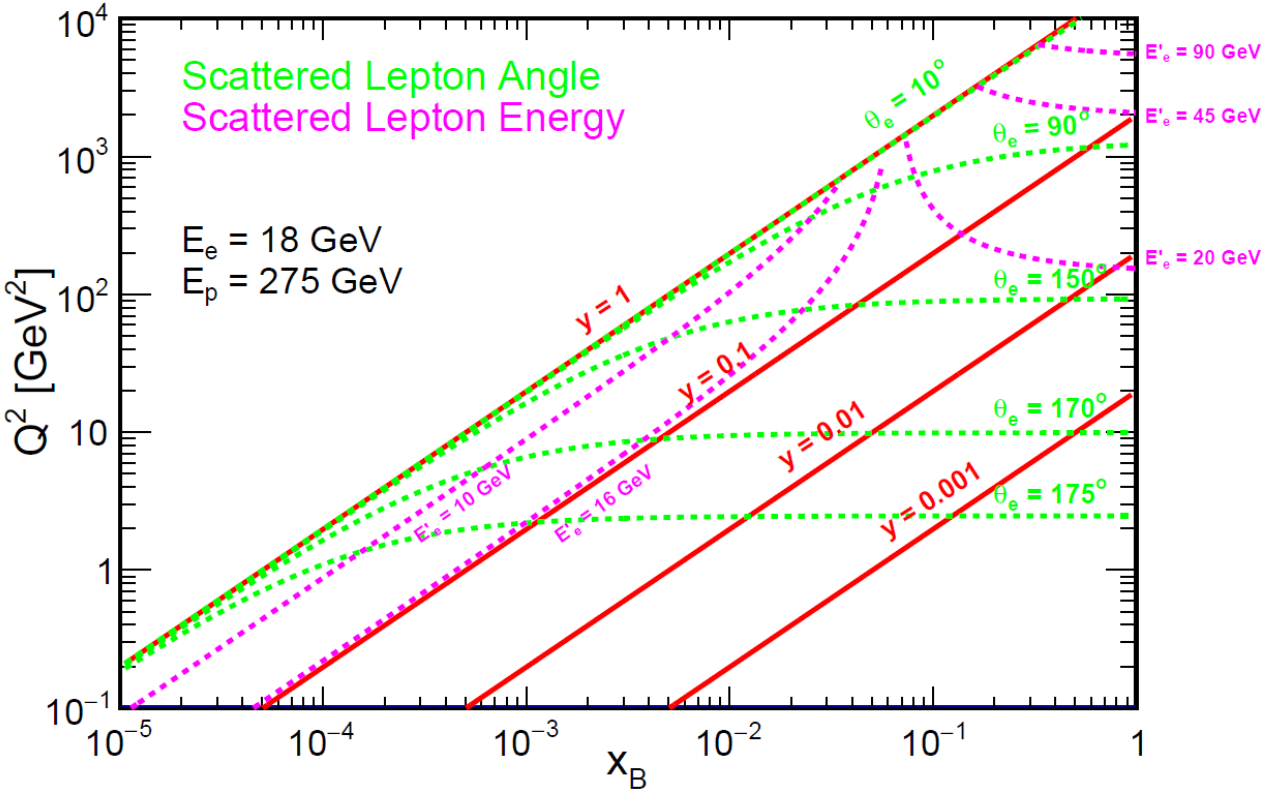
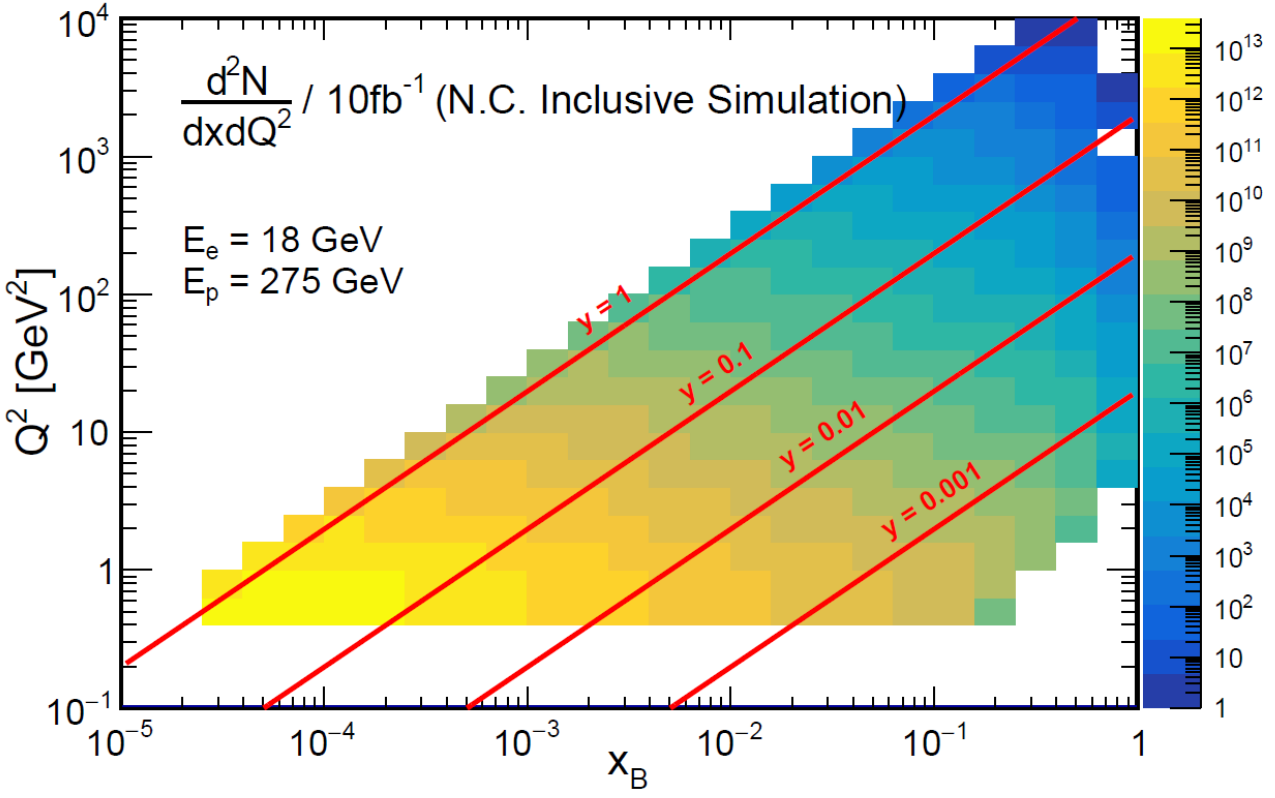
Unpolarized e-p NC Cross Section

