Determination of reconstruction efficiency

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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.

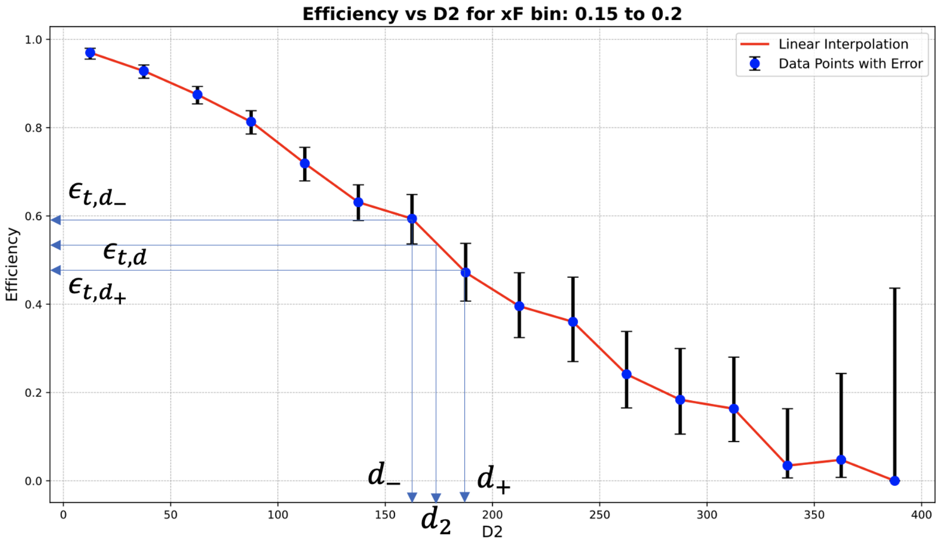


Figure 1: Determination of Efficiency and it's uncertainty

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:

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

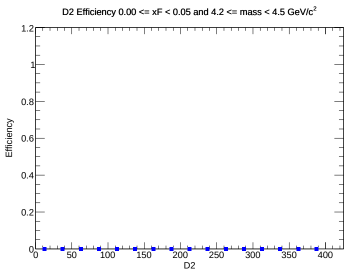
2 Results

Here, we report efficiency corrections under 2 scenerios.

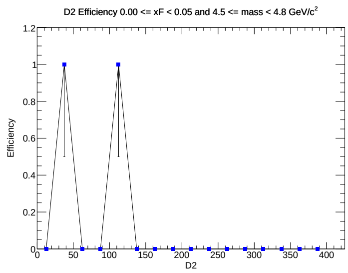
- Efficiency calculation only by using x_F bins (1-D Study)
- Efficiency calculation only by using both x_F and Mass bins (2-D Study)

3 Efficiency Curves by Kinematic Bin

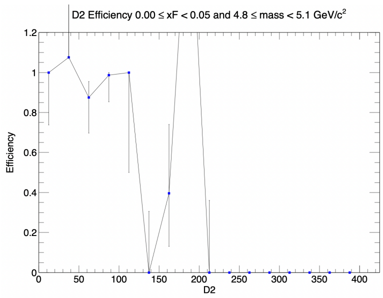
The following pages display the D2 efficiency curves for all 187 kinematic bins. Each page corresponds to a single bin in x_F, with the 11 mass bins for that x_F range arranged as sub-plots.



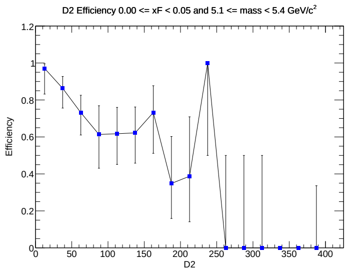
(a) $4.2 \leq m < 4.5$ GeV$/c^2$



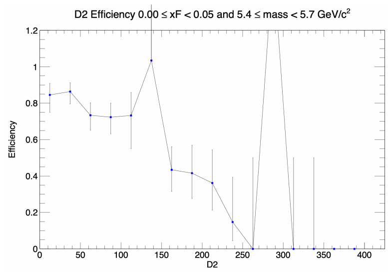
(b) $4.5 \leq m < 4.8$ GeV$/c^2$



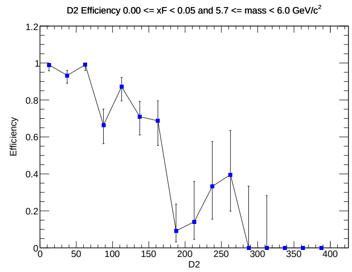
(c) $4.8 \leq m < 5.1$ GeV$/c^2$



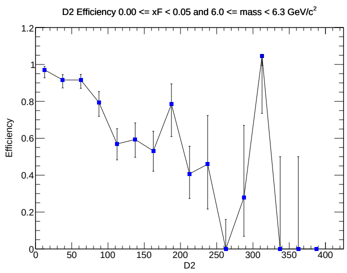
(d) $5.1 \leq m < 5.4$ GeV$/c^2$



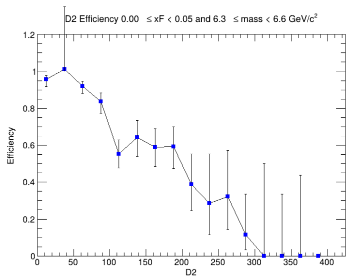
(e) $5.4 \leq m < 5.7$ GeV$/c^2$



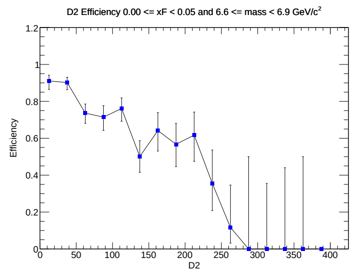
(f) $5.7 \leq m < 6.0$ GeV$/c^2$



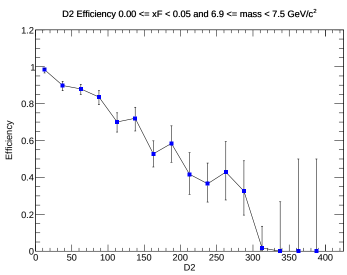
(g) $6.0 \leq m < 6.3$ GeV$/c^2$



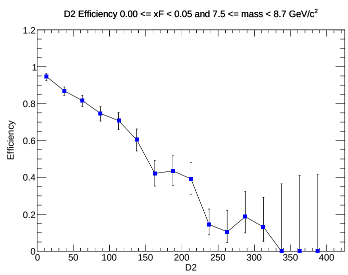
(h) $6.3 \leq m < 6.6$ GeV$/c^2$



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

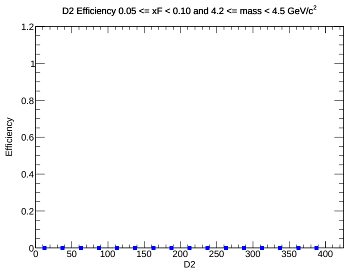


(j) $6.9 \leq m < 7.5$ GeV$/c^2$

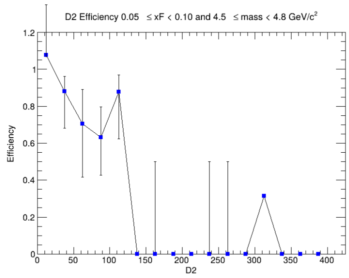


(k) $7.5 \leq m < 8.7$ GeV$/c^2$

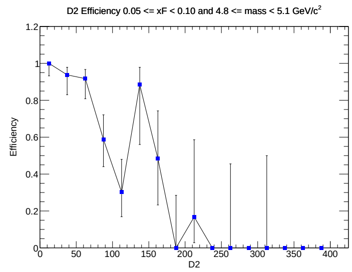
Figure 2: Efficiency plots for the x_F bin $0.00 \leq x_F < 0.05$.



