, we follow three main steps.

1.4.3 Simplify the Expression for ϵ_{t,d_2}

To make the calculation of derivatives more straightforward, we first rearrange the formula for ϵ_{t,d_2}:

$$\epsilon_{t,d_2} = \epsilon_{t,d_-} - \left(\frac{d_2 - d_-}{d_+ - d_-}\right)\epsilon_{t,d_+} + \left(\frac{d_2 - d_-}{d_+ - d_-}\right)\epsilon_{t,d_-}$$

Combining the terms that contain ϵ_{t,d_-}, we get:

$$\epsilon_{t,d_2} = \left(1 + \frac{d_2 - d_-}{d_+ - d_-}\right)\epsilon_{t,d_-} - \left(\frac{d_2 - d_-}{d_+ - d_-}\right)\epsilon_{t,d_+}$$

We can find a common denominator for the term multiplying ϵ_{t,d_-}:

$$\epsilon_{t,d_2} = \left(\frac{d_+ - d_- + d_2 - d_-}{d_+ - d_-}\right)\epsilon_{t,d_-} - \left(\frac{d_2 - d_-}{d_+ - d_-}\right)\epsilon_{t,d_+}$$

This simplifies to:

$$\epsilon_{t,d_2} = \left(\frac{d_+ + d_2 - 2d_-}{d_+ - d_-}\right)\epsilon_{t,d_-} - \left(\frac{d_2 - d_-}{d_+ - d_-}\right)\epsilon_{t,d_+}$$

1.4.4 Calculate the Partial Derivatives

With the simplified expression, we can now find the partial derivatives of ϵ_{t,d_2} with respect to ϵ_{t,d_+} and ϵ_{t,d_-}.

Derivative with respect to ϵ_{t,d_+}:

$$\frac{\partial \epsilon_{t,d_2}}{\partial \epsilon_{t,d_+}} = -\frac{d_2 - d_-}{d_+ - d_-} = \frac{d_- - d_2}{d_+ - d_-}$$

Derivative with respect to ϵ_{t,d_-}:

$$\frac{\partial \epsilon_{t,d_2}}{\partial \epsilon_{t,d_-}} = \frac{d_+ + d_2 - 2d_-}{d_+ - d_-}$$

1.4.5 Uncertainty Formula for one di-muon event

Finally, we substitute these partial derivatives back into the error propagation formula:

$$(\delta\epsilon_{t,d_2})^2 = \left(\frac{d_- - d_2}{d_+ - d_-}\right)^2 (\delta\epsilon_{t,d_+})^2 + \left(\frac{d_+ + d_2 - 2d_-}{d_+ - d_-}\right)^2 (\delta\epsilon_{t,d_-})^2$$

Taking the square root of both sides gives the final expression for the uncertainty, $\delta\epsilon_{t,d_2}$:

$$\delta\epsilon_{t,d_2} = \sqrt{\left(\frac{d_- - d_2}{d_+ - d_-}\right)^2 (\delta\epsilon_{t,d_+})^2 + \left(\frac{d_+ + d_2 - 2d_-}{d_+ - d_-}\right)^2 (\delta\epsilon_{t,d_-})^2}$$

This can also be written in a more compact form by factoring out the denominator:

$$\delta\epsilon_{t,d_2} = \frac{1}{|d_+ - d_-|}\sqrt{(d_- - d_2)^2(\delta\epsilon_{t,d_+})^2 + (d_+ + d_2 - 2d_-)^2(\delta\epsilon_{t,d_-})^2}$$

1.5 Average efficiency and final uncertainty

We determine average efficiency by iterating through all the di-muon events. The final efficiency $\bar{\epsilon}$ If you have N dimuon events, each with a calculated efficiency $(\epsilon_1, \epsilon_2, \ldots, \epsilon_N)$ and a corresponding error $(\delta\epsilon_1, \delta\epsilon_2, \ldots, \delta\epsilon_N)$, you first calculate the **average efficiency**, $\bar{\epsilon}$:

$$\bar{\epsilon} = \frac{1}{N}\sum_{i=1}^{N}\epsilon_i$$

The **error on this average efficiency**, which we'll call $\delta\bar{\epsilon}$, is then given by the standard formula for propagation of error for a sum:

$$\delta\bar{\epsilon} = \frac{1}{N}\sqrt{\sum_{i=1}^{N}(\delta\epsilon_i)^2}$$

This is equivalent to writing the sum of squares explicitly:

$$\delta\bar{\epsilon} = \sqrt{\frac{(\delta\epsilon_1)^2 + (\delta\epsilon_2)^2 + \cdots + (\delta\epsilon_N)^2}{N^2}}$$

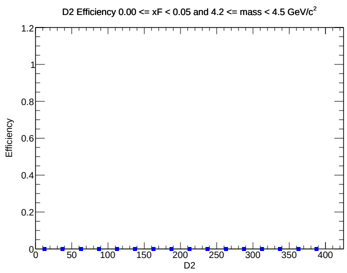
2 Results

Here, we report efficiency corrections under 2 scenerios.

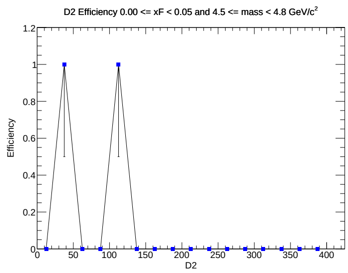
- Efficiency calculation only by using x_F bins (1-D Study)
- Efficiency calculation only by using both x_F and Mass bins (2-D Study)

3 Efficiency Curves by Kinematic Bin

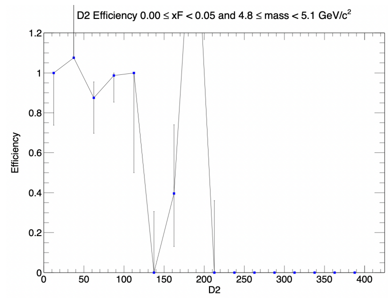
The following pages display the D2 efficiency curves for all 187 kinematic bins. Each page corresponds to a single bin in x_F, with the 11 mass bins for that x_F range arranged as sub-plots.



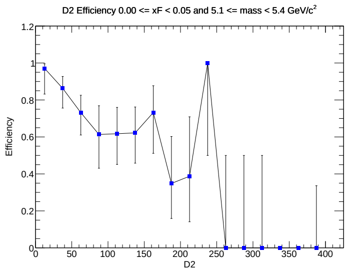
(a) $4.2 \leq m < 4.5$ GeV/c^2



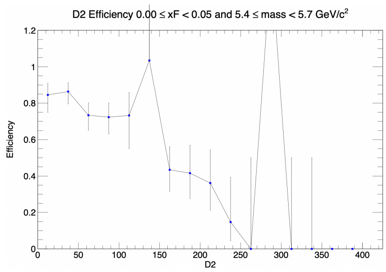
(b) $4.5 \leq m < 4.8$ GeV/c^2



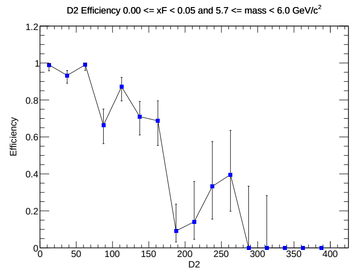
(c) $4.8 \leq m < 5.1$ GeV/c^2



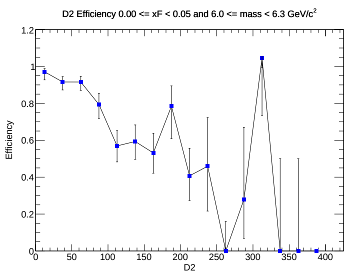
(d) $5.1 \leq m < 5.4$ GeV/c^2



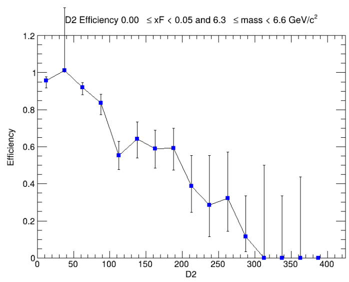
(e) $5.4 \leq m < 5.7$ GeV/c^2



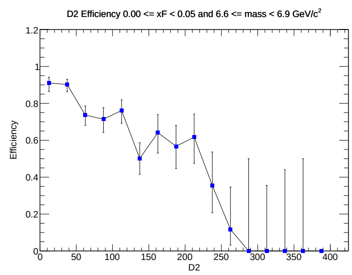
(f) $5.7 \leq m < 6.0$ GeV/c^2



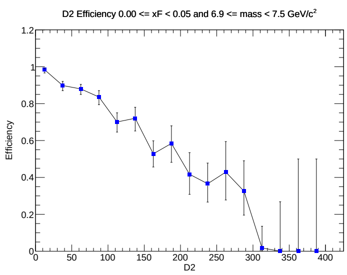
(g) $6.0 \leq m < 6.3$ GeV/c^2



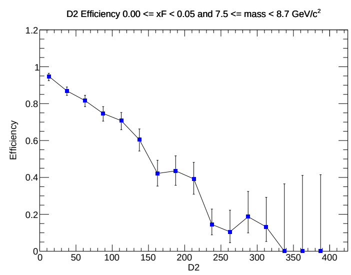
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

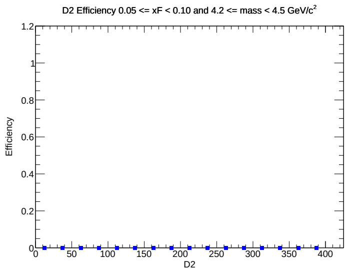


(j) $6.9 \leq m < 7.5$ GeV/c^2

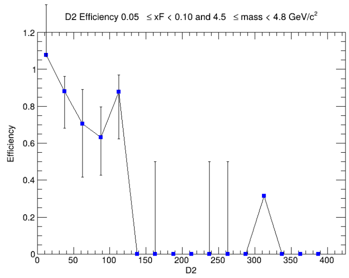


(k) $7.5 \leq m < 8.7$ GeV/c^2

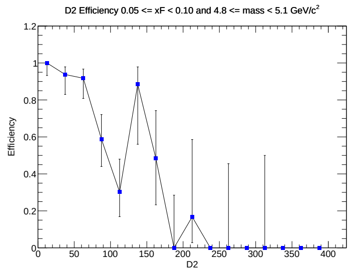
Figure 2: Efficiency plots for the x_F bin $0.00 \leq x_F < 0.05$.



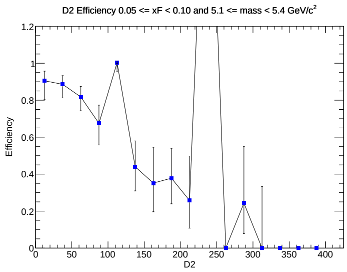
(a) $4.2 \leq m < 4.5$ GeV/c^2



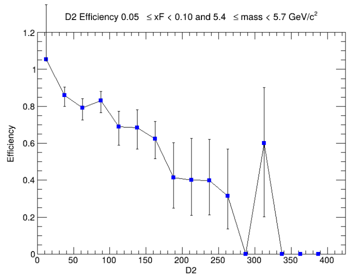
(b) $4.5 \leq m < 4.8$ GeV/c^2



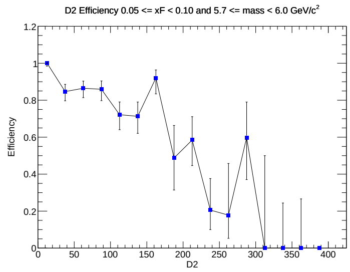
(c) $4.8 \leq m < 5.1$ GeV/c^2



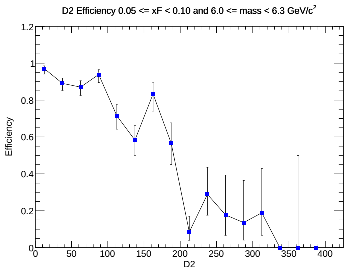
(d) $5.1 \leq m < 5.4$ GeV/c^2



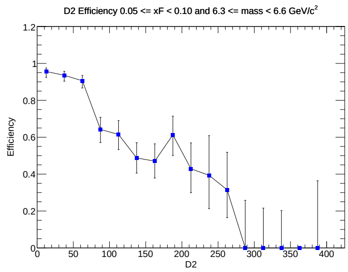
(e) $5.4 \leq m < 5.7$ GeV/c^2



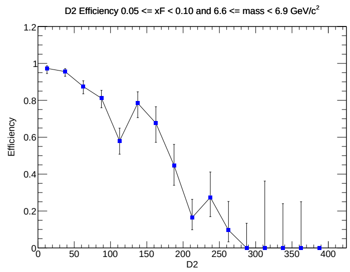
(f) $5.7 \leq m < 6.0$ GeV/c^2



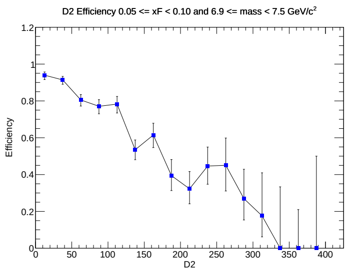
(g) $6.0 \leq m < 6.3$ GeV/c^2



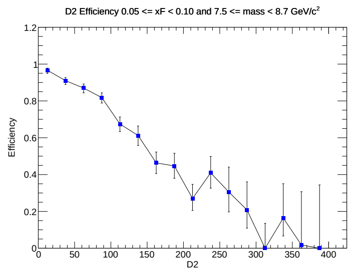
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

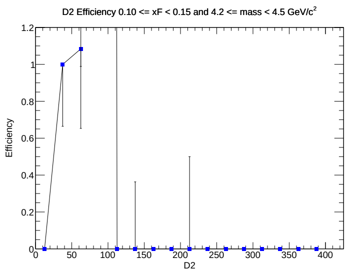


(j) $6.9 \leq m < 7.5$ GeV/c^2

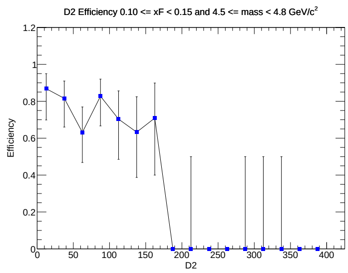


(k) $7.5 \leq m < 8.7$ GeV/c^2

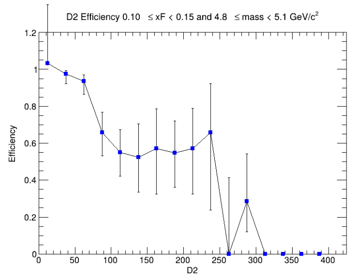
Figure 3: Efficiency plots for the x_F bin $0.05 \leq x_F < 0.10$.



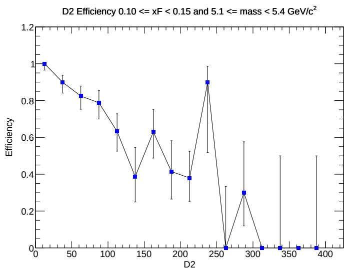
(a) $4.2 \leq m < 4.5$ GeV/c^2



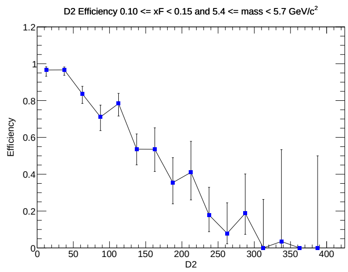
(b) $4.5 \leq m < 4.8$ GeV/c^2



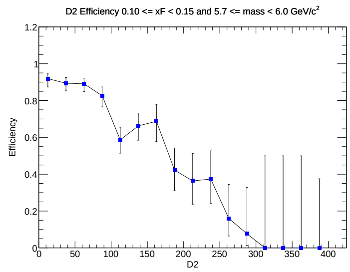
(c) $4.8 \leq m < 5.1$ GeV/c^2



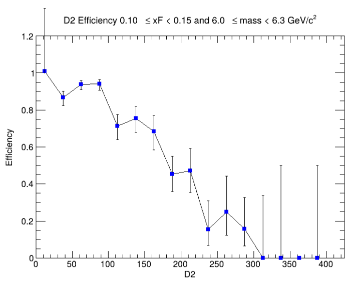
(d) $5.1 \leq m < 5.4$ GeV/c^2



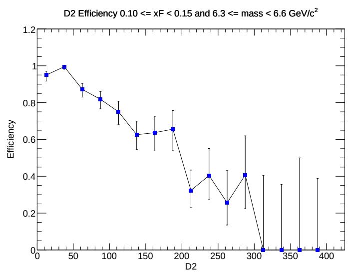
(e) $5.4 \leq m < 5.7$ GeV/c^2



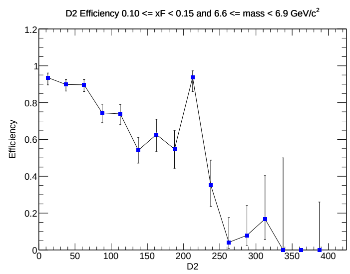
(f) $5.7 \leq m < 6.0$ GeV/c^2



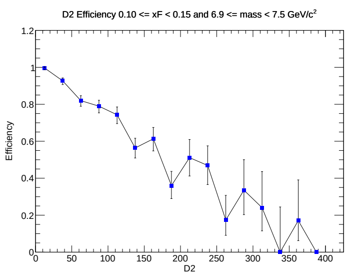
(g) $6.0 \leq m < 6.3$ GeV/c^2



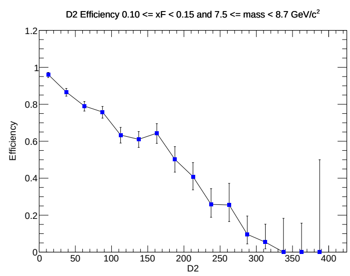
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

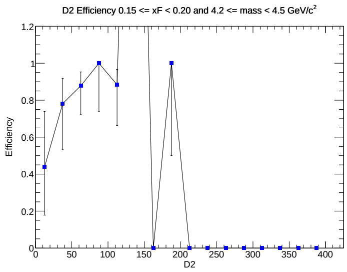


(j) $6.9 \leq m < 7.5$ GeV/c^2

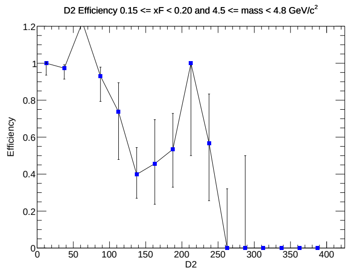


(k) $7.5 \leq m < 8.7$ GeV/c^2

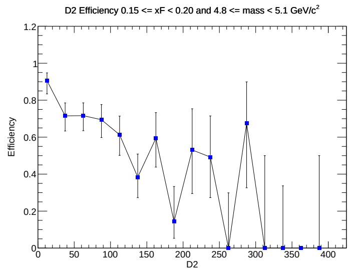
Figure 4: Efficiency plots for the x_F bin $0.10 \leq x_F < 0.15$.