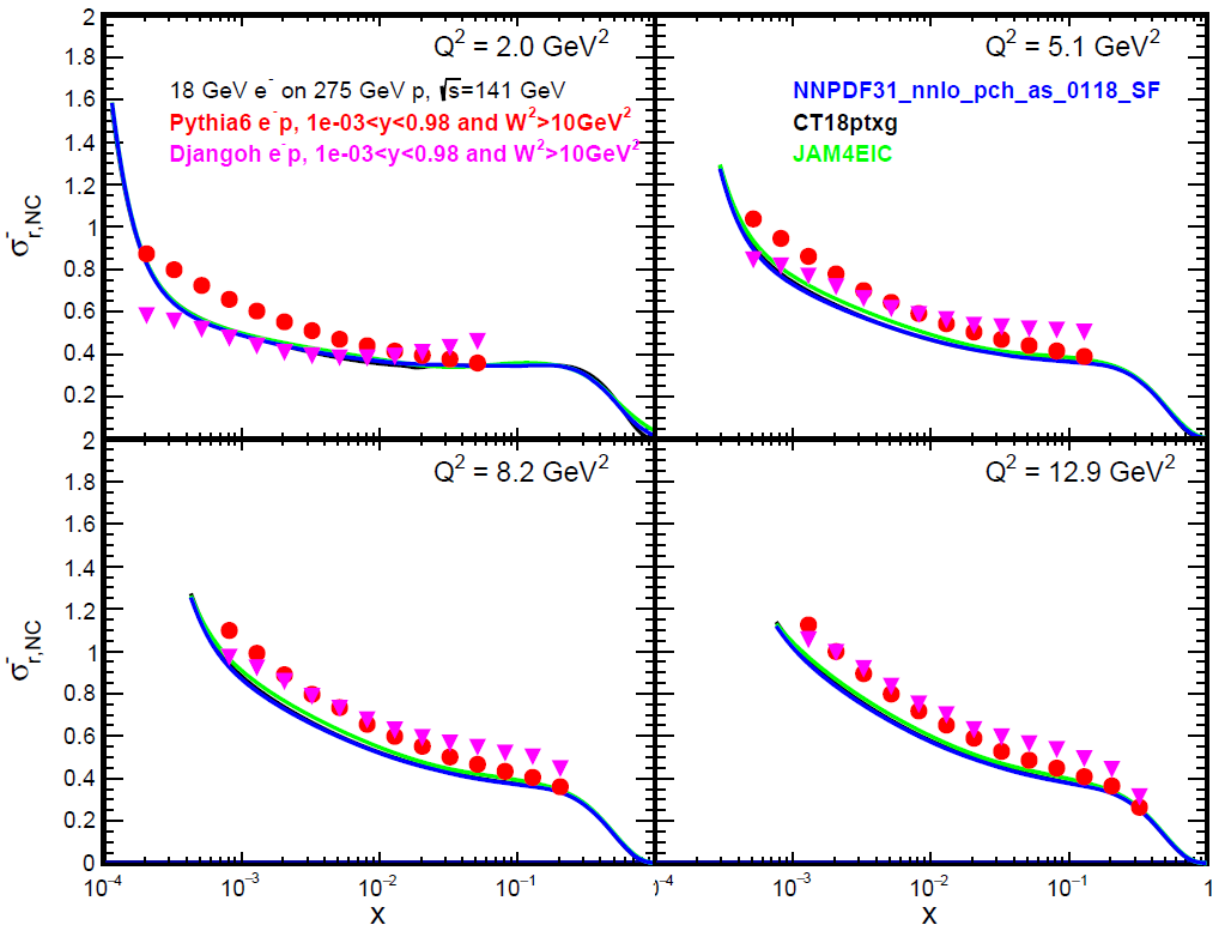
Barak Schmookler

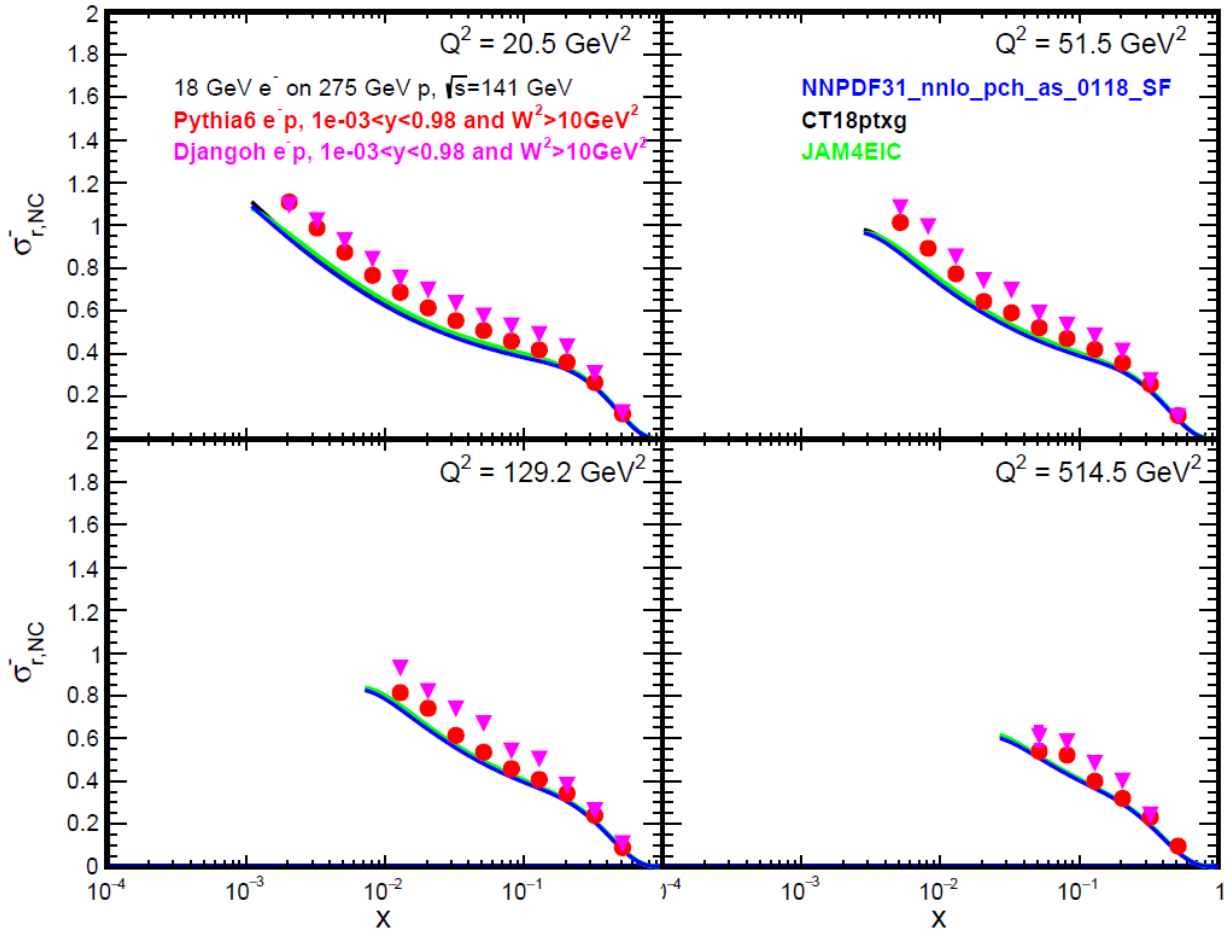
Last Time


Scattered Lepton Angle
Scattered Lepton Energy
E_e = 18 GeV
E_p = 275 GeV
E'_e = 90 GeV
E'_e = 45 GeV
E'_e = 20 GeV
θ_e = 10°
θ_e = 90°
θ_e = 150°
θ_e = 170°
θ_e = 175°
y = 1
y = 0.1
y = 0.01
y = 0.001
E'_e = 10 GeV
E'_e = 16 GeV
Q^2 [GeV^2]
x_B


$\frac{d^2N}{dxdQ^2}$ / 10fb^{-1} (N.C. Inclusive Simulation)
E_e = 18 GeV
E_p = 275 GeV
y = 1
y = 0.1
y = 0.01
y = 0.001
Q^2 [GeV^2]
x_B

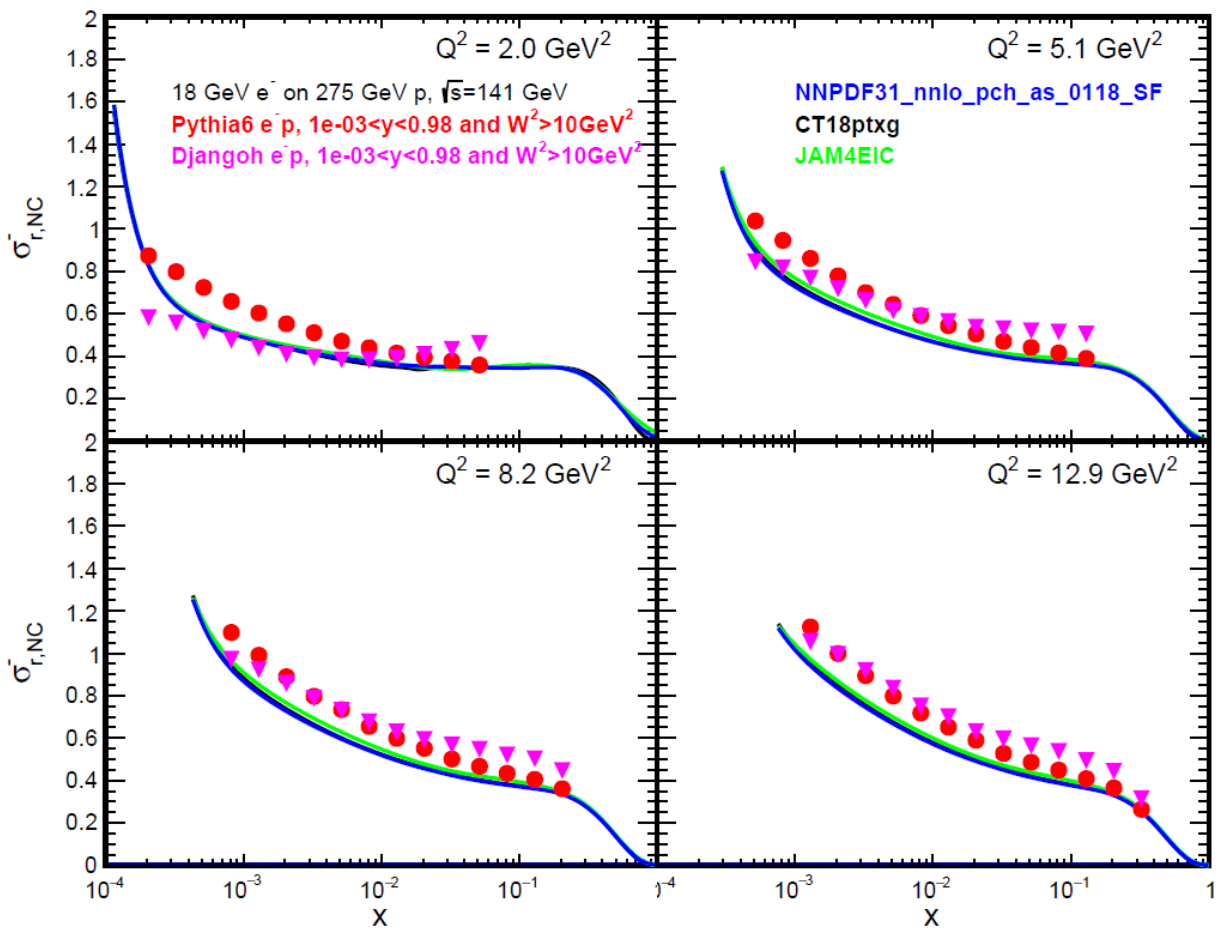
Last Time

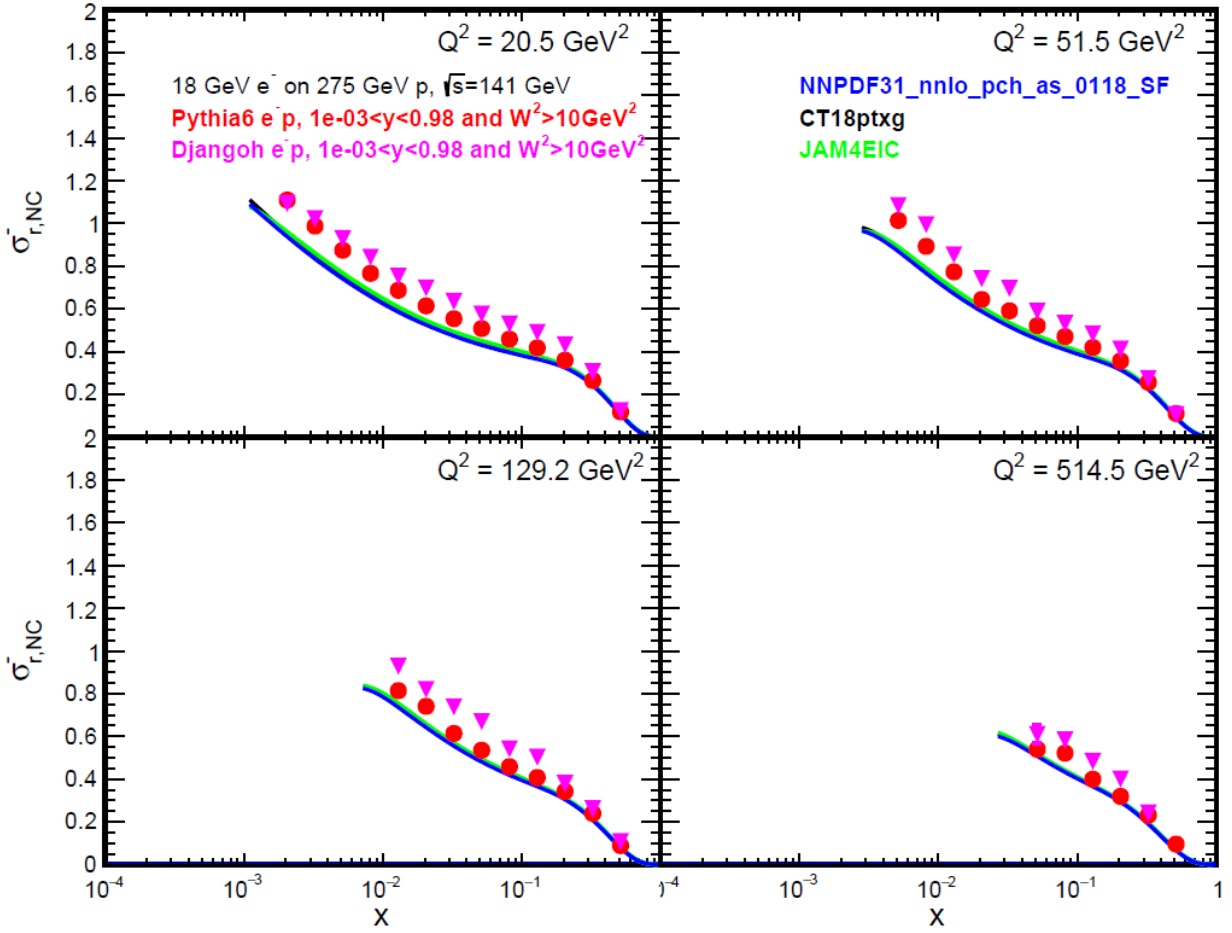

Q^2 = 2.0 GeV^2
Q^2 = 5.1 GeV^2
Q^2 = 8.2 GeV^2
Q^2 = 12.9 GeV^2
18 GeV e$^-$ on 275 GeV p, $\sqrt{s}$=141 GeV
Pythia6 e$^-$p, 1e-03<y<0.98 and W^2>10GeV^2
Djangoh e$^-$p, 1e-03<y<0.98 and W^2>10GeV^2
NNPDF31_nnlo_pch_as_0118_SF
CT18ptxg
JAM4EIC
$\sigma^-_{r,NC}$
X