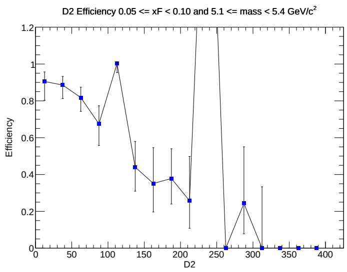
(a) $4.2 \leq m < 4.5$ GeV$/c^2$



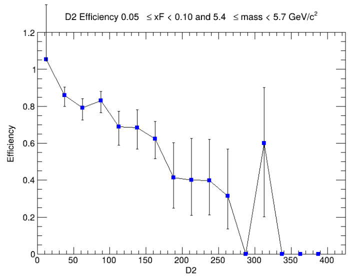
(b) $4.5 \leq m < 4.8$ GeV$/c^2$



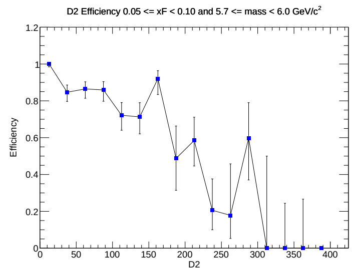
(c) $4.8 \leq m < 5.1$ GeV$/c^2$



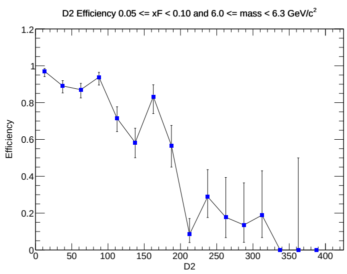
(d) $5.1 \leq m < 5.4$ GeV$/c^2$



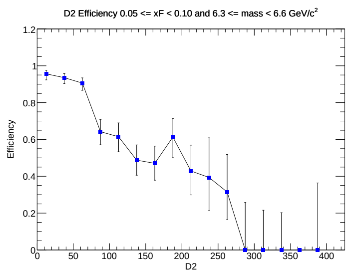
(e) $5.4 \leq m < 5.7$ GeV$/c^2$



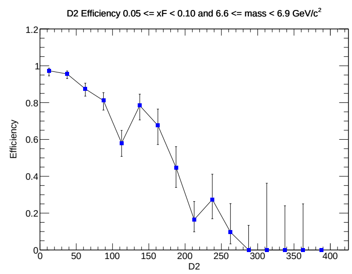
(f) $5.7 \leq m < 6.0$ GeV$/c^2$



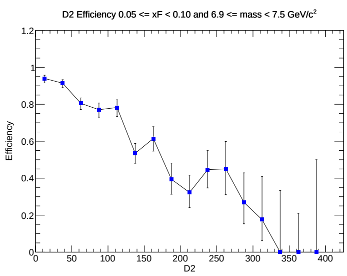
(g) $6.0 \leq m < 6.3$ GeV$/c^2$



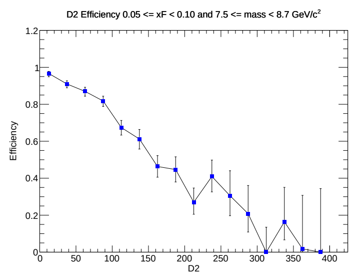
(h) $6.3 \leq m < 6.6$ GeV$/c^2$



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

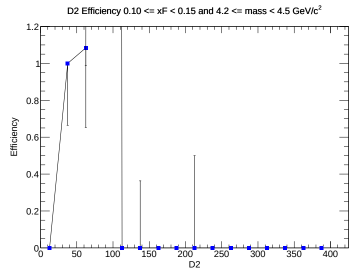


(j) $6.9 \leq m < 7.5$ GeV$/c^2$

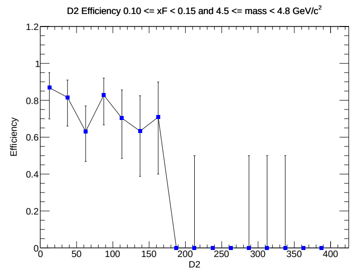


(k) $7.5 \leq m < 8.7$ GeV$/c^2$

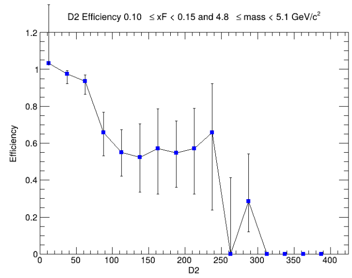
Figure 3: Efficiency plots for the x_F bin $0.05 \leq x_F < 0.10$.



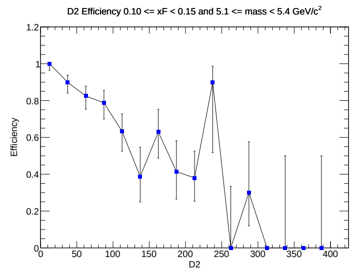
(a) $4.2 \leq m < 4.5$ GeV/c^2



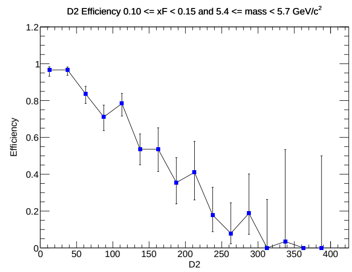
(b) $4.5 \leq m < 4.8$ GeV/c^2



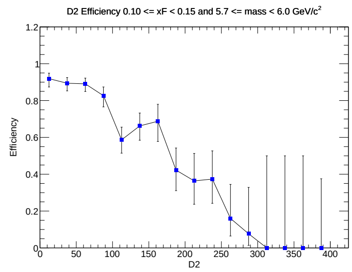
(c) $4.8 \leq m < 5.1$ GeV/c^2



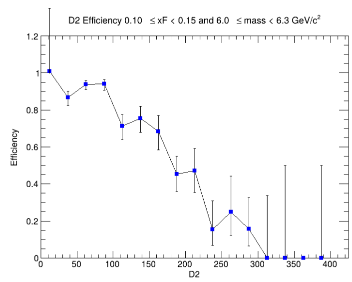
(d) $5.1 \leq m < 5.4$ GeV/c^2



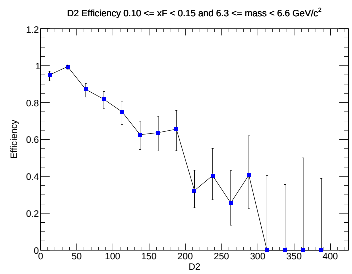
(e) $5.4 \leq m < 5.7$ GeV/c^2



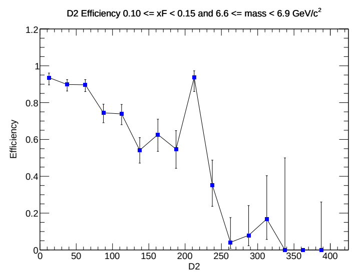
(f) $5.7 \leq m < 6.0$ GeV/c^2



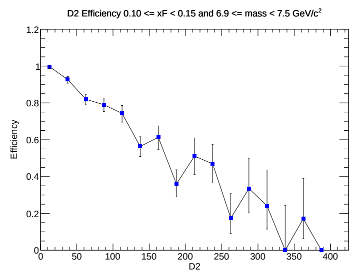
(g) $6.0 \leq m < 6.3$ GeV/c^2



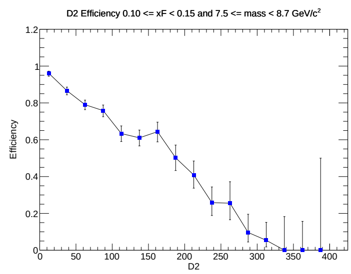
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

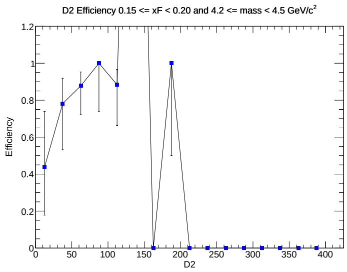


(j) $6.9 \leq m < 7.5$ GeV/c^2

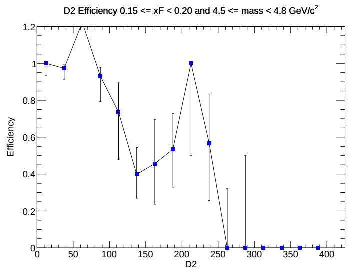


(k) $7.5 \leq m < 8.7$ GeV/c^2

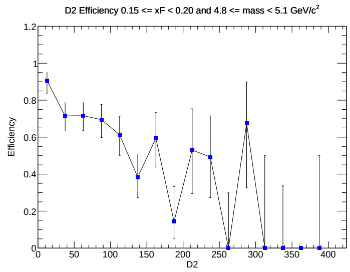
Figure 4: Efficiency plots for the x_F bin $0.10 \leq x_F < 0.15$.



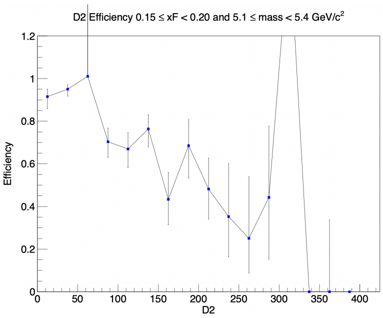
(a) $4.2 \leq m < 4.5$ GeV/c^2



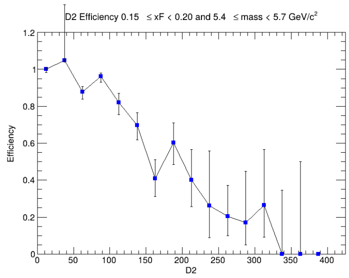
(b) $4.5 \leq m < 4.8$ GeV/c^2



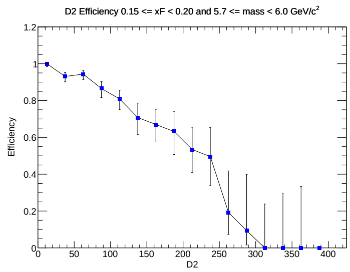
(c) $4.8 \leq m < 5.1$ GeV/c^2



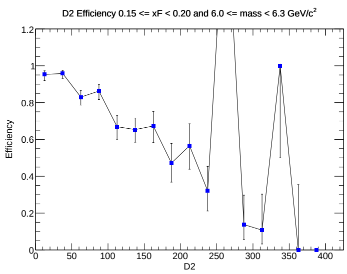
(d) $5.1 \leq m < 5.4$ GeV/c^2



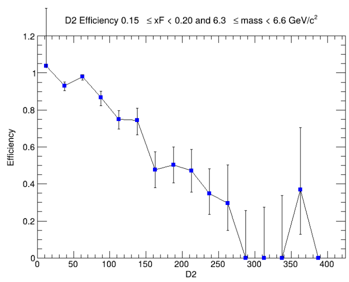
(e) $5.4 \leq m < 5.7$ GeV/c^2



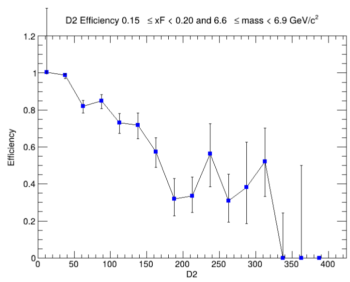
(f) $5.7 \leq m < 6.0$ GeV/c^2



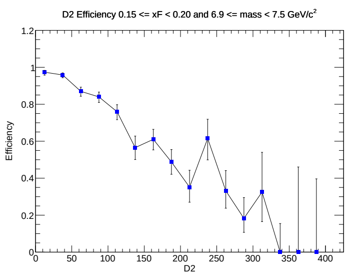
(g) $6.0 \leq m < 6.3$ GeV/c^2



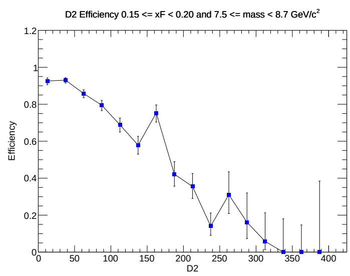
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