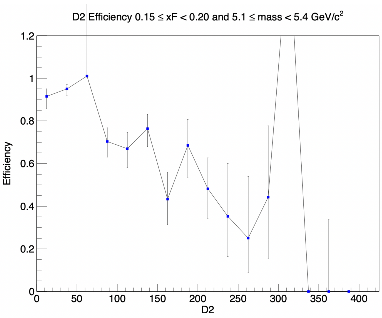
(a) $4.2 \leq m < 4.5$ GeV/c^2



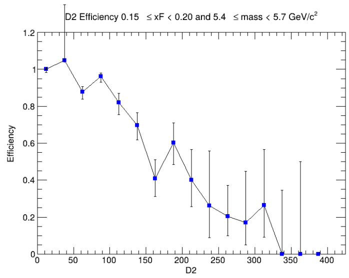
(b) $4.5 \leq m < 4.8$ GeV/c^2



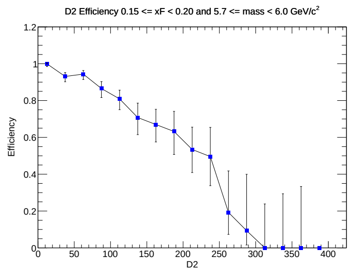
(c) $4.8 \leq m < 5.1$ GeV/c^2



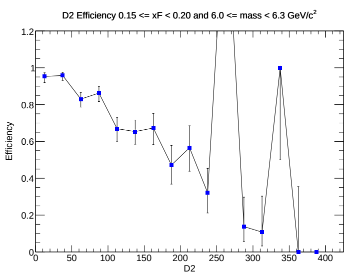
(d) $5.1 \leq m < 5.4$ GeV/c^2



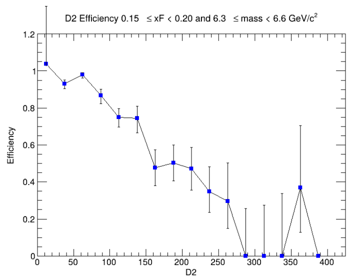
(e) $5.4 \leq m < 5.7$ GeV/c^2



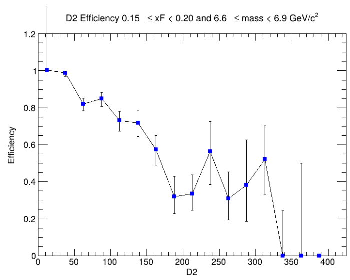
(f) $5.7 \leq m < 6.0$ GeV/c^2



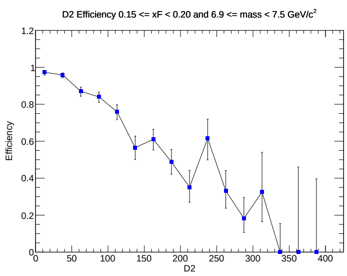
(g) $6.0 \leq m < 6.3$ GeV/c^2



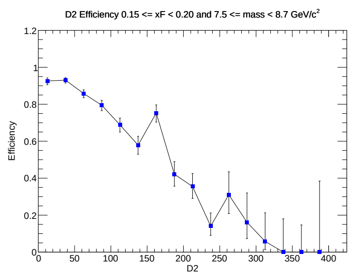
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

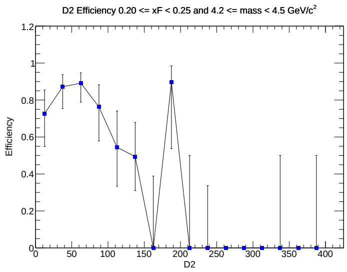


(j) $6.9 \leq m < 7.5$ GeV/c^2

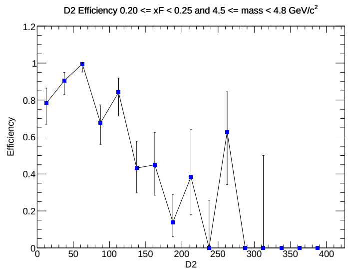


(k) $7.5 \leq m < 8.7$ GeV/c^2

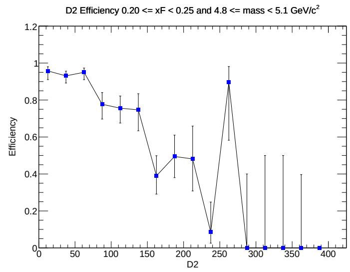
Figure 5: Efficiency plots for the x_F bin $0.15 \leq x_F < 0.20$.



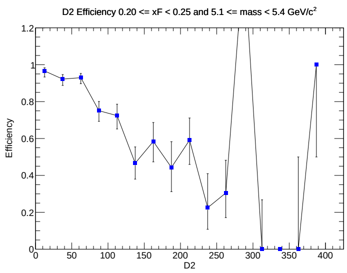
(a) $4.2 \leq m < 4.5$ GeV/c^2



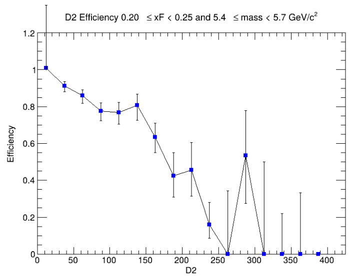
(b) $4.5 \leq m < 4.8$ GeV/c^2



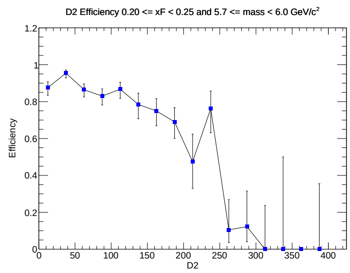
(c) $4.8 \leq m < 5.1$ GeV/c^2



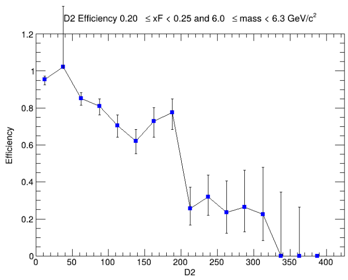
(d) $5.1 \leq m < 5.4$ GeV/c^2



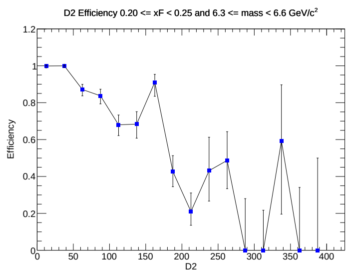
(e) $5.4 \leq m < 5.7$ GeV/c^2



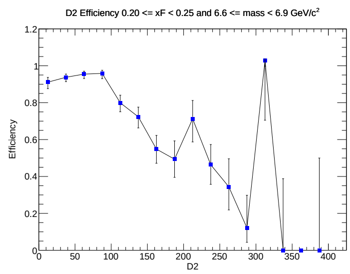
(f) $5.7 \leq m < 6.0$ GeV/c^2



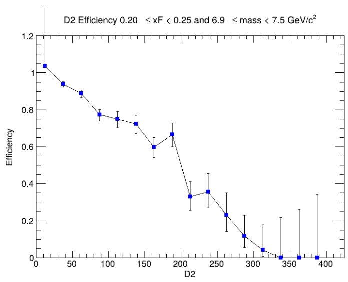
(g) $6.0 \leq m < 6.3$ GeV/c^2



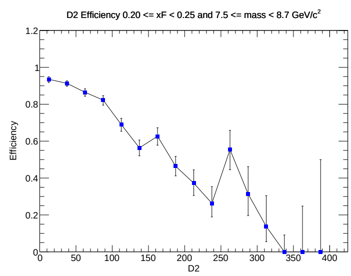
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

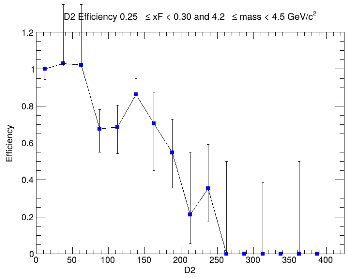


(j) $6.9 \leq m < 7.5$ GeV/c^2

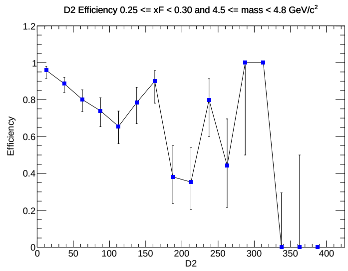


(k) $7.5 \leq m < 8.7$ GeV/c^2

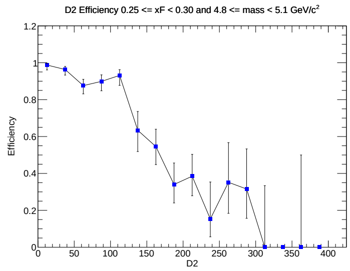
Figure 6: Efficiency plots for the x_F bin $0.20 \leq x_F < 0.25$.



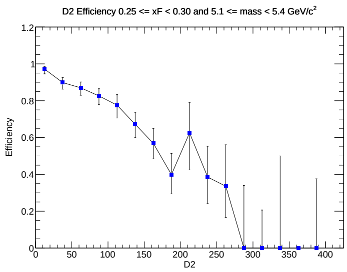
(a) $4.2 \leq m < 4.5$ GeV/c^2



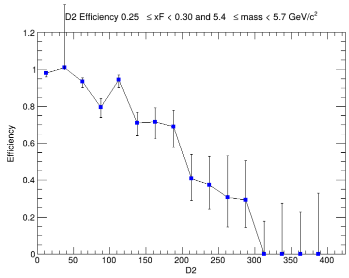
(b) $4.5 \leq m < 4.8$ GeV/c^2



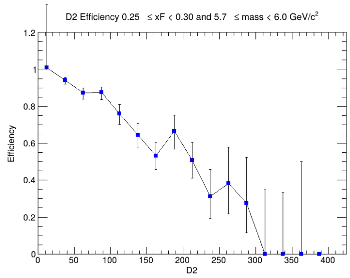
(c) $4.8 \leq m < 5.1$ GeV/c^2



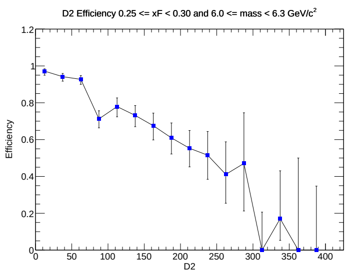
(d) $5.1 \leq m < 5.4$ GeV/c^2



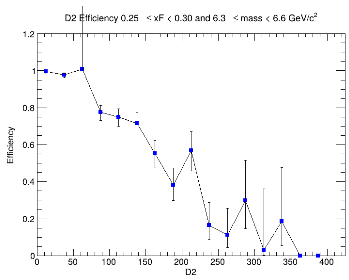
(e) $5.4 \leq m < 5.7$ GeV/c^2



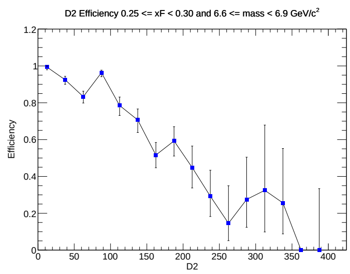
(f) $5.7 \leq m < 6.0$ GeV/c^2



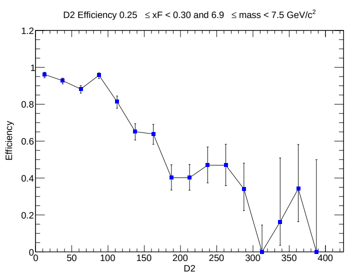
(g) $6.0 \leq m < 6.3$ GeV/c^2



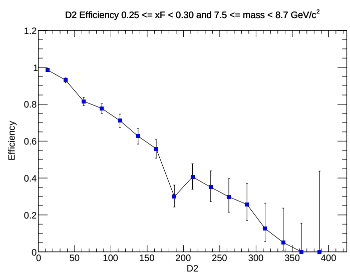
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

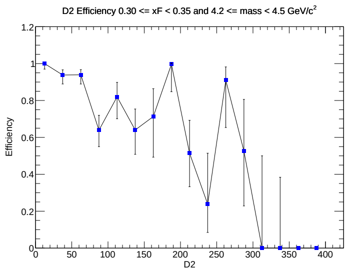


(j) $6.9 \leq m < 7.5$ GeV/c^2

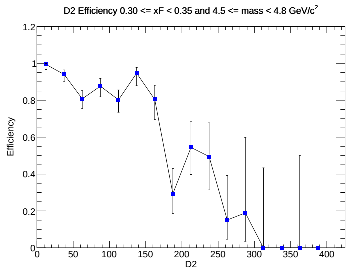


(k) $7.5 \leq m < 8.7$ GeV/c^2

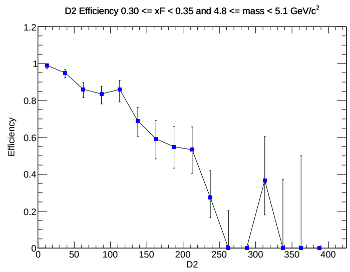
Figure 7: Efficiency plots for the x_F bin $0.25 \leq x_F < 0.30$.



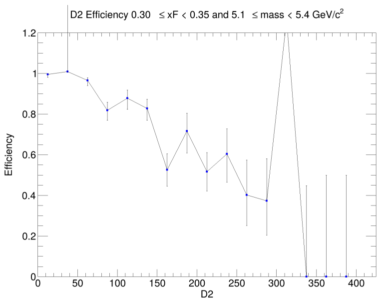
(a) $4.2 \leq m < 4.5$ GeV/c^2



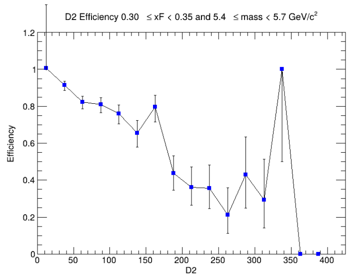
(b) $4.5 \leq m < 4.8$ GeV/c^2



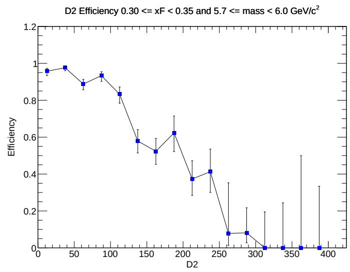
(c) $4.8 \leq m < 5.1$ GeV/c^2



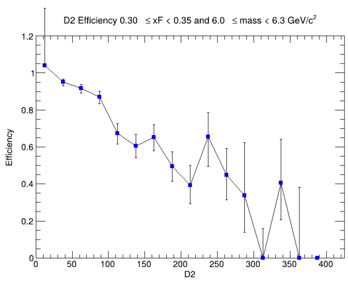
(d) $5.1 \leq m < 5.4$ GeV/c^2



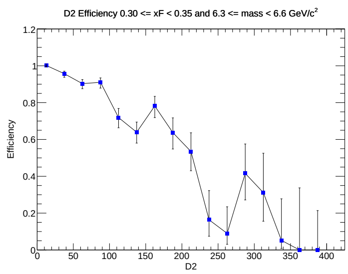
(e) $5.4 \leq m < 5.7$ GeV/c^2



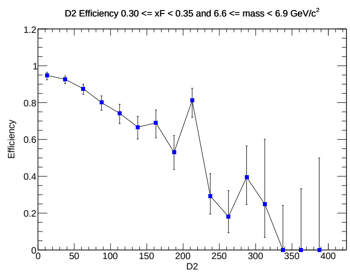
(f) $5.7 \leq m < 6.0$ GeV/c^2



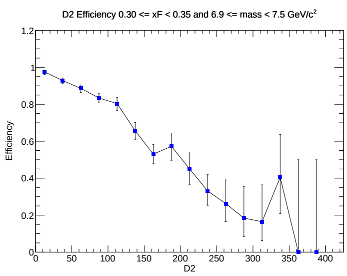
(g) $6.0 \leq m < 6.3$ GeV/c^2



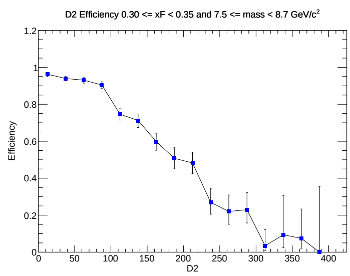
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

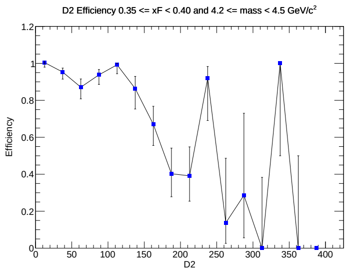


(j) $6.9 \leq m < 7.5$ GeV/c^2

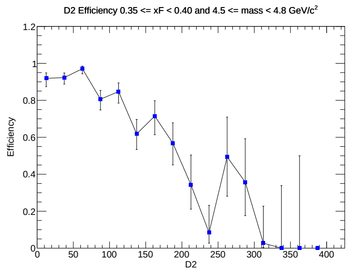


(k) $7.5 \leq m < 8.7$ GeV/c^2

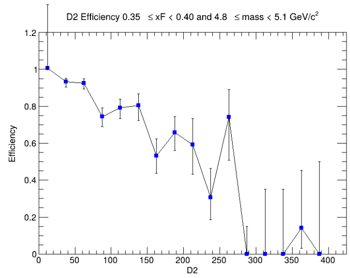
Figure 8: Efficiency plots for the x_F bin $0.30 \leq x_F < 0.35$.



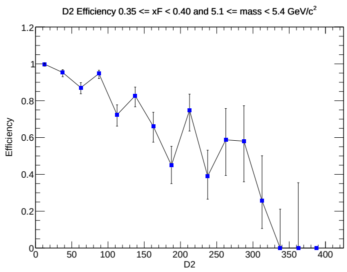
(a) $4.2 \leq m < 4.5$ GeV$/c^2$



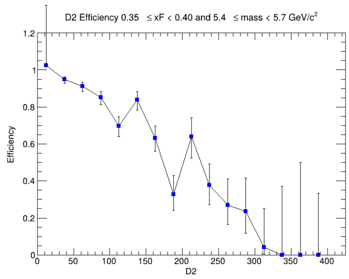
(b) $4.5 \leq m < 4.8$ GeV$/c^2$



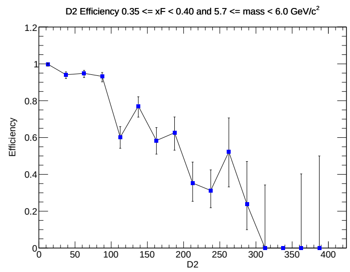
(c) $4.8 \leq m < 5.1$ GeV$/c^2$



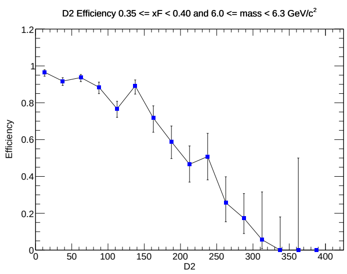
(d) $5.1 \leq m < 5.4$ GeV$/c^2$



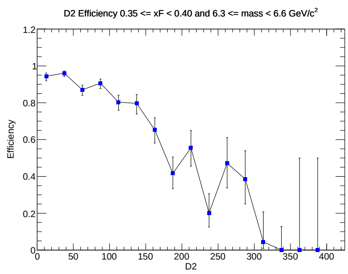
(e) $5.4 \leq m < 5.7$ GeV$/c^2$



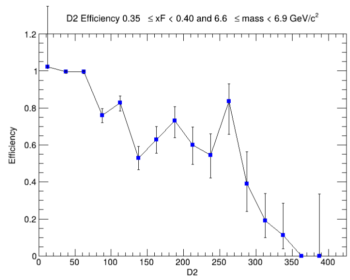
(f) $5.7 \leq m < 6.0$ GeV$/c^2$



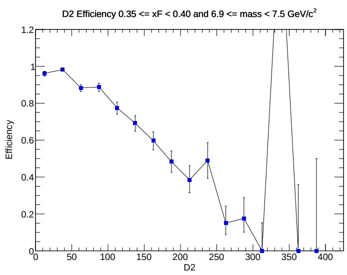
(g) $6.0 \leq m < 6.3$ GeV$/c^2$



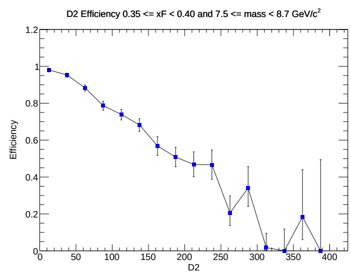
(h) $6.3 \leq m < 6.6$ GeV$/c^2$



(i) $6.6 \leq m < 6.9$ GeV$/c^2$

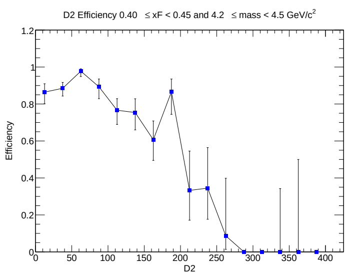


(j) $6.9 \leq m < 7.5$ GeV$/c^2$

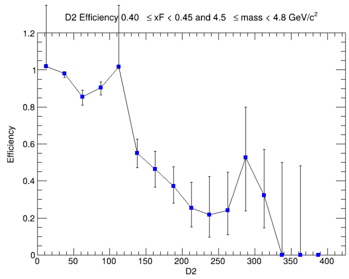


(k) $7.5 \leq m < 8.7$ GeV$/c^2$

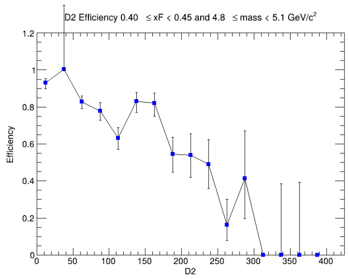
Figure 9: Efficiency plots for the x_F bin $0.35 \leq x_F < 0.40$.