Q^2 = 20.5 GeV^2
Q^2 = 51.5 GeV^2
Q^2 = 129.2 GeV^2
Q^2 = 514.5 GeV^2
18 GeV e$^-$ on 275 GeV p, $\sqrt{s}$=141 GeV
Pythia6 e$^-$p, 1e-03<y<0.98 and W^2>10GeV^2
Djangoh e$^-$p, 1e-03<y<0.98 and W^2>10GeV^2
NNPDF31_nnlo_pch_as_0118_SF
CT18ptxg
JAM4EIC
$\sigma^-_{r,NC}$
X

Last Time

Pythia6 and *Djangoh* events generated with QED radiative effects OFF, and perfect detector acceptance and resolution.





Cross Section Measurement

We want to measure:

$$\sigma_{r,NC}^{e^{\pm}p\to e^{\pm}X} = \frac{Q^4 x}{2\pi\alpha^2 Y_+} \times \frac{d^2\sigma_{NC}^{e^{\pm}p\to e^{\pm}X}}{dxdQ^2} = F_2 + \frac{Y_-}{Y_+} xF_3 - \frac{y^2}{Y_+} F_L \qquad Y_{\pm} = 1 \pm (1-y)^2$$

We actually measure:

$$\left(\frac{d\sigma}{dxdQ^2}\right)_{meas} = \frac{N_{bin}}{\mathcal{L}\Delta x \Delta Q^2}$$

Cross Section Measurement

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We should apply a bin-centering correction factor:

(assuming QED radiative effects are OFF in event generator)

$$\left(\frac{d\sigma^{Born}}{dxdQ^2}\right)^{corr}_{meas} = \left(\frac{d\sigma}{dxdQ^2}\right)_{meas} \times \frac{\sigma^{Model,Born}_{Center}}{\sigma^{Model,Born}_{Average}}$$

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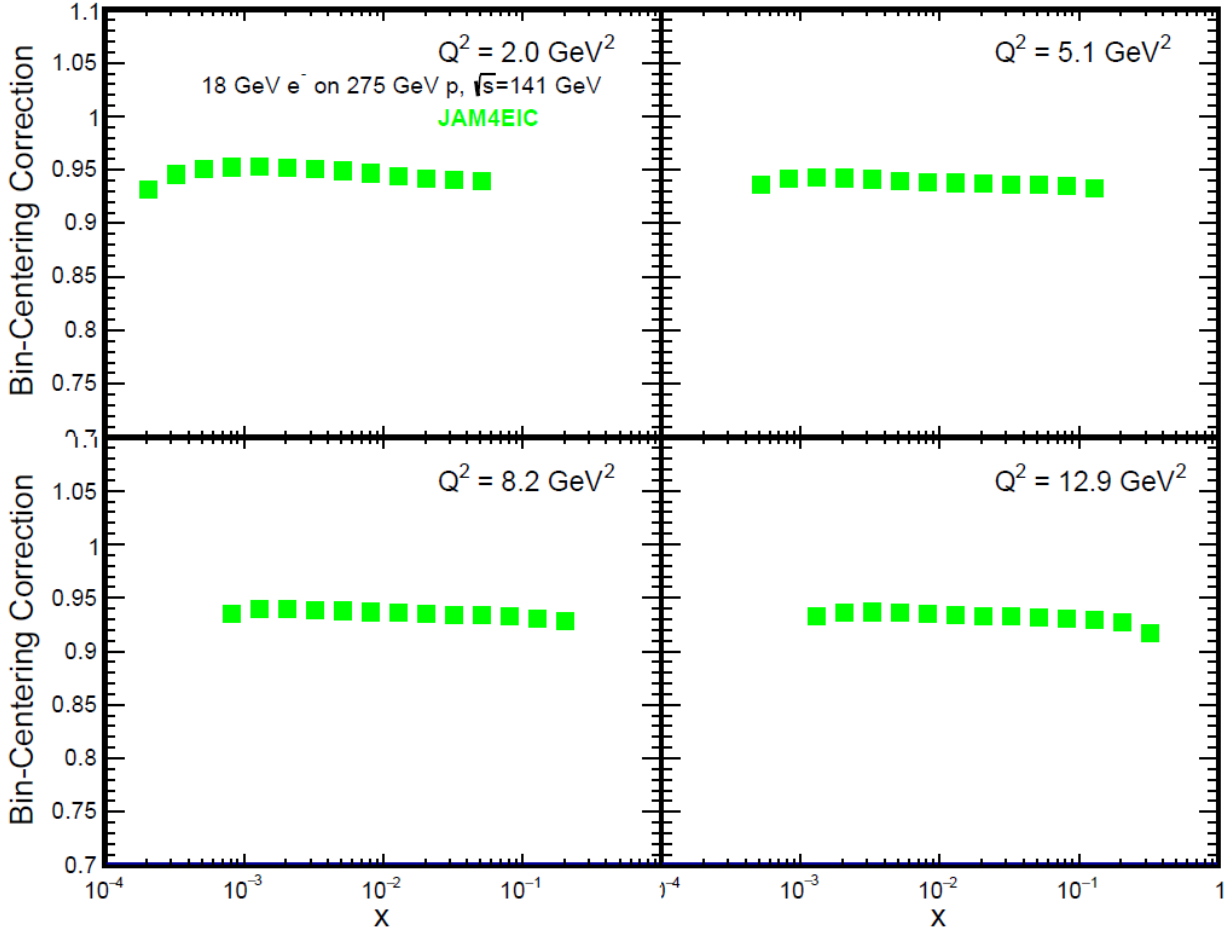
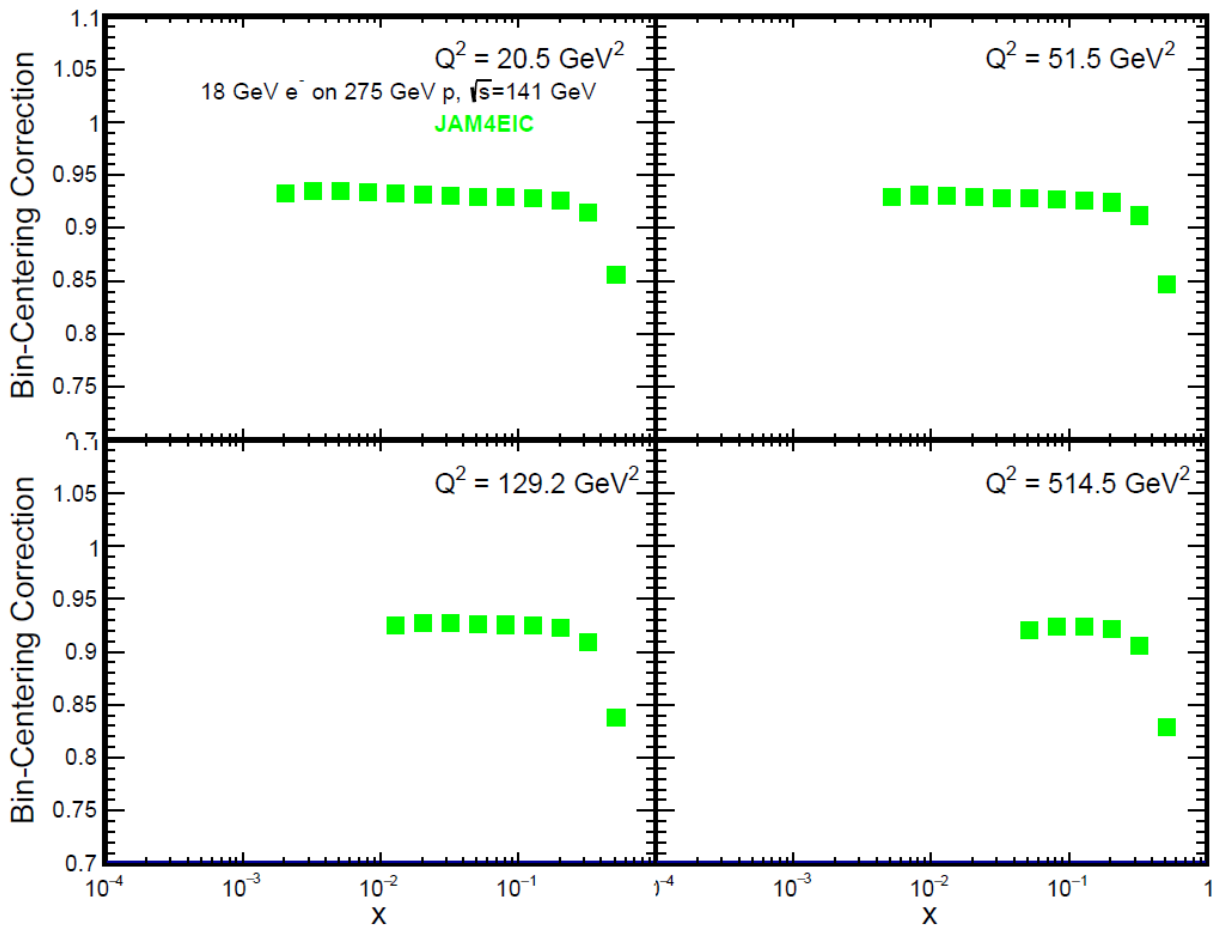
BC Correction Factor

