

Dijets and Azimuthal Correlations

Magnus Hansson

HaQ January 25, 2006

Outline

→ Motivation and Selection

→ Control Plots

→ $\frac{d\sigma}{dQ^2 d\Delta\phi^*}$: P, S, C, systematic uncertainties

→ $\frac{d\sigma}{dQ^2 dx}$, $\frac{d\sigma}{dQ^2 dx dE_{T,max}}$, $\frac{d\sigma}{dQ^2 dx d|\Delta\eta^*|}$ compared to published 96/97 data

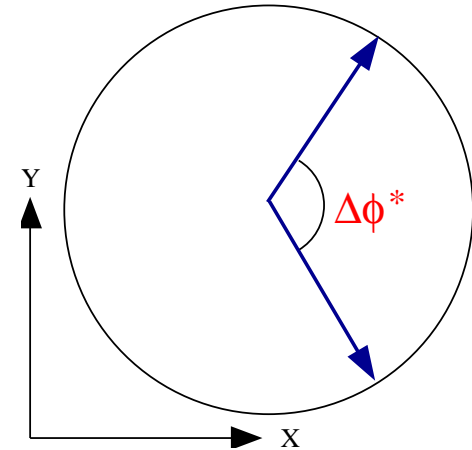
→ Summary

Motivation And Selection

- Azimuthal correlations: $\frac{d\sigma}{dQ^2 \Delta\phi^*}$

$$k_t^{*2} = E_{T1}^{*2} + E_{T2}^{*2} + 2|E_{T1}^*||E_{T2}^*|\cos\Delta\phi^*$$

Sensitive to unintegrated gluon density.

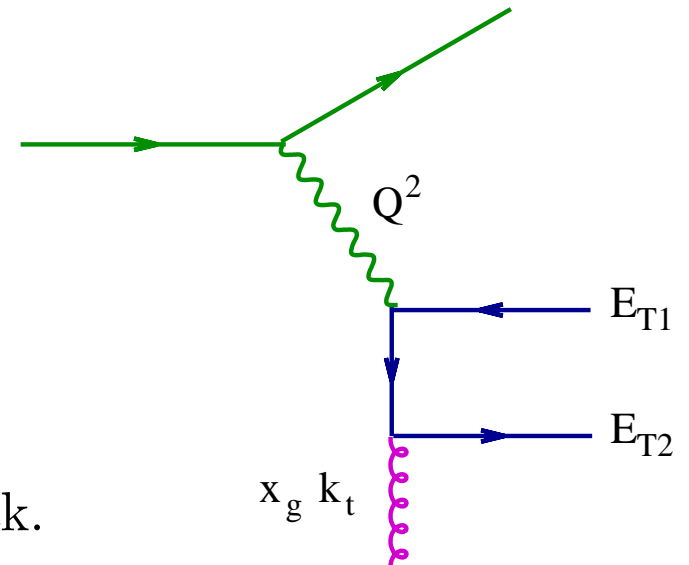


- $\frac{d\sigma}{dQ^2 dx}$, $\frac{d\sigma}{dQ^2 dx dE_{T,max}^*}$, $\frac{d\sigma}{dQ^2 dx d|\Delta\eta^*|}$

$$x_g = x(1 + \frac{\hat{s}}{Q^2})$$

Small x , E_T , $\Delta\eta \Rightarrow$ NLO DGLAP fails?

Already measured using 96/97 data: Cross check.



Motivation And Selection

	DIS Cuts			Dijet Cuts	
$5 \text{ GeV}^2 <$	Q^2	$< 100 \text{ GeV}^2$	$-1 <$	η_j	< 2.5
$0.1 <$	y	< 0.7	$5 \text{ GeV} <$	$E_{\perp j1,2}^*$	
$10^{-4} <$	x_{Bj}	$< 10^{-2}$		Sort in η	
$9 \text{ GeV} <$	E_e				
$156^\circ <$	θ_e	$< 175^\circ$			
$35 \text{ GeV} <$	$E - p_z$	$< 70 \text{ GeV}$			
	$ z_{vtx} $	$< 35 \text{ cm}$			
	R_{clus}	$< 3.5 \text{ cm}$			
	E_{had}	$< 0.5 \text{ GeV}$			
	E_{veto}	$< 1.0 \text{ GeV}$			

Using Jet Calibration Package

Motivation And Selection

Monte Carlo and Data Sets

Using 1999/2000 e^+ , excluding shifted vertex and min. bias runs.

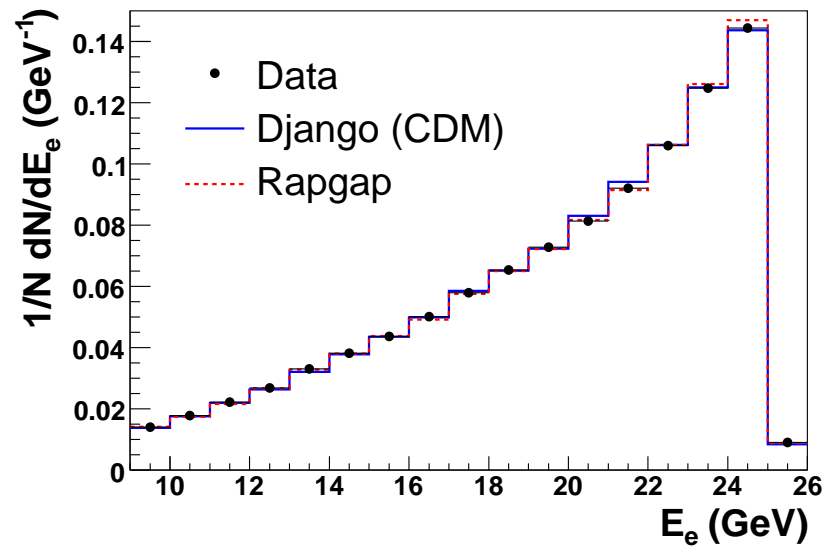
	Dijet events (w/o weights)	factor
Data 99/00 e^+	101 000	1
Rapgap 3.1 (Dir)	575 000	5.8
Djangoh 1.4 (CDM)	489 000	4.9

Need More Monte Carlo Events

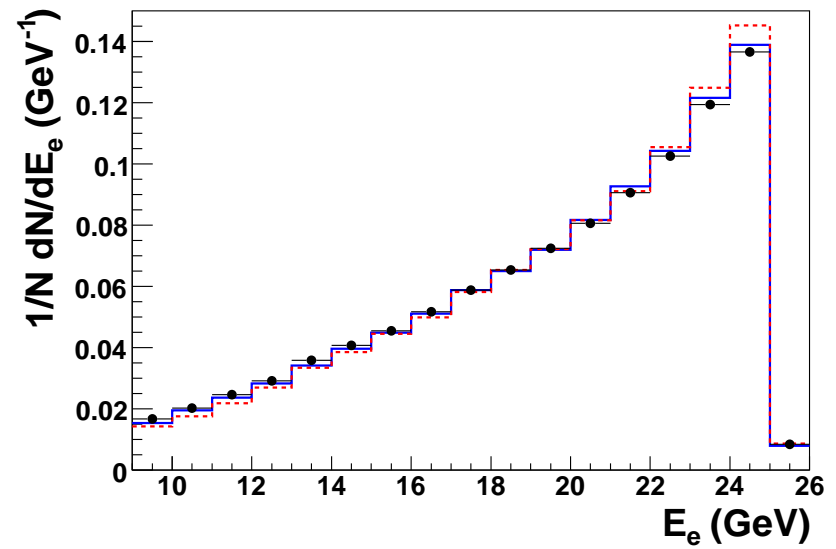
Control Plots

New OO-version

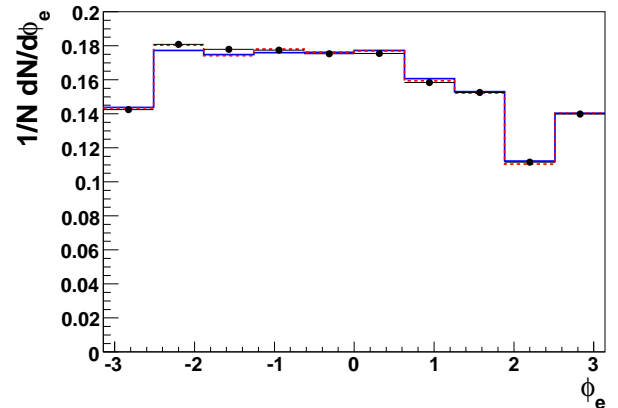
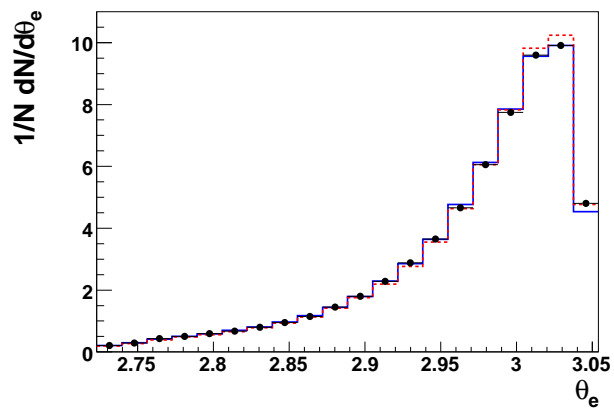
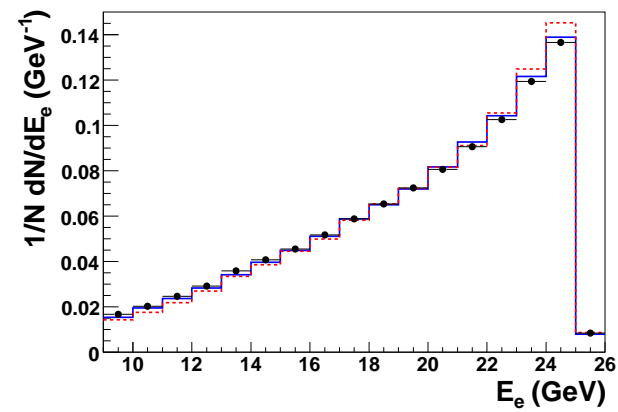
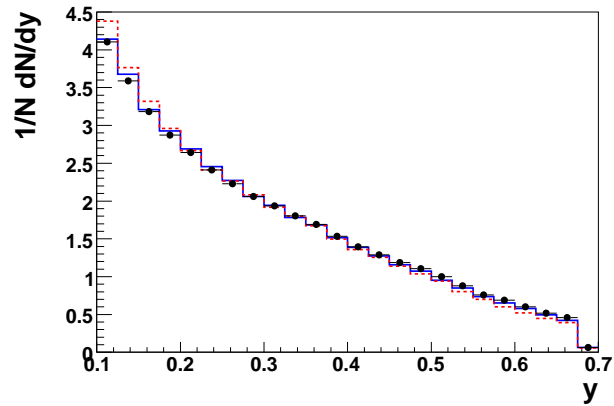
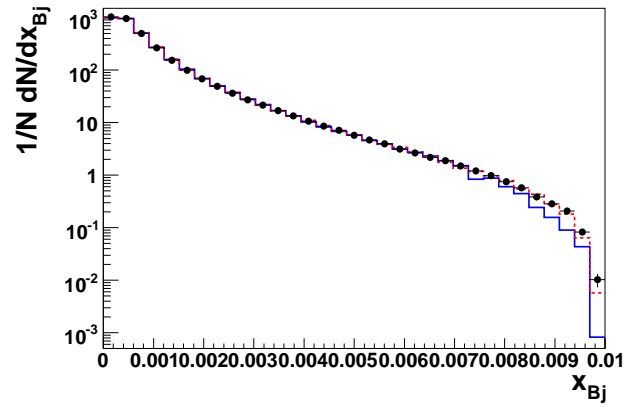
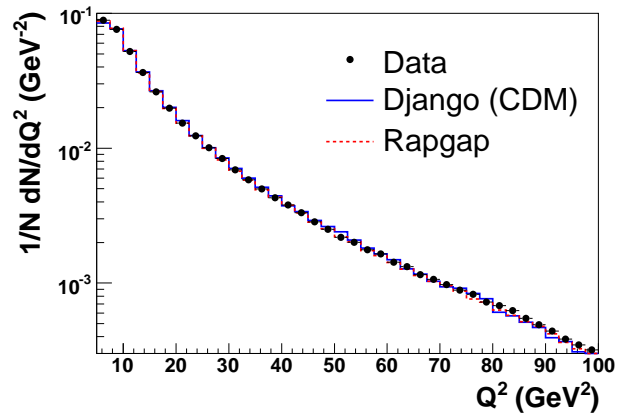
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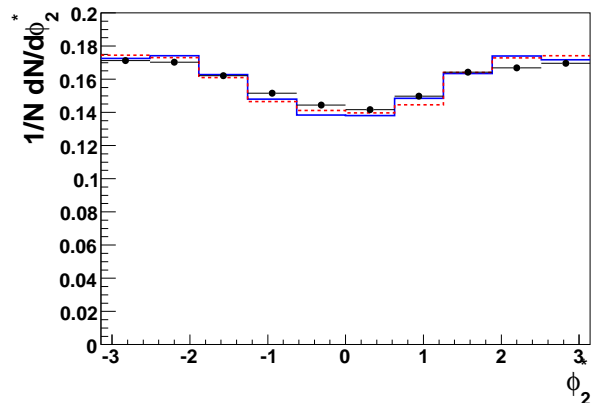
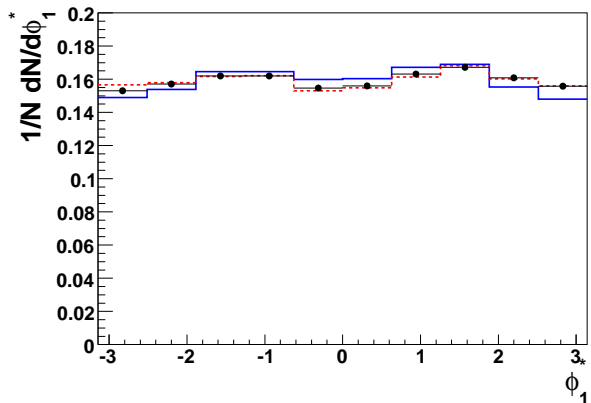
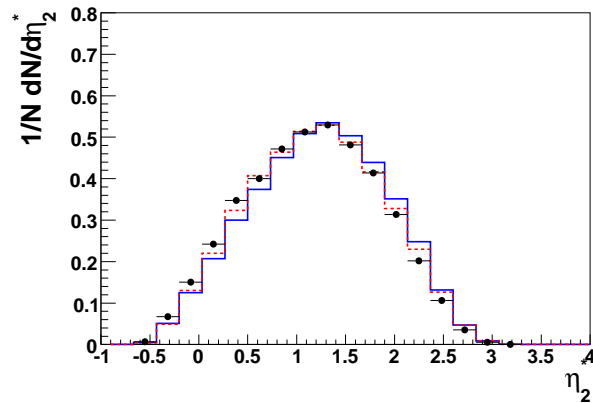
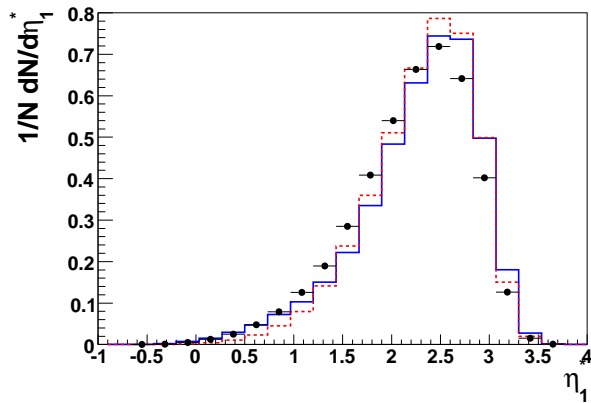
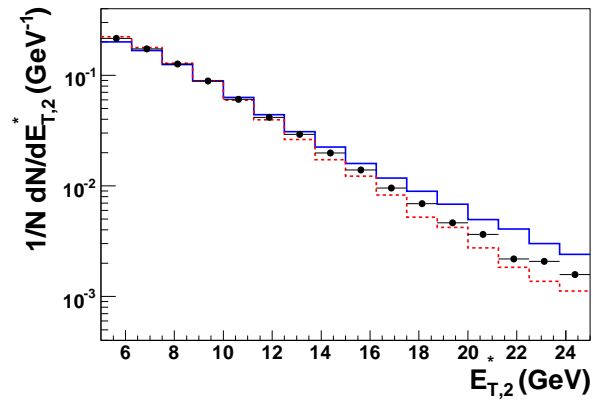
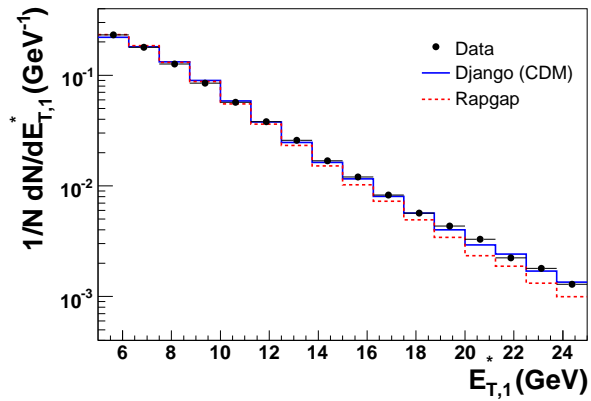
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Control Plots DIS Sample