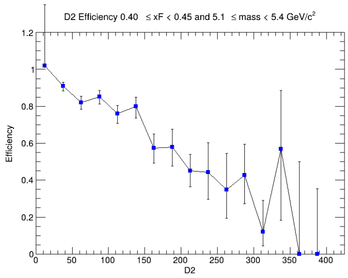
(a) $4.2 \leq m < 4.5$ GeV$/c^2$



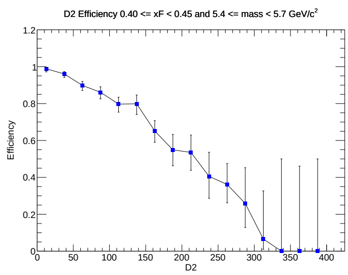
(b) $4.5 \leq m < 4.8$ GeV$/c^2$



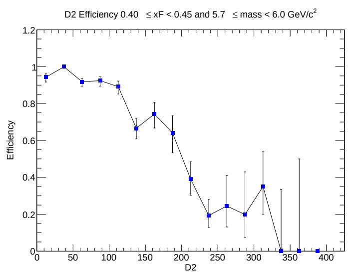
(c) $4.8 \leq m < 5.1$ GeV$/c^2$



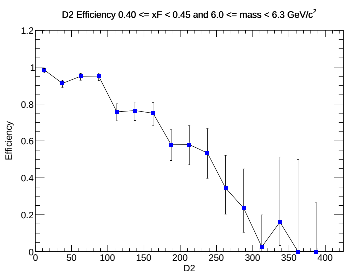
(d) $5.1 \leq m < 5.4$ GeV$/c^2$



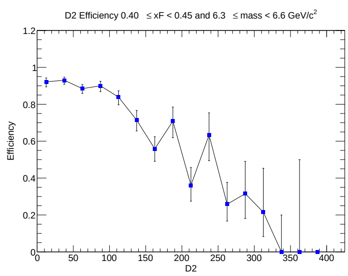
(e) $5.4 \leq m < 5.7$ GeV$/c^2$



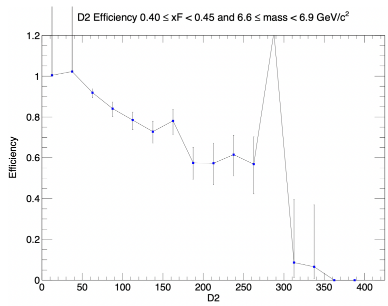
(f) $5.7 \leq m < 6.0$ GeV$/c^2$



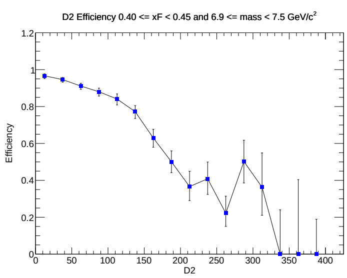
(g) $6.0 \leq m < 6.3$ GeV$/c^2$



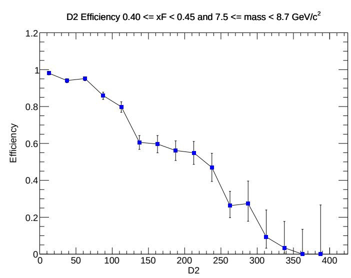
(h) $6.3 \leq m < 6.6$ GeV$/c^2$



(i) $6.6 \leq m < 6.9$ GeV$/c^2$

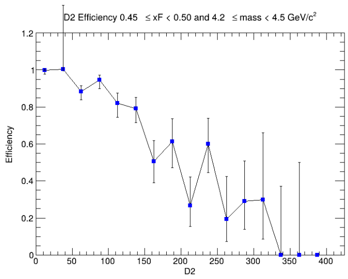


(j) $6.9 \leq m < 7.5$ GeV$/c^2$

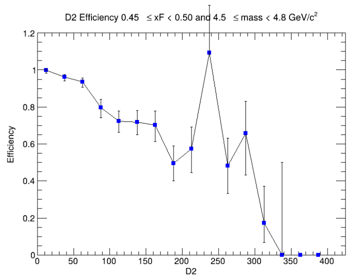


(k) $7.5 \leq m < 8.7$ GeV$/c^2$

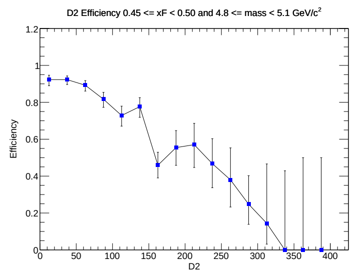
Figure 10: Efficiency plots for the x_F bin $0.40 \leq x_F < 0.45$.



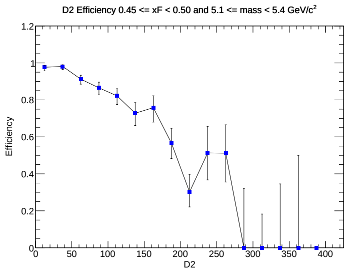
(a) $4.2 \leq m < 4.5$ GeV/c^2



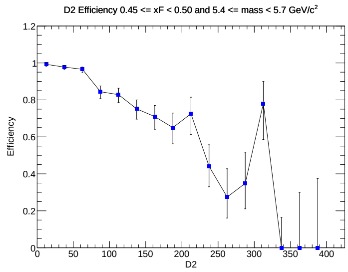
(b) $4.5 \leq m < 4.8$ GeV/c^2



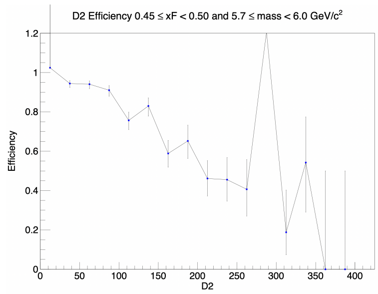
(c) $4.8 \leq m < 5.1$ GeV/c^2



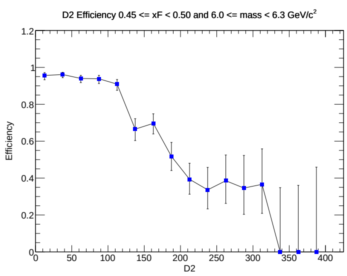
(d) $5.1 \leq m < 5.4$ GeV/c^2



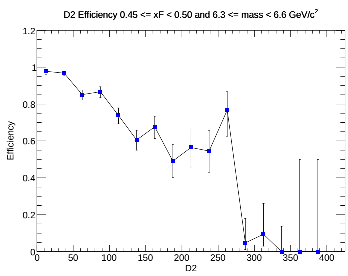
(e) $5.4 \leq m < 5.7$ GeV/c^2



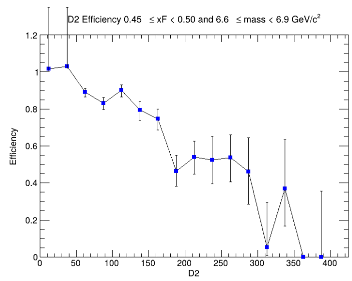
(f) $5.7 \leq m < 6.0$ GeV/c^2



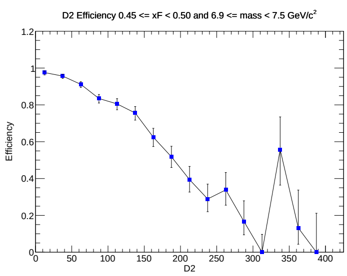
(g) $6.0 \leq m < 6.3$ GeV/c^2



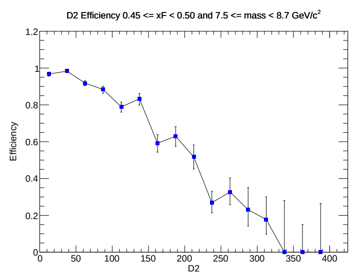
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

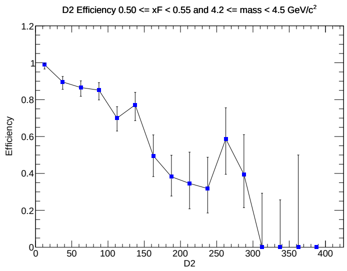


(j) $6.9 \leq m < 7.5$ GeV/c^2

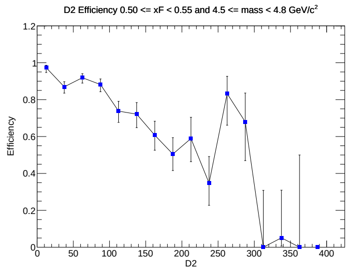


(k) $7.5 \leq m < 8.7$ GeV/c^2

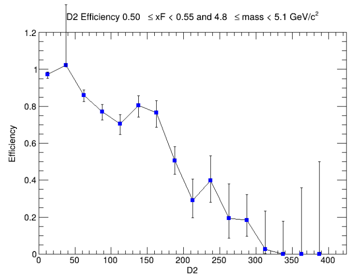
Figure 11: Efficiency plots for the x_F bin $0.45 \leq x_F < 0.50$.



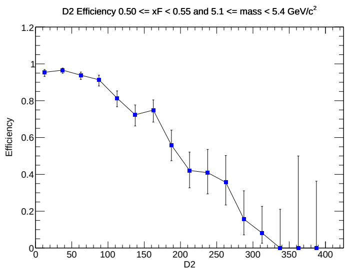
(a) $4.2 \leq m < 4.5$ GeV/c^2



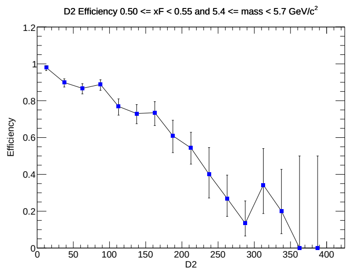
(b) $4.5 \leq m < 4.8$ GeV/c^2



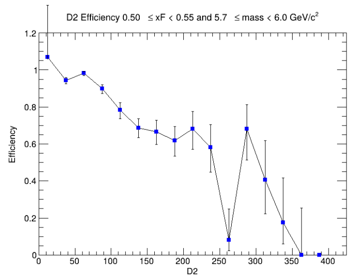
(c) $4.8 \leq m < 5.1$ GeV/c^2



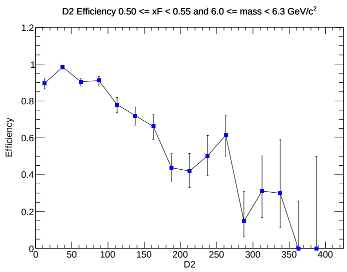
(d) $5.1 \leq m < 5.4$ GeV/c^2



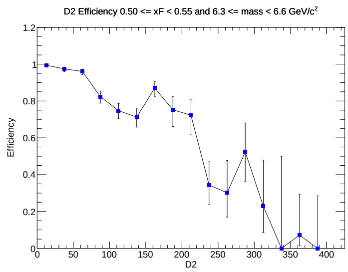
(e) $5.4 \leq m < 5.7$ GeV/c^2



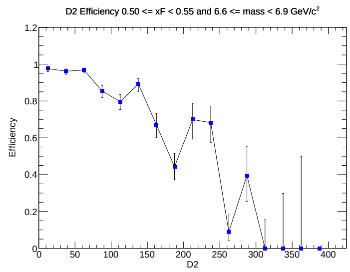
(f) $5.7 \leq m < 6.0$ GeV/c^2



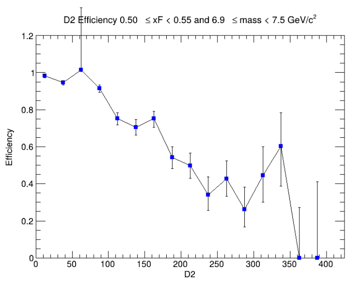
(g) $6.0 \leq m < 6.3$ GeV/c^2



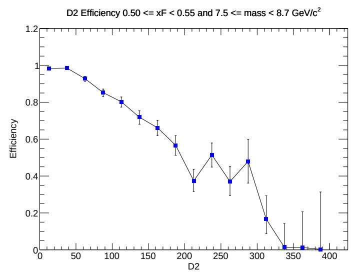
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

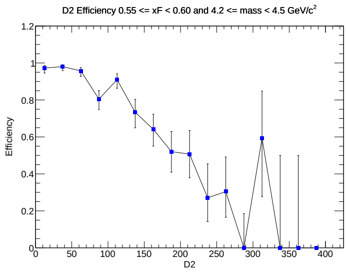


(j) $6.9 \leq m < 7.5$ GeV/c^2

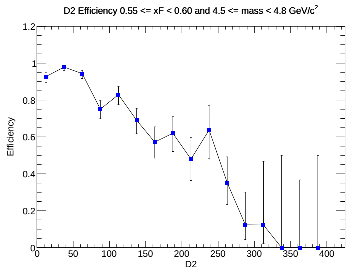


(k) $7.5 \leq m < 8.7$ GeV/c^2

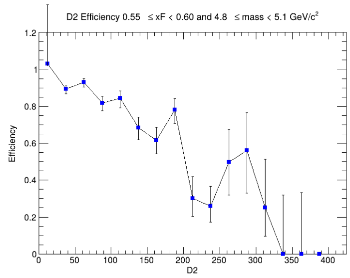
Figure 12: Efficiency plots for the x_F bin $0.50 \leq x_F < 0.55$.



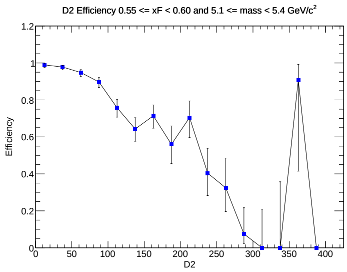
(a) $4.2 \leq m < 4.5$ GeV/c^2



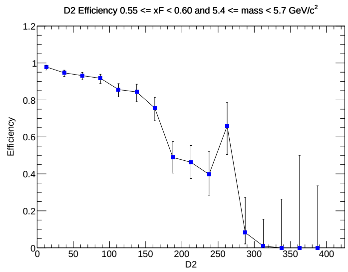
(b) $4.5 \leq m < 4.8$ GeV/c^2



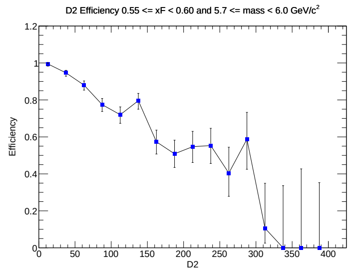
(c) $4.8 \leq m < 5.1$ GeV/c^2



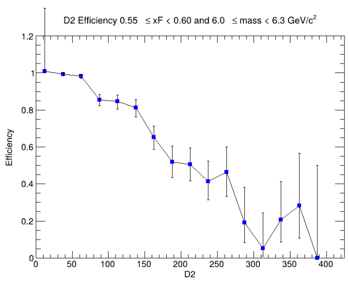
(d) $5.1 \leq m < 5.4$ GeV/c^2



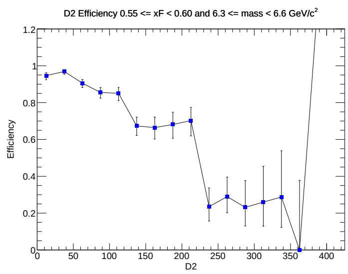
(e) $5.4 \leq m < 5.7$ GeV/c^2



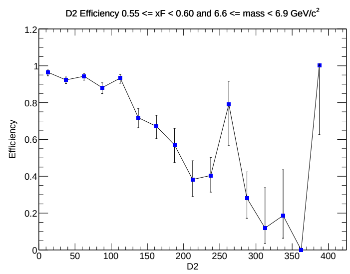
(f) $5.7 \leq m < 6.0$ GeV/c^2



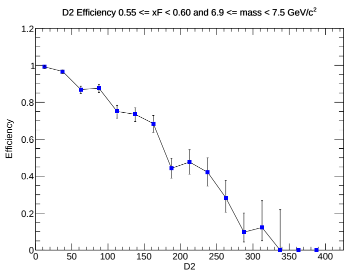
(g) $6.0 \leq m < 6.3$ GeV/c^2



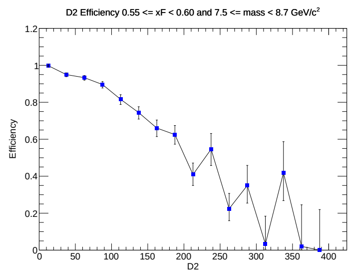
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

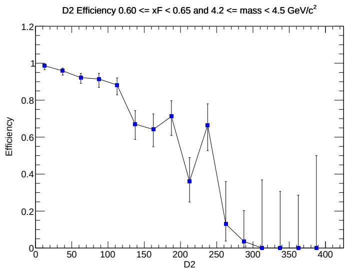


(j) $6.9 \leq m < 7.5$ GeV/c^2

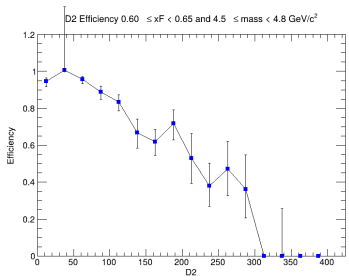


(k) $7.5 \leq m < 8.7$ GeV/c^2

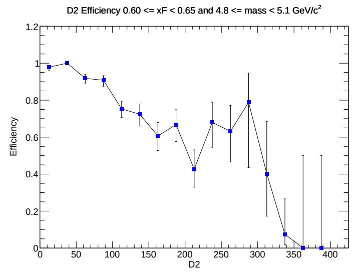
Figure 13: Efficiency plots for the x_F bin $0.55 \leq x_F < 0.60$.



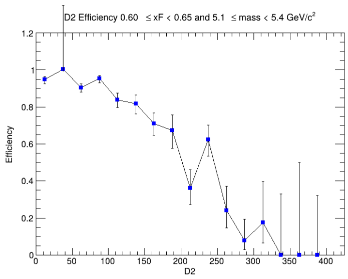
(a) $4.2 \leq m < 4.5$ GeV/c^2



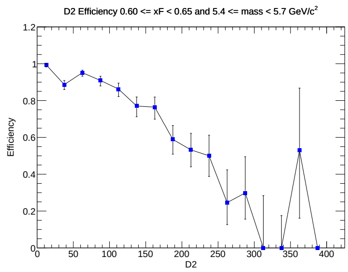
(b) $4.5 \leq m < 4.8$ GeV/c^2



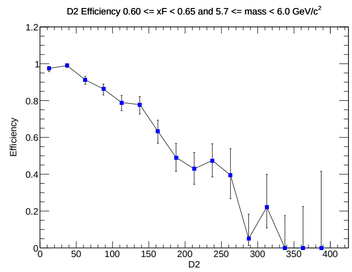
(c) $4.8 \leq m < 5.1$ GeV/c^2



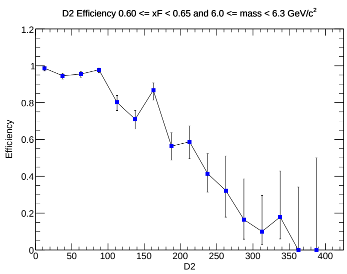
(d) $5.1 \leq m < 5.4$ GeV/c^2



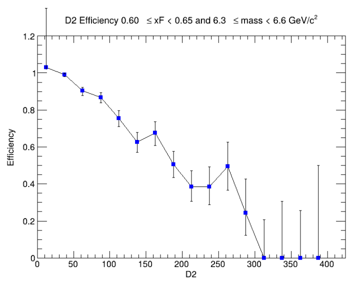
(e) $5.4 \leq m < 5.7$ GeV/c^2



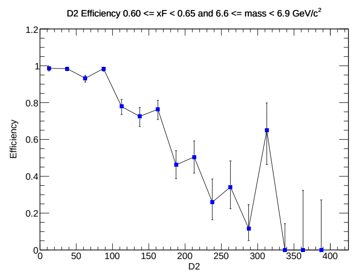
(f) $5.7 \leq m < 6.0$ GeV/c^2



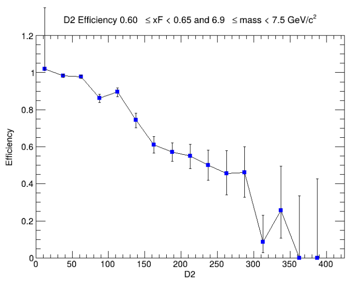
(g) $6.0 \leq m < 6.3$ GeV/c^2



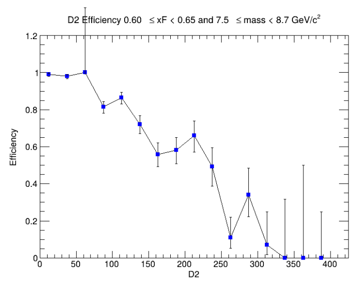
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

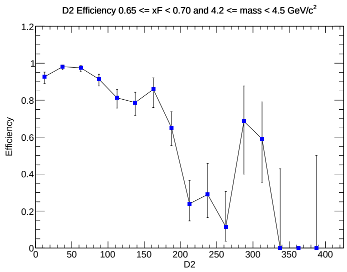


(j) $6.9 \leq m < 7.5$ GeV/c^2

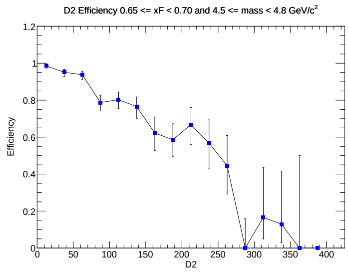


(k) $7.5 \leq m < 8.7$ GeV/c^2

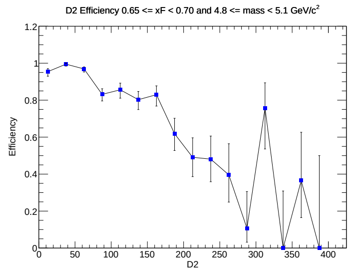
Figure 14: Efficiency plots for the x_F bin $0.60 \leq x_F < 0.65$.