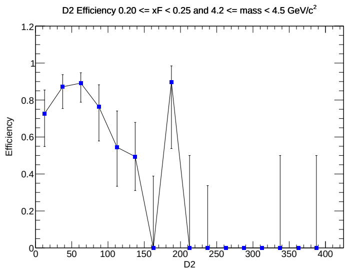


(j) $6.9 \leq m < 7.5$ GeV/c^2

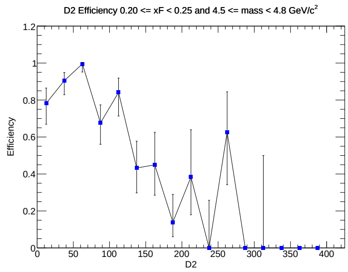


(k) $7.5 \leq m < 8.7$ GeV/c^2

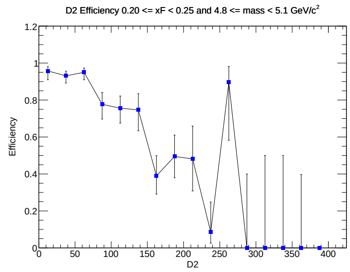
Figure 5: Efficiency plots for the x_F bin $0.15 \leq x_F < 0.20$.



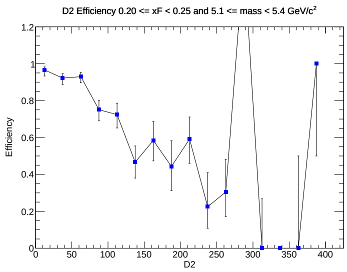
(a) $4.2 \leq m < 4.5$ GeV/c^2



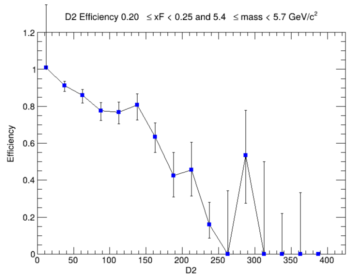
(b) $4.5 \leq m < 4.8$ GeV/c^2



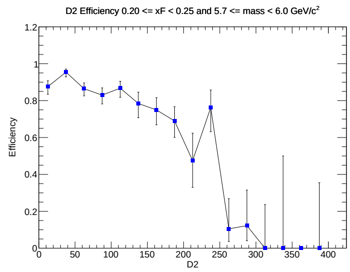
(c) $4.8 \leq m < 5.1$ GeV/c^2



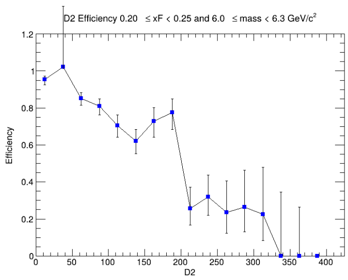
(d) $5.1 \leq m < 5.4$ GeV/c^2



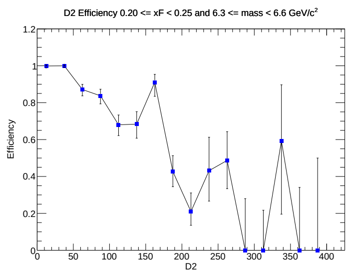
(e) $5.4 \leq m < 5.7$ GeV/c^2



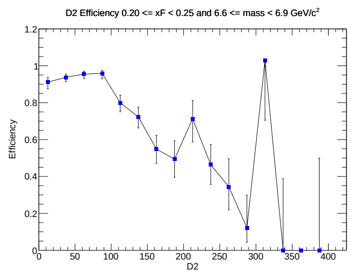
(f) $5.7 \leq m < 6.0$ GeV/c^2



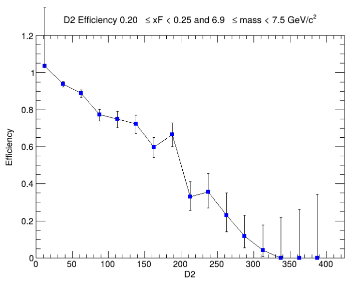
(g) $6.0 \leq m < 6.3$ GeV/c^2



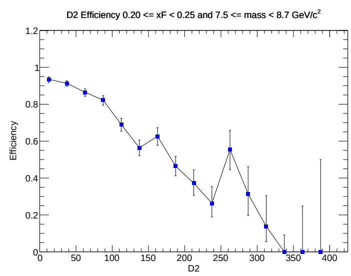
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

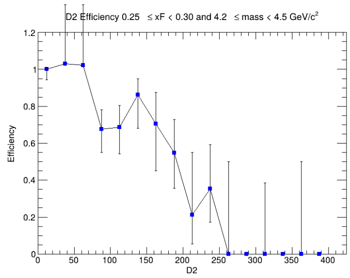


(j) $6.9 \leq m < 7.5$ GeV/c^2

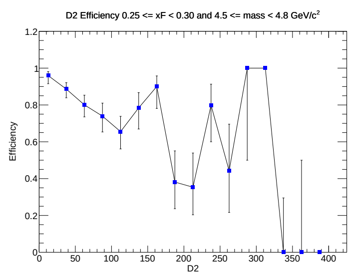


(k) $7.5 \leq m < 8.7$ GeV/c^2

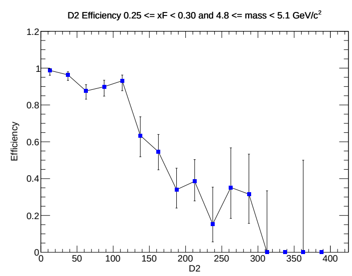
Figure 6: Efficiency plots for the x_F bin $0.20 \leq x_F < 0.25$.



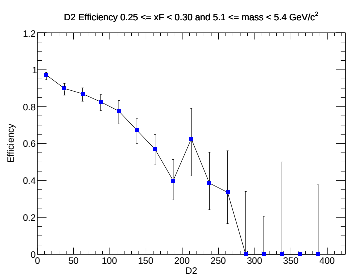
(a) $4.2 \leq m < 4.5$ GeV/c^2



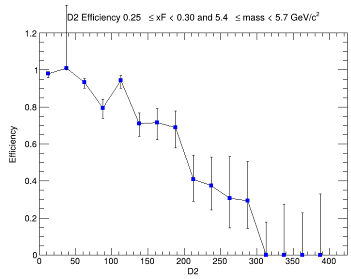
(b) $4.5 \leq m < 4.8$ GeV/c^2



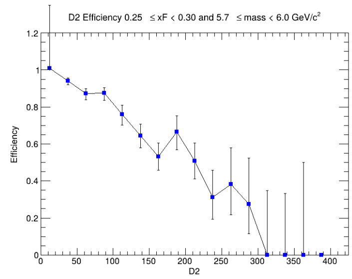
(c) $4.8 \leq m < 5.1$ GeV/c^2



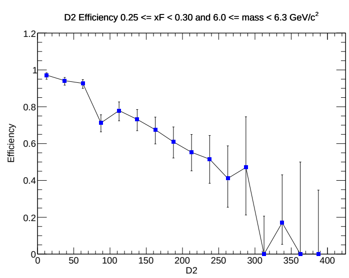
(d) $5.1 \leq m < 5.4$ GeV/c^2



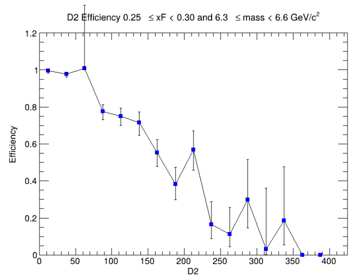
(e) $5.4 \leq m < 5.7$ GeV/c^2



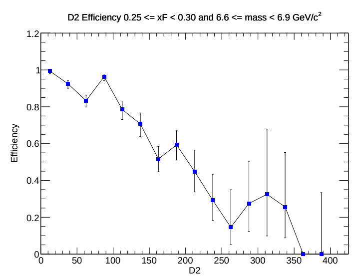
(f) $5.7 \leq m < 6.0$ GeV/c^2



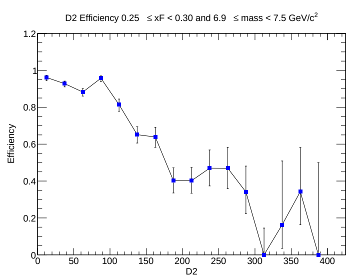
(g) $6.0 \leq m < 6.3$ GeV/c^2



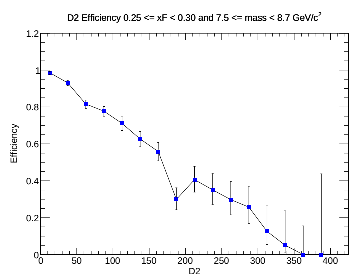
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

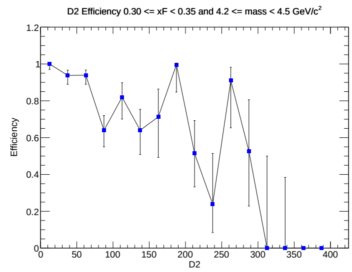


(j) $6.9 \leq m < 7.5$ GeV/c^2

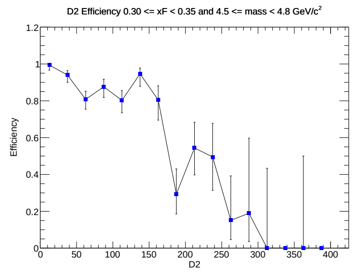


(k) $7.5 \leq m < 8.7$ GeV/c^2

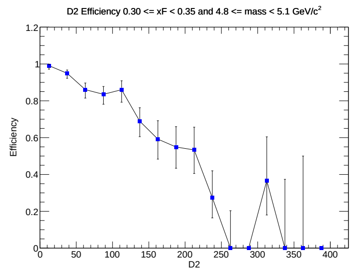
Figure 7: Efficiency plots for the x_F bin $0.25 \leq x_F < 0.30$.