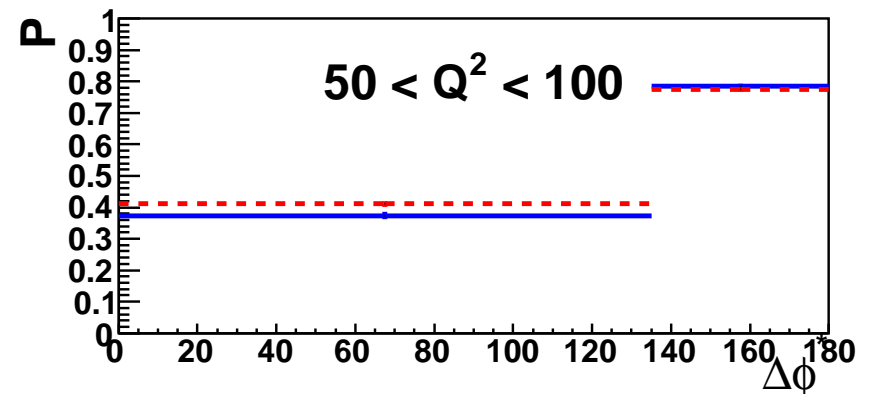
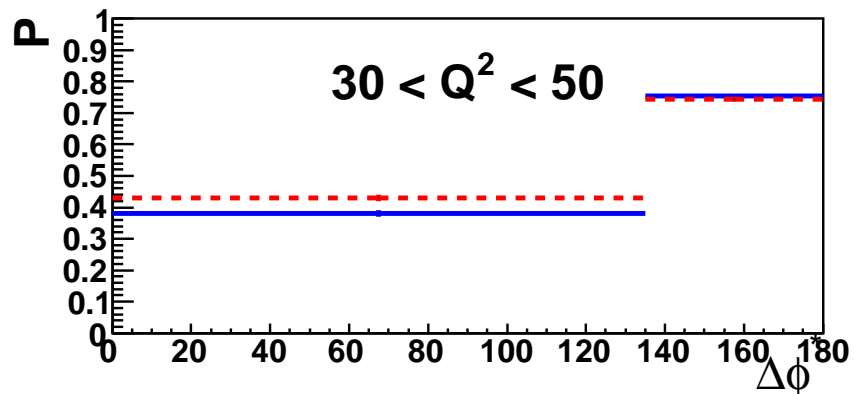
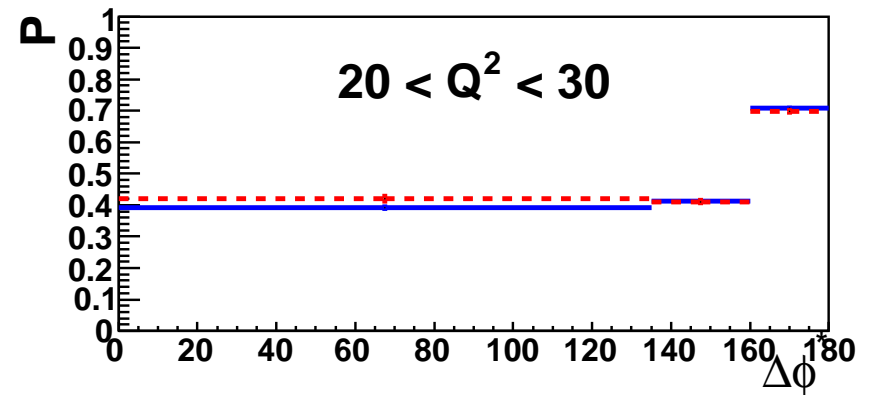
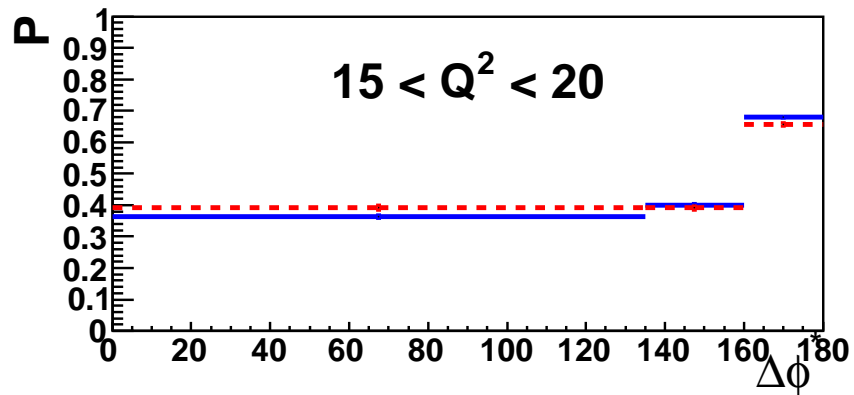
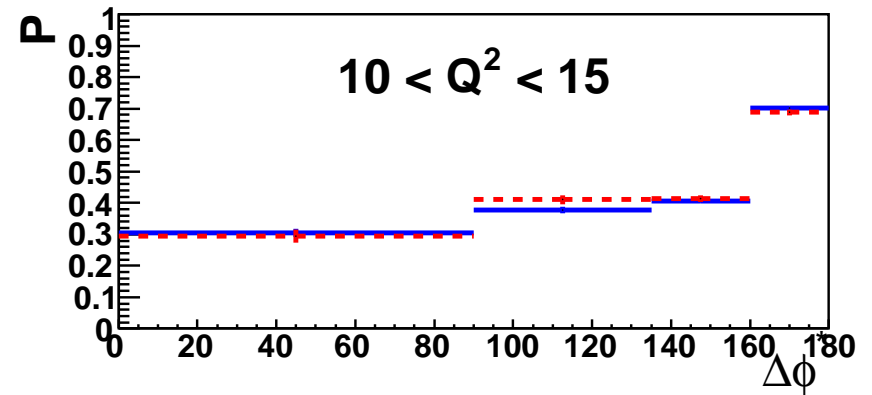
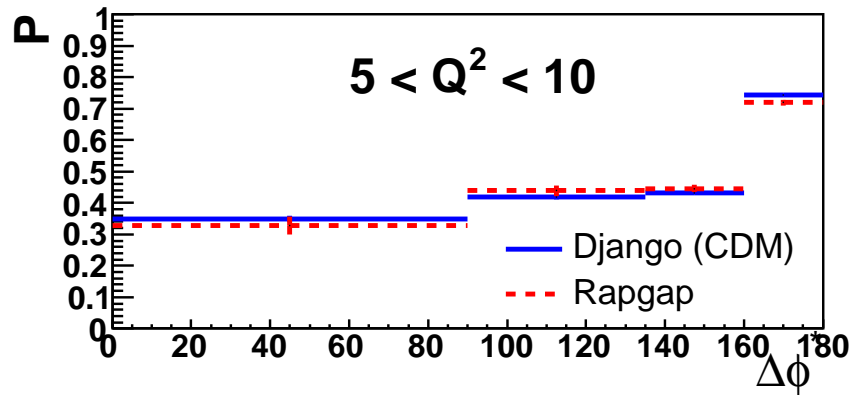


Control Plots Dijets



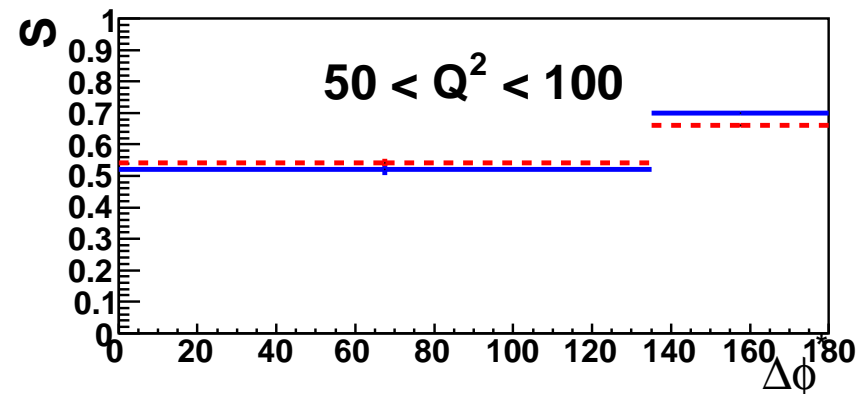
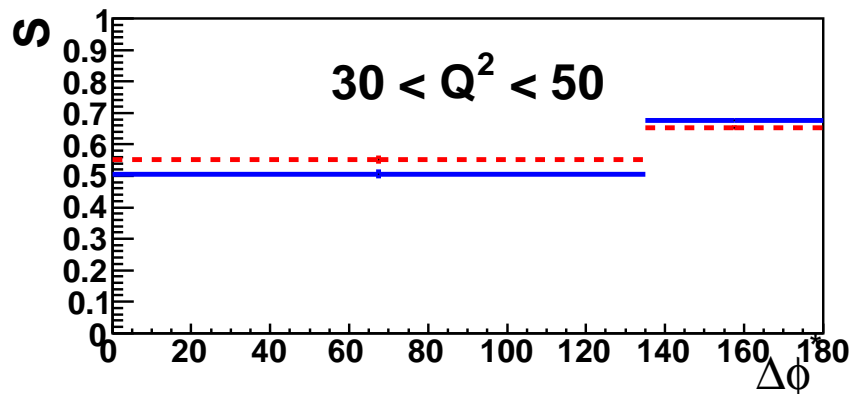
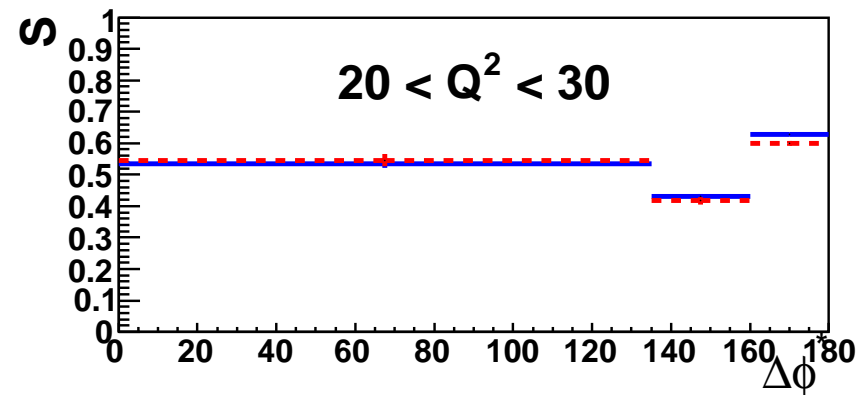
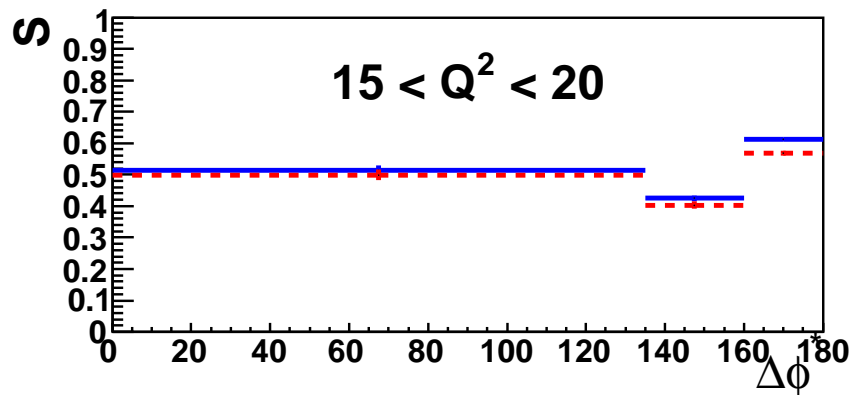
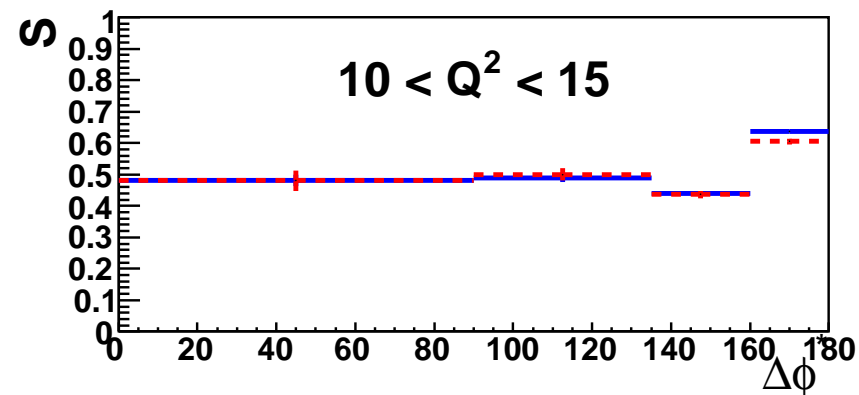
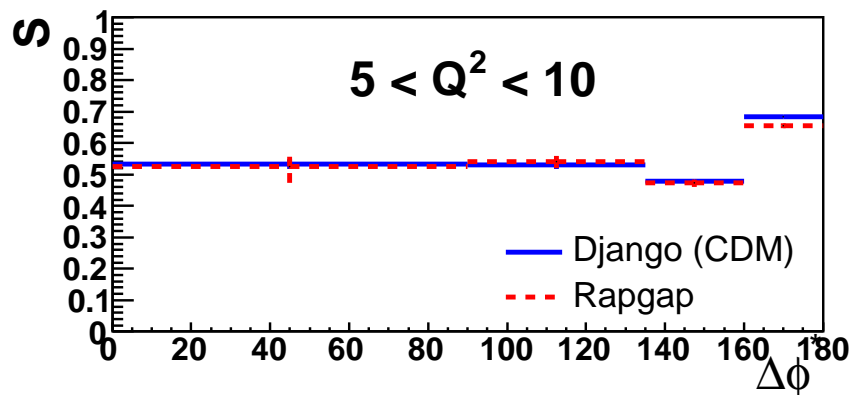
$d\sigma/dQ^2 d\Delta\phi^*$ Purity