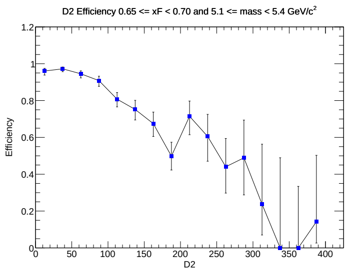
(a) $4.2 \leq m < 4.5$ GeV/c^2



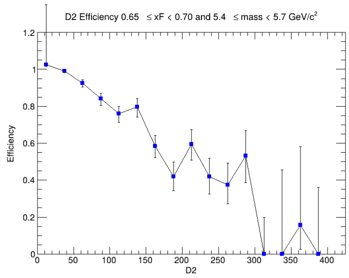
(b) $4.5 \leq m < 4.8$ GeV/c^2



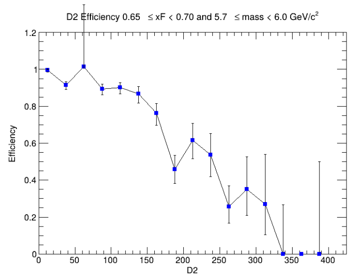
(c) $4.8 \leq m < 5.1$ GeV/c^2



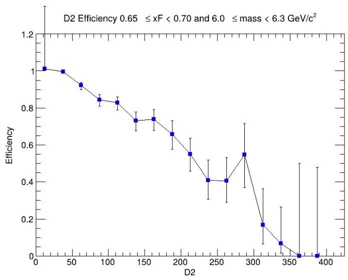
(d) $5.1 \leq m < 5.4$ GeV/c^2



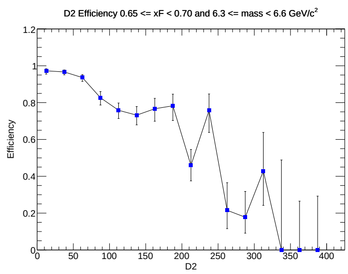
(e) $5.4 \leq m < 5.7$ GeV/c^2



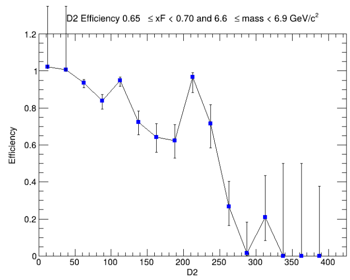
(f) $5.7 \leq m < 6.0$ GeV/c^2



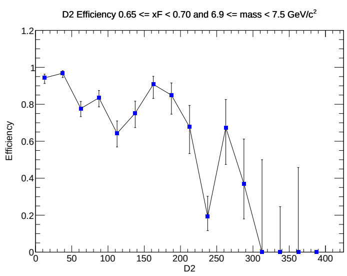
(g) $6.0 \leq m < 6.3$ GeV/c^2



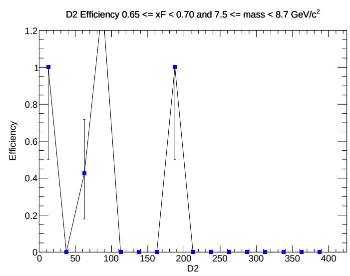
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

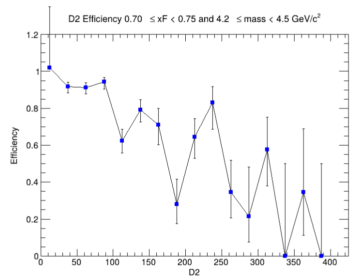


(j) $6.9 \leq m < 7.5$ GeV/c^2

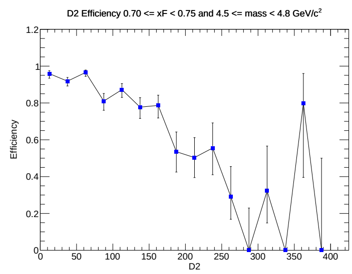


(k) $7.5 \leq m < 8.7$ GeV/c^2

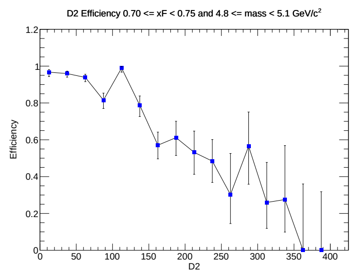
Figure 15: Efficiency plots for the x_F bin $0.65 \leq x_F < 0.70$.



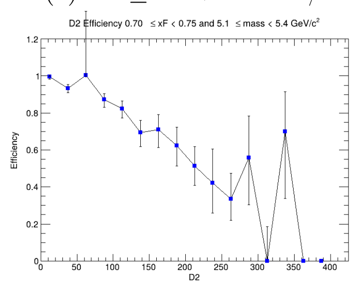
(a) $4.2 \leq m < 4.5$ GeV/c^2



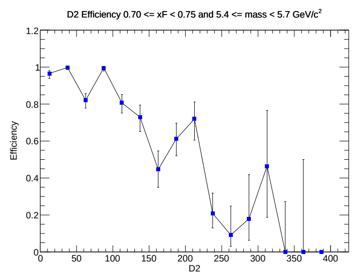
(b) $4.5 \leq m < 4.8$ GeV/c^2



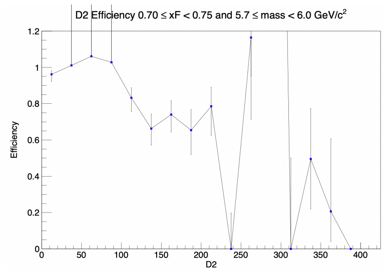
(c) $4.8 \leq m < 5.1$ GeV/c^2



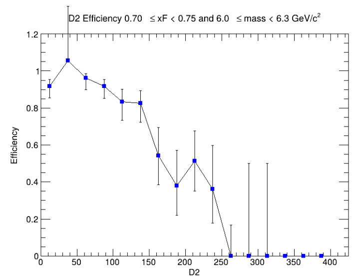
(d) $5.1 \leq m < 5.4$ GeV/c^2



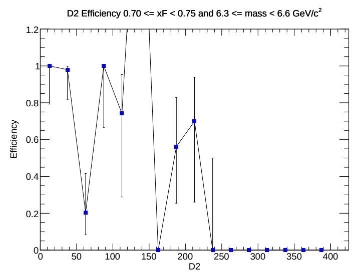
(e) $5.4 \leq m < 5.7$ GeV/c^2



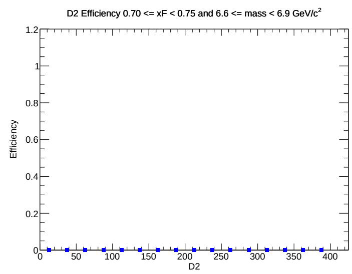
(f) $5.7 \leq m < 6.0$ GeV/c^2



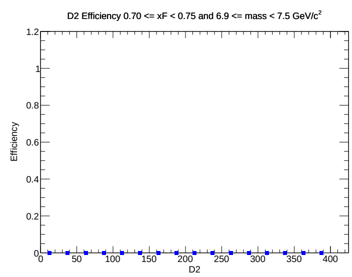
(g) $6.0 \leq m < 6.3$ GeV/c^2



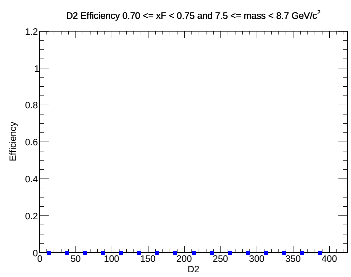
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

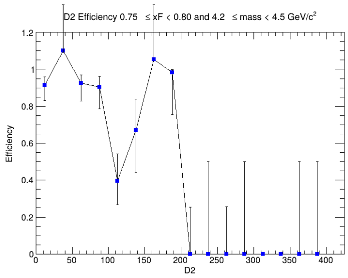


(j) $6.9 \leq m < 7.5$ GeV/c^2

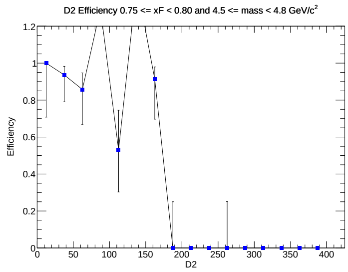


(k) $7.5 \leq m < 8.7$ GeV/c^2

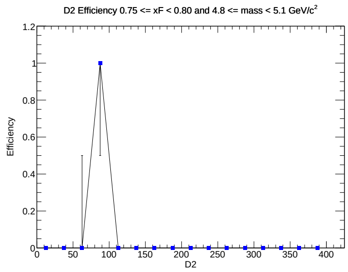
Figure 16: Efficiency plots for the x_F bin $0.70 \leq x_F < 0.75$.



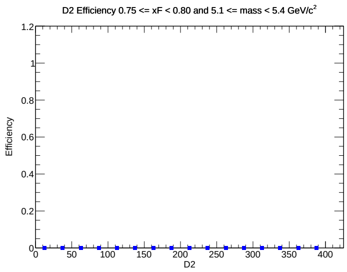
(a) $4.2 \leq m < 4.5$ GeV/c^2



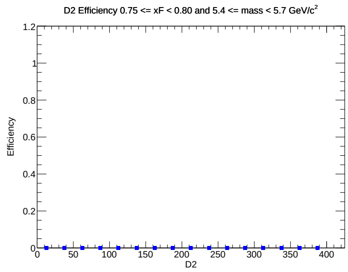
(b) $4.5 \leq m < 4.8$ GeV/c^2



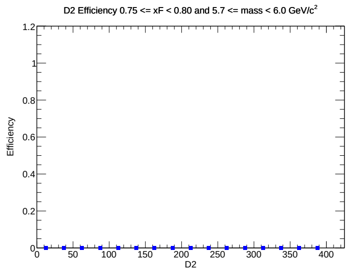
(c) $4.8 \leq m < 5.1$ GeV/c^2



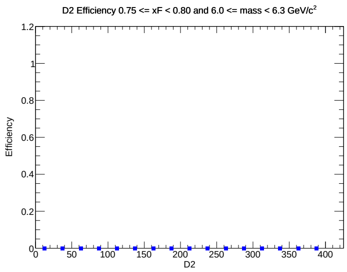
(d) $5.1 \leq m < 5.4$ GeV/c^2



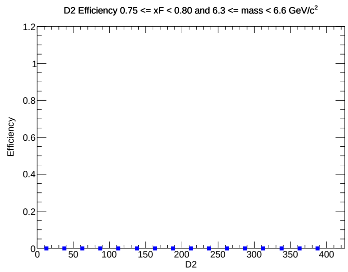
(e) $5.4 \leq m < 5.7$ GeV/c^2



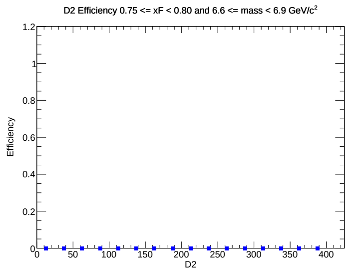
(f) $5.7 \leq m < 6.0$ GeV/c^2



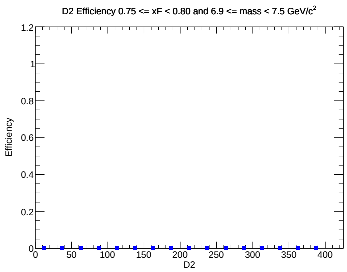
(g) $6.0 \leq m < 6.3$ GeV/c^2



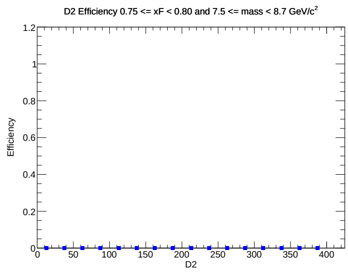
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2

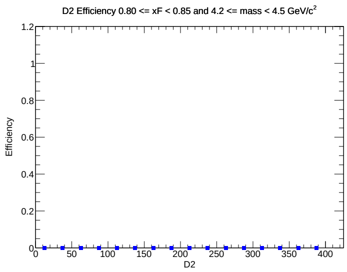


(j) $6.9 \leq m < 7.5$ GeV/c^2

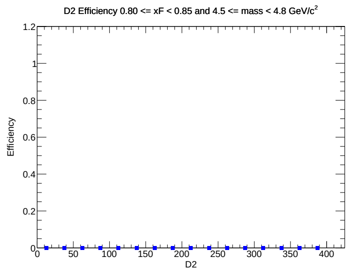


(k) $7.5 \leq m < 8.7$ GeV/c^2

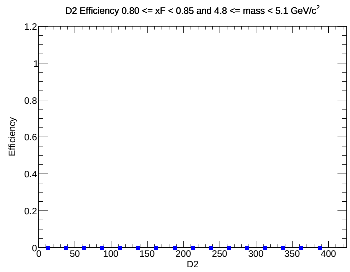
Figure 17: Efficiency plots for the x_F bin $0.75 \leq x_F < 0.80$.



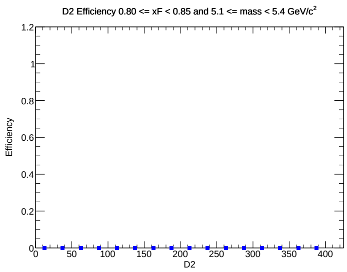
(a) $4.2 \leq m < 4.5$ GeV/c^2



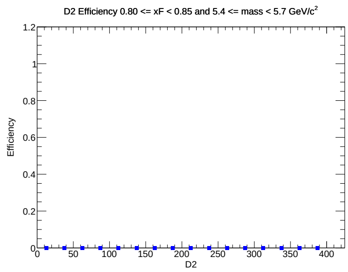
(b) $4.5 \leq m < 4.8$ GeV/c^2



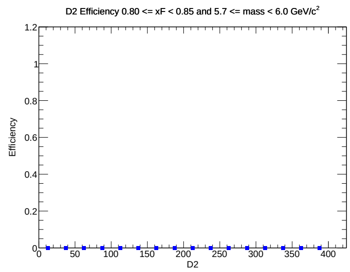
(c) $4.8 \leq m < 5.1$ GeV/c^2



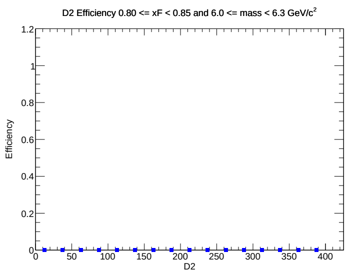
(d) $5.1 \leq m < 5.4$ GeV/c^2



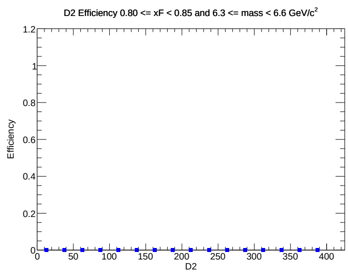
(e) $5.4 \leq m < 5.7$ GeV/c^2



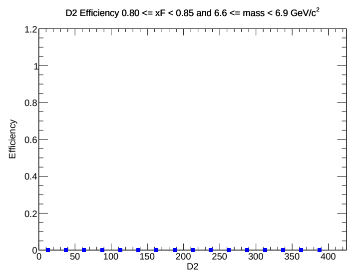
(f) $5.7 \leq m < 6.0$ GeV/c^2



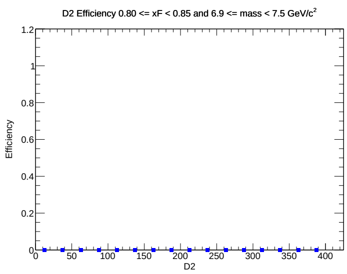
(g) $6.0 \leq m < 6.3$ GeV/c^2



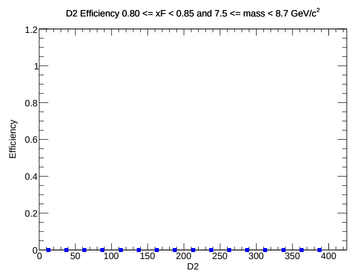
(h) $6.3 \leq m < 6.6$ GeV/c^2



(i) $6.6 \leq m < 6.9$ GeV/c^2



(j) $6.9 \leq m < 7.5$ GeV/c^2



(k) $7.5 \leq m < 8.7$ GeV/c^2

Figure 18: Efficiency plots for the x_F bin $0.80 \leq x_F < 0.85$.

4 Methodology: Calculating Average Efficiencies

With the efficiency data saved in '.npz' files, a Python script is used to calculate the average efficiency for a separate dataset of dimuon events. For each event in the dataset, its corresponding efficiency is found by linearly interpolating the efficiency curve from the appropriate (x_F, m) bin. The average efficiency for each bin is then calculated along with its associated errors.

The key quantities are defined as follows:

- **Average Efficiency ($< \epsilon >$):** The simple arithmetic mean of the interpolated efficiency values, ϵ_i, for all N events in a bin, as shown in Equation 1.

$$\langle \epsilon \rangle = \frac{1}{N} \sum_{i=1}^{N} \epsilon_i \tag{1}$$

- **Statistical Error ($\delta_{\mathbf{stat}} < \epsilon >$):** The standard error on the mean of the efficiency distribution within the bin, which quantifies the statistical uncertainty.

$$\delta_{\text{stat}} \langle \epsilon \rangle = \sqrt{\frac{\langle \epsilon^2 \rangle - \langle \epsilon \rangle^2}{N}} \tag{2}$$

- **Propagated Error ($\delta_{\mathbf{prop}} < \epsilon >$):** The error on the average efficiency found by propagating the uncertainties from the original efficiency curve points, $\delta\epsilon_i$.

$$\delta_{\text{prop}} \langle \epsilon \rangle = \frac{\sqrt{\sum_{i=1}^{N} (\delta \epsilon_i)^2}}{N} \tag{3}$$

- **Inverse Average Efficiency ($1/ < \epsilon >$):** The reciprocal of the average efficiency, often used in cross-section calculations.

- **Propagated Error of the Inverse ($\delta(1/ < \epsilon >)$):** The uncertainty on the inverse efficiency, found using standard error propagation.

$$\delta(1/\langle \epsilon \rangle) = \frac{\delta_{\text{prop}} \langle \epsilon \rangle}{\langle \epsilon \rangle^2} \tag{4}$$

5 Results: Average Efficiency Tables

The final results of the analysis are summarized in the following tables.