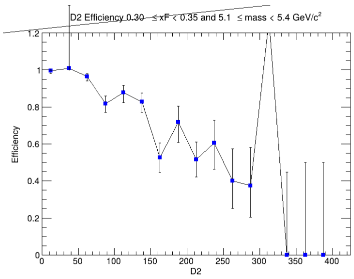
(a) $4.2 \leq m < 4.5$ GeV/c^2



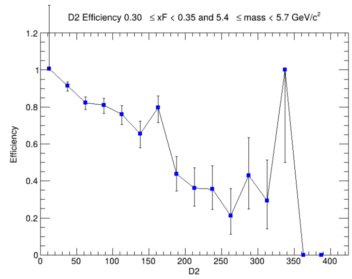
(b) $4.5 \leq m < 4.8$ GeV/c^2



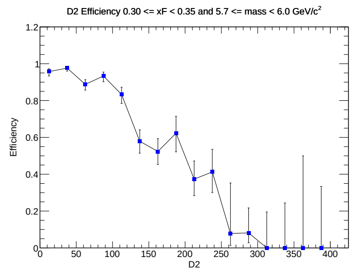
(c) $4.8 \leq m < 5.1$ GeV/c^2



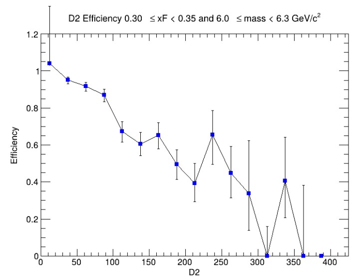
(d) $5.1 \leq m < 5.4$ GeV/c^2



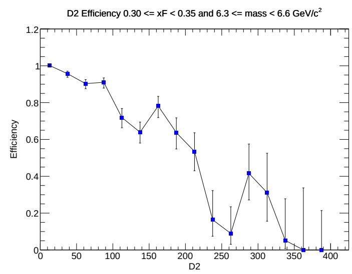
(e) $5.4 \leq m < 5.7$ GeV/c^2



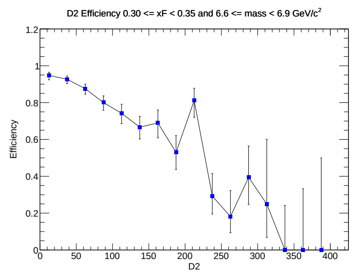
(f) $5.7 \leq m < 6.0$ GeV/c^2



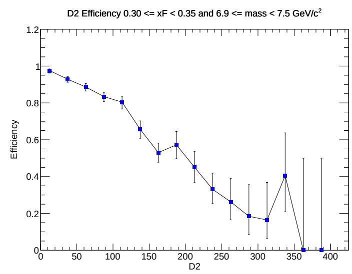
(g) $6.0 \leq m < 6.3$ GeV/c^2



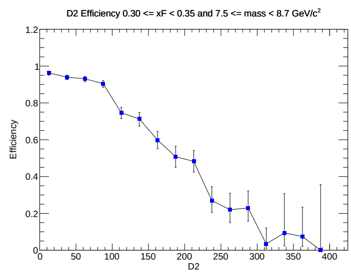
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

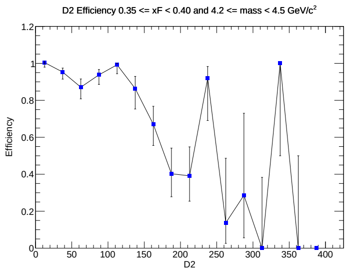


(j) $6.9 \leq m < 7.5$ GeV/c^2

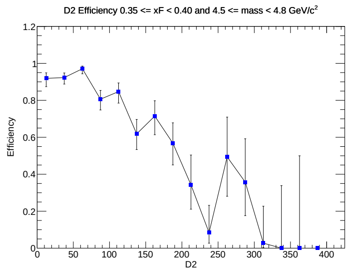


(k) $7.5 \leq m < 8.7$ GeV/c^2

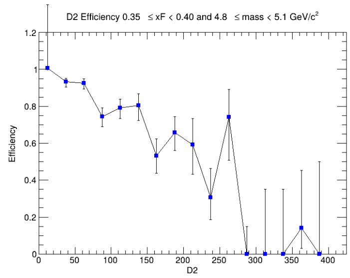
Figure 8: Efficiency plots for the x_F bin $0.30 \leq x_F < 0.35$.



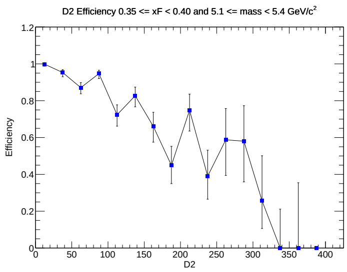
(a) $4.2 \leq m < 4.5$ GeV/c^2



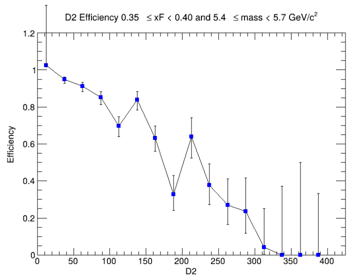
(b) $4.5 \leq m < 4.8$ GeV/c^2



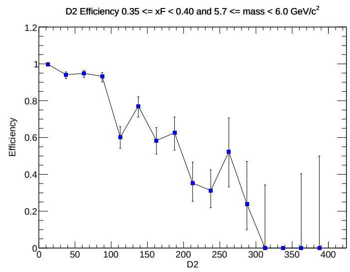
(c) $4.8 \leq m < 5.1$ GeV/c^2



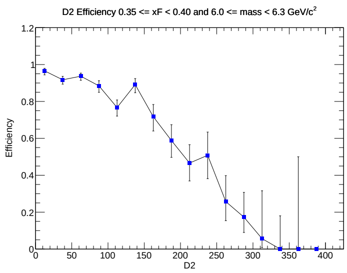
(d) $5.1 \leq m < 5.4$ GeV/c^2



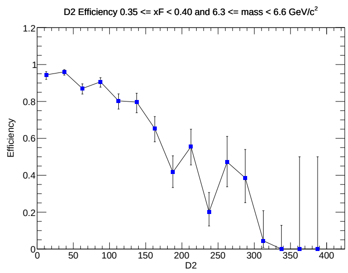
(e) $5.4 \leq m < 5.7$ GeV/c^2



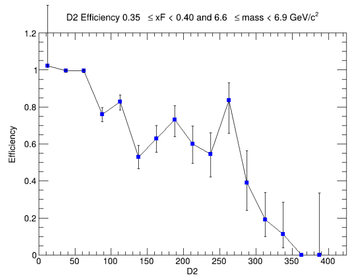
(f) $5.7 \leq m < 6.0$ GeV/c^2



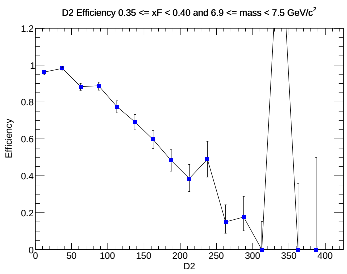
(g) $6.0 \leq m < 6.3$ GeV/c^2



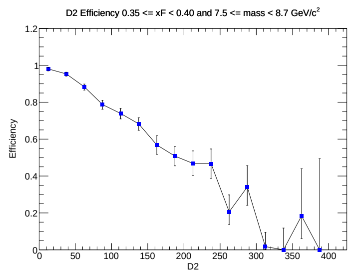
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

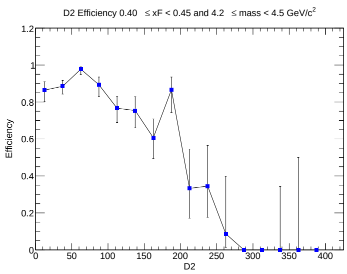


(j) $6.9 \leq m < 7.5$ GeV/c^2

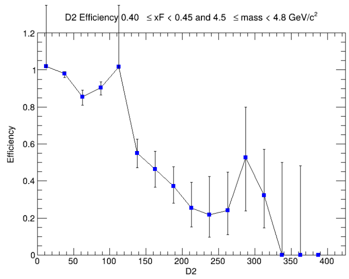


(k) $7.5 \leq m < 8.7$ GeV/c^2

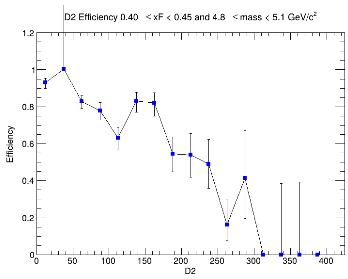
Figure 9: Efficiency plots for the x_F bin $0.35 \leq x_F < 0.40$.