$$P = \frac{N_{DET\&\&HAD}}{N_{DET}}$$



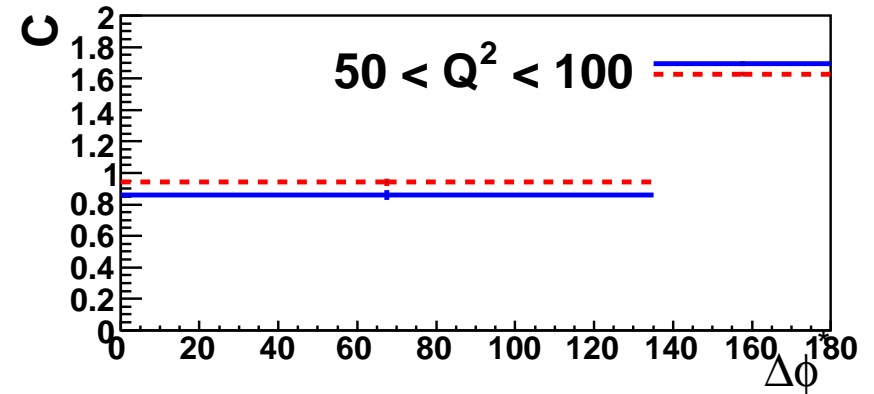
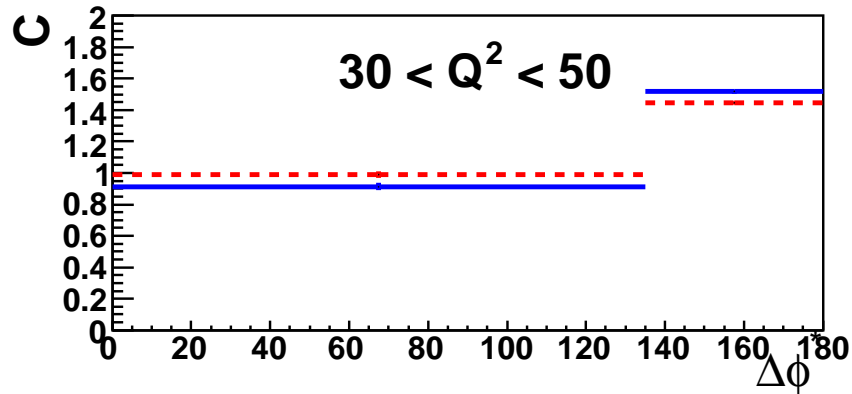
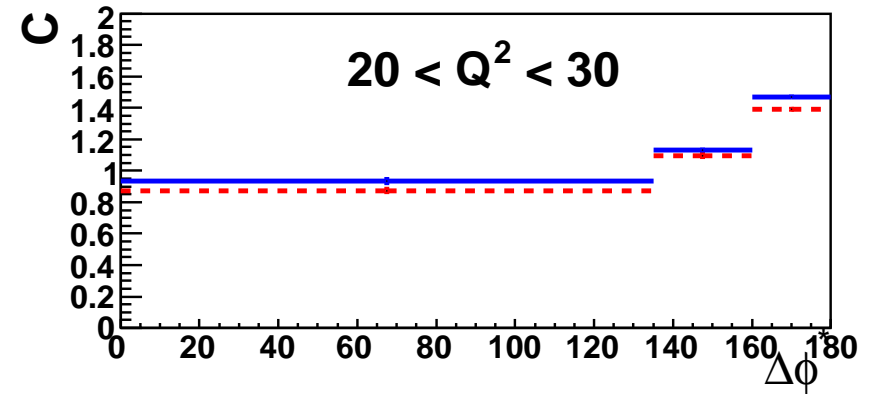
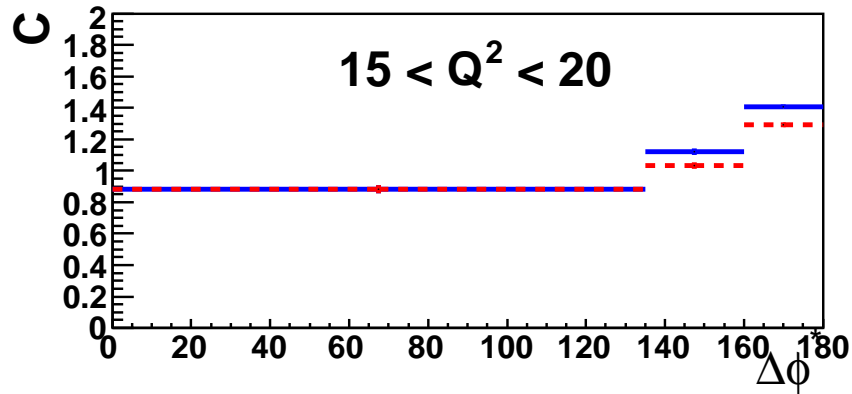
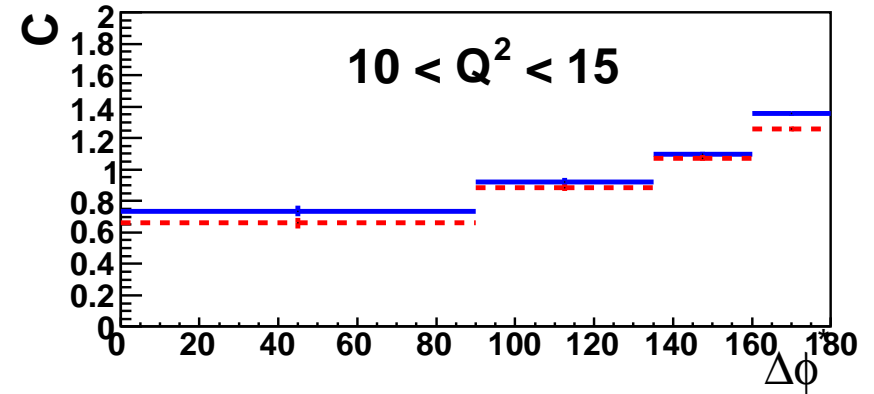
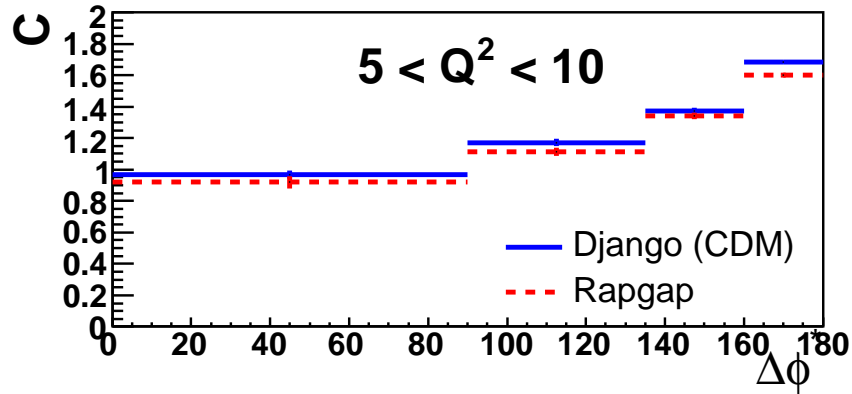
$d\sigma/dQ^2 d\Delta\phi^*$ Stability

$$S = \frac{N_{DET\&\&HAD}}{N_{HAD}}$$



$d\sigma/dQ^2 d\Delta\phi^*$ Corrections

$$C = \frac{N_{HAD, NONRAD}}{N_{DET}}$$



$$d\sigma / dQ^2 d\Delta\phi^*$$

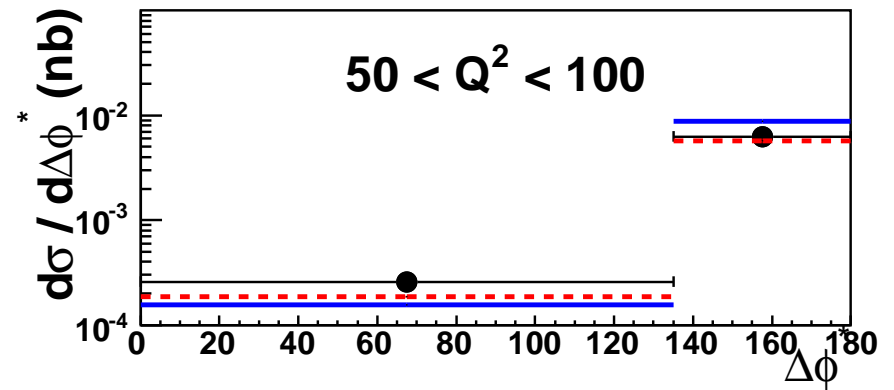
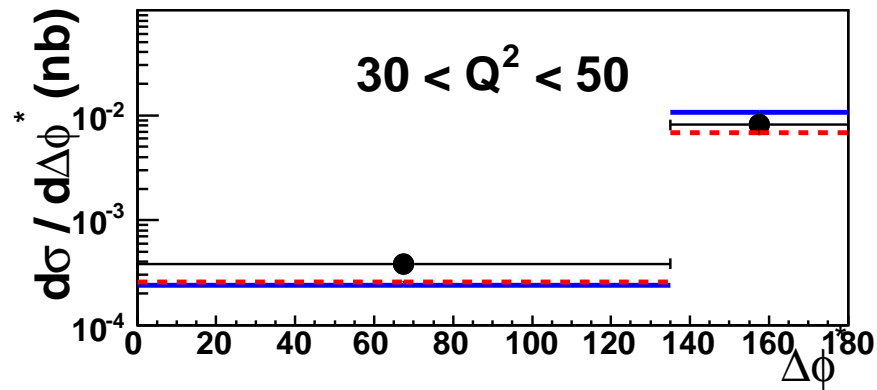
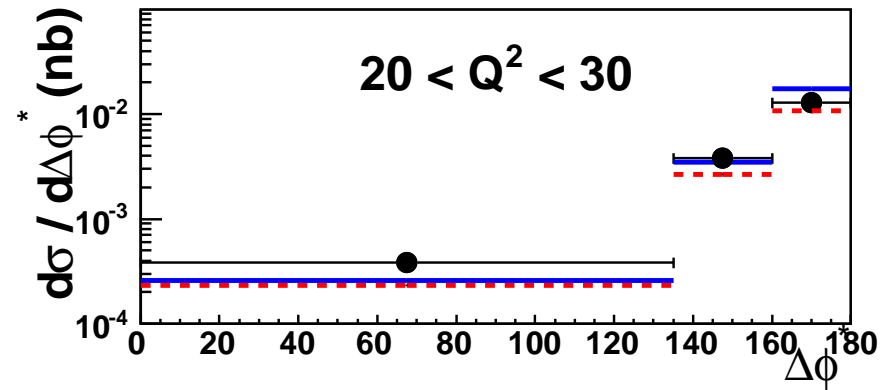
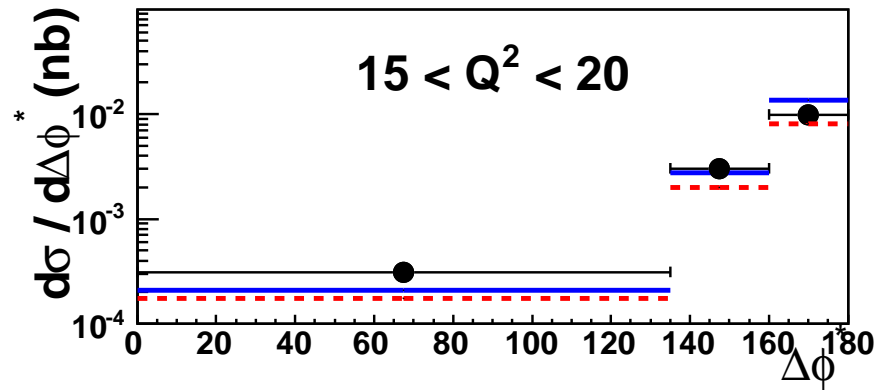
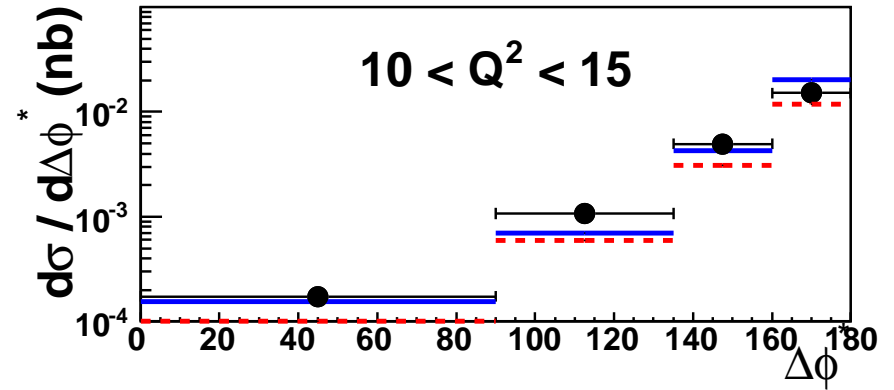
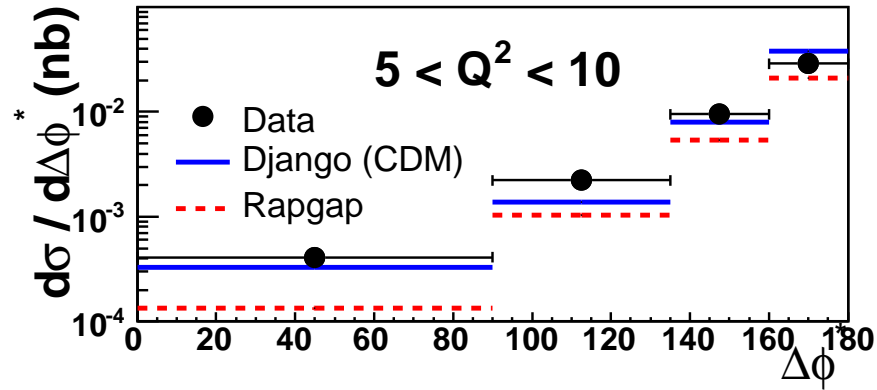
Systematic Uncertainties