- Efficiency Table made by using RS-67 LH2 only target 1
- Efficiency Table made by using RS-67 all targets 2
- Efficiency Table made by using RS-57-70 LH2 only target 3
- Efficiency Table made by using RS-57-70 all targets 4

5.1 Average Efficiency Calculations using RS67 LH2 target only

Table 1: Average Efficiency and Errors calculated for x_F and Mass bins using RS67 LH2 target only

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$< \epsilon >$	$\delta_{\text{stat}} < \epsilon >$	$\delta_{\text{prop}} < \epsilon >$	$1/ < \epsilon >$	$\delta(1/ < \epsilon >)$
[0.0, 0.05)	[4.2, 4.5)	1	0.0000	0.0000	0.0000	–	–
[0.0, 0.05)	[4.5, 4.8)	9	0.1378	0.0878	0.0248	7.258	1.305
[0.0, 0.05)	[4.8, 5.1)	40	0.8807	0.0827	0.0209	1.135	0.027
[0.0, 0.05)	[5.1, 5.4)	72	0.6521	0.0167	0.0216	1.534	0.051
[0.0, 0.05)	[5.4, 5.7)	66	0.6728	0.0262	0.0119	1.486	0.026
[0.0, 0.05)	[5.7, 6.0)	37	0.5828	0.0505	0.0174	1.716	0.051
[0.0, 0.05)	[6.0, 6.3)	27	0.6133	0.0487	0.0186	1.631	0.050
[0.0, 0.05)	[6.3, 6.6)	15	0.5970	0.0532	0.0313	1.675	0.088
[0.0, 0.05)	[6.6, 6.9)	12	0.7055	0.0394	0.0250	1.417	0.050
[0.0, 0.05)	[6.9, 7.5)	9	0.6253	0.0865	0.0272	1.599	0.070
[0.0, 0.05)	[7.5, 8.7)	1	0.6066	0.0000	0.0595	1.649	0.162
[0.05, 0.1)	[4.2, 4.5)	2	0.0000	0.0000	0.0000	–	–
[0.05, 0.1)	[4.5, 4.8)	39	0.2746	0.0516	0.0222	3.642	0.294
[0.05, 0.1)	[4.8, 5.1)	81	0.5004	0.0360	0.0185	1.999	0.074
[0.05, 0.1)	[5.1, 5.4)	95	0.7206	0.0381	0.0099	1.388	0.019
[0.05, 0.1)	[5.4, 5.7)	78	0.6643	0.0204	0.0121	1.505	0.027
[0.05, 0.1)	[5.7, 6.0)	53	0.7379	0.0231	0.0122	1.355	0.022
[0.05, 0.1)	[6.0, 6.3)	39	0.7318	0.0325	0.0117	1.367	0.022
[0.05, 0.1)	[6.3, 6.6)	25	0.5964	0.0379	0.0204	1.677	0.057
[0.05, 0.1)	[6.6, 6.9)	5	0.5670	0.1215	0.0382	1.764	0.119
[0.05, 0.1)	[6.9, 7.5)	7	0.6487	0.0764	0.0268	1.541	0.064
[0.05, 0.1)	[7.5, 8.7)	6	0.5979	0.1095	0.0270	1.672	0.075
[0.1, 0.15)	[4.2, 4.5)	31	13.2153	3.4691	0.0144	0.076	0.000
[0.1, 0.15)	[4.5, 4.8)	97	0.5642	0.0287	0.0171	1.772	0.054
[0.1, 0.15)	[4.8, 5.1)	140	0.6170	0.0155	0.0142	1.621	0.037
[0.1, 0.15)	[5.1, 5.4)	133	0.5928	0.0155	0.0113	1.687	0.032
[0.1, 0.15)	[5.4, 5.7)	87	0.6659	0.0247	0.0091	1.502	0.021
[0.1, 0.15)	[5.7, 6.0)	77	0.6895	0.0192	0.0088	1.450	0.019
[0.1, 0.15)	[6.0, 6.3)	53	0.7156	0.0258	0.0100	1.398	0.020
[0.1, 0.15)	[6.3, 6.6)	28	0.7879	0.0218	0.0113	1.269	0.018
[0.1, 0.15)	[6.6, 6.9)	10	0.7518	0.0446	0.0193	1.330	0.034
[0.1, 0.15)	[6.9, 7.5)	11	0.6798	0.0405	0.0167	1.471	0.036
[0.1, 0.15)	[7.5, 8.7)	7	0.7011	0.0352	0.0140	1.426	0.029
[0.15, 0.2)	[4.2, 4.5)	83	1.1271	0.1084	0.0121	0.887	0.010
[0.15, 0.2)	[4.5, 4.8)	170	0.7035	0.0215	0.0131	1.421	0.027
[0.15, 0.2)	[4.8, 5.1)	240	0.5329	0.0099	0.0087	1.877	0.031
[0.15, 0.2)	[5.1, 5.4)	206	0.6986	0.0132	0.0070	1.432	0.014
[0.15, 0.2)	[5.4, 5.7)	115	0.6923	0.0212	0.0086	1.444	0.018
[0.15, 0.2)	[5.7, 6.0)	99	0.7341	0.0188	0.0086	1.362	0.016
[0.15, 0.2)	[6.0, 6.3)	68	0.7129	0.0175	0.0089	1.403	0.017
[0.15, 0.2)	[6.3, 6.6)	36	0.7514	0.0397	0.0105	1.331	0.019
[0.15, 0.2)	[6.6, 6.9)	16	0.6784	0.0492	0.0176	1.474	0.038
[0.15, 0.2)	[6.9, 7.5)	12	0.6677	0.0281	0.0149	1.498	0.033
[0.15, 0.2)	[7.5, 8.7)	3	0.6570	0.1554	0.0400	1.522	0.093

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Table 1: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$< \epsilon >$	$\delta_{\text{stat}} < \epsilon >$	$\delta_{\text{prop}} < \epsilon >$	$1/ < \epsilon >$	$\delta(1/ < \epsilon >)$
[0.2, 0.25)	[4.2, 4.5)	185	0.5419	0.0213	0.0127	1.845	0.043
[0.2, 0.25)	[4.5, 4.8)	294	0.5943	0.0152	0.0073	1.683	0.021
[0.2, 0.25)	[4.8, 5.1)	285	0.6938	0.0116	0.0057	1.441	0.012
[0.2, 0.25)	[5.1, 5.4)	227	0.6730	0.0123	0.0056	1.486	0.012
[0.2, 0.25)	[5.4, 5.7)	149	0.6935	0.0162	0.0066	1.442	0.014
[0.2, 0.25)	[5.7, 6.0)	110	0.7851	0.0137	0.0061	1.274	0.010
[0.2, 0.25)	[6.0, 6.3)	54	0.7371	0.0250	0.0086	1.357	0.016
[0.2, 0.25)	[6.3, 6.6)	46	0.7367	0.0252	0.0097	1.357	0.018
[0.2, 0.25)	[6.6, 6.9)	21	0.7909	0.0341	0.0111	1.264	0.018
[0.2, 0.25)	[6.9, 7.5)	10	0.6953	0.0456	0.0153	1.438	0.032
[0.2, 0.25)	[7.5, 8.7)	6	0.7790	0.0427	0.0117	1.284	0.019
[0.25, 0.3)	[4.2, 4.5)	385	0.6954	0.0120	0.0074	1.438	0.015
[0.25, 0.3)	[4.5, 4.8)	448	0.7160	0.0069	0.0051	1.397	0.010
[0.25, 0.3)	[4.8, 5.1)	347	0.6962	0.0131	0.0045	1.436	0.009
[0.25, 0.3)	[5.1, 5.4)	273	0.6967	0.0110	0.0051	1.435	0.011
[0.25, 0.3)	[5.4, 5.7)	199	0.7569	0.0126	0.0055	1.321	0.010
[0.25, 0.3)	[5.7, 6.0)	91	0.7372	0.0192	0.0073	1.356	0.013
[0.25, 0.3)	[6.0, 6.3)	62	0.7643	0.0153	0.0076	1.308	0.013
[0.25, 0.3)	[6.3, 6.6)	39	0.7777	0.0233	0.0081	1.286	0.013
[0.25, 0.3)	[6.6, 6.9)	27	0.6931	0.0368	0.0131	1.443	0.027
[0.25, 0.3)	[6.9, 7.5)	26	0.7356	0.0370	0.0104	1.360	0.019
[0.25, 0.3)	[7.5, 8.7)	2	0.5631	0.0363	0.0336	1.776	0.106
[0.3, 0.35)	[4.2, 4.5)	574	0.7521	0.0064	0.0050	1.330	0.009
[0.3, 0.35)	[4.5, 4.8)	530	0.7698	0.0083	0.0037	1.299	0.006
[0.3, 0.35)	[4.8, 5.1)	425	0.7158	0.0090	0.0039	1.397	0.008
[0.3, 0.35)	[5.1, 5.4)	301	0.7891	0.0085	0.0038	1.267	0.006
[0.3, 0.35)	[5.4, 5.7)	209	0.7093	0.0112	0.0046	1.410	0.009
[0.3, 0.35)	[5.7, 6.0)	100	0.7073	0.0227	0.0061	1.414	0.012
[0.3, 0.35)	[6.0, 6.3)	63	0.7262	0.0219	0.0081	1.377	0.015
[0.3, 0.35)	[6.3, 6.6)	46	0.7800	0.0265	0.0077	1.282	0.013
[0.3, 0.35)	[6.6, 6.9)	25	0.7720	0.0154	0.0113	1.295	0.019
[0.3, 0.35)	[6.9, 7.5)	19	0.7341	0.0488	0.0124	1.362	0.023
[0.3, 0.35)	[7.5, 8.7)	10	0.7321	0.0629	0.0118	1.366	0.022
[0.35, 0.4)	[4.2, 4.5)	681	0.8006	0.0077	0.0034	1.249	0.005
[0.35, 0.4)	[4.5, 4.8)	595	0.7260	0.0078	0.0034	1.377	0.006
[0.35, 0.4)	[4.8, 5.1)	460	0.7454	0.0067	0.0035	1.342	0.006
[0.35, 0.4)	[5.1, 5.4)	334	0.7731	0.0085	0.0039	1.293	0.007
[0.35, 0.4)	[5.4, 5.7)	172	0.7554	0.0132	0.0044	1.324	0.008
[0.35, 0.4)	[5.7, 6.0)	129	0.7513	0.0167	0.0053	1.331	0.009
[0.35, 0.4)	[6.0, 6.3)	73	0.7796	0.0221	0.0068	1.283	0.011
[0.35, 0.4)	[6.3, 6.6)	47	0.7828	0.0232	0.0075	1.277	0.012
[0.35, 0.4)	[6.6, 6.9)	22	0.7455	0.0288	0.0119	1.341	0.021
[0.35, 0.4)	[6.9, 7.5)	19	0.7659	0.0476	0.0091	1.306	0.016
[0.35, 0.4)	[7.5, 8.7)	8	0.6464	0.0596	0.0164	1.547	0.039
[0.4, 0.45)	[4.2, 4.5)	727	0.7649	0.0067	0.0033	1.307	0.006
[0.4, 0.45)	[4.5, 4.8)	571	0.7143	0.0110	0.0031	1.400	0.006
[0.4, 0.45)	[4.8, 5.1)	455	0.7405	0.0071	0.0030	1.350	0.006
[0.4, 0.45)	[5.1, 5.4)	288	0.7271	0.0091	0.0041	1.375	0.008

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Table 1: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}}<\epsilon>$	$\delta_{\text{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.4, 0.45)	[5.4, 5.7)	207	0.7540	0.0121	0.0042	1.326	0.007
[0.4, 0.45)	[5.7, 6.0)	117	0.7764	0.0172	0.0052	1.288	0.009
[0.4, 0.45)	[6.0, 6.3)	87	0.7993	0.0136	0.0058	1.251	0.009
[0.4, 0.45)	[6.3, 6.6)	50	0.7329	0.0239	0.0083	1.364	0.015
[0.4, 0.45)	[6.6, 6.9)	25	0.8221	0.0238	0.0087	1.216	0.013
[0.4, 0.45)	[6.9, 7.5)	22	0.7415	0.0401	0.0095	1.349	0.017
[0.4, 0.45)	[7.5, 8.7)	8	0.8233	0.0525	0.0100	1.215	0.015
[0.45, 0.5)	[4.2, 4.5)	748	0.7659	0.0067	0.0029	1.306	0.005
[0.45, 0.5)	[4.5, 4.8)	616	0.7536	0.0055	0.0026	1.327	0.005
[0.45, 0.5)	[4.8, 5.1)	417	0.7138	0.0078	0.0033	1.401	0.007
[0.45, 0.5)	[5.1, 5.4)	271	0.7484	0.0116	0.0039	1.336	0.007
[0.45, 0.5)	[5.4, 5.7)	181	0.7800	0.0108	0.0047	1.282	0.008
[0.45, 0.5)	[5.7, 6.0)	113	0.7730	0.0153	0.0053	1.294	0.009
[0.45, 0.5)	[6.0, 6.3)	64	0.7775	0.0264	0.0070	1.286	0.012
[0.45, 0.5)	[6.3, 6.6)	54	0.7185	0.0182	0.0080	1.392	0.015
[0.45, 0.5)	[6.6, 6.9)	19	0.7740	0.0347	0.0134	1.292	0.022
[0.45, 0.5)	[6.9, 7.5)	29	0.7864	0.0231	0.0063	1.272	0.010
[0.45, 0.5)	[7.5, 8.7)	8	0.8275	0.0459	0.0110	1.208	0.016
[0.5, 0.55)	[4.2, 4.5)	721	0.6792	0.0072	0.0033	1.472	0.007
[0.5, 0.55)	[4.5, 4.8)	487	0.7263	0.0070	0.0032	1.377	0.006
[0.5, 0.55)	[4.8, 5.1)	336	0.7164	0.0103	0.0035	1.396	0.007
[0.5, 0.55)	[5.1, 5.4)	245	0.7580	0.0115	0.0038	1.319	0.007
[0.5, 0.55)	[5.4, 5.7)	170	0.7682	0.0086	0.0041	1.302	0.007
[0.5, 0.55)	[5.7, 6.0)	89	0.7787	0.0151	0.0059	1.284	0.010
[0.5, 0.55)	[6.0, 6.3)	49	0.7067	0.0271	0.0088	1.415	0.018
[0.5, 0.55)	[6.3, 6.6)	42	0.8119	0.0204	0.0075	1.232	0.011
[0.5, 0.55)	[6.6, 6.9)	20	0.7857	0.0256	0.0124	1.273	0.020
[0.5, 0.55)	[6.9, 7.5)	15	0.8274	0.0461	0.0099	1.209	0.015
[0.5, 0.55)	[7.5, 8.7)	11	0.7586	0.0439	0.0102	1.318	0.018
[0.55, 0.6)	[4.2, 4.5)	565	0.7673	0.0076	0.0031	1.303	0.005
[0.55, 0.6)	[4.5, 4.8)	448	0.7441	0.0071	0.0033	1.344	0.006
[0.55, 0.6)	[4.8, 5.1)	286	0.7291	0.0110	0.0041	1.372	0.008
[0.55, 0.6)	[5.1, 5.4)	181	0.7664	0.0133	0.0044	1.305	0.008
[0.55, 0.6)	[5.4, 5.7)	111	0.7781	0.0176	0.0056	1.285	0.009
[0.55, 0.6)	[5.7, 6.0)	71	0.7315	0.0163	0.0060	1.367	0.011
[0.55, 0.6)	[6.0, 6.3)	52	0.8107	0.0221	0.0067	1.233	0.010
[0.55, 0.6)	[6.3, 6.6)	26	0.7791	0.0290	0.0098	1.284	0.016
[0.55, 0.6)	[6.6, 6.9)	18	0.8203	0.0334	0.0111	1.219	0.016
[0.55, 0.6)	[6.9, 7.5)	17	0.7324	0.0504	0.0101	1.365	0.019
[0.55, 0.6)	[7.5, 8.7)	5	0.7910	0.0674	0.0155	1.264	0.025
[0.6, 0.65)	[4.2, 4.5)	452	0.7862	0.0083	0.0032	1.272	0.005
[0.6, 0.65)	[4.5, 4.8)	289	0.7690	0.0099	0.0040	1.300	0.007
[0.6, 0.65)	[4.8, 5.1)	199	0.7582	0.0102	0.0048	1.319	0.008
[0.6, 0.65)	[5.1, 5.4)	130	0.8185	0.0148	0.0043	1.222	0.006
[0.6, 0.65)	[5.4, 5.7)	81	0.8009	0.0162	0.0060	1.249	0.009
[0.6, 0.65)	[5.7, 6.0)	59	0.7266	0.0216	0.0071	1.376	0.013
[0.6, 0.65)	[6.0, 6.3)	44	0.8146	0.0258	0.0078	1.228	0.012
[0.6, 0.65)	[6.3, 6.6)	27	0.7482	0.0381	0.0096	1.336	0.017

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Table 1: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\mathrm{stat}}<\epsilon>$	$\delta_{\mathrm{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.6, 0.65)	[6.6, 6.9)	13	0.9021	0.0308	0.0081	1.109	0.010
[0.6, 0.65)	[6.9, 7.5)	11	0.8028	0.0723	0.0130	1.246	0.020
[0.6, 0.65)	[7.5, 8.7)	4	0.8472	0.0841	0.0193	1.180	0.027
[0.65, 0.7)	[4.2, 4.5)	301	0.7887	0.0119	0.0039	1.268	0.006
[0.65, 0.7)	[4.5, 4.8)	220	0.7684	0.0093	0.0045	1.301	0.008
[0.65, 0.7)	[4.8, 5.1)	131	0.8002	0.0143	0.0052	1.250	0.008
[0.65, 0.7)	[5.1, 5.4)	102	0.7953	0.0134	0.0054	1.257	0.009
[0.65, 0.7)	[5.4, 5.7)	61	0.7377	0.0222	0.0068	1.356	0.013
[0.65, 0.7)	[5.7, 6.0)	33	0.8108	0.0310	0.0094	1.233	0.014
[0.65, 0.7)	[6.0, 6.3)	30	0.7968	0.0257	0.0090	1.255	0.014
[0.65, 0.7)	[6.3, 6.6)	9	0.7798	0.0436	0.0173	1.282	0.028
[0.65, 0.7)	[6.6, 6.9)	9	0.8424	0.0382	0.0151	1.187	0.021
[0.65, 0.7)	[6.9, 7.5)	15	0.7883	0.0219	0.0162	1.269	0.026
[0.65, 0.7)	[7.5, 8.7)	5	0.0786	0.0548	0.0410	12.717	6.635
[0.7, 0.75)	[4.2, 4.5)	190	0.7409	0.0123	0.0054	1.350	0.010
[0.7, 0.75)	[4.5, 4.8)	150	0.7718	0.0132	0.0053	1.296	0.009
[0.7, 0.75)	[4.8, 5.1)	97	0.7930	0.0169	0.0064	1.261	0.010
[0.7, 0.75)	[5.1, 5.4)	53	0.7841	0.0206	0.0097	1.275	0.016
[0.7, 0.75)	[5.4, 5.7)	30	0.7500	0.0398	0.0112	1.333	0.020
[0.7, 0.75)	[5.7, 6.0)	20	0.9249	0.0696	0.0161	1.081	0.019
[0.7, 0.75)	[6.0, 6.3)	18	0.7275	0.0573	0.0256	1.375	0.048
[0.7, 0.75)	[6.3, 6.6)	12	0.8809	0.1134	0.0458	1.135	0.059
[0.7, 0.75)	[6.6, 6.9)	7	0.0000	0.0000	0.0000	–	–
[0.7, 0.75)	[6.9, 7.5)	3	0.0000	0.0000	0.0000	–	–
[0.7, 0.75)	[7.5, 8.7)	2	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[4.2, 4.5)	139	0.7004	0.0245	0.0094	1.428	0.019
[0.75, 0.8)	[4.5, 4.8)	60	0.8745	0.0492	0.0087	1.144	0.011
[0.75, 0.8)	[4.8, 5.1)	44	0.0809	0.0295	0.0125	12.360	1.911
[0.75, 0.8)	[5.1, 5.4)	29	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[5.4, 5.7)	21	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[5.7, 6.0)	17	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.0, 6.3)	16	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.3, 6.6)	5	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.6, 6.9)	3	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.9, 7.5)	1	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[7.5, 8.7)	3	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.2, 4.5)	59	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.5, 4.8)	39	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.8, 5.1)	24	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.1, 5.4)	12	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.4, 5.7)	10	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.7, 6.0)	8	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.0, 6.3)	1	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.3, 6.6)	1	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.6, 6.9)	3	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.9, 7.5)	2	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[7.5, 8.7)	0	–	–	–	–	–

5.2 Average Efficiency Calculations using RS67 all targets only

Table 2: Average Efficiency and Errors calculated for x_F and Mass bins using RS67 all targets