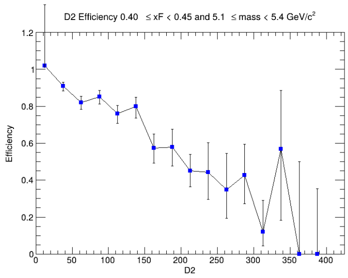
(a) $4.2 \leq m < 4.5$ GeV/c^2



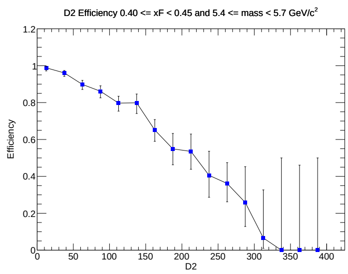
(b) $4.5 \leq m < 4.8$ GeV/c^2



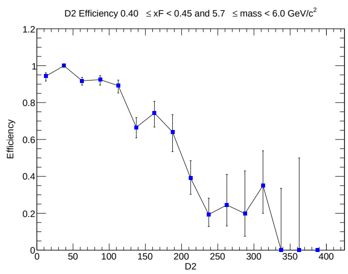
(c) $4.8 \leq m < 5.1$ GeV/c^2



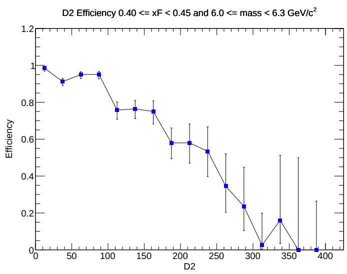
(d) $5.1 \leq m < 5.4$ GeV/c^2



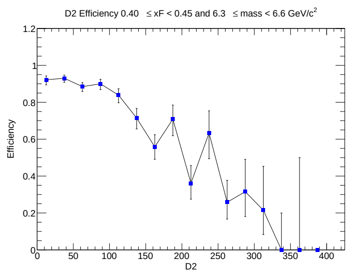
(e) $5.4 \leq m < 5.7$ GeV/c^2



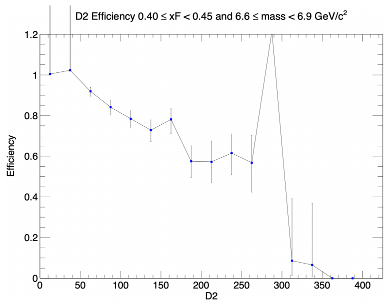
(f) $5.7 \leq m < 6.0$ GeV/c^2



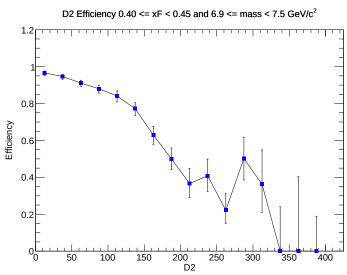
(g) $6.0 \leq m < 6.3$ GeV/c^2



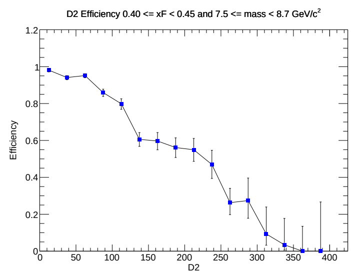
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

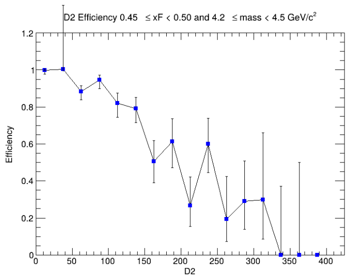


(j) $6.9 \leq m < 7.5$ GeV/c^2

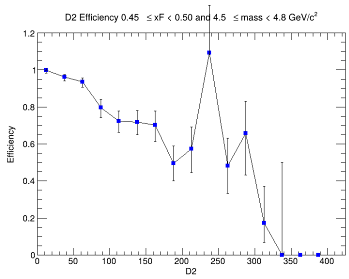


(k) $7.5 \leq m < 8.7$ GeV/c^2

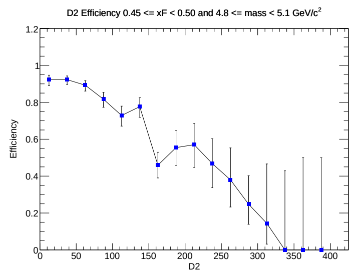
Figure 10: Efficiency plots for the x_F bin $0.40 \leq x_F < 0.45$.



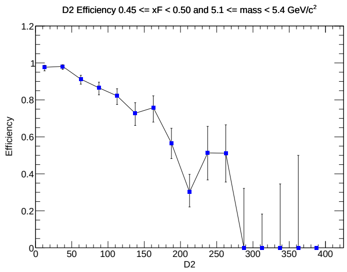
(a) $4.2 \leq m < 4.5$ GeV/c^2



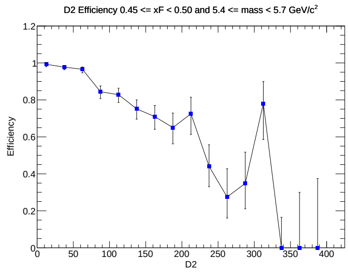
(b) $4.5 \leq m < 4.8$ GeV/c^2



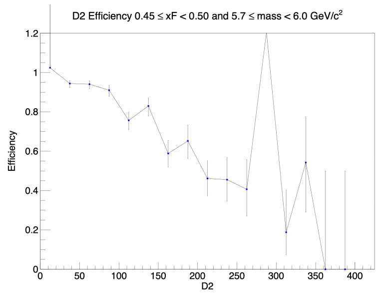
(c) $4.8 \leq m < 5.1$ GeV/c^2



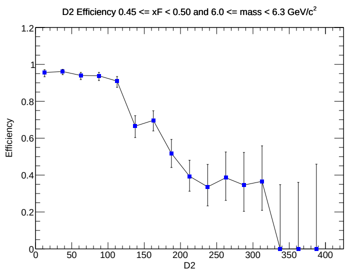
(d) $5.1 \leq m < 5.4$ GeV/c^2



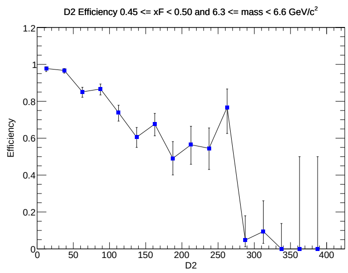
(e) $5.4 \leq m < 5.7$ GeV/c^2



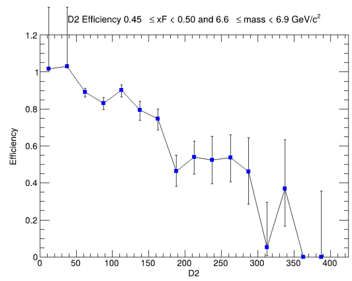
(f) $5.7 \leq m < 6.0$ GeV/c^2



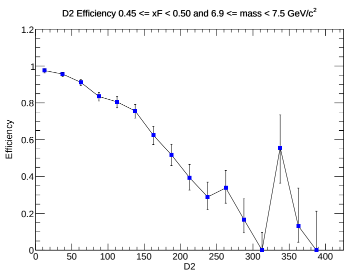
(g) $6.0 \leq m < 6.3$ GeV/c^2



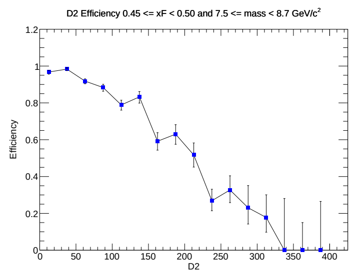
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

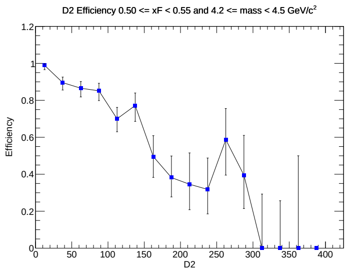


(j) $6.9 \leq m < 7.5$ GeV/c^2

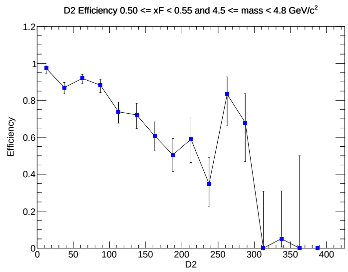


(k) $7.5 \leq m < 8.7$ GeV/c^2

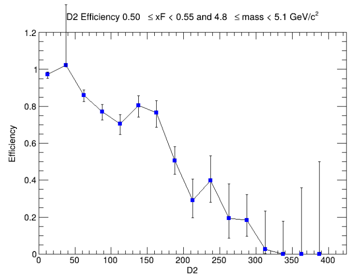
Figure 11: Efficiency plots for the x_F bin $0.45 \leq x_F < 0.50$.