Estimated using Rapgap

... except model dependence: $\frac{|C_{Rapgap} - C_{Django}|}{2}$

Source		Uncertainty
Electron Energy E'_e	$\pm 1\%$	0.1 - 1 %
Electron azimuthal angle θ_e	± 1 mrad	0.2 - 2 %
LAr Hadronic Energy	$\pm 4\%$	} 1 - 20 %
SPACAL Hadronic Energy	$\pm 5\%$	
Track Energy	$\pm 3\%$	
Model dependence		0 - 5 %

$$d\sigma / dQ^2 d\Delta\phi^*$$



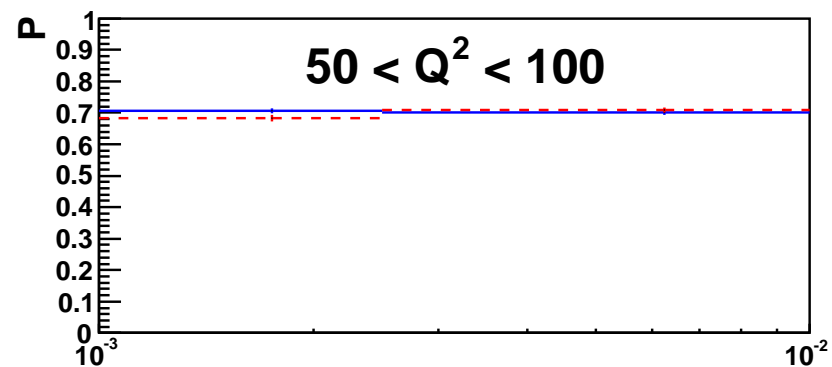
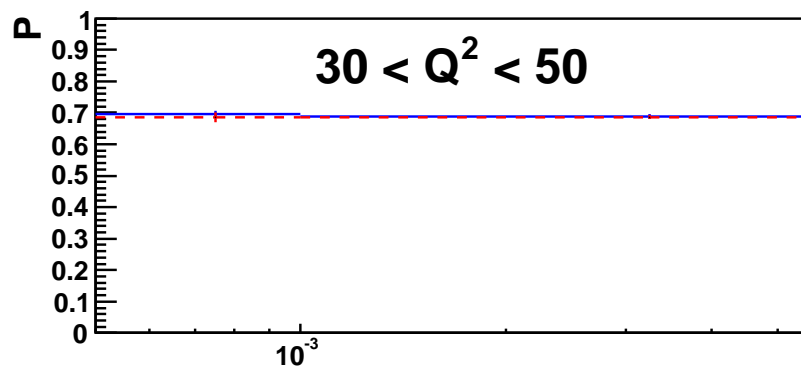
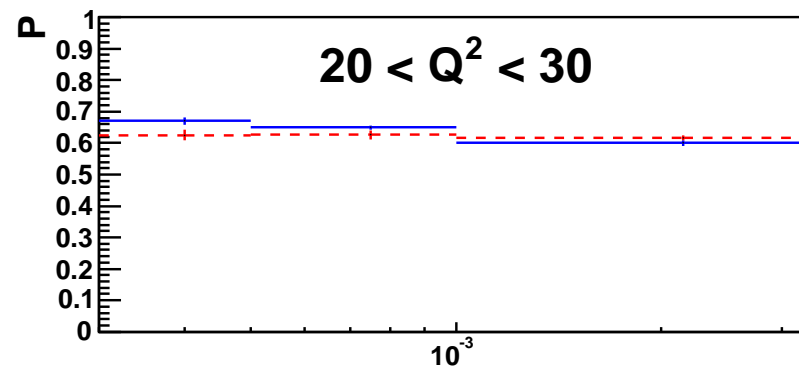
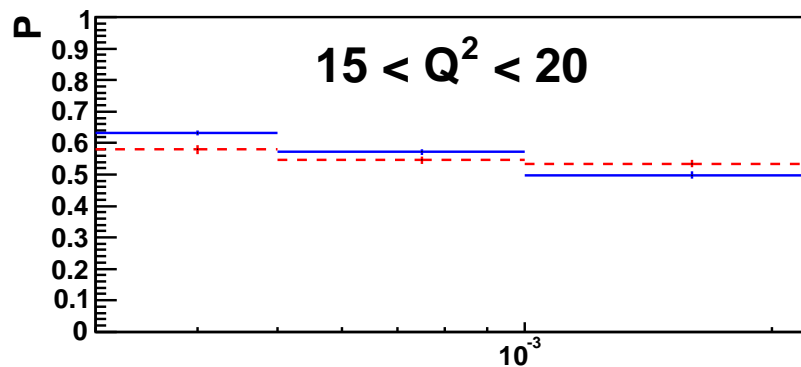
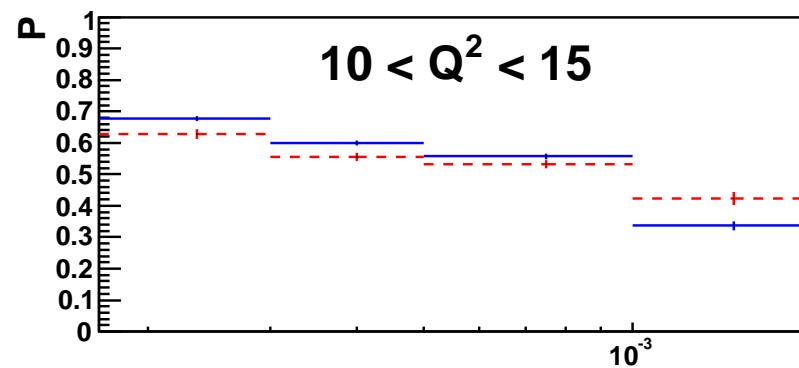
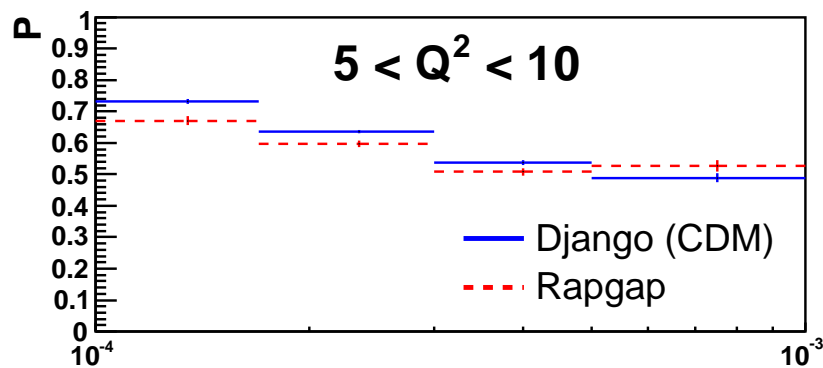
$$\frac{d\sigma}{dQ^2 dx}, \quad \frac{d\sigma}{dQ^2 dx dE_{T,max}^*}, \quad \frac{d\sigma}{dQ^2 dx d|\Delta\eta^*|}$$

Selection

	DIS Cuts		Dijet Cuts
5 GeV ² <	Q^2	< 100 GeV ²	-1 < η_j < 2.5
0.1 <	y	< 0.7	7 GeV < $E_{\perp j1}^*$
10^{-4} <	x_{Bj}	< 10^{-2}	5 GeV < $E_{\perp j2}^*$
9 GeV <	E_e		Sort in E_{\perp}^*
156° <	θ_e	< 175°	
35 GeV <	$E - p_z$	< 70 GeV	
	$ z_{vtx} $	< 35 cm	
	R_{clus}	< 3.5 cm	
	E_{had}	< 0.5 GeV	
	E_{veto}	< 1.0 GeV	

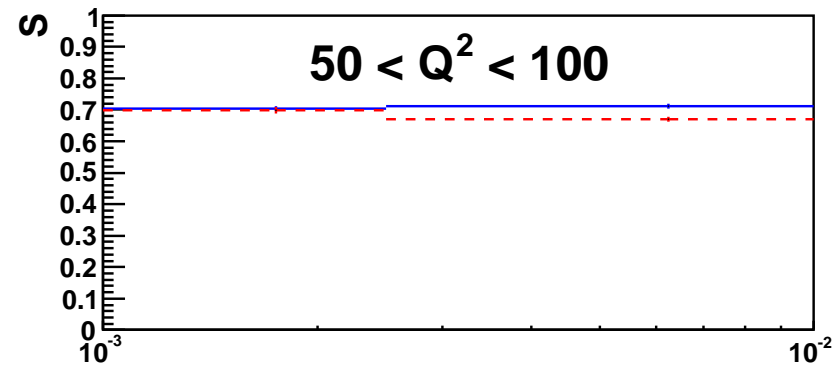
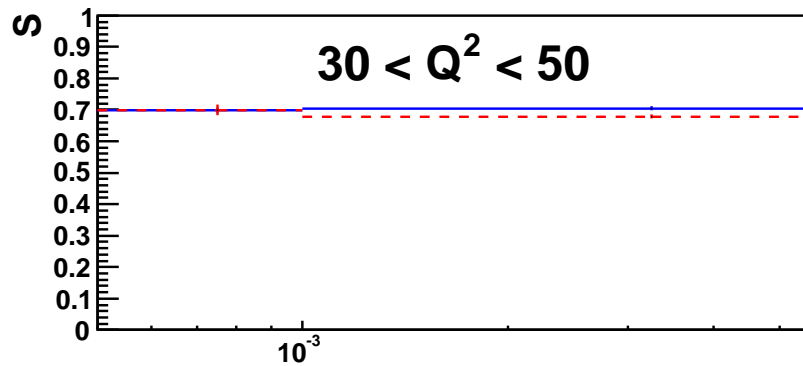
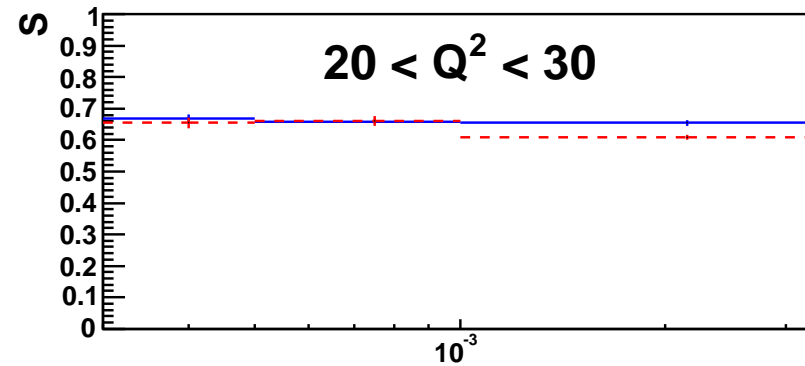
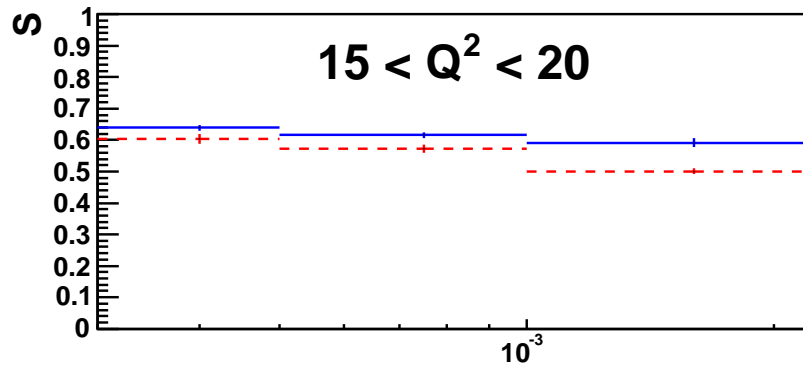
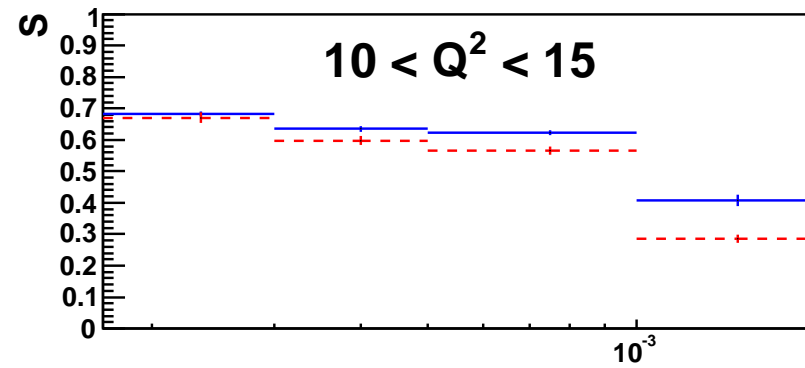
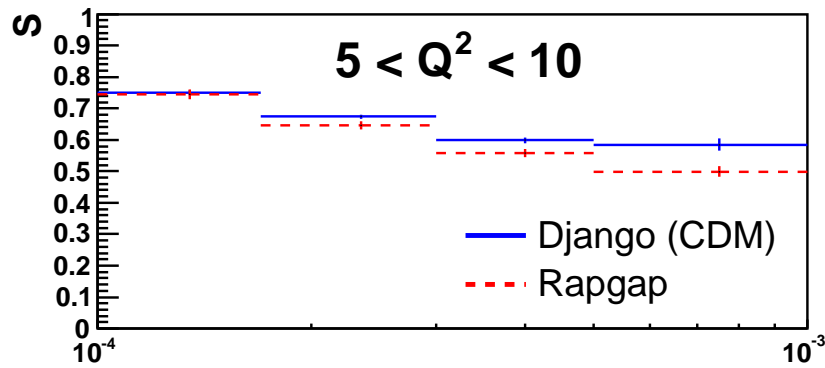
$d\sigma/dQ^2 dx$ Purity