Bin-Centering Correction Factor

$$\frac{\sigma^{Model,Born}_{Center}}{\sigma^{Model,Born}_{Average}}$$

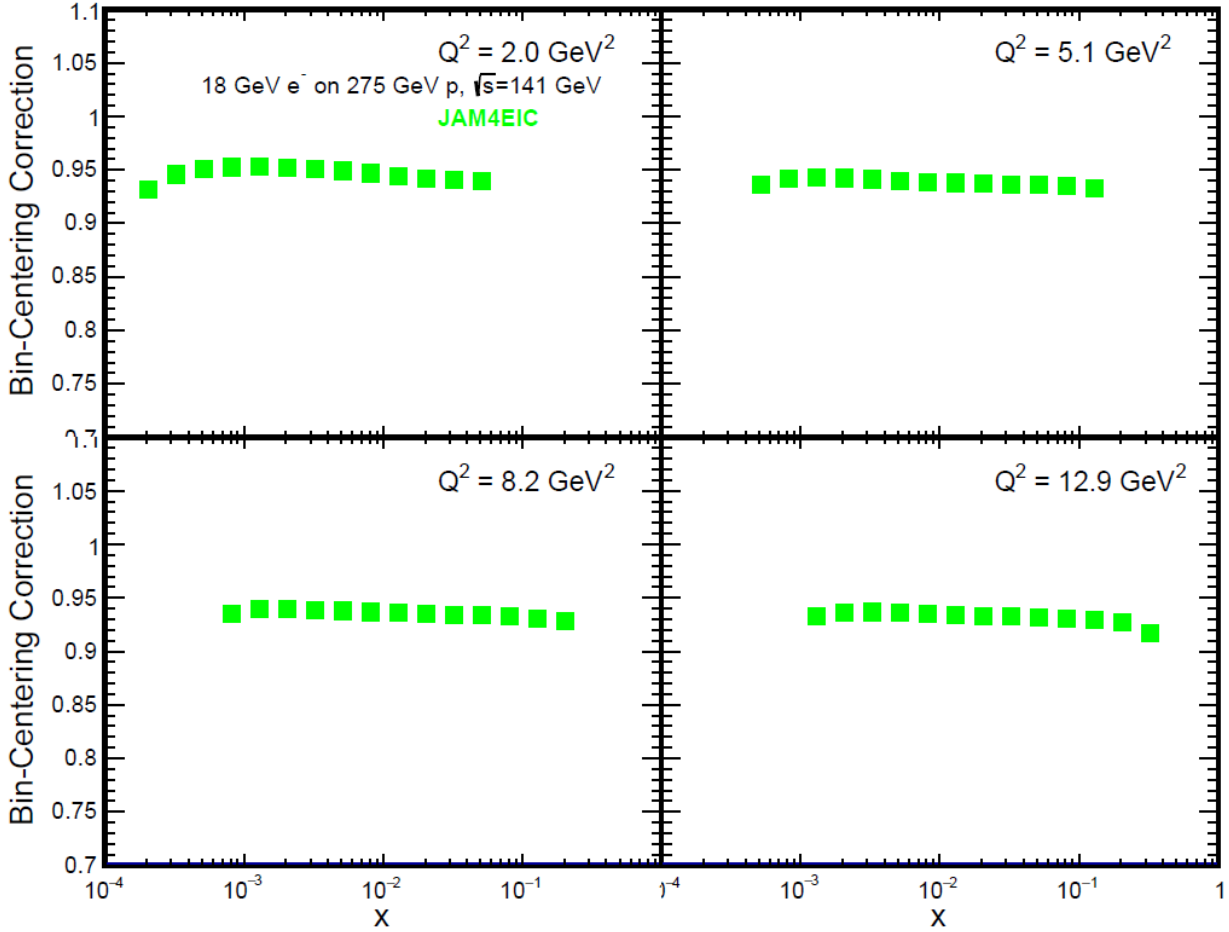


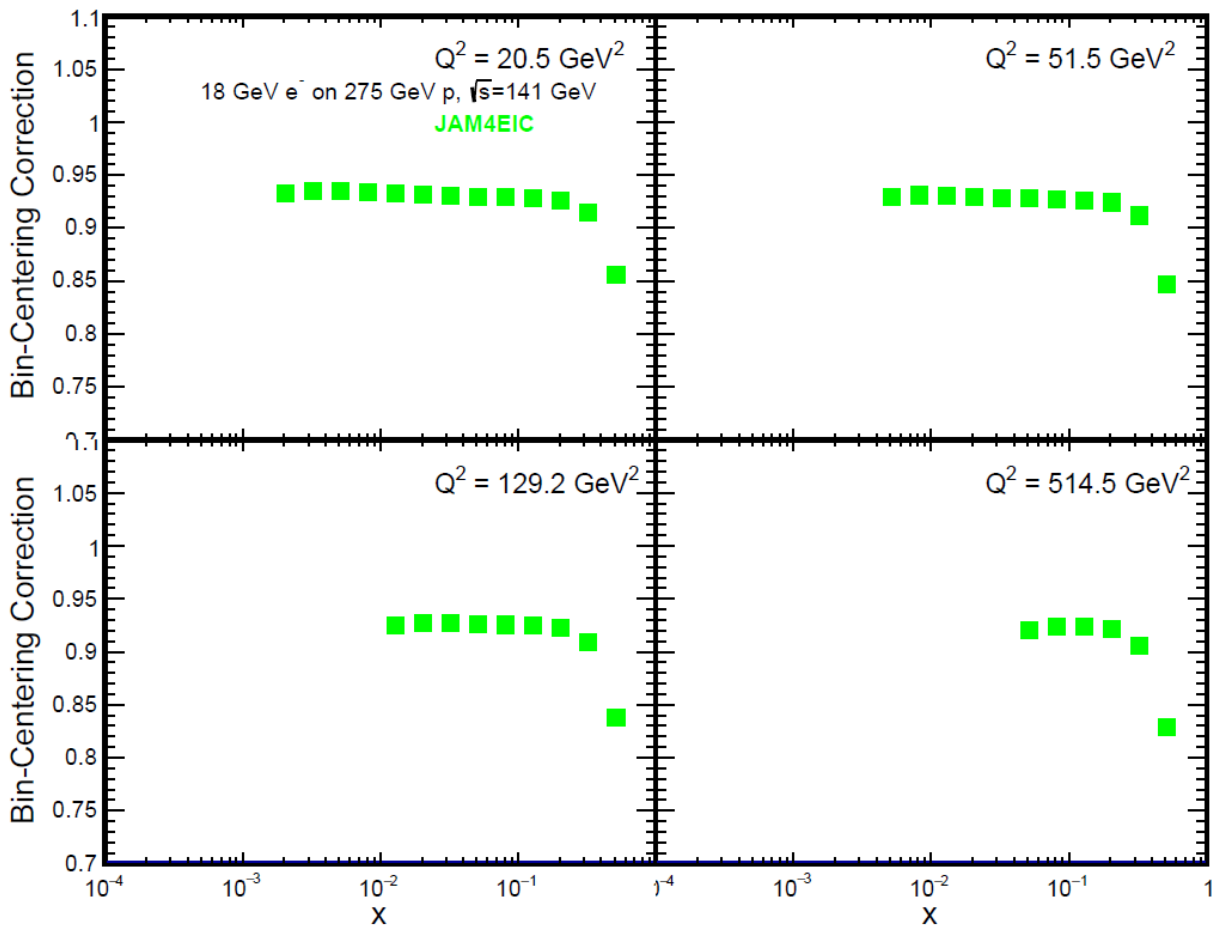


Bin-Centering Correction Factor

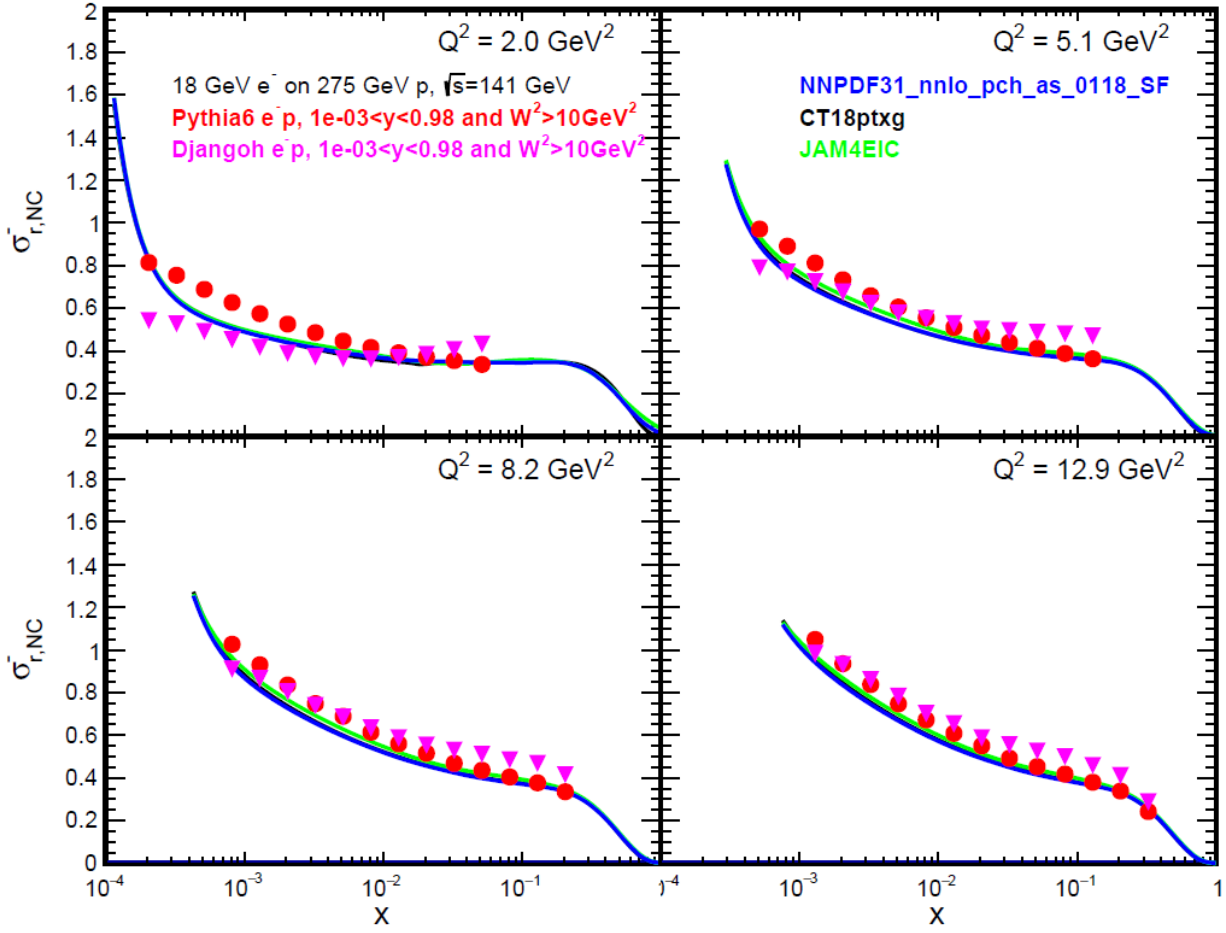
$$\frac{\sigma^{Model,Born}_{Center}}{\sigma^{Model,Born}_{Average}}$$