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$< \epsilon >$	$\delta_{\text{stat}} < \epsilon >$	$\delta_{\text{prop}} < \epsilon >$	$1/ < \epsilon >$	$\delta(1/ < \epsilon >)$
[0.0, 0.05)	[4.2, 4.5)	2	0.0000	0.0000	0.0000	–	–
[0.0, 0.05)	[4.5, 4.8)	33	0.1782	0.0465	0.0140	5.612	0.440
[0.0, 0.05)	[4.8, 5.1)	133	0.7940	0.0451	0.0120	1.260	0.019
[0.0, 0.05)	[5.1, 5.4)	200	0.6265	0.0107	0.0127	1.596	0.032
[0.0, 0.05)	[5.4, 5.7)	207	0.6752	0.0150	0.0067	1.481	0.015
[0.0, 0.05)	[5.7, 6.0)	147	0.6548	0.0230	0.0079	1.527	0.019
[0.0, 0.05)	[6.0, 6.3)	109	0.6673	0.0207	0.0093	1.498	0.021
[0.0, 0.05)	[6.3, 6.6)	56	0.6430	0.0260	0.0144	1.555	0.035
[0.0, 0.05)	[6.6, 6.9)	28	0.7049	0.0198	0.0147	1.419	0.030
[0.0, 0.05)	[6.9, 7.5)	29	0.6924	0.0390	0.0132	1.444	0.027
[0.0, 0.05)	[7.5, 8.7)	4	0.7334	0.0395	0.0217	1.364	0.040
[0.05, 0.1)	[4.2, 4.5)	10	0.0000	0.0000	0.0000	–	–
[0.05, 0.1)	[4.5, 4.8)	113	0.3243	0.0329	0.0147	3.084	0.140
[0.05, 0.1)	[4.8, 5.1)	261	0.5304	0.0193	0.0101	1.885	0.036
[0.05, 0.1)	[5.1, 5.4)	321	0.6912	0.0217	0.0061	1.447	0.013
[0.05, 0.1)	[5.4, 5.7)	269	0.6654	0.0104	0.0067	1.503	0.015
[0.05, 0.1)	[5.7, 6.0)	215	0.7406	0.0113	0.0063	1.350	0.011
[0.05, 0.1)	[6.0, 6.3)	128	0.7174	0.0177	0.0063	1.394	0.012
[0.05, 0.1)	[6.3, 6.6)	85	0.6176	0.0183	0.0098	1.619	0.026
[0.05, 0.1)	[6.6, 6.9)	37	0.6574	0.0347	0.0124	1.521	0.029
[0.05, 0.1)	[6.9, 7.5)	31	0.7089	0.0288	0.0095	1.411	0.019
[0.05, 0.1)	[7.5, 8.7)	14	0.6354	0.0618	0.0152	1.574	0.038
[0.1, 0.15)	[4.2, 4.5)	96	8.7853	1.6997	0.0093	0.114	0.000
[0.1, 0.15)	[4.5, 4.8)	316	0.5394	0.0168	0.0095	1.854	0.033
[0.1, 0.15)	[4.8, 5.1)	502	0.6230	0.0078	0.0075	1.605	0.019
[0.1, 0.15)	[5.1, 5.4)	486	0.6083	0.0084	0.0056	1.644	0.015
[0.1, 0.15)	[5.4, 5.7)	354	0.6480	0.0116	0.0046	1.543	0.011
[0.1, 0.15)	[5.7, 6.0)	236	0.6728	0.0120	0.0054	1.486	0.012
[0.1, 0.15)	[6.0, 6.3)	170	0.7252	0.0152	0.0056	1.379	0.011
[0.1, 0.15)	[6.3, 6.6)	103	0.7499	0.0141	0.0066	1.334	0.012
[0.1, 0.15)	[6.6, 6.9)	58	0.7386	0.0168	0.0079	1.354	0.014
[0.1, 0.15)	[6.9, 7.5)	34	0.7159	0.0235	0.0081	1.397	0.016
[0.1, 0.15)	[7.5, 8.7)	18	0.6957	0.0249	0.0096	1.437	0.020
[0.15, 0.2)	[4.2, 4.5)	311	1.2111	0.0601	0.0063	0.826	0.004
[0.15, 0.2)	[4.5, 4.8)	643	0.7138	0.0109	0.0066	1.401	0.013
[0.15, 0.2)	[4.8, 5.1)	807	0.5390	0.0059	0.0046	1.855	0.016
[0.15, 0.2)	[5.1, 5.4)	687	0.6905	0.0071	0.0039	1.448	0.008
[0.15, 0.2)	[5.4, 5.7)	424	0.7186	0.0111	0.0042	1.392	0.008
[0.15, 0.2)	[5.7, 6.0)	346	0.7544	0.0092	0.0043	1.326	0.008
[0.15, 0.2)	[6.0, 6.3)	209	0.7254	0.0113	0.0047	1.378	0.009
[0.15, 0.2)	[6.3, 6.6)	131	0.7516	0.0180	0.0058	1.331	0.010
[0.15, 0.2)	[6.6, 6.9)	59	0.7037	0.0260	0.0088	1.421	0.018
[0.15, 0.2)	[6.9, 7.5)	42	0.6736	0.0217	0.0082	1.485	0.018
[0.15, 0.2)	[7.5, 8.7)	20	0.6716	0.0468	0.0107	1.489	0.024
[0.2, 0.25)	[4.2, 4.5)	748	0.5316	0.0105	0.0064	1.881	0.023

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Table 2: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}}<\epsilon>$	$\delta_{\text{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.2, 0.25)	[4.5, 4.8)	1069	0.5939	0.0081	0.0038	1.684	0.011
[0.2, 0.25)	[4.8, 5.1)	1057	0.6847	0.0064	0.0030	1.460	0.006
[0.2, 0.25)	[5.1, 5.4)	855	0.6653	0.0063	0.0029	1.503	0.007
[0.2, 0.25)	[5.4, 5.7)	555	0.6937	0.0084	0.0034	1.441	0.007
[0.2, 0.25)	[5.7, 6.0)	410	0.7840	0.0071	0.0033	1.276	0.005
[0.2, 0.25)	[6.0, 6.3)	220	0.7241	0.0117	0.0044	1.381	0.008
[0.2, 0.25)	[6.3, 6.6)	157	0.7457	0.0137	0.0052	1.341	0.009
[0.2, 0.25)	[6.6, 6.9)	74	0.8240	0.0170	0.0055	1.214	0.008
[0.2, 0.25)	[6.9, 7.5)	58	0.7418	0.0210	0.0059	1.348	0.011
[0.2, 0.25)	[7.5, 8.7)	19	0.7242	0.0403	0.0087	1.381	0.017
[0.25, 0.3)	[4.2, 4.5)	1455	0.7032	0.0062	0.0038	1.422	0.008
[0.25, 0.3)	[4.5, 4.8)	1594	0.7156	0.0037	0.0027	1.397	0.005
[0.25, 0.3)	[4.8, 5.1)	1239	0.7012	0.0070	0.0024	1.426	0.005
[0.25, 0.3)	[5.1, 5.4)	989	0.7060	0.0054	0.0026	1.416	0.005
[0.25, 0.3)	[5.4, 5.7)	692	0.7712	0.0068	0.0028	1.297	0.005
[0.25, 0.3)	[5.7, 6.0)	361	0.7322	0.0088	0.0035	1.366	0.007
[0.25, 0.3)	[6.0, 6.3)	252	0.7556	0.0073	0.0038	1.323	0.007
[0.25, 0.3)	[6.3, 6.6)	151	0.7462	0.0149	0.0044	1.340	0.008
[0.25, 0.3)	[6.6, 6.9)	70	0.7253	0.0213	0.0089	1.379	0.017
[0.25, 0.3)	[6.9, 7.5)	91	0.7585	0.0174	0.0048	1.318	0.008
[0.25, 0.3)	[7.5, 8.7)	20	0.6224	0.0411	0.0098	1.607	0.025
[0.3, 0.35)	[4.2, 4.5)	2031	0.7482	0.0034	0.0027	1.337	0.005
[0.3, 0.35)	[4.5, 4.8)	1923	0.7547	0.0045	0.0020	1.325	0.004
[0.3, 0.35)	[4.8, 5.1)	1539	0.7174	0.0048	0.0020	1.394	0.004
[0.3, 0.35)	[5.1, 5.4)	1090	0.7827	0.0046	0.0020	1.278	0.003
[0.3, 0.35)	[5.4, 5.7)	714	0.7043	0.0060	0.0025	1.420	0.005
[0.3, 0.35)	[5.7, 6.0)	414	0.7174	0.0106	0.0031	1.394	0.006
[0.3, 0.35)	[6.0, 6.3)	258	0.7343	0.0106	0.0040	1.362	0.007
[0.3, 0.35)	[6.3, 6.6)	157	0.7575	0.0148	0.0046	1.320	0.008
[0.3, 0.35)	[6.6, 6.9)	99	0.7301	0.0133	0.0065	1.370	0.012
[0.3, 0.35)	[6.9, 7.5)	70	0.7077	0.0212	0.0061	1.413	0.012
[0.3, 0.35)	[7.5, 8.7)	27	0.7499	0.0345	0.0069	1.334	0.012
[0.35, 0.4)	[4.2, 4.5)	2398	0.7980	0.0042	0.0019	1.253	0.003
[0.35, 0.4)	[4.5, 4.8)	2088	0.7220	0.0043	0.0018	1.385	0.003
[0.35, 0.4)	[4.8, 5.1)	1607	0.7414	0.0039	0.0019	1.349	0.003
[0.35, 0.4)	[5.1, 5.4)	1157	0.7666	0.0044	0.0021	1.304	0.004
[0.35, 0.4)	[5.4, 5.7)	683	0.7445	0.0069	0.0023	1.343	0.004
[0.35, 0.4)	[5.7, 6.0)	448	0.7298	0.0094	0.0030	1.370	0.006
[0.35, 0.4)	[6.0, 6.3)	269	0.7824	0.0100	0.0035	1.278	0.006
[0.35, 0.4)	[6.3, 6.6)	158	0.7640	0.0141	0.0043	1.309	0.007
[0.35, 0.4)	[6.6, 6.9)	99	0.7462	0.0140	0.0061	1.340	0.011
[0.35, 0.4)	[6.9, 7.5)	85	0.7386	0.0213	0.0045	1.354	0.008
[0.35, 0.4)	[7.5, 8.7)	27	0.7163	0.0294	0.0075	1.396	0.015
[0.4, 0.45)	[4.2, 4.5)	2735	0.7463	0.0039	0.0018	1.340	0.003
[0.4, 0.45)	[4.5, 4.8)	2092	0.6973	0.0058	0.0016	1.434	0.003
[0.4, 0.45)	[4.8, 5.1)	1634	0.7308	0.0039	0.0017	1.368	0.003
[0.4, 0.45)	[5.1, 5.4)	1035	0.7210	0.0047	0.0022	1.387	0.004
[0.4, 0.45)	[5.4, 5.7)	700	0.7580	0.0062	0.0022	1.319	0.004

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Table 2: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}}<\epsilon>$	$\delta_{\text{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.4, 0.45)	[5.7, 6.0)	445	0.7799	0.0095	0.0027	1.282	0.004
[0.4, 0.45)	[6.0, 6.3)	281	0.7872	0.0093	0.0036	1.270	0.006
[0.4, 0.45)	[6.3, 6.6)	176	0.7500	0.0120	0.0044	1.333	0.008
[0.4, 0.45)	[6.6, 6.9)	98	0.7921	0.0118	0.0052	1.262	0.008
[0.4, 0.45)	[6.9, 7.5)	91	0.7787	0.0186	0.0042	1.284	0.007
[0.4, 0.45)	[7.5, 8.7)	24	0.8029	0.0299	0.0060	1.245	0.009
[0.45, 0.5)	[4.2, 4.5)	2747	0.7502	0.0038	0.0016	1.333	0.003
[0.45, 0.5)	[4.5, 4.8)	2107	0.7542	0.0030	0.0014	1.326	0.003
[0.45, 0.5)	[4.8, 5.1)	1472	0.7112	0.0043	0.0018	1.406	0.004
[0.45, 0.5)	[5.1, 5.4)	1022	0.7414	0.0060	0.0021	1.349	0.004
[0.45, 0.5)	[5.4, 5.7)	633	0.7828	0.0057	0.0024	1.277	0.004
[0.45, 0.5)	[5.7, 6.0)	432	0.7763	0.0077	0.0027	1.288	0.004
[0.45, 0.5)	[6.0, 6.3)	245	0.7938	0.0128	0.0033	1.260	0.005
[0.45, 0.5)	[6.3, 6.6)	162	0.7264	0.0103	0.0046	1.377	0.009
[0.45, 0.5)	[6.6, 6.9)	75	0.7881	0.0179	0.0066	1.269	0.011
[0.45, 0.5)	[6.9, 7.5)	87	0.7520	0.0170	0.0041	1.330	0.007
[0.45, 0.5)	[7.5, 8.7)	25	0.8017	0.0287	0.0068	1.247	0.011
[0.5, 0.55)	[4.2, 4.5)	2527	0.6804	0.0038	0.0018	1.470	0.004
[0.5, 0.55)	[4.5, 4.8)	1845	0.7307	0.0035	0.0017	1.369	0.003
[0.5, 0.55)	[4.8, 5.1)	1272	0.7080	0.0054	0.0018	1.412	0.004
[0.5, 0.55)	[5.1, 5.4)	818	0.7723	0.0062	0.0020	1.295	0.003
[0.5, 0.55)	[5.4, 5.7)	565	0.7536	0.0061	0.0024	1.327	0.004
[0.5, 0.55)	[5.7, 6.0)	333	0.7831	0.0082	0.0030	1.277	0.005
[0.5, 0.55)	[6.0, 6.3)	199	0.7361	0.0129	0.0039	1.359	0.007
[0.5, 0.55)	[6.3, 6.6)	126	0.8077	0.0115	0.0045	1.238	0.007
[0.5, 0.55)	[6.6, 6.9)	91	0.8206	0.0124	0.0048	1.219	0.007
[0.5, 0.55)	[6.9, 7.5)	58	0.7660	0.0242	0.0057	1.306	0.010
[0.5, 0.55)	[7.5, 8.7)	25	0.6935	0.0319	0.0084	1.442	0.017
[0.55, 0.6)	[4.2, 4.5)	2123	0.7524	0.0040	0.0017	1.329	0.003
[0.55, 0.6)	[4.5, 4.8)	1505	0.7323	0.0042	0.0019	1.366	0.003
[0.55, 0.6)	[4.8, 5.1)	1037	0.7398	0.0054	0.0021	1.352	0.004
[0.55, 0.6)	[5.1, 5.4)	657	0.7472	0.0070	0.0025	1.338	0.004
[0.55, 0.6)	[5.4, 5.7)	450	0.7780	0.0091	0.0027	1.285	0.005
[0.55, 0.6)	[5.7, 6.0)	250	0.7278	0.0088	0.0034	1.374	0.006
[0.55, 0.6)	[6.0, 6.3)	179	0.7871	0.0133	0.0041	1.270	0.007
[0.55, 0.6)	[6.3, 6.6)	105	0.7722	0.0156	0.0047	1.295	0.008
[0.55, 0.6)	[6.6, 6.9)	69	0.7750	0.0217	0.0068	1.290	0.011
[0.55, 0.6)	[6.9, 7.5)	56	0.7159	0.0244	0.0054	1.397	0.011
[0.55, 0.6)	[7.5, 8.7)	14	0.7765	0.0356	0.0101	1.288	0.017
[0.6, 0.65)	[4.2, 4.5)	1670	0.7646	0.0045	0.0018	1.308	0.003
[0.6, 0.65)	[4.5, 4.8)	1147	0.7620	0.0049	0.0021	1.312	0.004
[0.6, 0.65)	[4.8, 5.1)	758	0.7583	0.0052	0.0024	1.319	0.004
[0.6, 0.65)	[5.1, 5.4)	512	0.8108	0.0071	0.0023	1.233	0.003
[0.6, 0.65)	[5.4, 5.7)	301	0.7847	0.0094	0.0035	1.274	0.006
[0.6, 0.65)	[5.7, 6.0)	206	0.7561	0.0117	0.0036	1.323	0.006
[0.6, 0.65)	[6.0, 6.3)	149	0.7856	0.0163	0.0047	1.273	0.008
[0.6, 0.65)	[6.3, 6.6)	90	0.7328	0.0215	0.0056	1.365	0.010
[0.6, 0.65)	[6.6, 6.9)	52	0.8311	0.0240	0.0060	1.203	0.009

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Table 2: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}} <\epsilon>$	$\delta_{\text{prop}} <\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.6, 0.65)	[6.9, 7.5)	39	0.7622	0.0329	0.0080	1.312	0.014
[0.6, 0.65)	[7.5, 8.7)	13	0.7647	0.0427	0.0134	1.308	0.023
[0.65, 0.7)	[4.2, 4.5)	1122	0.7849	0.0061	0.0021	1.274	0.003
[0.65, 0.7)	[4.5, 4.8)	772	0.7602	0.0052	0.0024	1.315	0.004
[0.65, 0.7)	[4.8, 5.1)	514	0.7962	0.0070	0.0027	1.256	0.004
[0.65, 0.7)	[5.1, 5.4)	331	0.7859	0.0076	0.0031	1.272	0.005
[0.65, 0.7)	[5.4, 5.7)	219	0.7195	0.0119	0.0038	1.390	0.007
[0.65, 0.7)	[5.7, 6.0)	134	0.8178	0.0151	0.0048	1.223	0.007
[0.65, 0.7)	[6.0, 6.3)	93	0.7759	0.0153	0.0058	1.289	0.010
[0.65, 0.7)	[6.3, 6.6)	42	0.7969	0.0135	0.0075	1.255	0.012
[0.65, 0.7)	[6.6, 6.9)	29	0.8335	0.0240	0.0098	1.200	0.014
[0.65, 0.7)	[6.9, 7.5)	30	0.7975	0.0163	0.0111	1.254	0.017
[0.65, 0.7)	[7.5, 8.7)	14	0.3255	0.1116	0.0168	3.072	0.159
[0.7, 0.75)	[4.2, 4.5)	705	0.7281	0.0069	0.0029	1.374	0.006
[0.7, 0.75)	[4.5, 4.8)	494	0.7783	0.0073	0.0030	1.285	0.005
[0.7, 0.75)	[4.8, 5.1)	324	0.7758	0.0098	0.0038	1.289	0.006
[0.7, 0.75)	[5.1, 5.4)	211	0.7767	0.0109	0.0048	1.288	0.008
[0.7, 0.75)	[5.4, 5.7)	137	0.7577	0.0170	0.0055	1.320	0.010
[0.7, 0.75)	[5.7, 6.0)	86	0.8505	0.0260	0.0075	1.176	0.010
[0.7, 0.75)	[6.0, 6.3)	47	0.7228	0.0385	0.0157	1.383	0.030
[0.7, 0.75)	[6.3, 6.6)	42	0.7012	0.0549	0.0260	1.426	0.053
[0.7, 0.75)	[6.6, 6.9)	32	0.0000	0.0000	0.0000	–	–
[0.7, 0.75)	[6.9, 7.5)	13	0.0000	0.0000	0.0000	–	–
[0.7, 0.75)	[7.5, 8.7)	7	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[4.2, 4.5)	437	0.7087	0.0148	0.0053	1.411	0.011
[0.75, 0.8)	[4.5, 4.8)	256	0.8243	0.0251	0.0041	1.213	0.006
[0.75, 0.8)	[4.8, 5.1)	168	0.1443	0.0212	0.0091	6.931	0.439
[0.75, 0.8)	[5.1, 5.4)	107	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[5.4, 5.7)	77	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[5.7, 6.0)	55	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.0, 6.3)	37	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.3, 6.6)	21	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.6, 6.9)	13	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.9, 7.5)	11	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[7.5, 8.7)	8	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.2, 4.5)	181	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.5, 4.8)	156	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.8, 5.1)	80	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.1, 5.4)	63	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.4, 5.7)	41	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.7, 6.0)	23	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.0, 6.3)	7	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.3, 6.6)	12	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.6, 6.9)	5	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.9, 7.5)	5	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[7.5, 8.7)	2	0.0000	0.0000	0.0000	–	–

5.3 Average Efficiency Calculations using RS57-70 LH2 target only

Table 3: Average Efficiency and Errors calculated for x_F and Mass bins using RS57-70 LH2 target only