$$P = \frac{N_{DET\&\&HAD}}{N_{DET}}$$



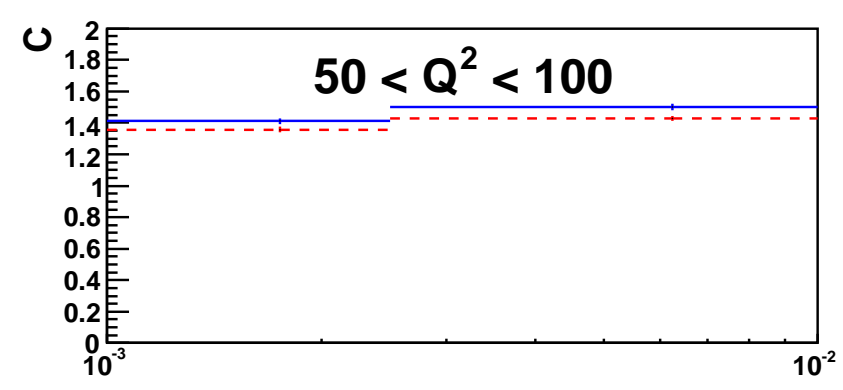
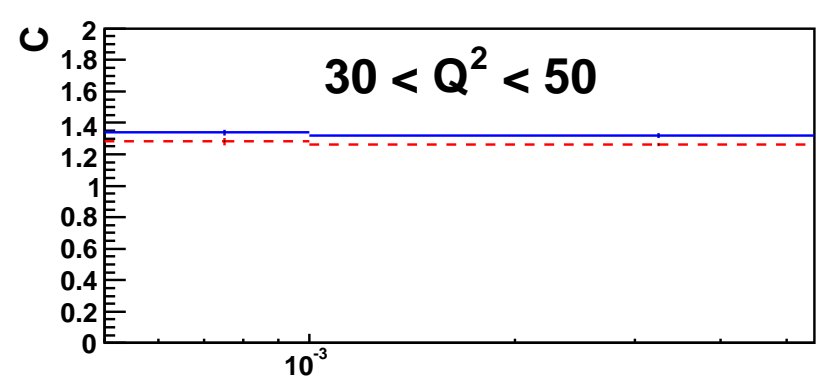
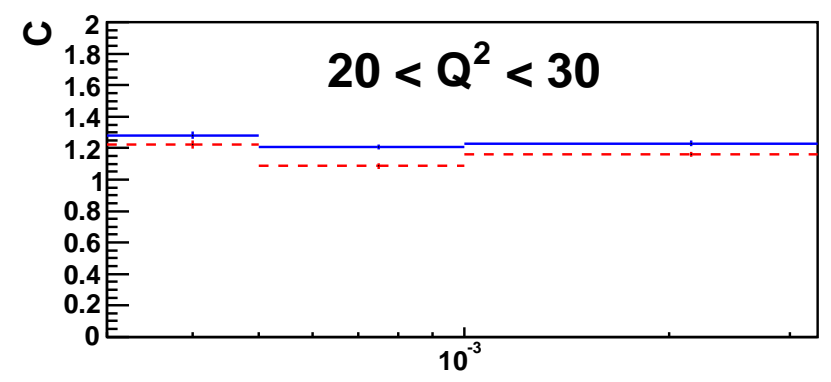
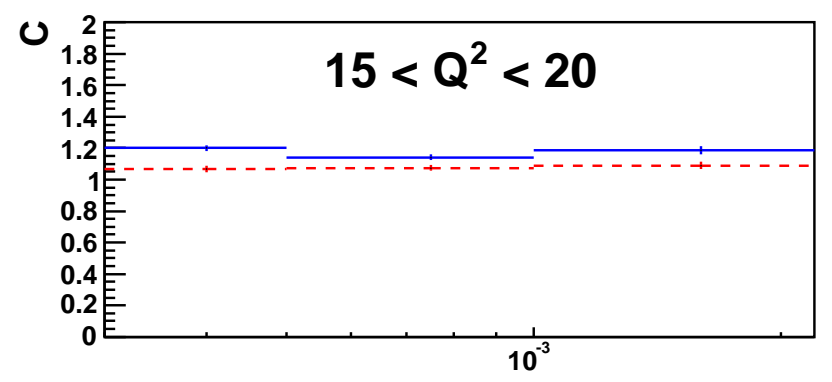
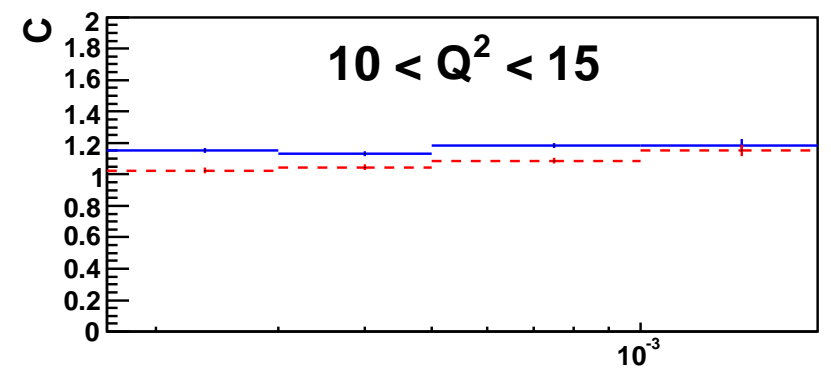
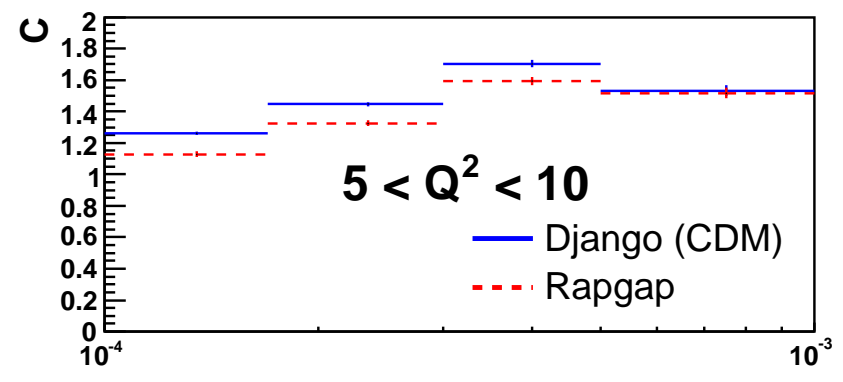
$d\sigma/dQ^2 dx$ Stability

$$S = \frac{N_{DET\&\&HAD}}{N_{HAD}}$$



dσ/dQ²dx Corrections

$$C = \frac{N_{HAD, NONRAD}}{N_{DET}}$$



$$d\sigma / dQ^2 dx$$

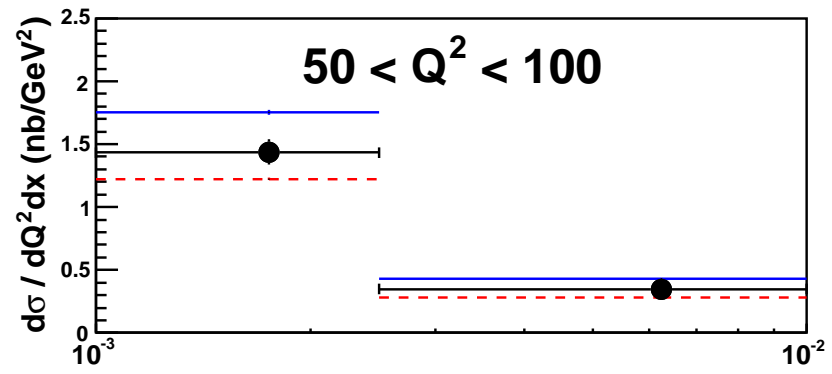
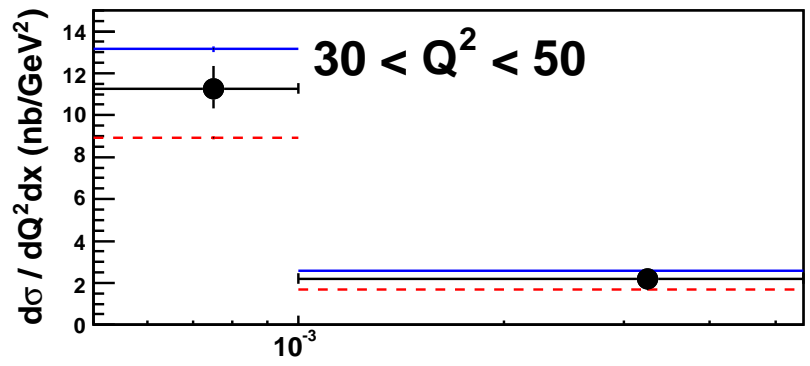
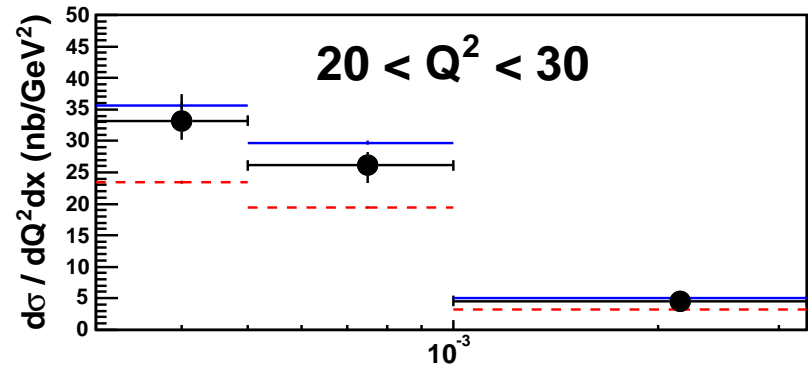
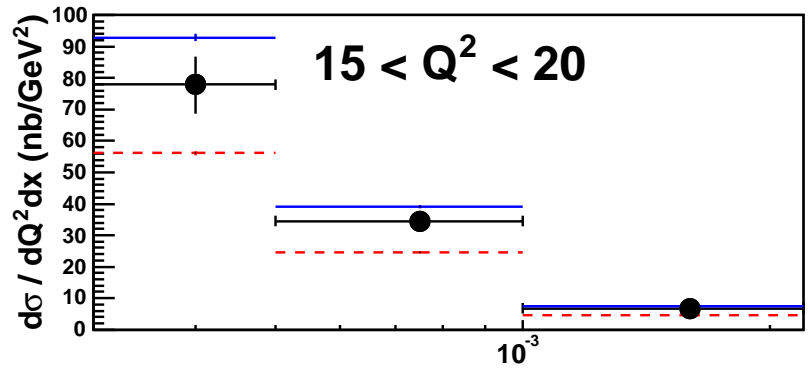
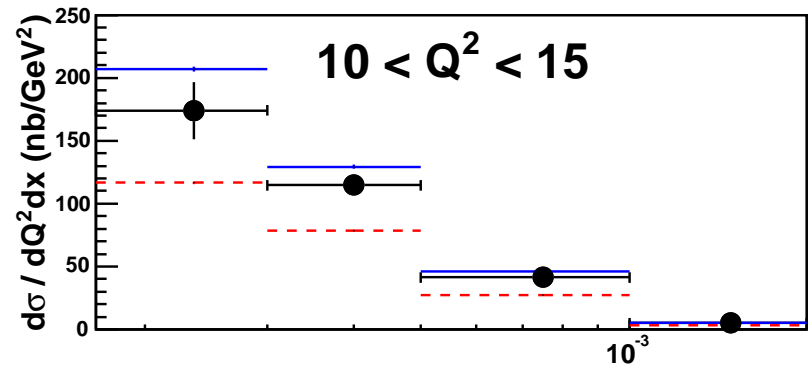
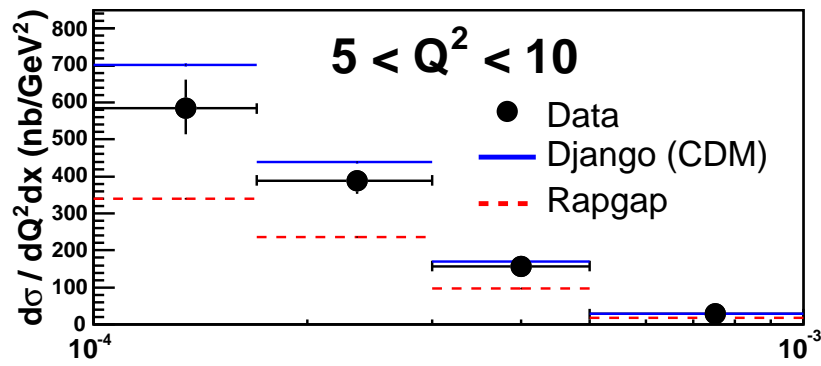
Systematic Uncertainties