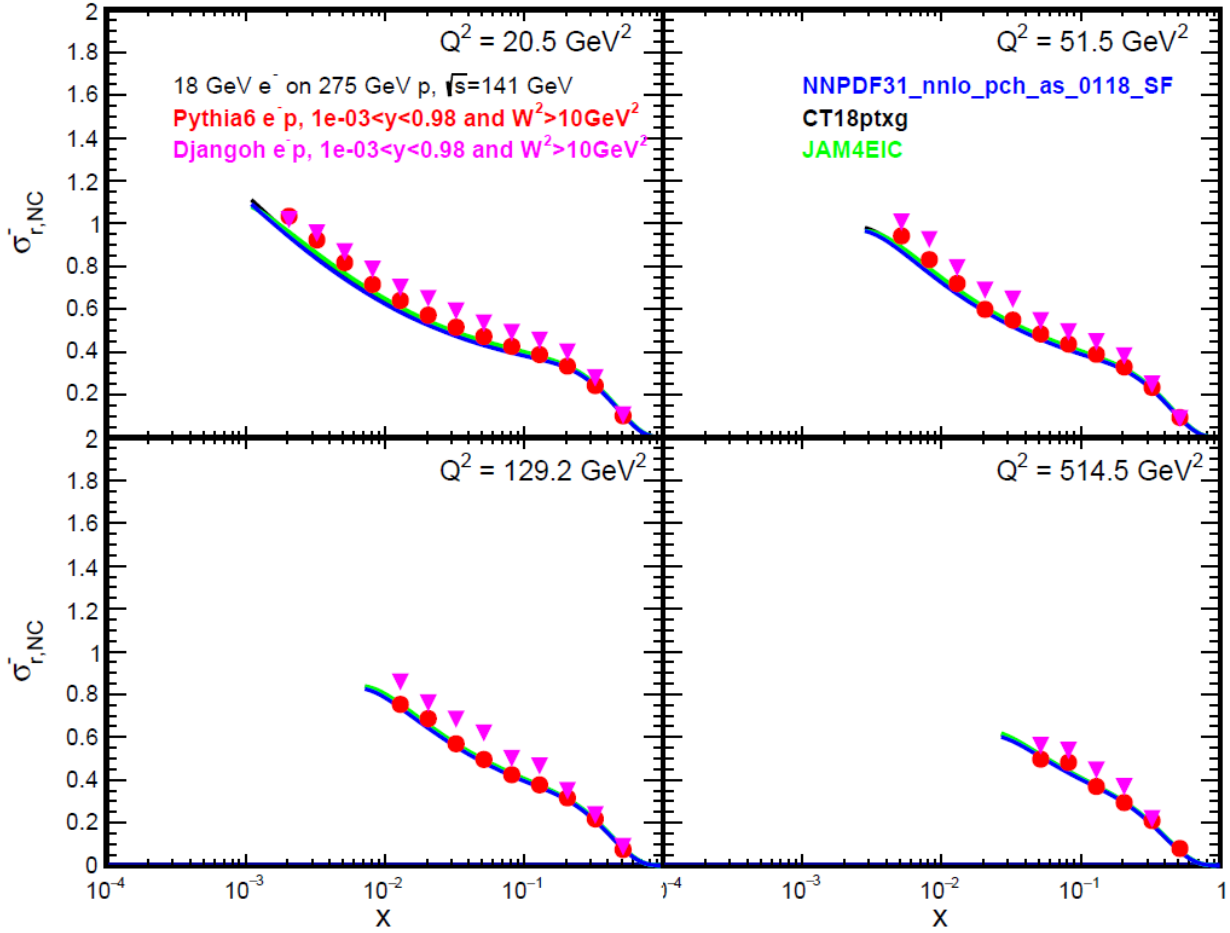
Correction is about 5-8% for the chosen binning





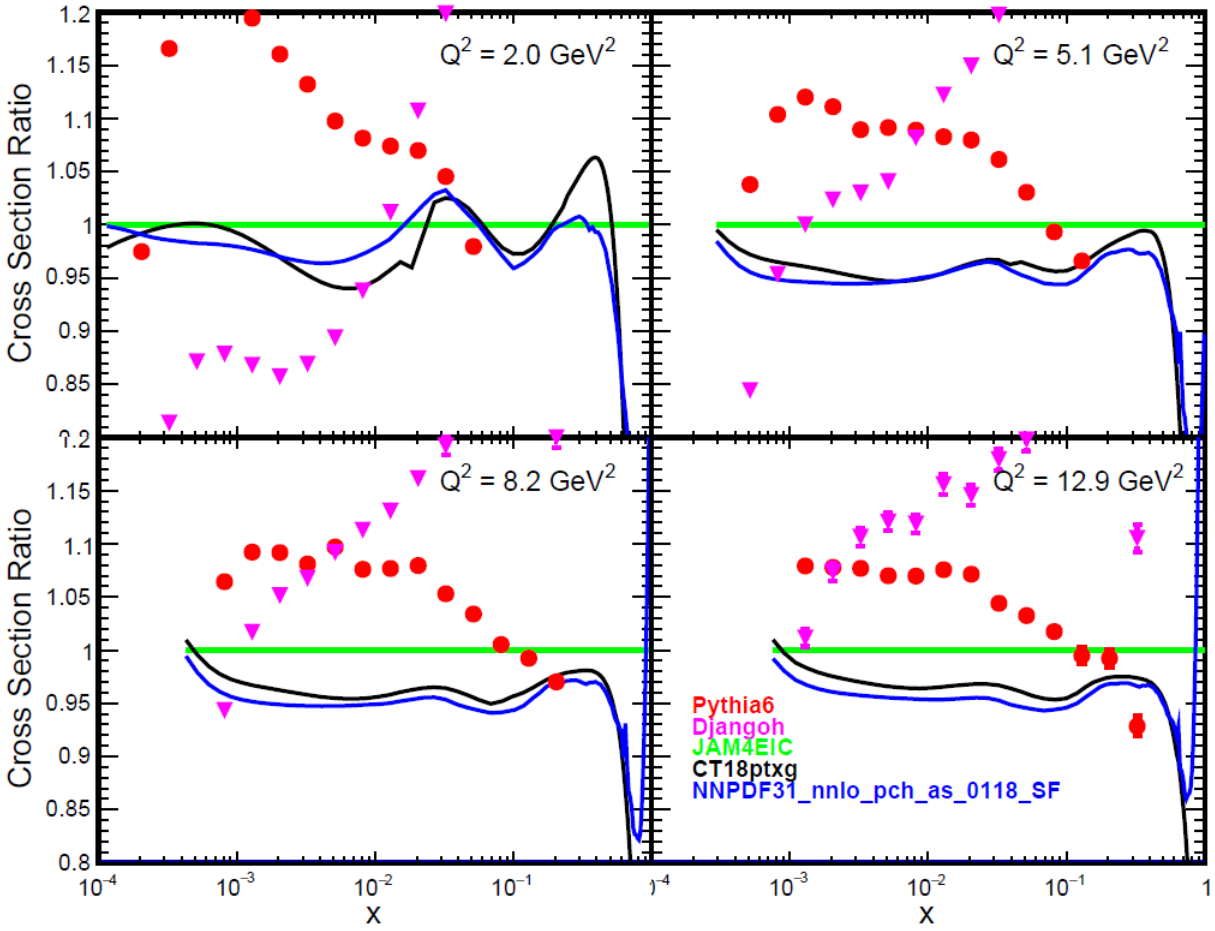
Cross Section with B.C. Correction

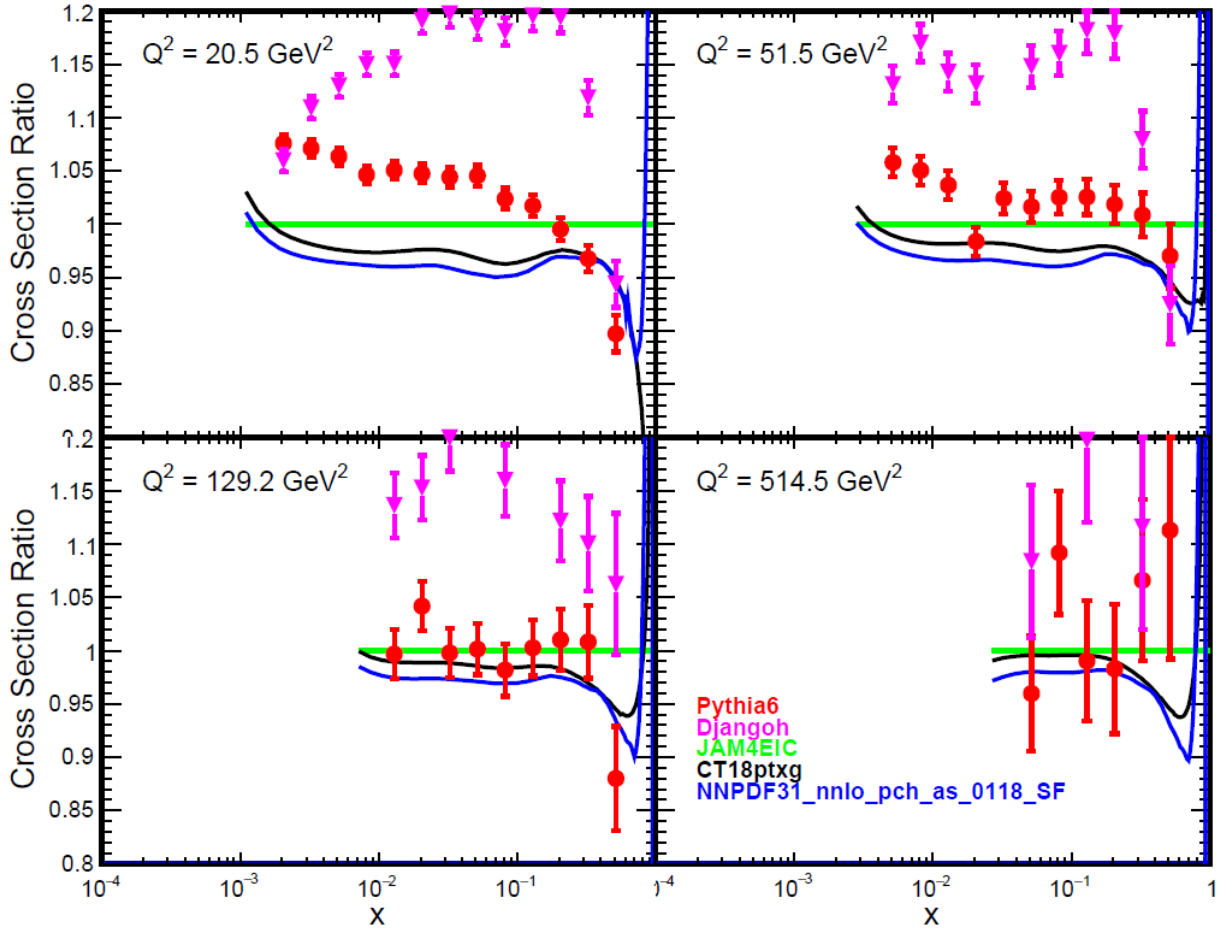




Cross Section Ratios

Uncertainties are based on the number of events generated – not scaled to any particular luminosity