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$< \epsilon >$	$\delta_{\text{stat}} < \epsilon >$	$\delta_{\text{prop}} < \epsilon >$	$1/ < \epsilon >$	$\delta(1/ < \epsilon >)$
[0.0, 0.05)	[4.2, 4.5)	1	0.0000	0.0000	0.0000	–	–
[0.0, 0.05)	[4.5, 4.8)	15	0.1600	0.0695	0.0202	6.250	0.790
[0.0, 0.05)	[4.8, 5.1)	63	0.7540	0.0681	0.0161	1.326	0.028
[0.0, 0.05)	[5.1, 5.4)	98	0.6199	0.0186	0.0188	1.613	0.049
[0.0, 0.05)	[5.4, 5.7)	105	0.6071	0.0254	0.0110	1.647	0.030
[0.0, 0.05)	[5.7, 6.0)	65	0.5932	0.0377	0.0132	1.686	0.037
[0.0, 0.05)	[6.0, 6.3)	48	0.5844	0.0351	0.0160	1.711	0.047
[0.0, 0.05)	[6.3, 6.6)	29	0.6437	0.0441	0.0207	1.553	0.050
[0.0, 0.05)	[6.6, 6.9)	18	0.6598	0.0489	0.0195	1.516	0.045
[0.0, 0.05)	[6.9, 7.5)	18	0.5822	0.0528	0.0203	1.718	0.060
[0.0, 0.05)	[7.5, 8.7)	3	0.4789	0.0527	0.0432	2.088	0.188
[0.05, 0.1)	[4.2, 4.5)	3	0.0000	0.0000	0.0000	–	–
[0.05, 0.1)	[4.5, 4.8)	64	0.2532	0.0422	0.0180	3.949	0.281
[0.05, 0.1)	[4.8, 5.1)	132	0.4897	0.0270	0.0143	2.042	0.060
[0.05, 0.1)	[5.1, 5.4)	156	0.7031	0.0280	0.0082	1.422	0.017
[0.05, 0.1)	[5.4, 5.7)	136	0.6435	0.0167	0.0100	1.554	0.024
[0.05, 0.1)	[5.7, 6.0)	96	0.7362	0.0168	0.0095	1.358	0.018
[0.05, 0.1)	[6.0, 6.3)	71	0.7301	0.0251	0.0087	1.370	0.016
[0.05, 0.1)	[6.3, 6.6)	38	0.5782	0.0334	0.0158	1.729	0.047
[0.05, 0.1)	[6.6, 6.9)	12	0.6250	0.0674	0.0230	1.600	0.059
[0.05, 0.1)	[6.9, 7.5)	11	0.6378	0.0606	0.0203	1.568	0.050
[0.05, 0.1)	[7.5, 8.7)	11	0.5861	0.0886	0.0183	1.706	0.053
[0.1, 0.15)	[4.2, 4.5)	50	11.9106	2.6768	0.0121	0.084	0.000
[0.1, 0.15)	[4.5, 4.8)	154	0.5236	0.0250	0.0134	1.910	0.049
[0.1, 0.15)	[4.8, 5.1)	231	0.5916	0.0139	0.0113	1.690	0.032
[0.1, 0.15)	[5.1, 5.4)	233	0.5939	0.0130	0.0084	1.684	0.024
[0.1, 0.15)	[5.4, 5.7)	159	0.6249	0.0201	0.0071	1.600	0.018
[0.1, 0.15)	[5.7, 6.0)	127	0.6793	0.0172	0.0074	1.472	0.016
[0.1, 0.15)	[6.0, 6.3)	93	0.7370	0.0213	0.0074	1.357	0.014
[0.1, 0.15)	[6.3, 6.6)	43	0.7542	0.0266	0.0104	1.326	0.018
[0.1, 0.15)	[6.6, 6.9)	29	0.7193	0.0324	0.0112	1.390	0.022
[0.1, 0.15)	[6.9, 7.5)	20	0.6820	0.0374	0.0124	1.466	0.027
[0.1, 0.15)	[7.5, 8.7)	9	0.6188	0.0594	0.0177	1.616	0.046
[0.15, 0.2)	[4.2, 4.5)	137	1.0519	0.0879	0.0094	0.951	0.008
[0.15, 0.2)	[4.5, 4.8)	293	0.6914	0.0180	0.0097	1.446	0.020
[0.15, 0.2)	[4.8, 5.1)	400	0.5172	0.0088	0.0069	1.934	0.026
[0.15, 0.2)	[5.1, 5.4)	338	0.7004	0.0100	0.0054	1.428	0.011
[0.15, 0.2)	[5.4, 5.7)	205	0.7100	0.0166	0.0063	1.408	0.013
[0.15, 0.2)	[5.7, 6.0)	158	0.7478	0.0137	0.0065	1.337	0.012
[0.15, 0.2)	[6.0, 6.3)	105	0.7177	0.0145	0.0069	1.393	0.013
[0.15, 0.2)	[6.3, 6.6)	61	0.7333	0.0315	0.0090	1.364	0.017
[0.15, 0.2)	[6.6, 6.9)	26	0.7088	0.0372	0.0135	1.411	0.027
[0.15, 0.2)	[6.9, 7.5)	36	0.7084	0.0212	0.0081	1.412	0.016
[0.15, 0.2)	[7.5, 8.7)	4	0.7244	0.1303	0.0303	1.380	0.058

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Table 3: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}} <\epsilon>$	$\delta_{\text{prop}} <\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.2, 0.25)	[4.2, 4.5)	348	0.5355	0.0160	0.0092	1.867	0.032
[0.2, 0.25)	[4.5, 4.8)	465	0.5805	0.0124	0.0059	1.723	0.018
[0.2, 0.25)	[4.8, 5.1)	481	0.6812	0.0097	0.0045	1.468	0.010
[0.2, 0.25)	[5.1, 5.4)	402	0.6719	0.0097	0.0042	1.488	0.009
[0.2, 0.25)	[5.4, 5.7)	259	0.6846	0.0132	0.0052	1.461	0.011
[0.2, 0.25)	[5.7, 6.0)	170	0.7757	0.0141	0.0051	1.289	0.009
[0.2, 0.25)	[6.0, 6.3)	100	0.7263	0.0190	0.0064	1.377	0.012
[0.2, 0.25)	[6.3, 6.6)	78	0.7499	0.0214	0.0071	1.334	0.013
[0.2, 0.25)	[6.6, 6.9)	28	0.8122	0.0289	0.0109	1.231	0.017
[0.2, 0.25)	[6.9, 7.5)	25	0.7370	0.0267	0.0092	1.357	0.017
[0.2, 0.25)	[7.5, 8.7)	10	0.7015	0.0401	0.0146	1.425	0.030
[0.25, 0.3)	[4.2, 4.5)	608	0.6842	0.0102	0.0059	1.462	0.013
[0.25, 0.3)	[4.5, 4.8)	746	0.7141	0.0057	0.0040	1.400	0.008
[0.25, 0.3)	[4.8, 5.1)	607	0.6847	0.0104	0.0036	1.461	0.008
[0.25, 0.3)	[5.1, 5.4)	454	0.6764	0.0095	0.0042	1.478	0.009
[0.25, 0.3)	[5.4, 5.7)	322	0.7508	0.0112	0.0045	1.332	0.008
[0.25, 0.3)	[5.7, 6.0)	175	0.7214	0.0146	0.0054	1.386	0.010
[0.25, 0.3)	[6.0, 6.3)	117	0.7537	0.0134	0.0063	1.327	0.011
[0.25, 0.3)	[6.3, 6.6)	62	0.7271	0.0252	0.0079	1.375	0.015
[0.25, 0.3)	[6.6, 6.9)	43	0.6770	0.0316	0.0117	1.477	0.025
[0.25, 0.3)	[6.9, 7.5)	35	0.7536	0.0306	0.0083	1.327	0.015
[0.25, 0.3)	[7.5, 8.7)	2	0.5631	0.0363	0.0336	1.776	0.106
[0.3, 0.35)	[4.2, 4.5)	929	0.7522	0.0053	0.0039	1.329	0.007
[0.3, 0.35)	[4.5, 4.8)	851	0.7512	0.0072	0.0031	1.331	0.005
[0.3, 0.35)	[4.8, 5.1)	742	0.6996	0.0077	0.0030	1.429	0.006
[0.3, 0.35)	[5.1, 5.4)	500	0.7915	0.0078	0.0031	1.263	0.005
[0.3, 0.35)	[5.4, 5.7)	351	0.7161	0.0091	0.0036	1.396	0.007
[0.3, 0.35)	[5.7, 6.0)	195	0.7134	0.0173	0.0044	1.402	0.009
[0.3, 0.35)	[6.0, 6.3)	121	0.7320	0.0155	0.0056	1.366	0.010
[0.3, 0.35)	[6.3, 6.6)	83	0.7714	0.0200	0.0062	1.296	0.010
[0.3, 0.35)	[6.6, 6.9)	51	0.7555	0.0165	0.0081	1.324	0.014
[0.3, 0.35)	[6.9, 7.5)	31	0.6848	0.0441	0.0113	1.460	0.024
[0.3, 0.35)	[7.5, 8.7)	16	0.7594	0.0466	0.0088	1.317	0.015
[0.35, 0.4)	[4.2, 4.5)	1160	0.7967	0.0063	0.0027	1.255	0.004
[0.35, 0.4)	[4.5, 4.8)	1020	0.7217	0.0064	0.0026	1.386	0.005
[0.35, 0.4)	[4.8, 5.1)	771	0.7292	0.0061	0.0029	1.371	0.005
[0.35, 0.4)	[5.1, 5.4)	550	0.7680	0.0071	0.0031	1.302	0.005
[0.35, 0.4)	[5.4, 5.7)	303	0.7238	0.0115	0.0037	1.382	0.007
[0.35, 0.4)	[5.7, 6.0)	227	0.7241	0.0132	0.0046	1.381	0.009
[0.35, 0.4)	[6.0, 6.3)	127	0.7861	0.0166	0.0050	1.272	0.008
[0.35, 0.4)	[6.3, 6.6)	83	0.7483	0.0216	0.0063	1.336	0.011
[0.35, 0.4)	[6.6, 6.9)	44	0.7978	0.0210	0.0079	1.253	0.012
[0.35, 0.4)	[6.9, 7.5)	33	0.7708	0.0330	0.0069	1.297	0.012
[0.35, 0.4)	[7.5, 8.7)	17	0.7598	0.0422	0.0085	1.316	0.015
[0.4, 0.45)	[4.2, 4.5)	1274	0.7487	0.0060	0.0025	1.336	0.005
[0.4, 0.45)	[4.5, 4.8)	1043	0.6955	0.0085	0.0025	1.438	0.005
[0.4, 0.45)	[4.8, 5.1)	783	0.7380	0.0057	0.0024	1.355	0.004
[0.4, 0.45)	[5.1, 5.4)	511	0.7128	0.0074	0.0034	1.403	0.007

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Table 3: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}}<\epsilon>$	$\delta_{\text{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.4, 0.45)	[5.4, 5.7)	353	0.7475	0.0093	0.0033	1.338	0.006
[0.4, 0.45)	[5.7, 6.0)	194	0.7846	0.0135	0.0040	1.274	0.006
[0.4, 0.45)	[6.0, 6.3)	149	0.8273	0.0100	0.0039	1.209	0.006
[0.4, 0.45)	[6.3, 6.6)	91	0.7577	0.0182	0.0057	1.320	0.010
[0.4, 0.45)	[6.6, 6.9)	42	0.8269	0.0172	0.0066	1.209	0.010
[0.4, 0.45)	[6.9, 7.5)	34	0.7409	0.0337	0.0078	1.350	0.014
[0.4, 0.45)	[7.5, 8.7)	9	0.8325	0.0475	0.0091	1.201	0.013
[0.45, 0.5)	[4.2, 4.5)	1245	0.7614	0.0054	0.0024	1.313	0.004
[0.45, 0.5)	[4.5, 4.8)	1039	0.7470	0.0049	0.0021	1.339	0.004
[0.45, 0.5)	[4.8, 5.1)	728	0.7038	0.0069	0.0028	1.421	0.006
[0.45, 0.5)	[5.1, 5.4)	485	0.7386	0.0099	0.0030	1.354	0.006
[0.45, 0.5)	[5.4, 5.7)	312	0.7845	0.0088	0.0035	1.275	0.006
[0.45, 0.5)	[5.7, 6.0)	192	0.7727	0.0118	0.0040	1.294	0.007
[0.45, 0.5)	[6.0, 6.3)	110	0.7723	0.0211	0.0056	1.295	0.009
[0.45, 0.5)	[6.3, 6.6)	73	0.7187	0.0161	0.0071	1.391	0.014
[0.45, 0.5)	[6.6, 6.9)	31	0.7521	0.0272	0.0116	1.330	0.021
[0.45, 0.5)	[6.9, 7.5)	50	0.7417	0.0281	0.0058	1.348	0.010
[0.45, 0.5)	[7.5, 8.7)	12	0.8096	0.0418	0.0096	1.235	0.015
[0.5, 0.55)	[4.2, 4.5)	1221	0.6750	0.0057	0.0026	1.481	0.006
[0.5, 0.55)	[4.5, 4.8)	842	0.7314	0.0055	0.0025	1.367	0.005
[0.5, 0.55)	[4.8, 5.1)	591	0.7043	0.0088	0.0028	1.420	0.006
[0.5, 0.55)	[5.1, 5.4)	439	0.7485	0.0096	0.0029	1.336	0.005
[0.5, 0.55)	[5.4, 5.7)	272	0.7660	0.0087	0.0035	1.306	0.006
[0.5, 0.55)	[5.7, 6.0)	155	0.7768	0.0134	0.0046	1.287	0.008
[0.5, 0.55)	[6.0, 6.3)	89	0.7238	0.0203	0.0062	1.382	0.012
[0.5, 0.55)	[6.3, 6.6)	63	0.7951	0.0204	0.0068	1.258	0.011
[0.5, 0.55)	[6.6, 6.9)	29	0.7849	0.0267	0.0099	1.274	0.016
[0.5, 0.55)	[6.9, 7.5)	25	0.8269	0.0348	0.0073	1.209	0.011
[0.5, 0.55)	[7.5, 8.7)	15	0.7485	0.0400	0.0090	1.336	0.016
[0.55, 0.6)	[4.2, 4.5)	989	0.7547	0.0062	0.0025	1.325	0.004
[0.55, 0.6)	[4.5, 4.8)	724	0.7389	0.0058	0.0026	1.353	0.005
[0.55, 0.6)	[4.8, 5.1)	456	0.7346	0.0087	0.0032	1.361	0.006
[0.55, 0.6)	[5.1, 5.4)	324	0.7578	0.0124	0.0035	1.320	0.006
[0.55, 0.6)	[5.4, 5.7)	203	0.7906	0.0130	0.0039	1.265	0.006
[0.55, 0.6)	[5.7, 6.0)	122	0.7404	0.0124	0.0046	1.351	0.008
[0.55, 0.6)	[6.0, 6.3)	90	0.7928	0.0173	0.0054	1.261	0.009
[0.55, 0.6)	[6.3, 6.6)	49	0.7420	0.0271	0.0077	1.348	0.014
[0.55, 0.6)	[6.6, 6.9)	29	0.7835	0.0275	0.0110	1.276	0.018
[0.55, 0.6)	[6.9, 7.5)	26	0.7674	0.0383	0.0075	1.303	0.013
[0.55, 0.6)	[7.5, 8.7)	8	0.8404	0.0479	0.0101	1.190	0.014
[0.6, 0.65)	[4.2, 4.5)	758	0.7741	0.0074	0.0026	1.292	0.004
[0.6, 0.65)	[4.5, 4.8)	550	0.7692	0.0076	0.0029	1.300	0.005
[0.6, 0.65)	[4.8, 5.1)	349	0.7565	0.0081	0.0040	1.322	0.007
[0.6, 0.65)	[5.1, 5.4)	234	0.8047	0.0132	0.0035	1.243	0.005
[0.6, 0.65)	[5.4, 5.7)	153	0.7911	0.0129	0.0045	1.264	0.007
[0.6, 0.65)	[5.7, 6.0)	102	0.7046	0.0170	0.0057	1.419	0.011
[0.6, 0.65)	[6.0, 6.3)	66	0.8156	0.0200	0.0062	1.226	0.009
[0.6, 0.65)	[6.3, 6.6)	44	0.7413	0.0323	0.0093	1.349	0.017

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Table 3: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}}<\epsilon>$	$\delta_{\text{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.6, 0.65)	[6.6, 6.9)	27	0.9000	0.0197	0.0056	1.111	0.007
[0.6, 0.65)	[6.9, 7.5)	18	0.7508	0.0588	0.0152	1.332	0.027
[0.6, 0.65)	[7.5, 8.7)	8	0.8233	0.0567	0.0139	1.215	0.021
[0.65, 0.7)	[4.2, 4.5)	527	0.7887	0.0089	0.0030	1.268	0.005
[0.65, 0.7)	[4.5, 4.8)	387	0.7592	0.0077	0.0034	1.317	0.006
[0.65, 0.7)	[4.8, 5.1)	229	0.7965	0.0122	0.0043	1.256	0.007
[0.65, 0.7)	[5.1, 5.4)	180	0.7849	0.0113	0.0047	1.274	0.008
[0.65, 0.7)	[5.4, 5.7)	113	0.7462	0.0174	0.0050	1.340	0.009
[0.65, 0.7)	[5.7, 6.0)	66	0.8122	0.0213	0.0071	1.231	0.011
[0.65, 0.7)	[6.0, 6.3)	54	0.7958	0.0222	0.0074	1.257	0.012
[0.65, 0.7)	[6.3, 6.6)	25	0.7773	0.0375	0.0107	1.287	0.018
[0.65, 0.7)	[6.6, 6.9)	15	0.8053	0.0304	0.0141	1.242	0.022
[0.65, 0.7)	[6.9, 7.5)	20	0.7746	0.0312	0.0145	1.291	0.024
[0.65, 0.7)	[7.5, 8.7)	5	0.0786	0.0548	0.0410	12.717	6.635
[0.7, 0.75)	[4.2, 4.5)	327	0.7368	0.0092	0.0042	1.357	0.008
[0.7, 0.75)	[4.5, 4.8)	242	0.7680	0.0103	0.0044	1.302	0.007
[0.7, 0.75)	[4.8, 5.1)	168	0.7904	0.0136	0.0052	1.265	0.008
[0.7, 0.75)	[5.1, 5.4)	86	0.7830	0.0176	0.0077	1.277	0.013
[0.7, 0.75)	[5.4, 5.7)	67	0.7453	0.0218	0.0079	1.342	0.014
[0.7, 0.75)	[5.7, 6.0)	36	0.8839	0.0434	0.0120	1.131	0.015
[0.7, 0.75)	[6.0, 6.3)	34	0.7284	0.0458	0.0193	1.373	0.036
[0.7, 0.75)	[6.3, 6.6)	25	0.8257	0.0730	0.0357	1.211	0.052
[0.7, 0.75)	[6.6, 6.9)	11	0.0000	0.0000	0.0000	–	–
[0.7, 0.75)	[6.9, 7.5)	3	0.0000	0.0000	0.0000	–	–
[0.7, 0.75)	[7.5, 8.7)	4	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[4.2, 4.5)	224	0.6932	0.0203	0.0075	1.443	0.016
[0.75, 0.8)	[4.5, 4.8)	107	0.8326	0.0397	0.0069	1.201	0.010
[0.75, 0.8)	[4.8, 5.1)	76	0.0955	0.0262	0.0107	10.468	1.177
[0.75, 0.8)	[5.1, 5.4)	57	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[5.4, 5.7)	35	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[5.7, 6.0)	27	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.0, 6.3)	19	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.3, 6.6)	6	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.6, 6.9)	7	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.9, 7.5)	5	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[7.5, 8.7)	4	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.2, 4.5)	97	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.5, 4.8)	65	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.8, 5.1)	40	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.1, 5.4)	17	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.4, 5.7)	19	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.7, 6.0)	12	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.0, 6.3)	4	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.3, 6.6)	6	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.6, 6.9)	5	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.9, 7.5)	2	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[7.5, 8.7)	1	0.0000	0.0000	0.0000	–	–

5.4 Average Efficiency Calculations using RS57-70 all targets only

Table 4: Average Efficiency and Errors calculated for x_F and Mass bins using RS57-70 all targets