Estimated using Rapgap

...except model dependence: $\frac{|C_{Rapgap} - C_{Django}|}{2}$

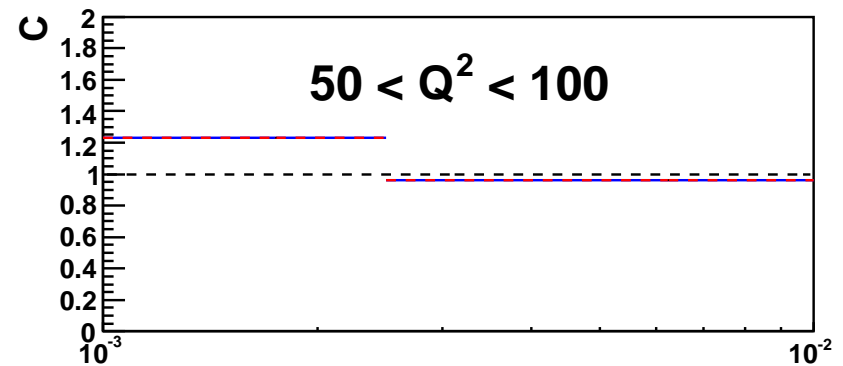
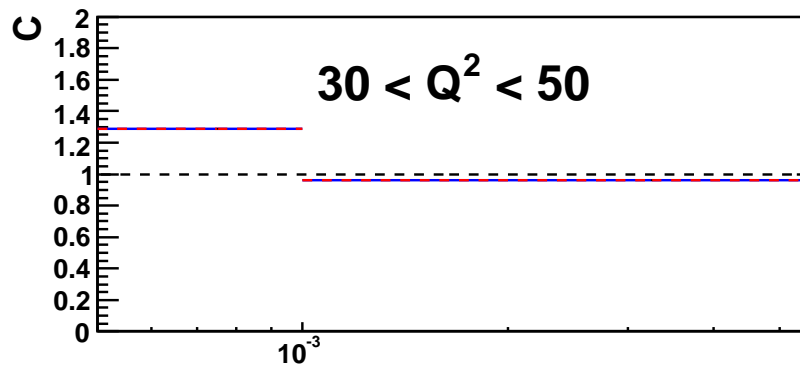
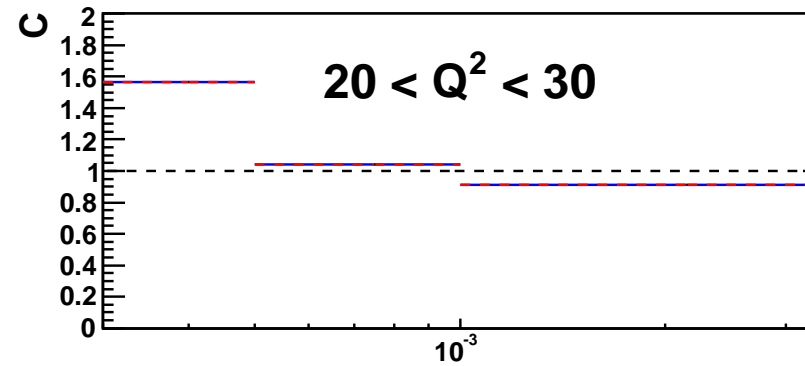
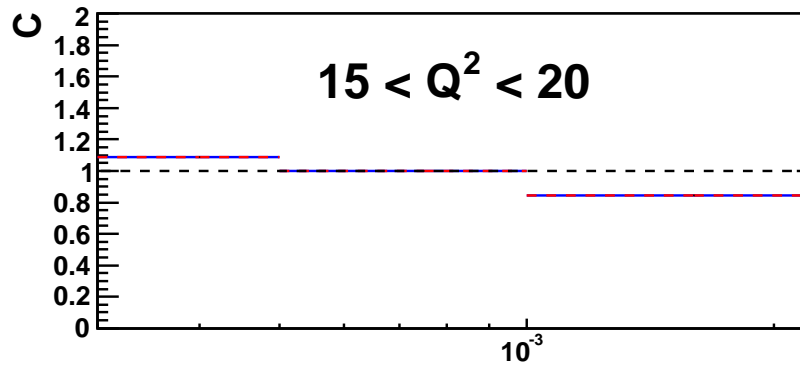
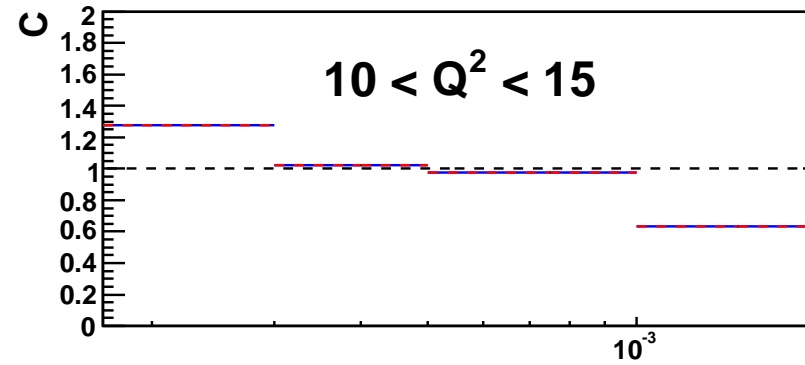
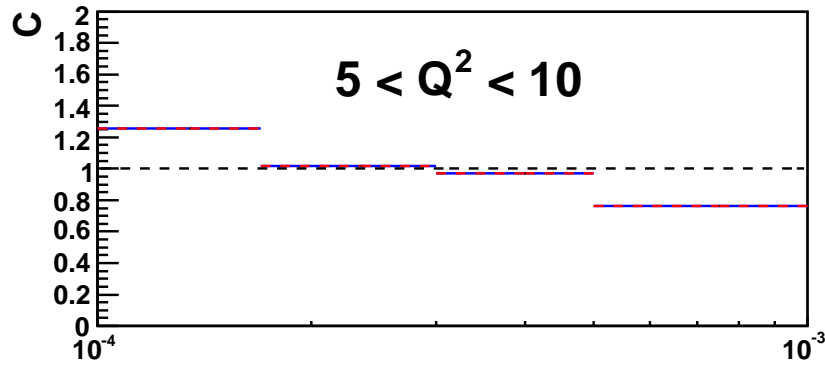
Source		Uncertainty
Electron Energy E'_e	$\pm 1\%$	0 - 6 %
Electron azimuthal angle θ_e	± 1 mrad	0 - 2 %
LAr Hadronic Energy	$\pm 4\%$	} 0 - 53 (!) %
SPACAL Hadronic Energy	$\pm 5\%$	
Track Energy	$\pm 3\%$	
Model dependence		1 - 7 %

$d\sigma / dQ^2 dx$

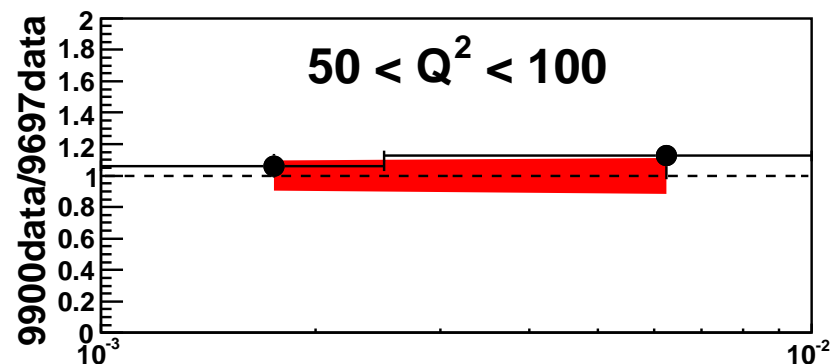
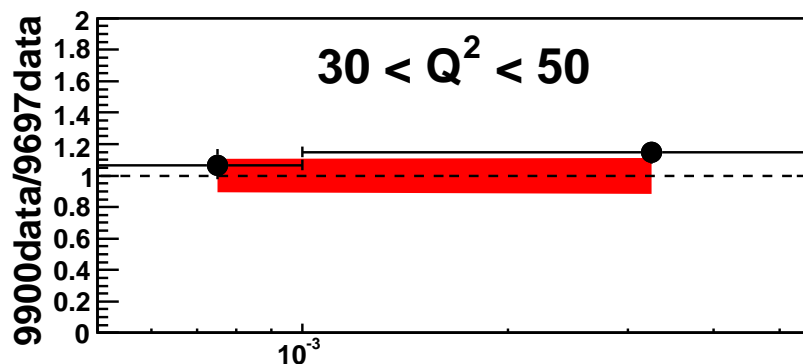
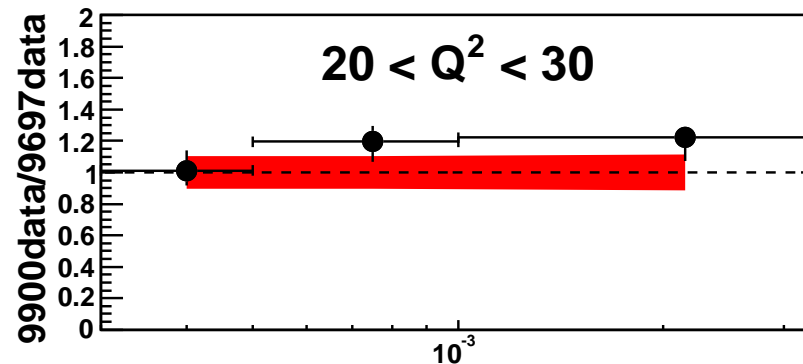
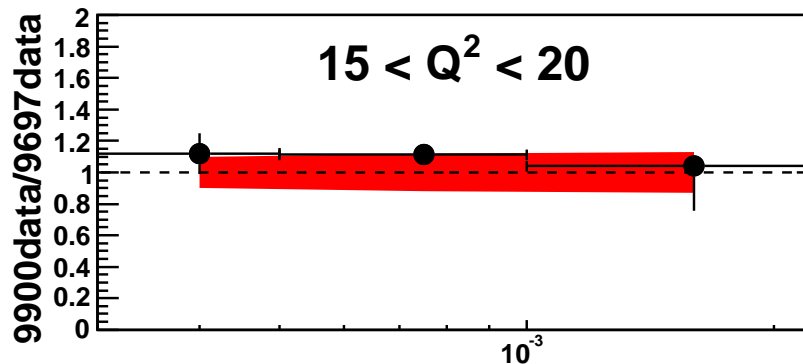
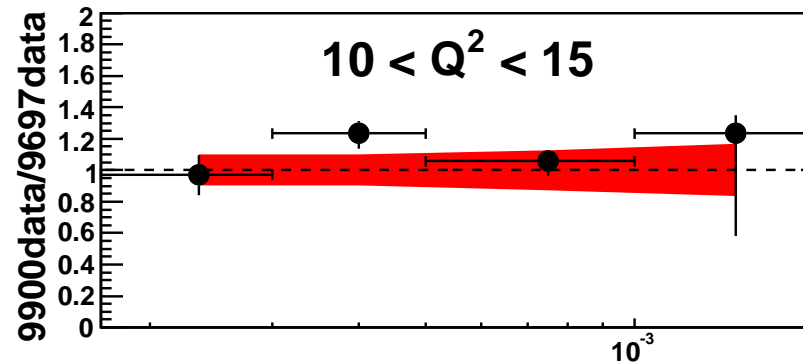
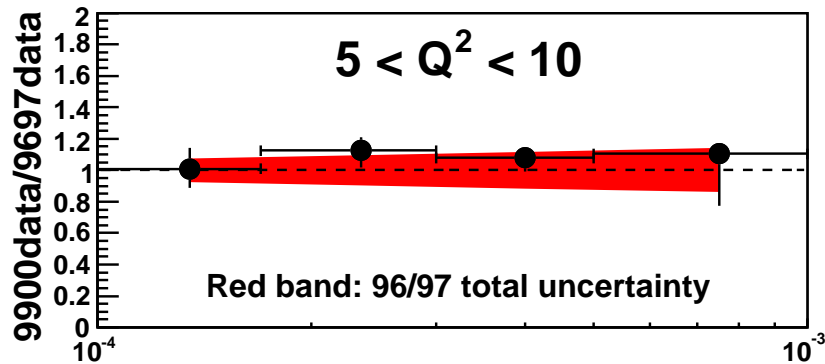