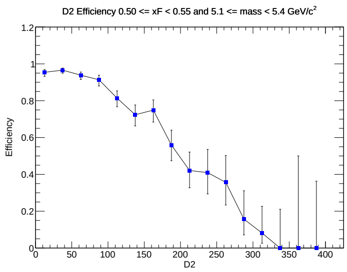
(a) $4.2 \leq m < 4.5$ GeV/c^2



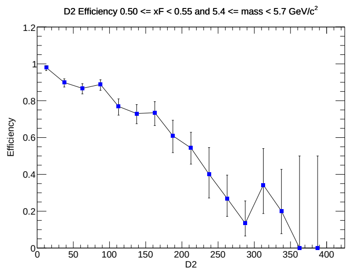
(b) $4.5 \leq m < 4.8$ GeV/c^2



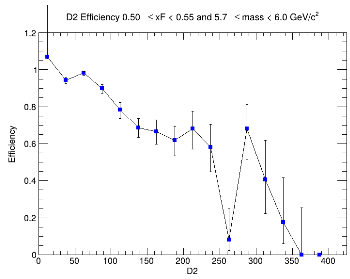
(c) $4.8 \leq m < 5.1$ GeV/c^2



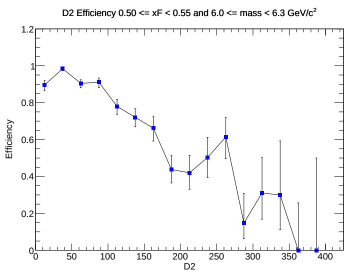
(d) $5.1 \leq m < 5.4$ GeV/c^2



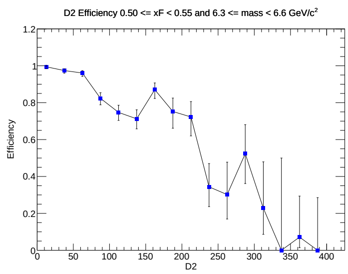
(e) $5.4 \leq m < 5.7$ GeV/c^2



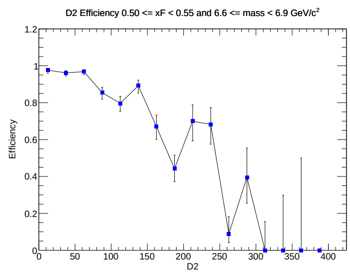
(f) $5.7 \leq m < 6.0$ GeV/c^2



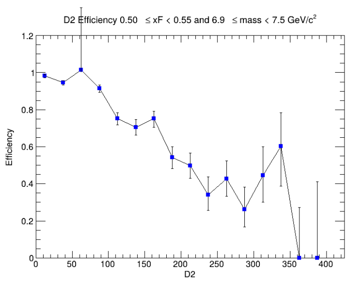
(g) $6.0 \leq m < 6.3$ GeV/c^2



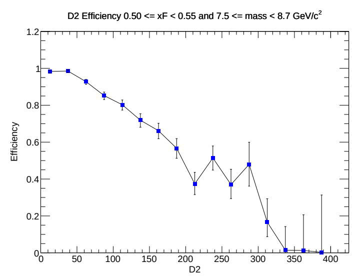
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

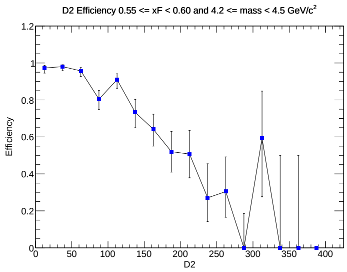


(j) $6.9 \leq m < 7.5$ GeV/c^2

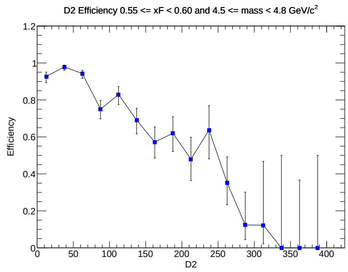


(k) $7.5 \leq m < 8.7$ GeV/c^2

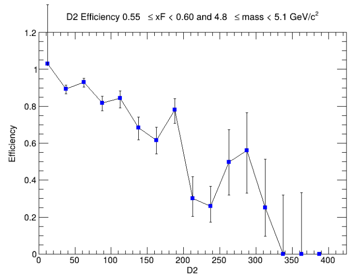
Figure 12: Efficiency plots for the x_F bin $0.50 \leq x_F < 0.55$.



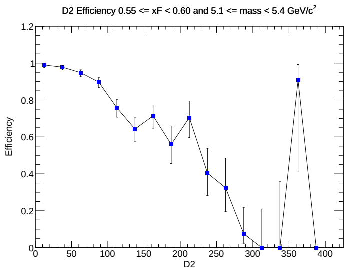
(a) $4.2 \leq m < 4.5$ GeV/c^2



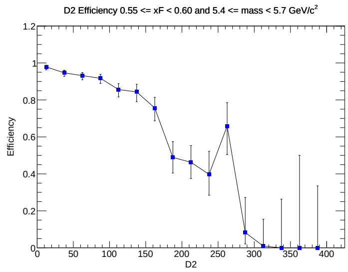
(b) $4.5 \leq m < 4.8$ GeV/c^2



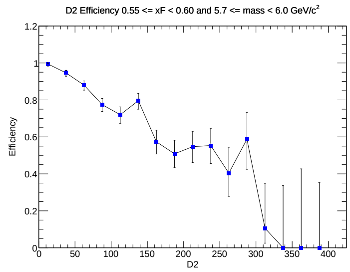
(c) $4.8 \leq m < 5.1$ GeV/c^2



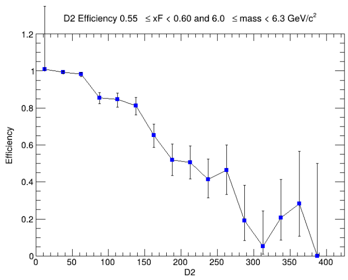
(d) $5.1 \leq m < 5.4$ GeV/c^2



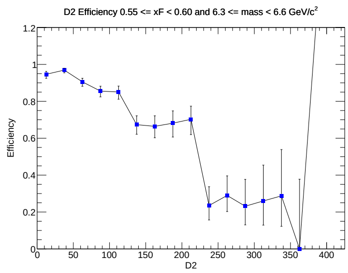
(e) $5.4 \leq m < 5.7$ GeV/c^2



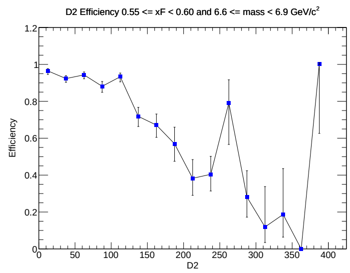
(f) $5.7 \leq m < 6.0$ GeV/c^2



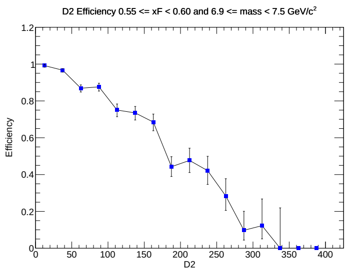
(g) $6.0 \leq m < 6.3$ GeV/c^2



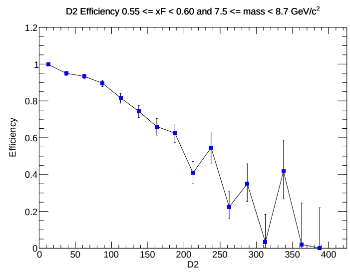
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

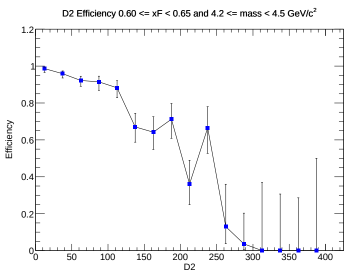


(j) $6.9 \leq m < 7.5$ GeV/c^2

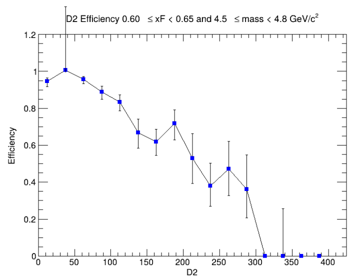


(k) $7.5 \leq m < 8.7$ GeV/c^2

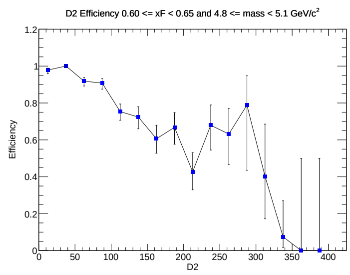
Figure 13: Efficiency plots for the x_F bin $0.55 \leq x_F < 0.60$.



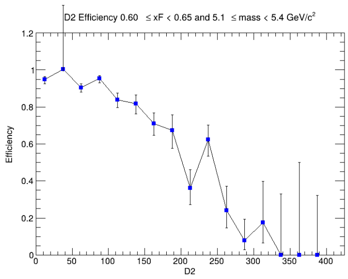
(a) $4.2 \leq m < 4.5$ GeV/c^2



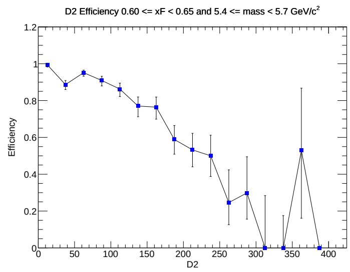
(b) $4.5 \leq m < 4.8$ GeV/c^2



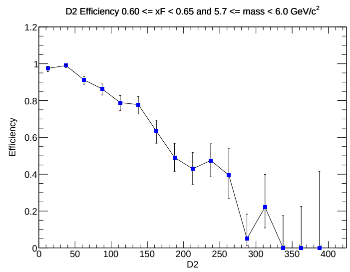
(c) $4.8 \leq m < 5.1$ GeV/c^2



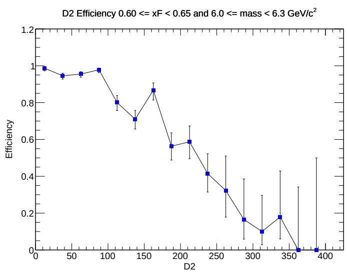
(d) $5.1 \leq m < 5.4$ GeV/c^2



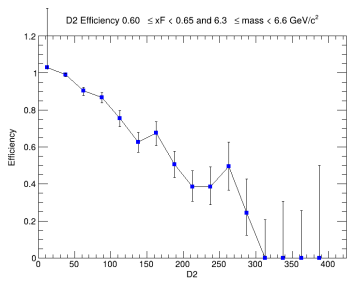
(e) $5.4 \leq m < 5.7$ GeV/c^2



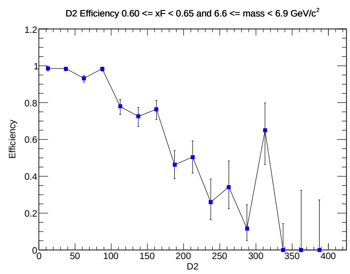
(f) $5.7 \leq m < 6.0$ GeV/c^2



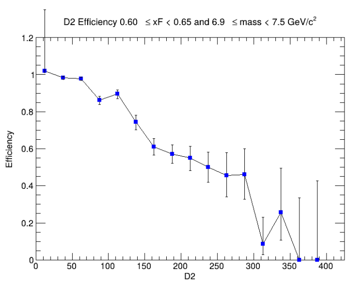
(g) $6.0 \leq m < 6.3$ GeV/c^2



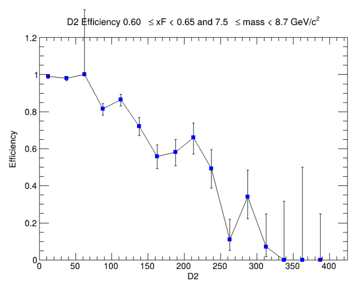
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