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\mathrm{stat}}<\epsilon>$	$\delta_{\mathrm{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.0, 0.05)	[4.2, 4.5)	2	0.0000	0.0000	0.0000	–	–
[0.0, 0.05)	[4.5, 4.8)	58	0.2186	0.0384	0.0120	4.574	0.251
[0.0, 0.05)	[4.8, 5.1)	210	0.7313	0.0357	0.0093	1.367	0.017
[0.0, 0.05)	[5.1, 5.4)	322	0.6007	0.0112	0.0100	1.665	0.028
[0.0, 0.05)	[5.4, 5.7)	332	0.6512	0.0138	0.0057	1.536	0.014
[0.0, 0.05)	[5.7, 6.0)	252	0.6583	0.0178	0.0061	1.519	0.014
[0.0, 0.05)	[6.0, 6.3)	180	0.6595	0.0159	0.0076	1.516	0.017
[0.0, 0.05)	[6.3, 6.6)	110	0.6639	0.0205	0.0098	1.506	0.022
[0.0, 0.05)	[6.6, 6.9)	48	0.6775	0.0210	0.0113	1.476	0.025
[0.0, 0.05)	[6.9, 7.5)	57	0.6714	0.0274	0.0098	1.489	0.022
[0.0, 0.05)	[7.5, 8.7)	9	0.5661	0.0833	0.0271	1.766	0.085
[0.05, 0.1)	[4.2, 4.5)	22	0.0000	0.0000	0.0000	–	–
[0.05, 0.1)	[4.5, 4.8)	185	0.3146	0.0260	0.0115	3.178	0.116
[0.05, 0.1)	[4.8, 5.1)	457	0.4959	0.0147	0.0077	2.017	0.031
[0.05, 0.1)	[5.1, 5.4)	529	0.6826	0.0158	0.0047	1.465	0.010
[0.05, 0.1)	[5.4, 5.7)	490	0.6542	0.0085	0.0052	1.529	0.012
[0.05, 0.1)	[5.7, 6.0)	358	0.7325	0.0098	0.0049	1.365	0.009
[0.05, 0.1)	[6.0, 6.3)	209	0.7106	0.0154	0.0052	1.407	0.010
[0.05, 0.1)	[6.3, 6.6)	148	0.6179	0.0155	0.0072	1.618	0.019
[0.05, 0.1)	[6.6, 6.9)	65	0.6878	0.0252	0.0088	1.454	0.019
[0.05, 0.1)	[6.9, 7.5)	61	0.6746	0.0218	0.0078	1.482	0.017
[0.05, 0.1)	[7.5, 8.7)	24	0.6253	0.0499	0.0111	1.599	0.028
[0.1, 0.15)	[4.2, 4.5)	161	8.1673	1.2842	0.0073	0.122	0.000
[0.1, 0.15)	[4.5, 4.8)	518	0.5176	0.0137	0.0074	1.932	0.028
[0.1, 0.15)	[4.8, 5.1)	811	0.6135	0.0067	0.0059	1.630	0.016
[0.1, 0.15)	[5.1, 5.4)	858	0.6040	0.0069	0.0042	1.656	0.012
[0.1, 0.15)	[5.4, 5.7)	625	0.6263	0.0094	0.0036	1.597	0.009
[0.1, 0.15)	[5.7, 6.0)	416	0.6728	0.0096	0.0042	1.486	0.009
[0.1, 0.15)	[6.0, 6.3)	293	0.7289	0.0125	0.0043	1.372	0.008
[0.1, 0.15)	[6.3, 6.6)	159	0.7369	0.0133	0.0058	1.357	0.011
[0.1, 0.15)	[6.6, 6.9)	112	0.7193	0.0152	0.0060	1.390	0.012
[0.1, 0.15)	[6.9, 7.5)	75	0.7171	0.0190	0.0058	1.394	0.011
[0.1, 0.15)	[7.5, 8.7)	26	0.6676	0.0269	0.0089	1.498	0.020
[0.15, 0.2)	[4.2, 4.5)	487	1.1841	0.0482	0.0051	0.845	0.004
[0.15, 0.2)	[4.5, 4.8)	1052	0.7085	0.0091	0.0051	1.412	0.010
[0.15, 0.2)	[4.8, 5.1)	1362	0.5343	0.0048	0.0036	1.872	0.013
[0.15, 0.2)	[5.1, 5.4)	1163	0.6907	0.0057	0.0030	1.448	0.006
[0.15, 0.2)	[5.4, 5.7)	738	0.7110	0.0088	0.0034	1.407	0.007
[0.15, 0.2)	[5.7, 6.0)	564	0.7624	0.0072	0.0033	1.312	0.006
[0.15, 0.2)	[6.0, 6.3)	342	0.7256	0.0095	0.0037	1.378	0.007
[0.15, 0.2)	[6.3, 6.6)	239	0.7305	0.0144	0.0047	1.369	0.009
[0.15, 0.2)	[6.6, 6.9)	112	0.7293	0.0176	0.0062	1.371	0.012
[0.15, 0.2)	[6.9, 7.5)	92	0.7042	0.0163	0.0053	1.420	0.011
[0.15, 0.2)	[7.5, 8.7)	28	0.7024	0.0376	0.0084	1.424	0.017
[0.2, 0.25)	[4.2, 4.5)	1287	0.5234	0.0083	0.0048	1.911	0.018

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Table 4: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}} <\epsilon>$	$\delta_{\text{prop}} <\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.2, 0.25)	[4.5, 4.8)	1771	0.5882	0.0064	0.0030	1.700	0.009
[0.2, 0.25)	[4.8, 5.1)	1726	0.6759	0.0053	0.0024	1.479	0.005
[0.2, 0.25)	[5.1, 5.4)	1457	0.6635	0.0053	0.0022	1.507	0.005
[0.2, 0.25)	[5.4, 5.7)	973	0.6810	0.0071	0.0027	1.469	0.006
[0.2, 0.25)	[5.7, 6.0)	647	0.7697	0.0068	0.0027	1.299	0.005
[0.2, 0.25)	[6.0, 6.3)	391	0.7225	0.0096	0.0034	1.384	0.007
[0.2, 0.25)	[6.3, 6.6)	270	0.7401	0.0117	0.0040	1.351	0.007
[0.2, 0.25)	[6.6, 6.9)	113	0.8147	0.0149	0.0053	1.227	0.008
[0.2, 0.25)	[6.9, 7.5)	112	0.7571	0.0138	0.0041	1.321	0.007
[0.2, 0.25)	[7.5, 8.7)	33	0.6915	0.0287	0.0073	1.446	0.015
[0.25, 0.3)	[4.2, 4.5)	2334	0.6958	0.0052	0.0030	1.437	0.006
[0.25, 0.3)	[4.5, 4.8)	2649	0.7130	0.0031	0.0021	1.403	0.004
[0.25, 0.3)	[4.8, 5.1)	2161	0.6885	0.0056	0.0019	1.452	0.004
[0.25, 0.3)	[5.1, 5.4)	1660	0.6945	0.0046	0.0021	1.440	0.004
[0.25, 0.3)	[5.4, 5.7)	1155	0.7683	0.0057	0.0022	1.302	0.004
[0.25, 0.3)	[5.7, 6.0)	679	0.7170	0.0071	0.0027	1.395	0.005
[0.25, 0.3)	[6.0, 6.3)	440	0.7526	0.0066	0.0032	1.329	0.006
[0.25, 0.3)	[6.3, 6.6)	246	0.7377	0.0127	0.0038	1.356	0.007
[0.25, 0.3)	[6.6, 6.9)	131	0.7213	0.0166	0.0066	1.386	0.013
[0.25, 0.3)	[6.9, 7.5)	136	0.7627	0.0151	0.0038	1.311	0.007
[0.25, 0.3)	[7.5, 8.7)	31	0.6334	0.0332	0.0081	1.579	0.020
[0.3, 0.35)	[4.2, 4.5)	3427	0.7484	0.0028	0.0021	1.336	0.004
[0.3, 0.35)	[4.5, 4.8)	3121	0.7449	0.0038	0.0016	1.342	0.003
[0.3, 0.35)	[4.8, 5.1)	2660	0.7042	0.0041	0.0016	1.420	0.003
[0.3, 0.35)	[5.1, 5.4)	1804	0.7803	0.0040	0.0016	1.281	0.003
[0.3, 0.35)	[5.4, 5.7)	1217	0.6993	0.0050	0.0020	1.430	0.004
[0.3, 0.35)	[5.7, 6.0)	737	0.7166	0.0085	0.0023	1.395	0.005
[0.3, 0.35)	[6.0, 6.3)	459	0.7268	0.0084	0.0030	1.376	0.006
[0.3, 0.35)	[6.3, 6.6)	284	0.7595	0.0110	0.0034	1.317	0.006
[0.3, 0.35)	[6.6, 6.9)	172	0.7205	0.0115	0.0051	1.388	0.010
[0.3, 0.35)	[6.9, 7.5)	120	0.7036	0.0179	0.0049	1.421	0.010
[0.3, 0.35)	[7.5, 8.7)	45	0.7637	0.0257	0.0052	1.309	0.009
[0.35, 0.4)	[4.2, 4.5)	4154	0.7929	0.0033	0.0015	1.261	0.002
[0.35, 0.4)	[4.5, 4.8)	3597	0.7180	0.0035	0.0014	1.393	0.003
[0.35, 0.4)	[4.8, 5.1)	2740	0.7287	0.0033	0.0015	1.372	0.003
[0.35, 0.4)	[5.1, 5.4)	1947	0.7600	0.0038	0.0017	1.316	0.003
[0.35, 0.4)	[5.4, 5.7)	1156	0.7305	0.0057	0.0019	1.369	0.004
[0.35, 0.4)	[5.7, 6.0)	768	0.7145	0.0075	0.0025	1.400	0.005
[0.35, 0.4)	[6.0, 6.3)	475	0.7870	0.0077	0.0026	1.271	0.004
[0.35, 0.4)	[6.3, 6.6)	299	0.7530	0.0111	0.0034	1.328	0.006
[0.35, 0.4)	[6.6, 6.9)	178	0.7646	0.0112	0.0045	1.308	0.008
[0.35, 0.4)	[6.9, 7.5)	142	0.7335	0.0179	0.0036	1.363	0.007
[0.35, 0.4)	[7.5, 8.7)	52	0.7419	0.0222	0.0050	1.348	0.009
[0.4, 0.45)	[4.2, 4.5)	4687	0.7402	0.0032	0.0013	1.351	0.002
[0.4, 0.45)	[4.5, 4.8)	3755	0.6903	0.0044	0.0013	1.449	0.003
[0.4, 0.45)	[4.8, 5.1)	2761	0.7311	0.0032	0.0013	1.368	0.002
[0.4, 0.45)	[5.1, 5.4)	1874	0.7180	0.0037	0.0017	1.393	0.003
[0.4, 0.45)	[5.4, 5.7)	1209	0.7504	0.0052	0.0018	1.333	0.003

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Table 4: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}}<\epsilon>$	$\delta_{\text{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.4, 0.45)	[5.7, 6.0)	776	0.7713	0.0076	0.0021	1.296	0.004
[0.4, 0.45)	[6.0, 6.3)	489	0.7828	0.0077	0.0028	1.277	0.005
[0.4, 0.45)	[6.3, 6.6)	310	0.7582	0.0095	0.0032	1.319	0.006
[0.4, 0.45)	[6.6, 6.9)	169	0.8065	0.0092	0.0038	1.240	0.006
[0.4, 0.45)	[6.9, 7.5)	143	0.7609	0.0159	0.0036	1.314	0.006
[0.4, 0.45)	[7.5, 8.7)	34	0.7886	0.0259	0.0055	1.268	0.009
[0.45, 0.5)	[4.2, 4.5)	4659	0.7450	0.0030	0.0013	1.342	0.002
[0.45, 0.5)	[4.5, 4.8)	3627	0.7541	0.0025	0.0011	1.326	0.002
[0.45, 0.5)	[4.8, 5.1)	2571	0.7067	0.0036	0.0015	1.415	0.003
[0.45, 0.5)	[5.1, 5.4)	1783	0.7388	0.0049	0.0016	1.353	0.003
[0.45, 0.5)	[5.4, 5.7)	1088	0.7786	0.0050	0.0019	1.284	0.003
[0.45, 0.5)	[5.7, 6.0)	700	0.7706	0.0062	0.0022	1.298	0.004
[0.45, 0.5)	[6.0, 6.3)	435	0.7701	0.0102	0.0028	1.299	0.005
[0.45, 0.5)	[6.3, 6.6)	255	0.7313	0.0085	0.0036	1.367	0.007
[0.45, 0.5)	[6.6, 6.9)	129	0.7924	0.0139	0.0049	1.262	0.008
[0.45, 0.5)	[6.9, 7.5)	141	0.7439	0.0148	0.0033	1.344	0.006
[0.45, 0.5)	[7.5, 8.7)	45	0.7840	0.0273	0.0058	1.275	0.009
[0.5, 0.55)	[4.2, 4.5)	4306	0.6773	0.0030	0.0014	1.476	0.003
[0.5, 0.55)	[4.5, 4.8)	3228	0.7308	0.0028	0.0013	1.368	0.002
[0.5, 0.55)	[4.8, 5.1)	2223	0.7064	0.0043	0.0014	1.416	0.003
[0.5, 0.55)	[5.1, 5.4)	1444	0.7628	0.0051	0.0016	1.311	0.003
[0.5, 0.55)	[5.4, 5.7)	914	0.7484	0.0054	0.0020	1.336	0.004
[0.5, 0.55)	[5.7, 6.0)	580	0.7779	0.0069	0.0024	1.285	0.004
[0.5, 0.55)	[6.0, 6.3)	352	0.7311	0.0105	0.0032	1.368	0.006
[0.5, 0.55)	[6.3, 6.6)	211	0.7949	0.0110	0.0039	1.258	0.006
[0.5, 0.55)	[6.6, 6.9)	131	0.8114	0.0124	0.0040	1.232	0.006
[0.5, 0.55)	[6.9, 7.5)	107	0.7816	0.0171	0.0039	1.279	0.006
[0.5, 0.55)	[7.5, 8.7)	46	0.7344	0.0256	0.0058	1.362	0.011
[0.55, 0.6)	[4.2, 4.5)	3659	0.7458	0.0033	0.0013	1.341	0.002
[0.55, 0.6)	[4.5, 4.8)	2558	0.7304	0.0034	0.0014	1.369	0.003
[0.55, 0.6)	[4.8, 5.1)	1733	0.7319	0.0045	0.0016	1.366	0.003
[0.55, 0.6)	[5.1, 5.4)	1153	0.7508	0.0057	0.0019	1.332	0.003
[0.55, 0.6)	[5.4, 5.7)	791	0.7826	0.0072	0.0021	1.278	0.003
[0.55, 0.6)	[5.7, 6.0)	461	0.7215	0.0070	0.0026	1.386	0.005
[0.55, 0.6)	[6.0, 6.3)	310	0.7764	0.0107	0.0032	1.288	0.005
[0.55, 0.6)	[6.3, 6.6)	178	0.7579	0.0135	0.0038	1.320	0.007
[0.55, 0.6)	[6.6, 6.9)	113	0.7729	0.0176	0.0056	1.294	0.009
[0.55, 0.6)	[6.9, 7.5)	91	0.7624	0.0179	0.0038	1.312	0.007
[0.55, 0.6)	[7.5, 8.7)	25	0.7924	0.0322	0.0071	1.262	0.011
[0.6, 0.65)	[4.2, 4.5)	2841	0.7534	0.0039	0.0014	1.327	0.002
[0.6, 0.65)	[4.5, 4.8)	1979	0.7593	0.0041	0.0016	1.317	0.003
[0.6, 0.65)	[4.8, 5.1)	1276	0.7592	0.0043	0.0020	1.317	0.003
[0.6, 0.65)	[5.1, 5.4)	900	0.8001	0.0062	0.0018	1.250	0.003
[0.6, 0.65)	[5.4, 5.7)	535	0.7816	0.0082	0.0026	1.279	0.004
[0.6, 0.65)	[5.7, 6.0)	353	0.7361	0.0098	0.0029	1.359	0.005
[0.6, 0.65)	[6.0, 6.3)	228	0.7966	0.0125	0.0036	1.255	0.006
[0.6, 0.65)	[6.3, 6.6)	148	0.7245	0.0176	0.0048	1.380	0.009
[0.6, 0.65)	[6.6, 6.9)	85	0.8524	0.0169	0.0042	1.173	0.006

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Table 4: (Continued)

x_F Bin	Mass Bin (GeV/c^2)	N_{events}	$<\epsilon>$	$\delta_{\text{stat}}<\epsilon>$	$\delta_{\text{prop}}<\epsilon>$	$1/<\epsilon>$	$\delta(1/<\epsilon>)$
[0.6, 0.65)	[6.9, 7.5)	65	0.7452	0.0265	0.0069	1.342	0.012
[0.6, 0.65)	[7.5, 8.7)	23	0.7339	0.0431	0.0111	1.363	0.021
[0.65, 0.7)	[4.2, 4.5)	1977	0.7822	0.0048	0.0016	1.278	0.003
[0.65, 0.7)	[4.5, 4.8)	1353	0.7474	0.0047	0.0019	1.338	0.003
[0.65, 0.7)	[4.8, 5.1)	858	0.7918	0.0058	0.0022	1.263	0.003
[0.65, 0.7)	[5.1, 5.4)	576	0.7777	0.0064	0.0026	1.286	0.004
[0.65, 0.7)	[5.4, 5.7)	383	0.7330	0.0097	0.0029	1.364	0.005
[0.65, 0.7)	[5.7, 6.0)	241	0.8234	0.0110	0.0035	1.215	0.005
[0.65, 0.7)	[6.0, 6.3)	172	0.7830	0.0115	0.0042	1.277	0.007
[0.65, 0.7)	[6.3, 6.6)	86	0.7874	0.0155	0.0060	1.270	0.010
[0.65, 0.7)	[6.6, 6.9)	46	0.7974	0.0223	0.0087	1.254	0.014
[0.65, 0.7)	[6.9, 7.5)	48	0.7732	0.0189	0.0097	1.293	0.016
[0.65, 0.7)	[7.5, 8.7)	21	0.3154	0.0935	0.0142	3.171	0.143
[0.7, 0.75)	[4.2, 4.5)	1245	0.7274	0.0052	0.0023	1.375	0.004
[0.7, 0.75)	[4.5, 4.8)	833	0.7707	0.0060	0.0024	1.297	0.004
[0.7, 0.75)	[4.8, 5.1)	568	0.7776	0.0077	0.0029	1.286	0.005
[0.7, 0.75)	[5.1, 5.4)	356	0.7822	0.0087	0.0038	1.278	0.006
[0.7, 0.75)	[5.4, 5.7)	243	0.7451	0.0137	0.0044	1.342	0.008
[0.7, 0.75)	[5.7, 6.0)	143	0.8584	0.0311	0.0060	1.165	0.008
[0.7, 0.75)	[6.0, 6.3)	90	0.7598	0.0270	0.0110	1.316	0.019
[0.7, 0.75)	[6.3, 6.6)	77	0.7555	0.0444	0.0201	1.324	0.035
[0.7, 0.75)	[6.6, 6.9)	43	0.0000	0.0000	0.0000	–	–
[0.7, 0.75)	[6.9, 7.5)	19	0.0000	0.0000	0.0000	–	–
[0.7, 0.75)	[7.5, 8.7)	11	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[4.2, 4.5)	763	0.6989	0.0116	0.0040	1.431	0.008
[0.75, 0.8)	[4.5, 4.8)	438	0.7955	0.0202	0.0032	1.257	0.005
[0.75, 0.8)	[4.8, 5.1)	303	0.1510	0.0163	0.0069	6.624	0.302
[0.75, 0.8)	[5.1, 5.4)	190	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[5.4, 5.7)	133	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[5.7, 6.0)	91	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.0, 6.3)	55	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.3, 6.6)	36	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.6, 6.9)	23	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[6.9, 7.5)	21	0.0000	0.0000	0.0000	–	–
[0.75, 0.8)	[7.5, 8.7)	13	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.2, 4.5)	329	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.5, 4.8)	248	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[4.8, 5.1)	139	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.1, 5.4)	101	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.4, 5.7)	64	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[5.7, 6.0)	41	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.0, 6.3)	18	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.3, 6.6)	23	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.6, 6.9)	11	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[6.9, 7.5)	7	0.0000	0.0000	0.0000	–	–
[0.8, 0.85)	[7.5, 8.7)	3	0.0000	0.0000	0.0000	–	–

6 Disscussion

We calculated kTracker efficiency correcttions with the propagated uncertainties for different Mass and x_F bins by using Monte-Carlo events. It is evident that the efficiency corrections for some x_F and Mass bins couldn't calculate reliably due to low statistics. In some cases we cannot reliably determine the efficiency in these bins; sometimes the efficiency is even larger than one due to the large fluctuations. Also in some bins have an efficiency of zero and we have to delete these bins from the final results. We have to calculate efficiency curves for these 2D bins with the Monte-Carlo samples with high statistics.