$d\sigma/dQ^2 dx$ Corr. for $E_p = 920$ GeV

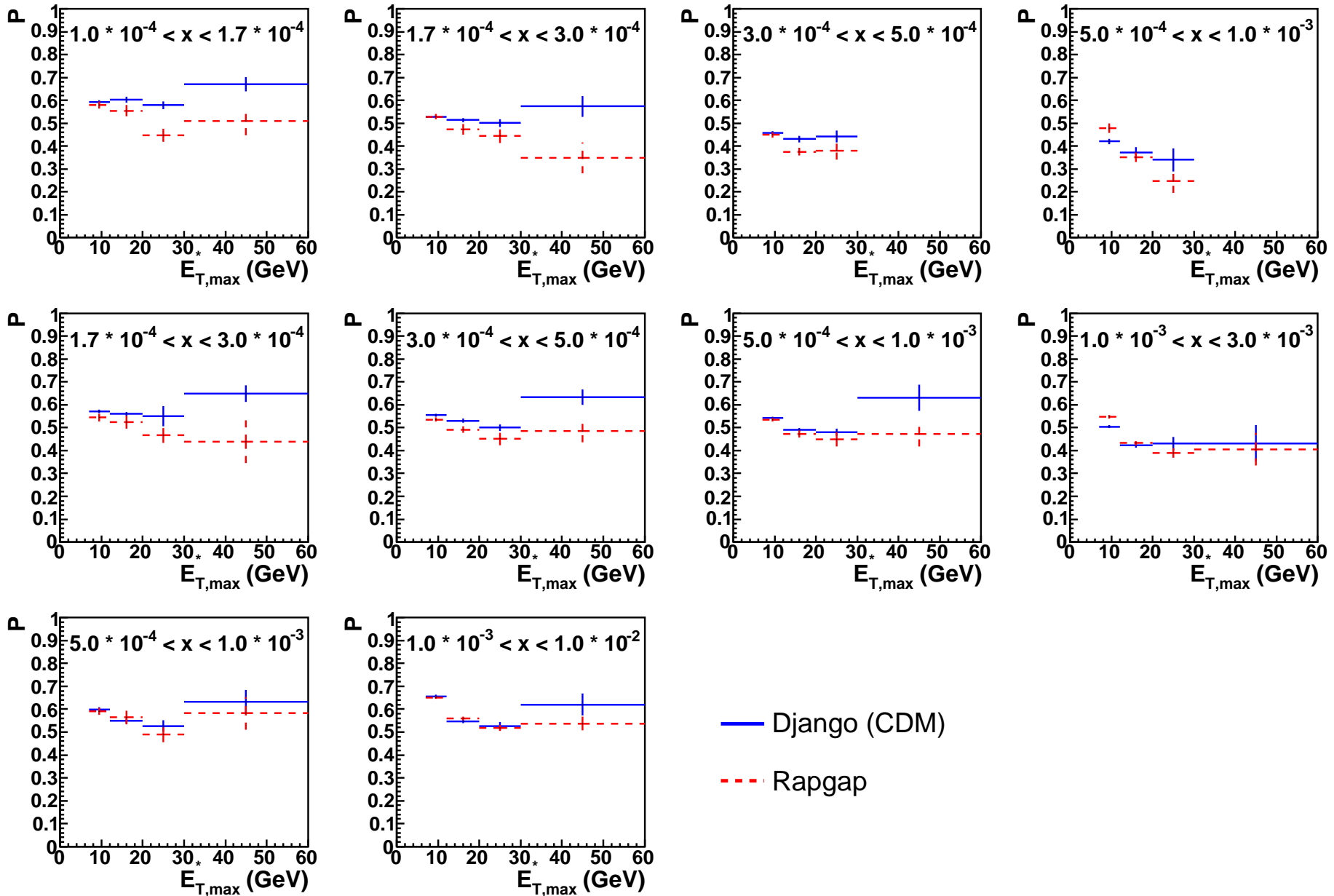
$$C = \frac{N_{HAD,920}}{N_{HAD,820}}$$



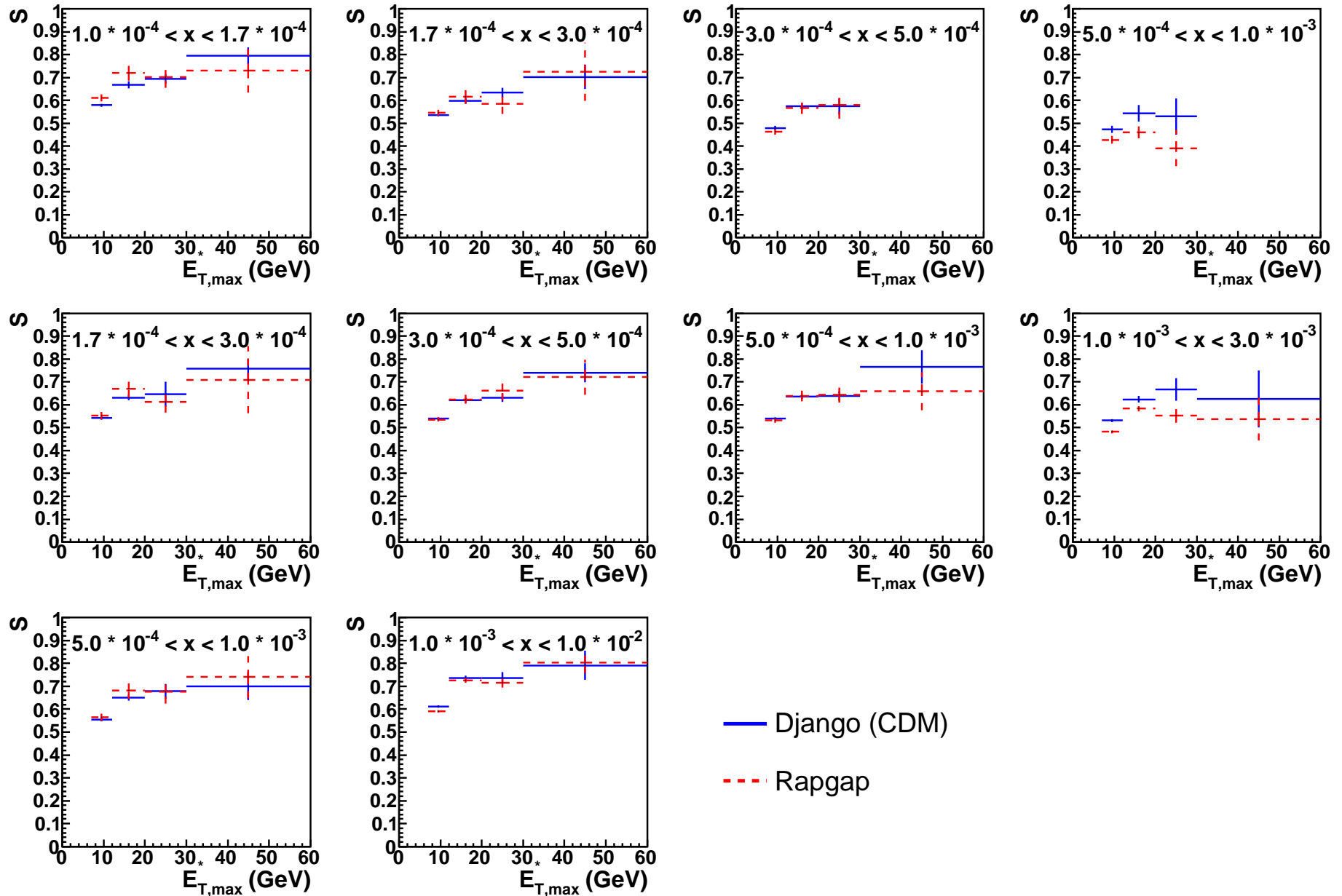
$d\sigma/dQ^2 dx$ 9900 Vs. 9697



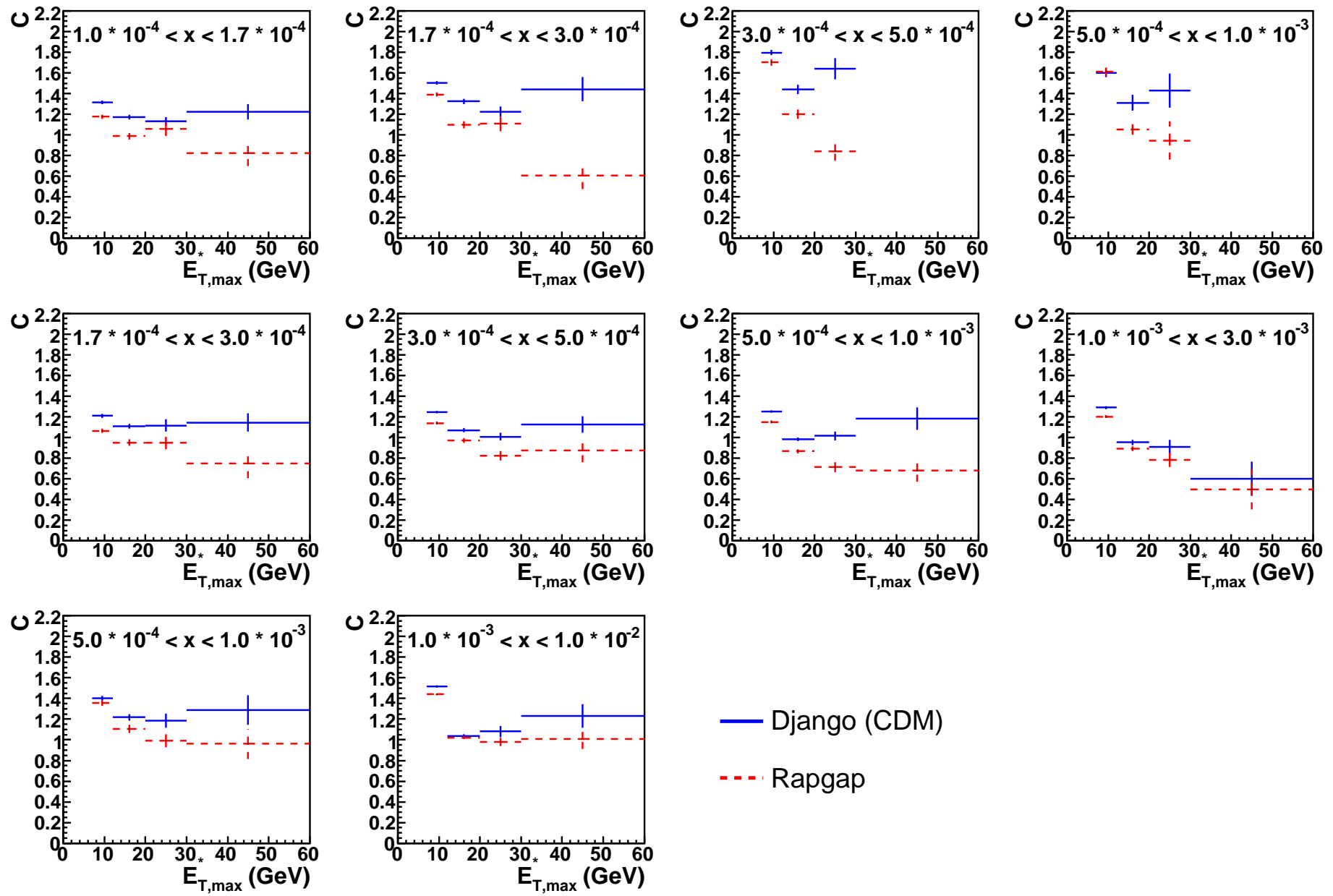
$d\sigma/dQ^2 dx dE_{T,max}$ Purity



$d\sigma/dQ^2 dx dE_{T,max}$ Stability



$d\sigma/dQ^2 dx dE_{T,max}$ Correction factors



— Django (CDM)
 - - - Rapgap

$$d\sigma / dQ^2 dx dE_{T,max}$$

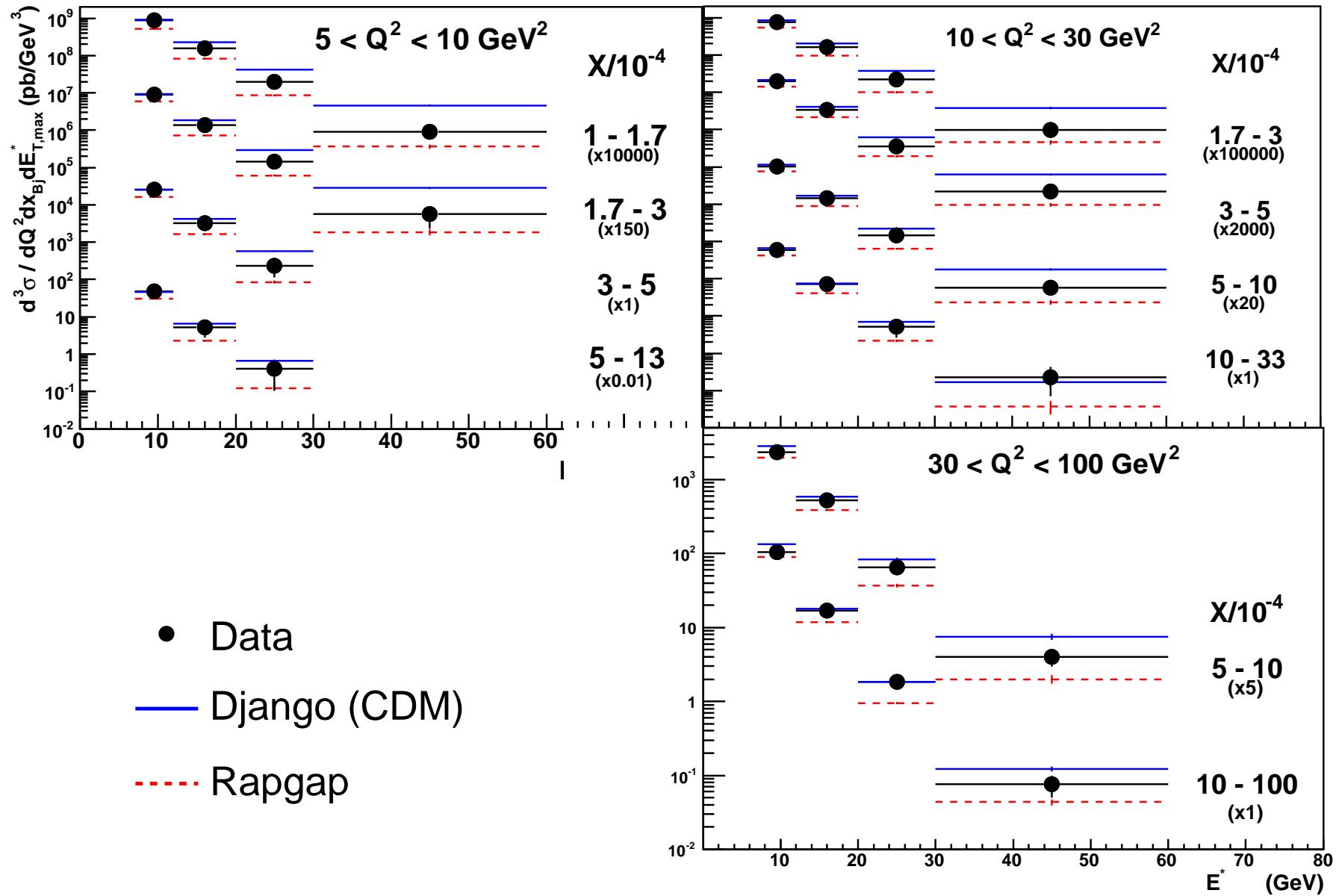
Systematic Uncertainties

Estimated using Rapgap

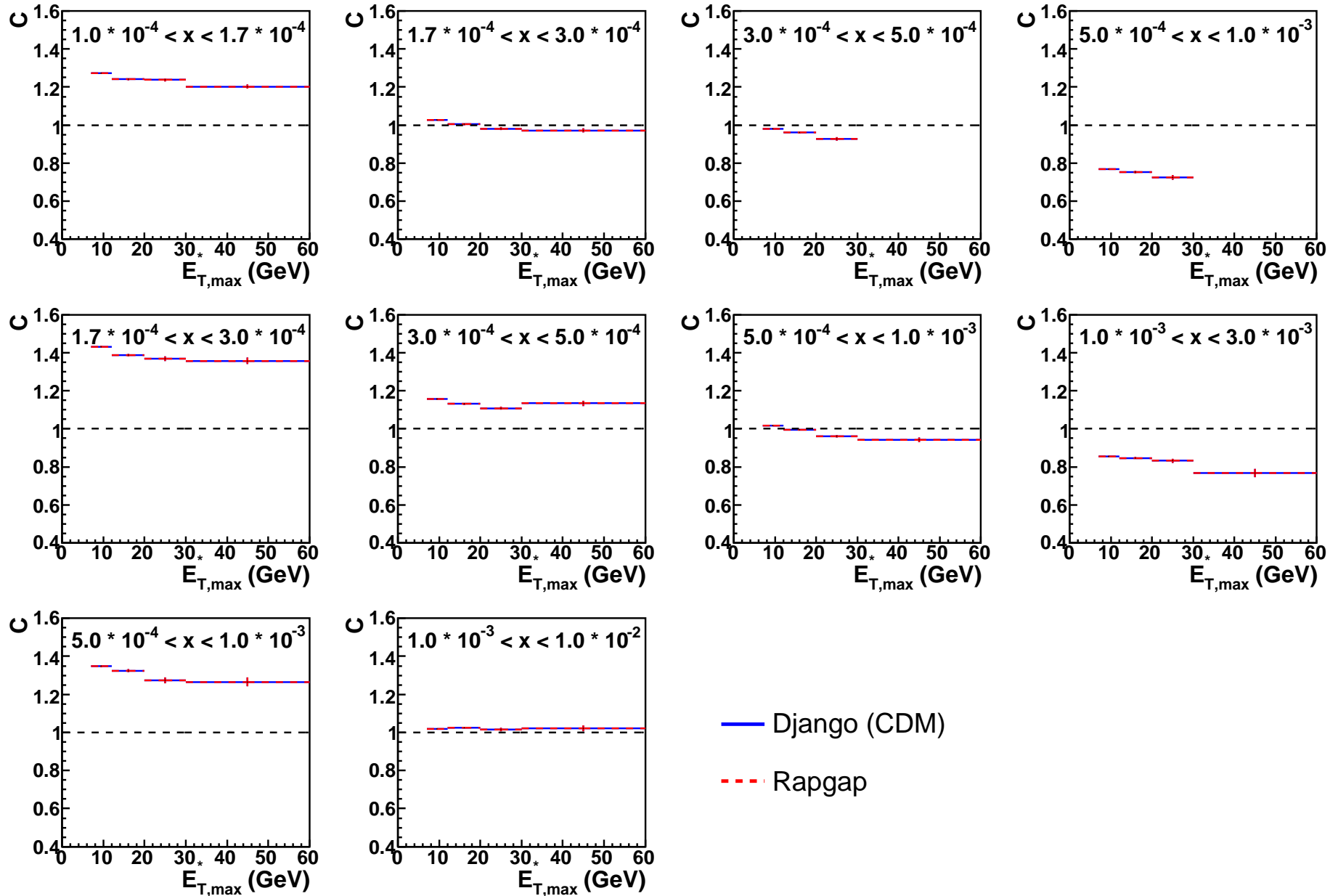
...except model dependence: $\frac{|C_{Rapgap} - C_{Django}|}{2}$

Source		Uncertainty
Electron Energy E'_e	$\pm 1\%$	0 - 20 (!) %