The central values for the 3 theory curves can vary by 3-4%

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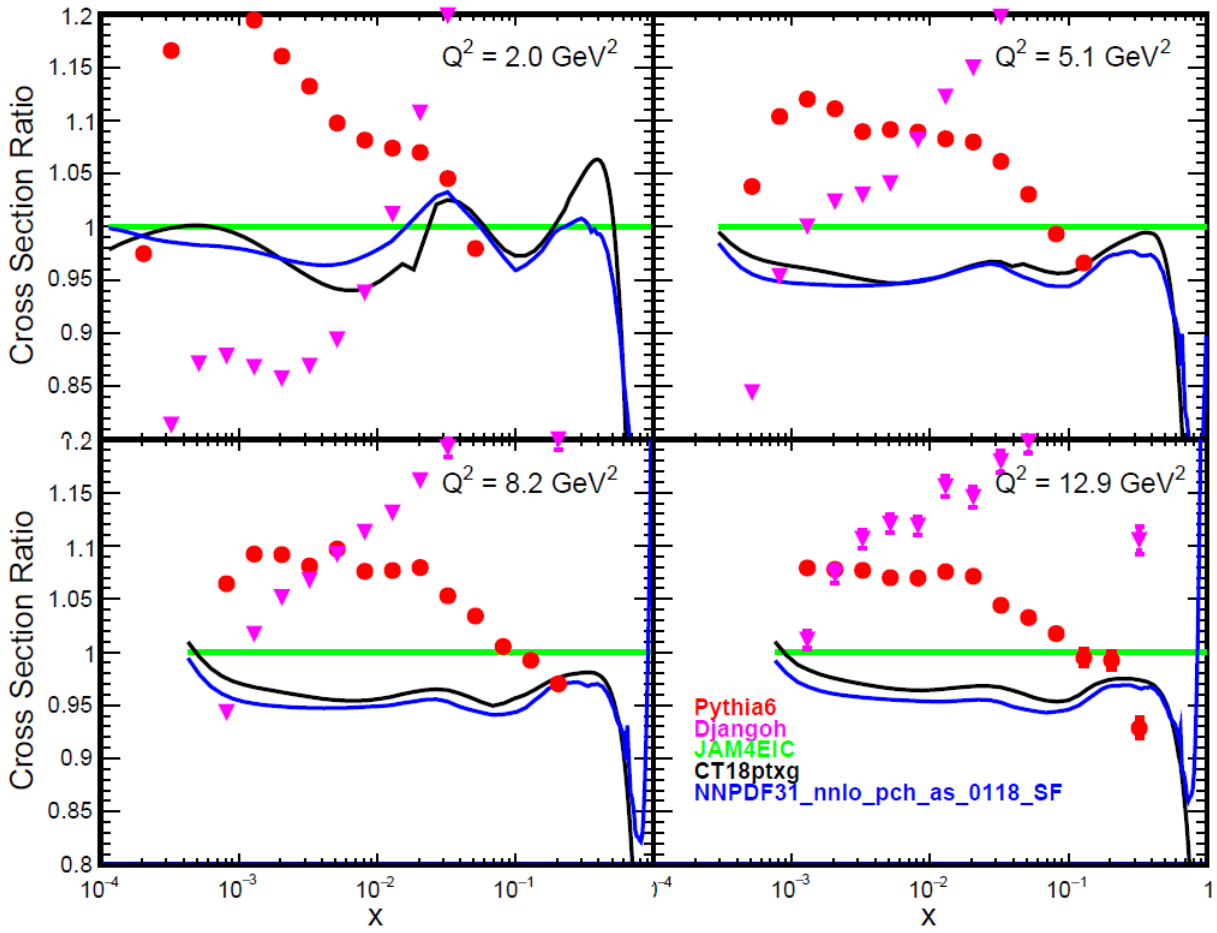
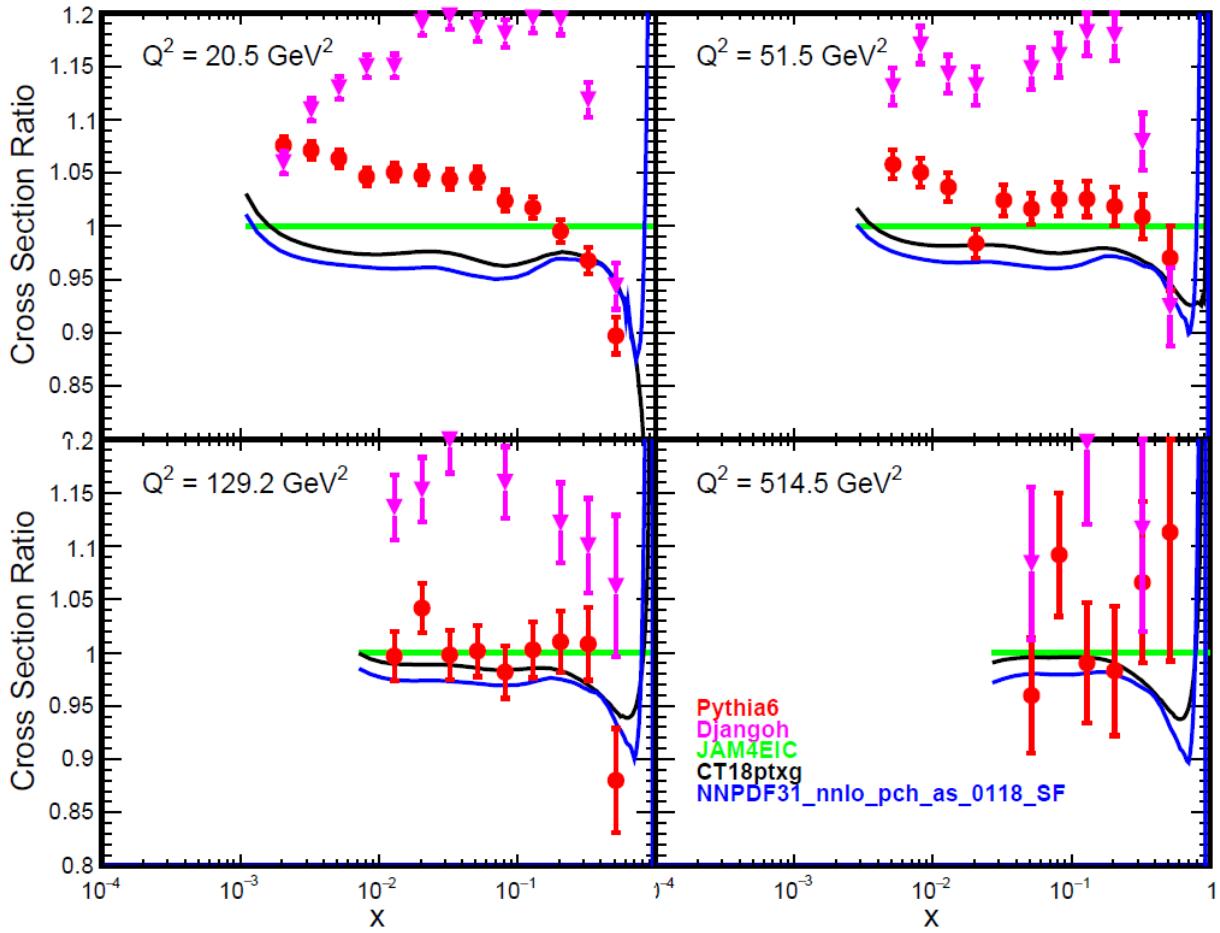
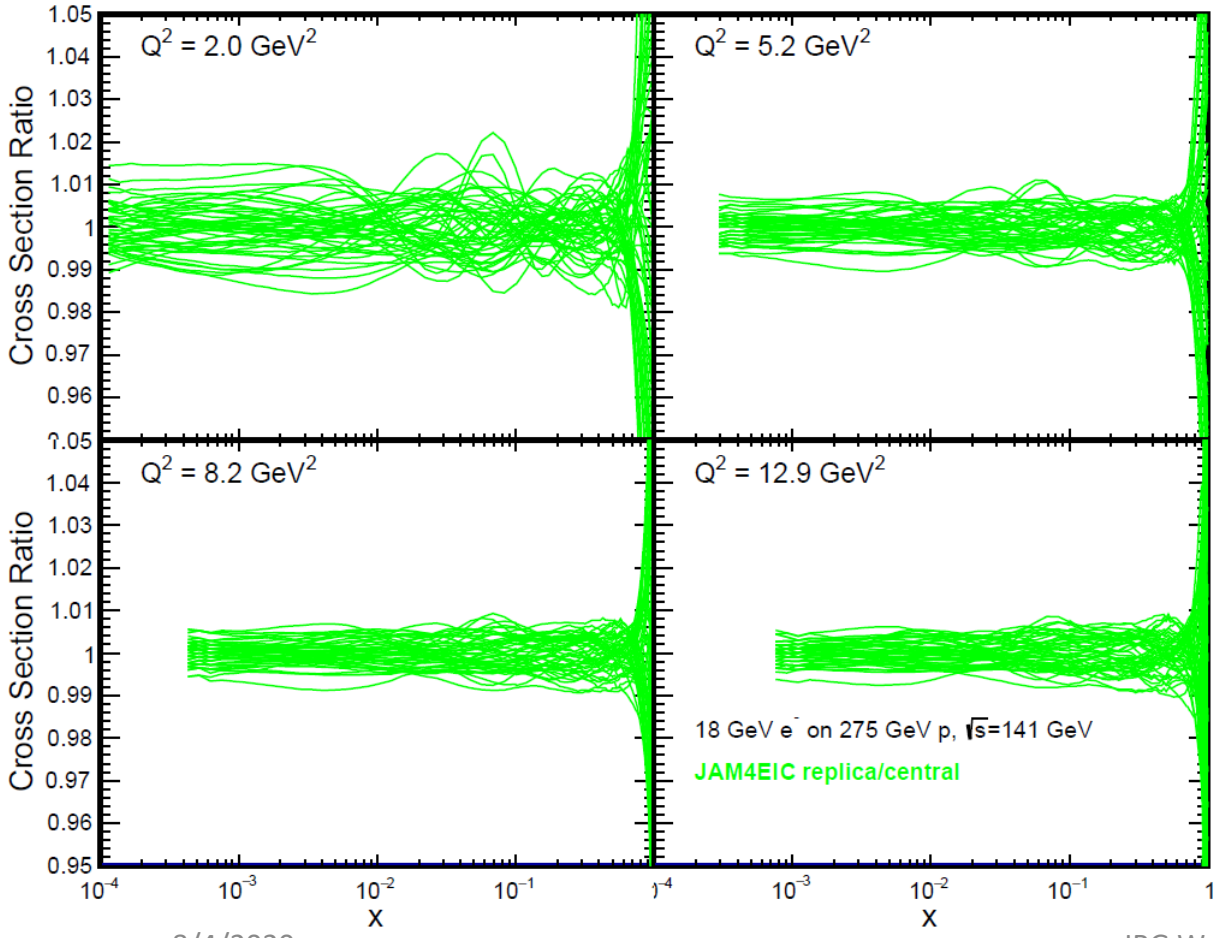
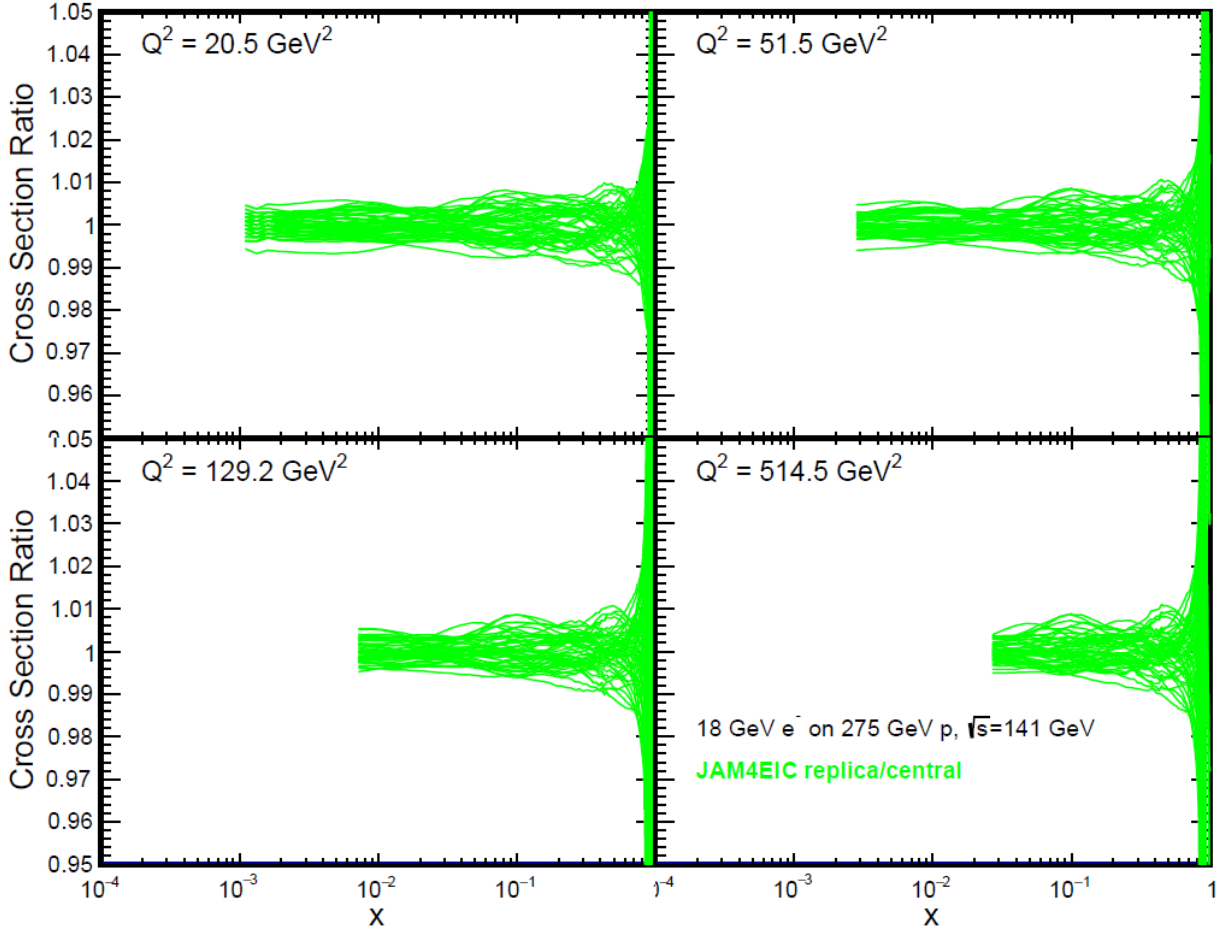