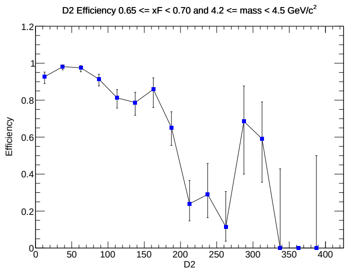


(j) $6.9 \leq m < 7.5$ GeV/c^2

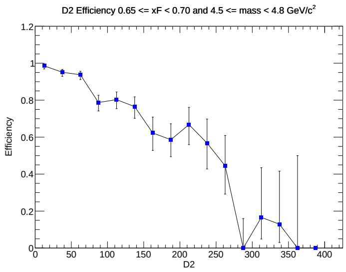


(k) $7.5 \leq m < 8.7$ GeV/c^2

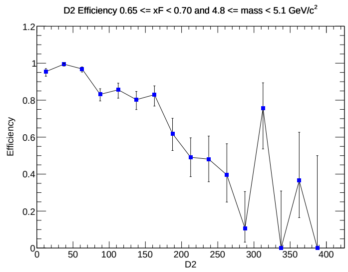
Figure 14: Efficiency plots for the x_F bin $0.60 \leq x_F < 0.65$.



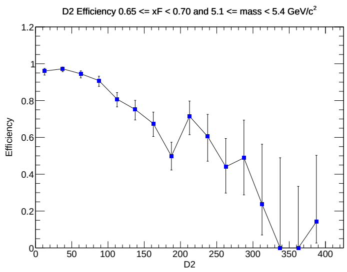
(a) $4.2 \leq m < 4.5$ GeV/c^2



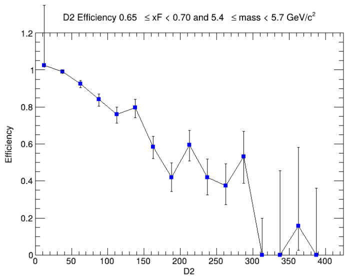
(b) $4.5 \leq m < 4.8$ GeV/c^2



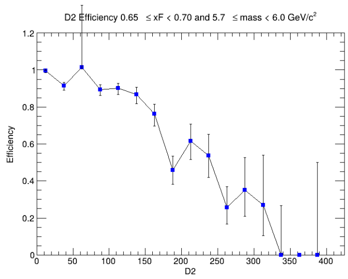
(c) $4.8 \leq m < 5.1$ GeV/c^2



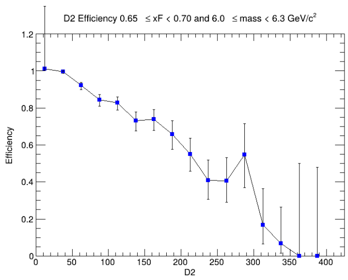
(d) $5.1 \leq m < 5.4$ GeV/c^2



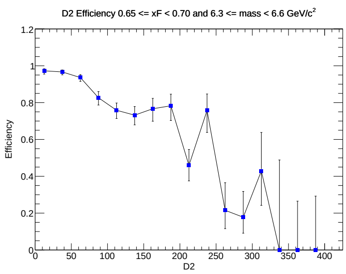
(e) $5.4 \leq m < 5.7$ GeV/c^2



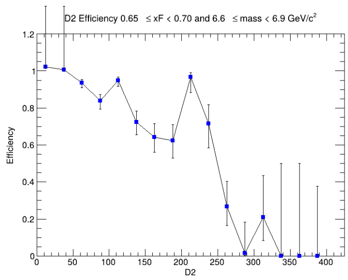
(f) $5.7 \leq m < 6.0$ GeV/c^2



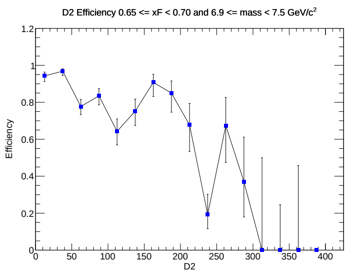
(g) $6.0 \leq m < 6.3$ GeV/c^2



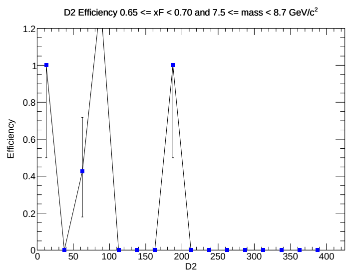
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

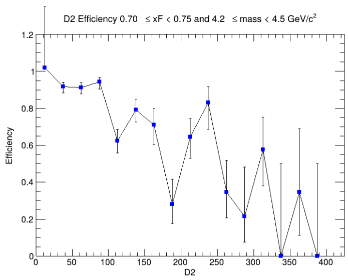


(j) $6.9 \leq m < 7.5$ GeV/c^2

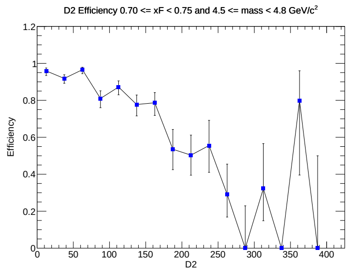


(k) $7.5 \leq m < 8.7$ GeV/c^2

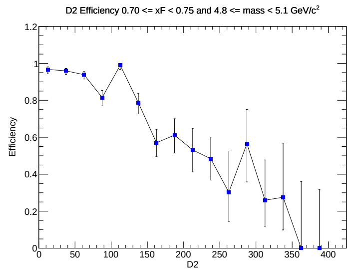
Figure 15: Efficiency plots for the x_F bin $0.65 \leq x_F < 0.70$.



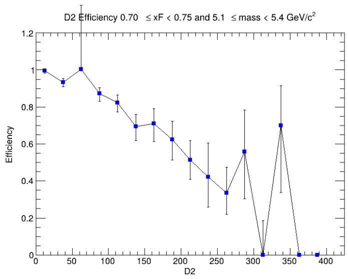
(a) $4.2 \leq m < 4.5$ GeV/c^2



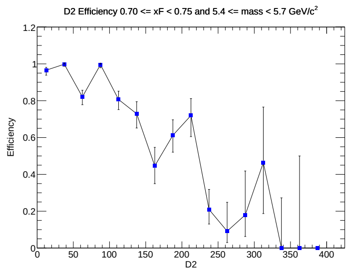
(b) $4.5 \leq m < 4.8$ GeV/c^2



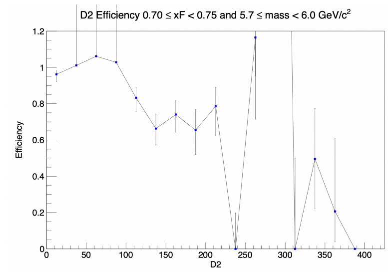
(c) $4.8 \leq m < 5.1$ GeV/c^2



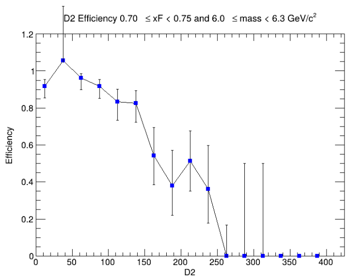
(d) $5.1 \leq m < 5.4$ GeV/c^2



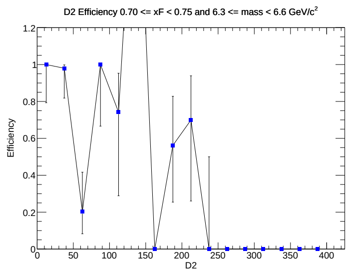
(e) $5.4 \leq m < 5.7$ GeV/c^2



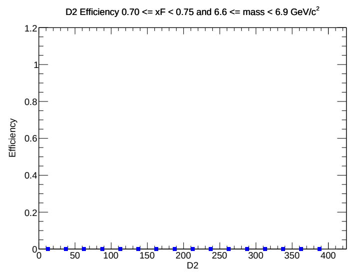
(f) $5.7 \leq m < 6.0$ GeV/c^2



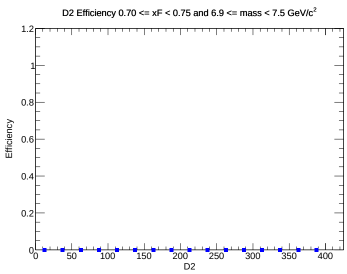
(g) $6.0 \leq m < 6.3$ GeV/c^2



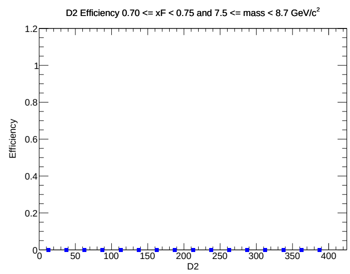
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

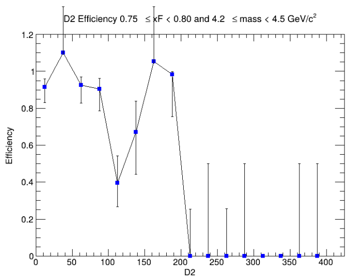


(j) $6.9 \leq m < 7.5$ GeV/c^2

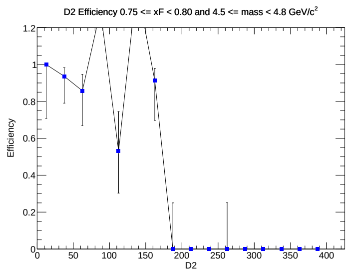


(k) $7.5 \leq m < 8.7$ GeV/c^2

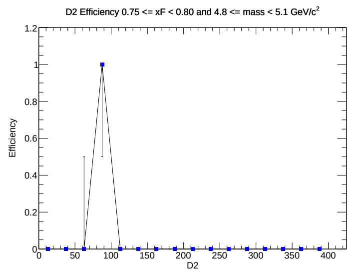
Figure 16: Efficiency plots for the x_F bin $0.70 \leq x_F < 0.75$.