The central values for the 3 theory curves can vary by 3-4% …and replicas vary by 1-2% from the central value. **So we probably need a total uncertainly of ~4% on the measurement to make an impact.**

Cross Section Ratios

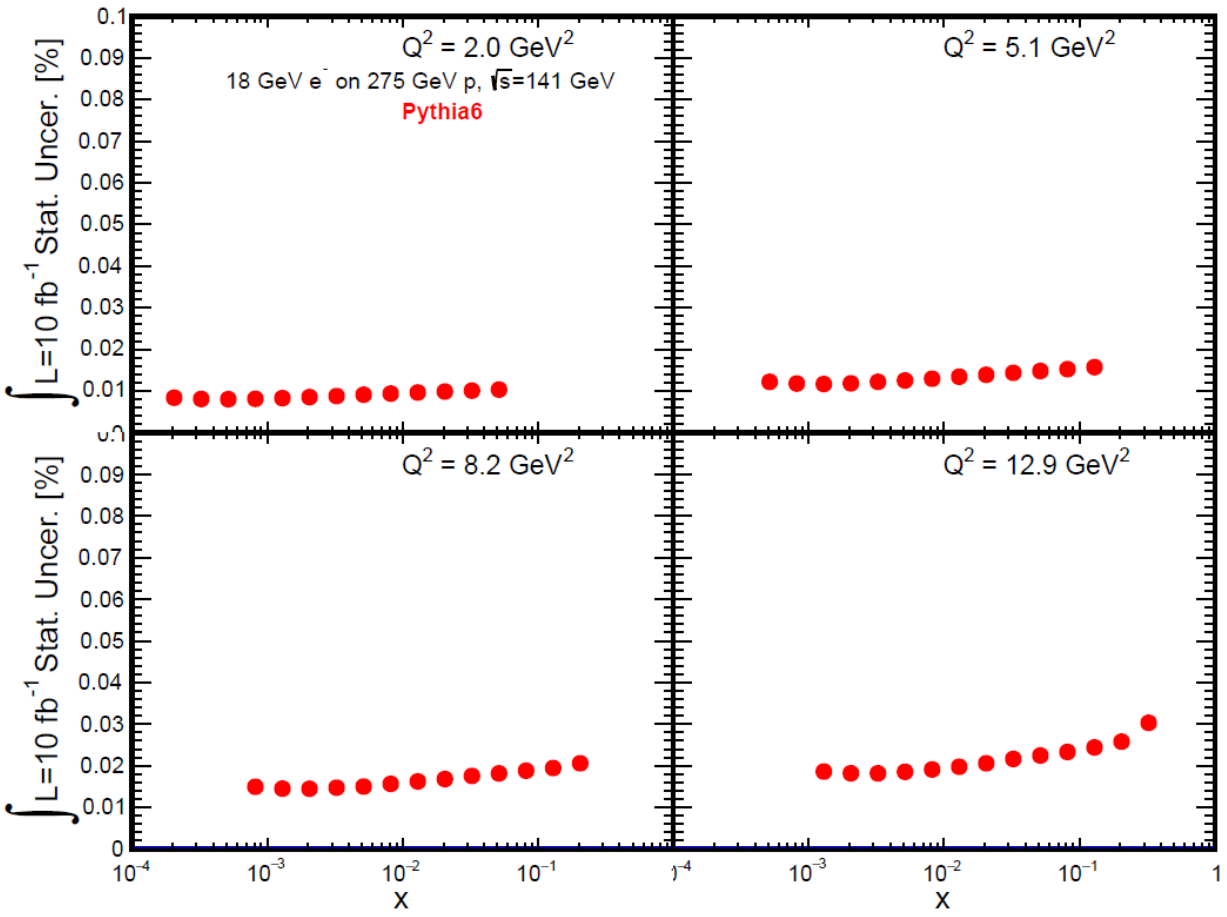


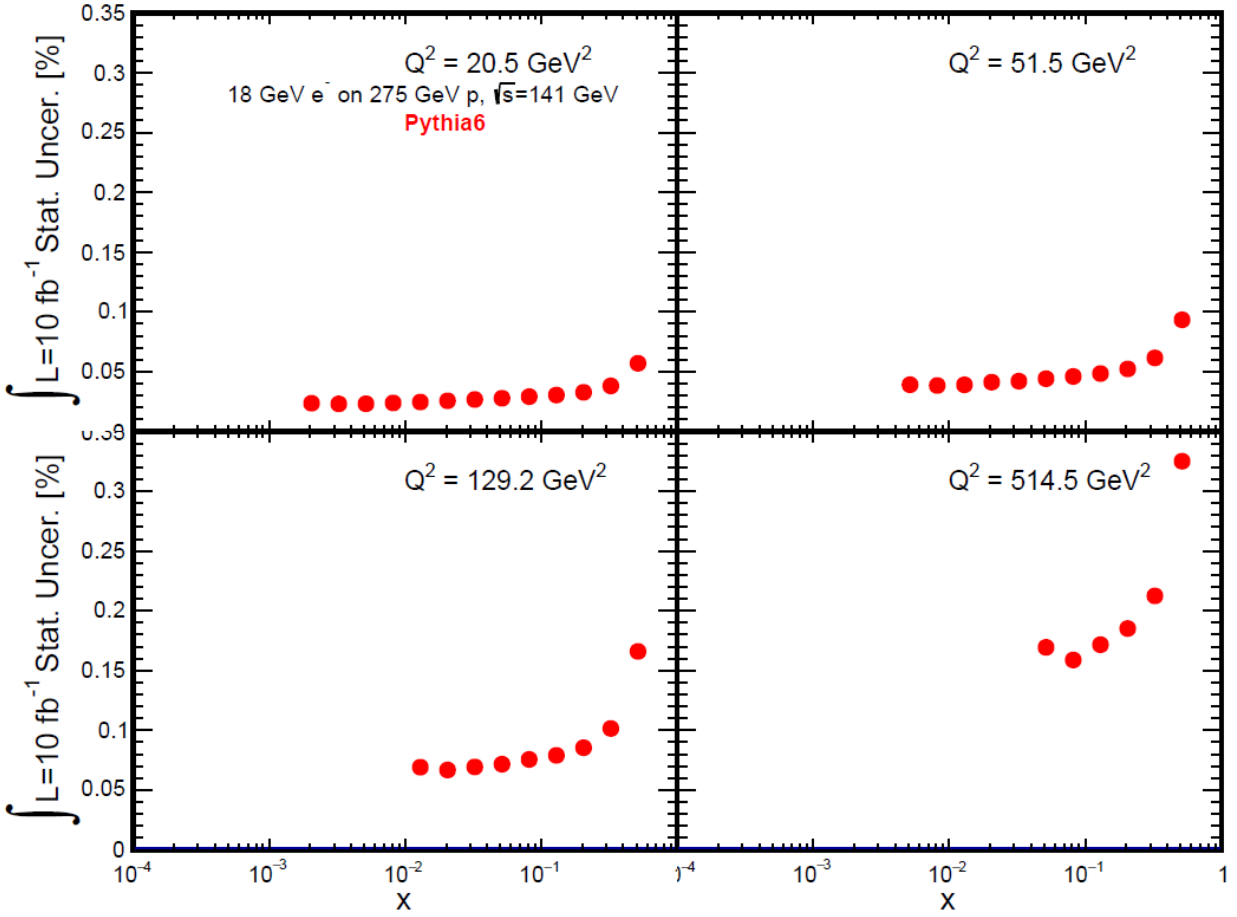


Cross Section Uncertainties

	Point-to-Point (%)	**Normalization (%)**
Statistics (10 fb^{-1})		