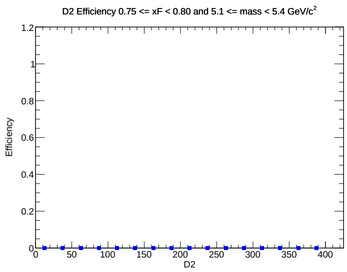
(a) $4.2 \leq m < 4.5$ GeV/c^2



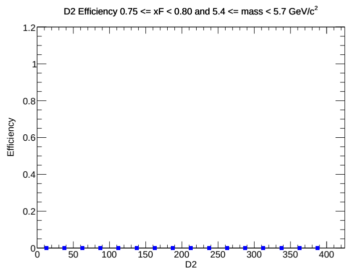
(b) $4.5 \leq m < 4.8$ GeV/c^2



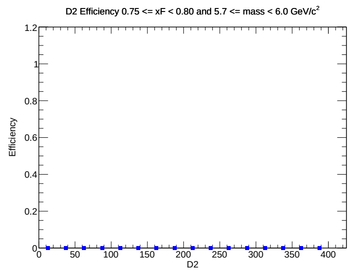
(c) $4.8 \leq m < 5.1$ GeV/c^2



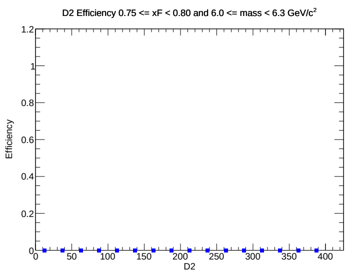
(d) $5.1 \leq m < 5.4$ GeV/c^2



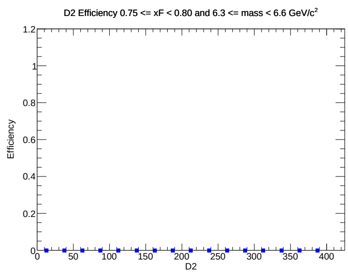
(e) $5.4 \leq m < 5.7$ GeV/c^2



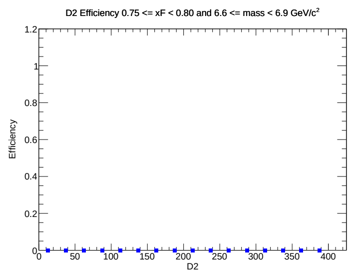
(f) $5.7 \leq m < 6.0$ GeV/c^2



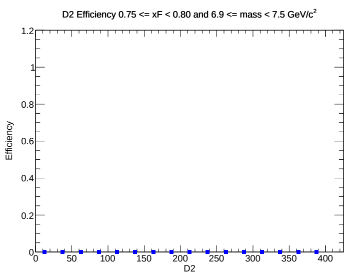
(g) $6.0 \leq m < 6.3$ GeV/c^2



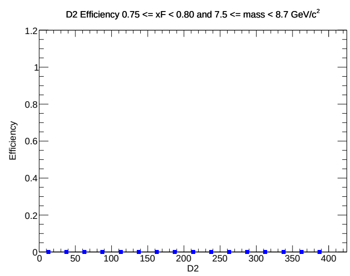
(h) $6.3 \leq m < 6.6$ GeV/c^2



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

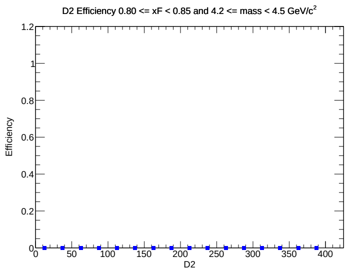


(j) $6.9 \leq m < 7.5$ GeV/c^2

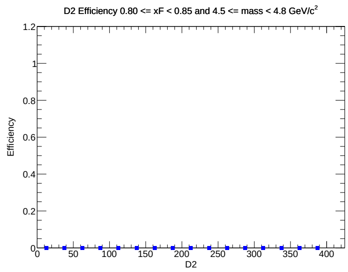


(k) $7.5 \leq m < 8.7$ GeV/c^2

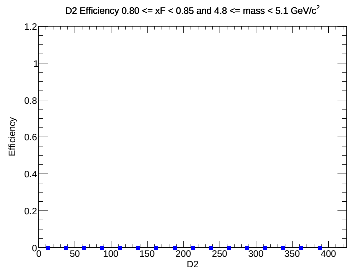
Figure 17: Efficiency plots for the x_F bin $0.75 \leq x_F < 0.80$.



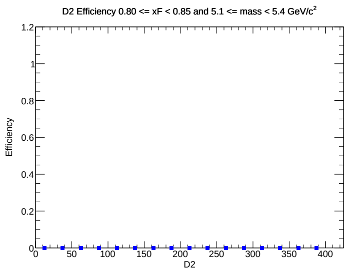
(a) $4.2 \leq m < 4.5$ GeV/c^2



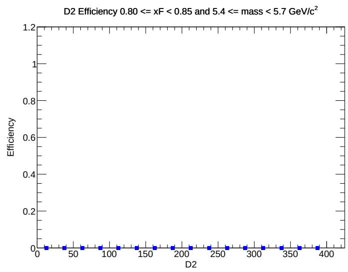
(b) $4.5 \leq m < 4.8$ GeV/c^2



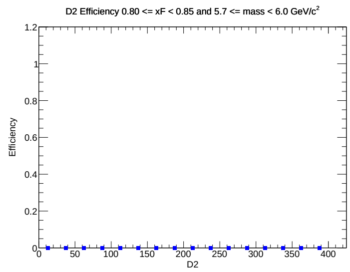
(c) $4.8 \leq m < 5.1$ GeV/c^2



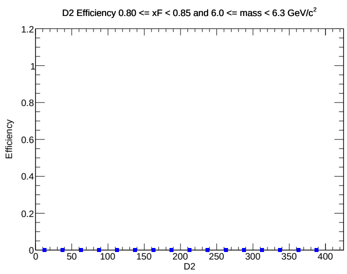
(d) $5.1 \leq m < 5.4$ GeV/c^2



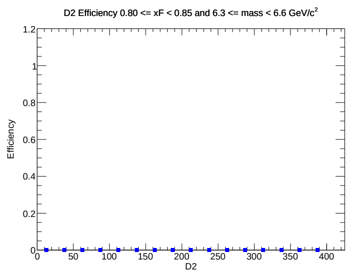
(e) $5.4 \leq m < 5.7$ GeV/c^2



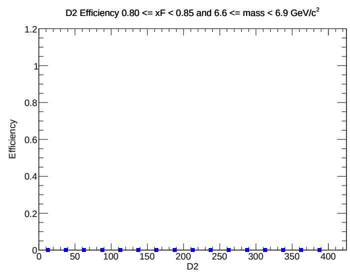
(f) $5.7 \leq m < 6.0$ GeV/c^2



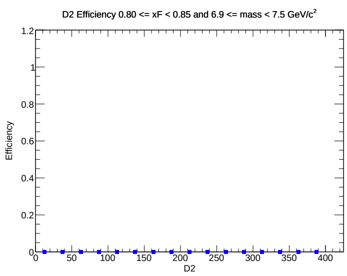
(g) $6.0 \leq m < 6.3$ GeV/c^2



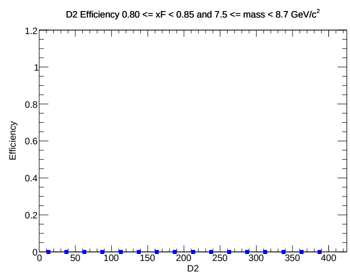
(h) $6.3 \leq m < 6.6$ GeV/c^2



(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 **??**.

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

- **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 **??**
- Efficiency Table made by using RS-67 all targets **??**
- Efficiency Table made by using RS-57-70 LH2 only target **??**
- Efficiency Table made by using RS-57-70 all targets **??**

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}	$< \epsilon >$	$\delta_{\text{stat}} < \epsilon >$	$\delta_{\text{prop}} < \epsilon >$	$1/ < \epsilon >$	$\delta(1/ < \epsilon >)$
[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}	$< \epsilon >$	$\delta_{\text{stat}} < \epsilon >$	$\delta_{\text{prop}} < \epsilon >$	$1/ < \epsilon >$	$\delta(1/ < \epsilon >)$
[0.0, 0.05)	[4.2, 4.5)	2	0.0000	0.0000	0.0000	–	–
[0.0, 0.05)	[4.5, 4.8)	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	–	–