Cross Section Uncertainties – Statistics





Cross Section Uncertainties

	Point-to-Point (%)	**Normalization (%)**
Statistics (10 fb^{-1})	<0.35	-

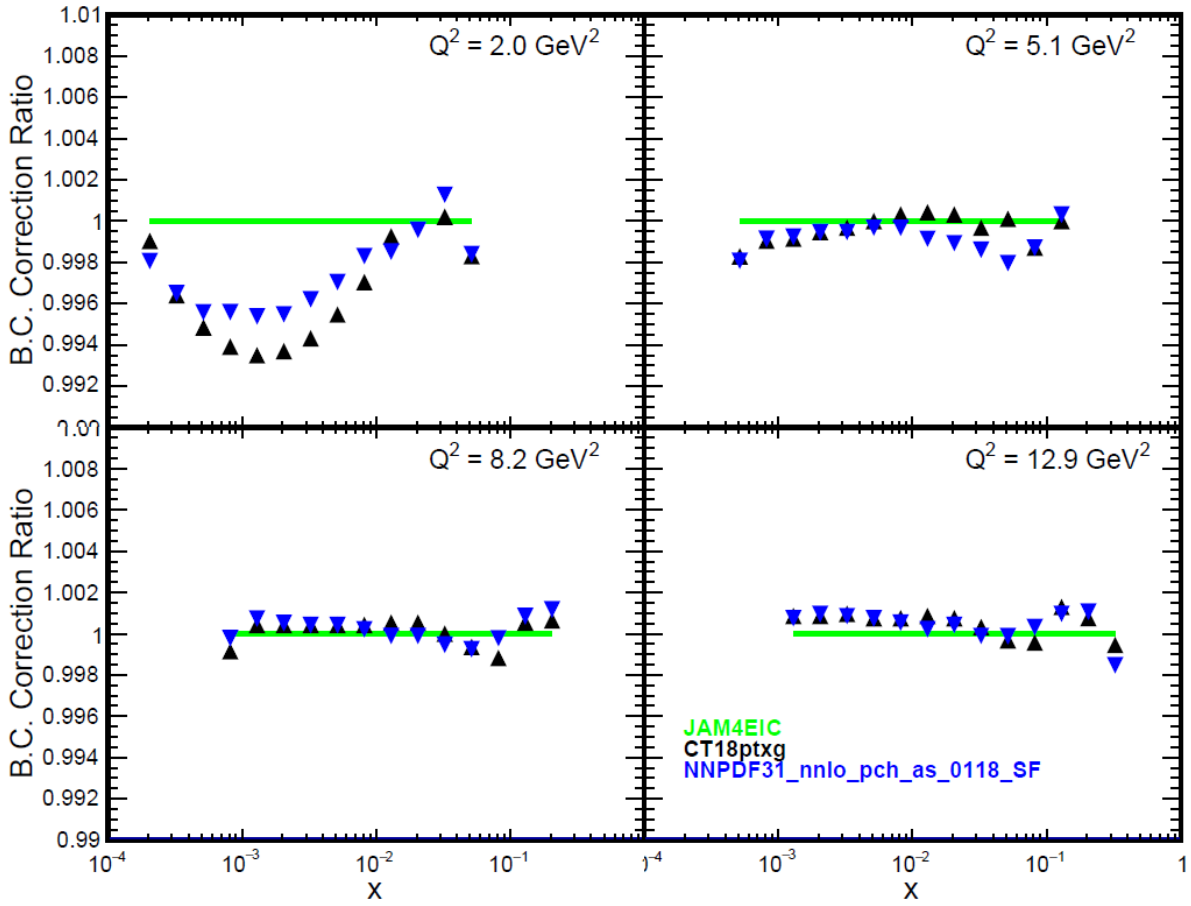
Cross Section Uncertainties

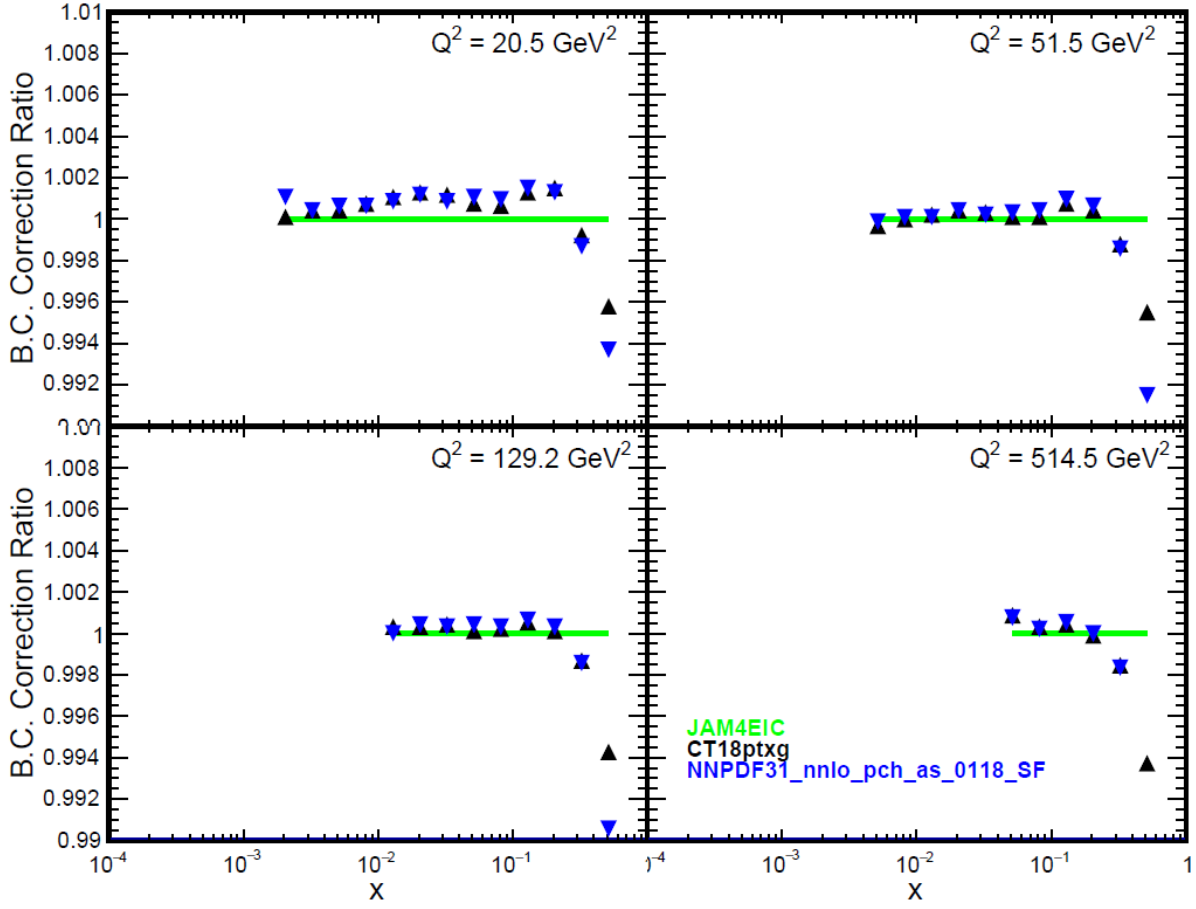
	Point-to-Point (%)	**Normalization (%)**
Statistics (10 fb^{-1})	<0.35	-
Luminosity	-	~1
Electron Purity	-	~1 (for 90% purity)

Cross Section Uncertainties

	Point-to-Point (%)	**Normalization (%)**
Statistics (10 fb^{-1})	<0.35	-
Luminosity	-	~1
Electron Purity	-	~1 (for 90% purity)
Bin-Centering		

Cross Section Uncertainties – Bin-Centering





Cross Section Uncertainties

	Point-to-Point (%)	**Normalization (%)**
Statistics (10 fb^{-1})	<0.35	-
Luminosity	-	~1
Electron Purity	-	~1 (for 90% purity)
Bin-Centering	<0.2	<0.5

Cross Section Uncertainties

	Point-to-Point (%)	**Normalization (%)**
Statistics (10 fb^{-1})	<0.35	-
Luminosity	-	~1
Electron Purity	-	~1 (for 90% purity)
Bin-Centering	<0.2	<0.5
Radiative Corrections		
Acceptance / Bin-Migration		
Total		

Cross Section Measurement: Simple ‘Unfolding’

For real data – or for an event generator with QED radiative effects and detector resolution/acceptance effects – we can extract the true cross section as follows:

$$\left(\frac{d\sigma^{Born}}{dxdQ^2}\right)^{corr}_{meas} = \left(\frac{d\sigma}{dxdQ^2}\right)_{meas} \times \frac{N^{Rad}_{gen}}{N^{Rad}_{rec}} \times \frac{\sigma^{Model,Born}_{Average}}{\sigma^{Model,Rad}_{Average}} \times \frac{\sigma^{Model,Born}_{Center}}{\sigma^{Model,Born}_{Average}}$$

$$\left(\frac{d\sigma}{dxdQ^2}\right)_{meas} = \frac{N_{bin}}{\mathcal{L}\Delta x\Delta Q^2}$$

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All detector acceptance and resolution effects are accounted for here. It is the ratio of the number of events generated divided by the number reconstructed in a given bin, calculated using an event generator including QED radiative effects. Note that the scattered electron should be used to calculate the kinematic variables in the numerator, rather than the (true) virtual Boson. To wit, the ratio goes to 1 (i.e. no correction) for a detector with perfect acceptance and resolution.

$$\left(\frac{d\sigma}{dxdQ^2}\right)_{meas} = \frac{N_{bin}}{\mathcal{L}\Delta x \Delta Q^2}$$

Cross Section Uncertainties

	Point-to-Point (%)	**Normalization (%)**
Statistics (10 fb^{-1})	<0.35	-
Luminosity	-	~1
Electron Purity	-	~1 (for 90% purity)
Bin-Centering	<0.2	<0.5
Radiative Corrections	Next Week	Next Week
Acceptance / Bin-Migration	Next Week	Next Week
Total	Next Week	Next Week