Electron azimuthal angle θ_e	± 1 mrad	0 - 10 (!) %
LAr Hadronic Energy	$\pm 4\%$	} 0 - 87 (!) %
SPACAL Hadronic Energy	$\pm 5\%$	
Track Energy	$\pm 3\%$	
Model dependence		0 - 40 (!) %

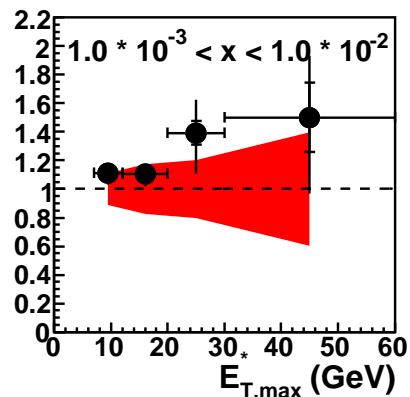
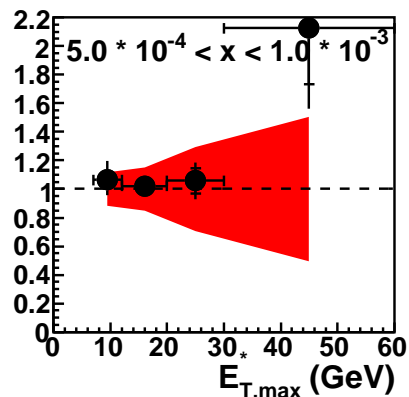
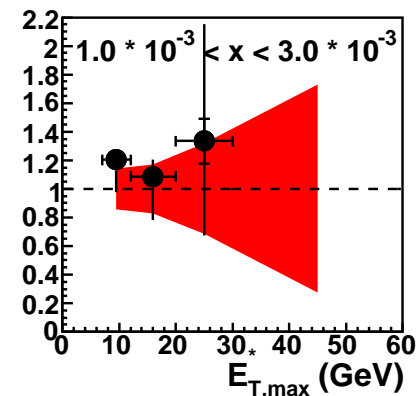
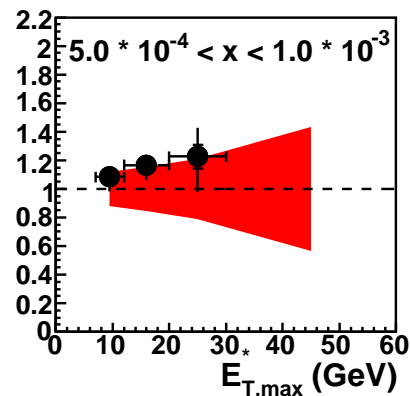
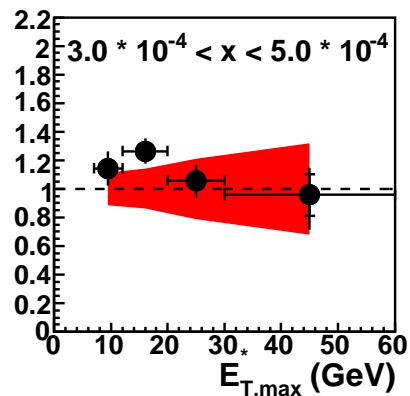
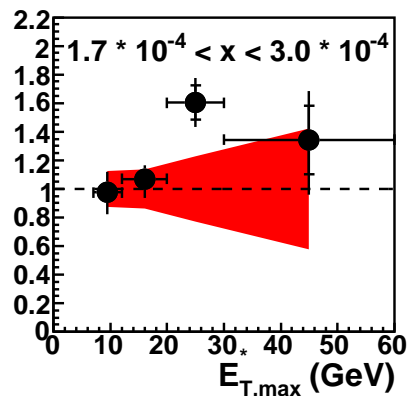
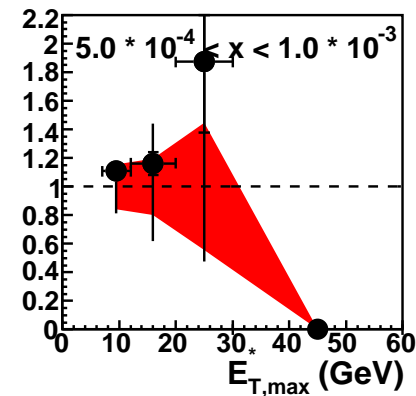
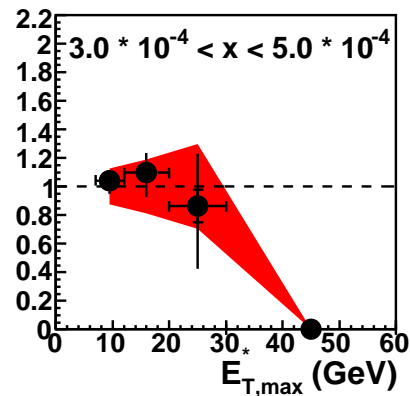
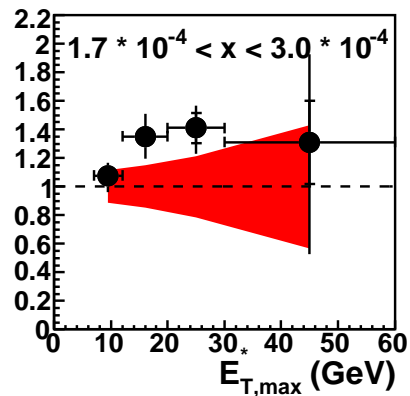
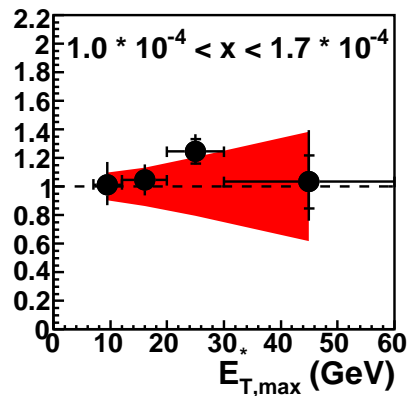
$d\sigma / dQ^2 dx dE_{T,max}$



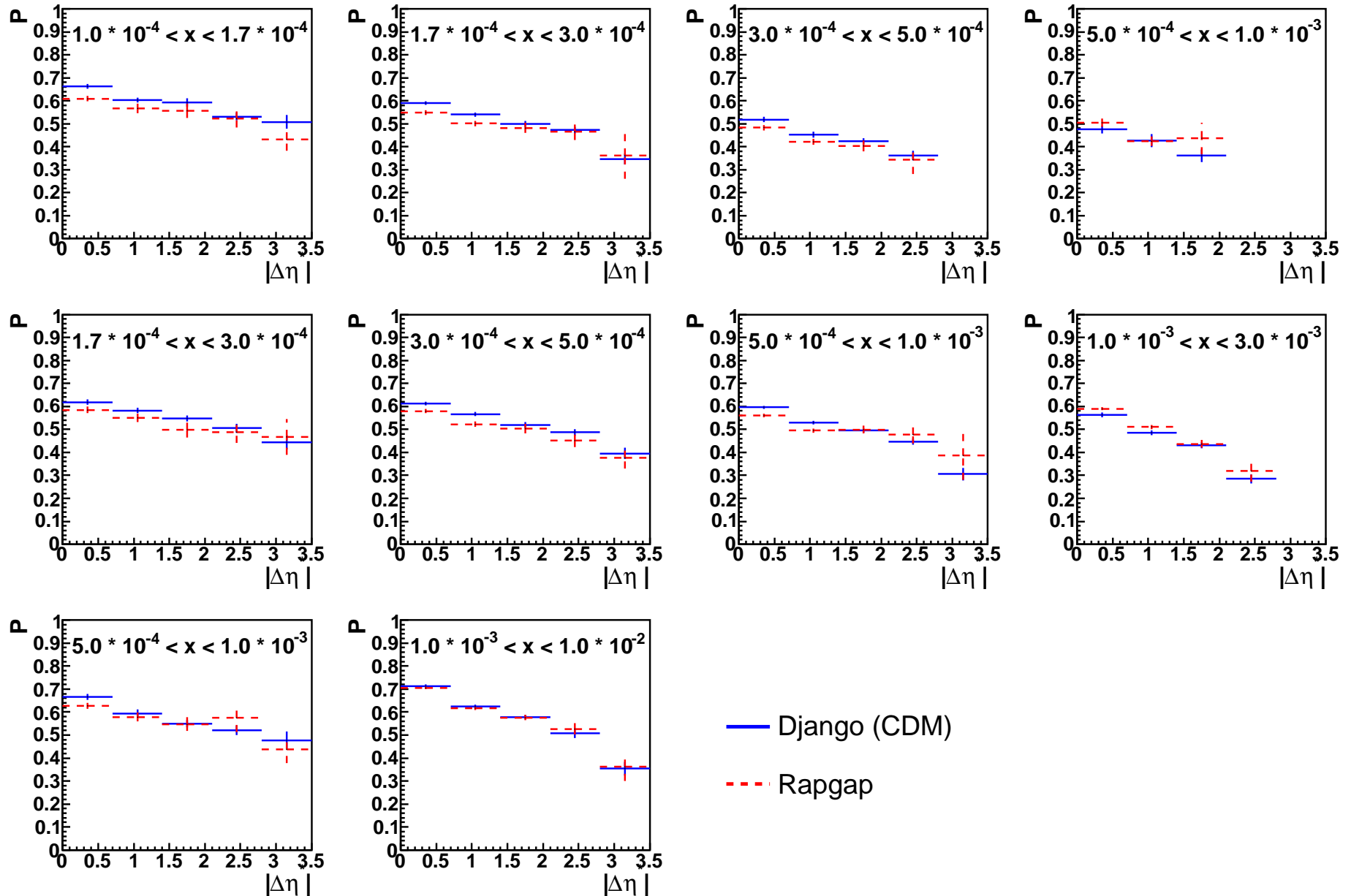
$d\sigma/dQ^2 dx dE_{T,max}$ Corr. for $E_p = 920$ GeV



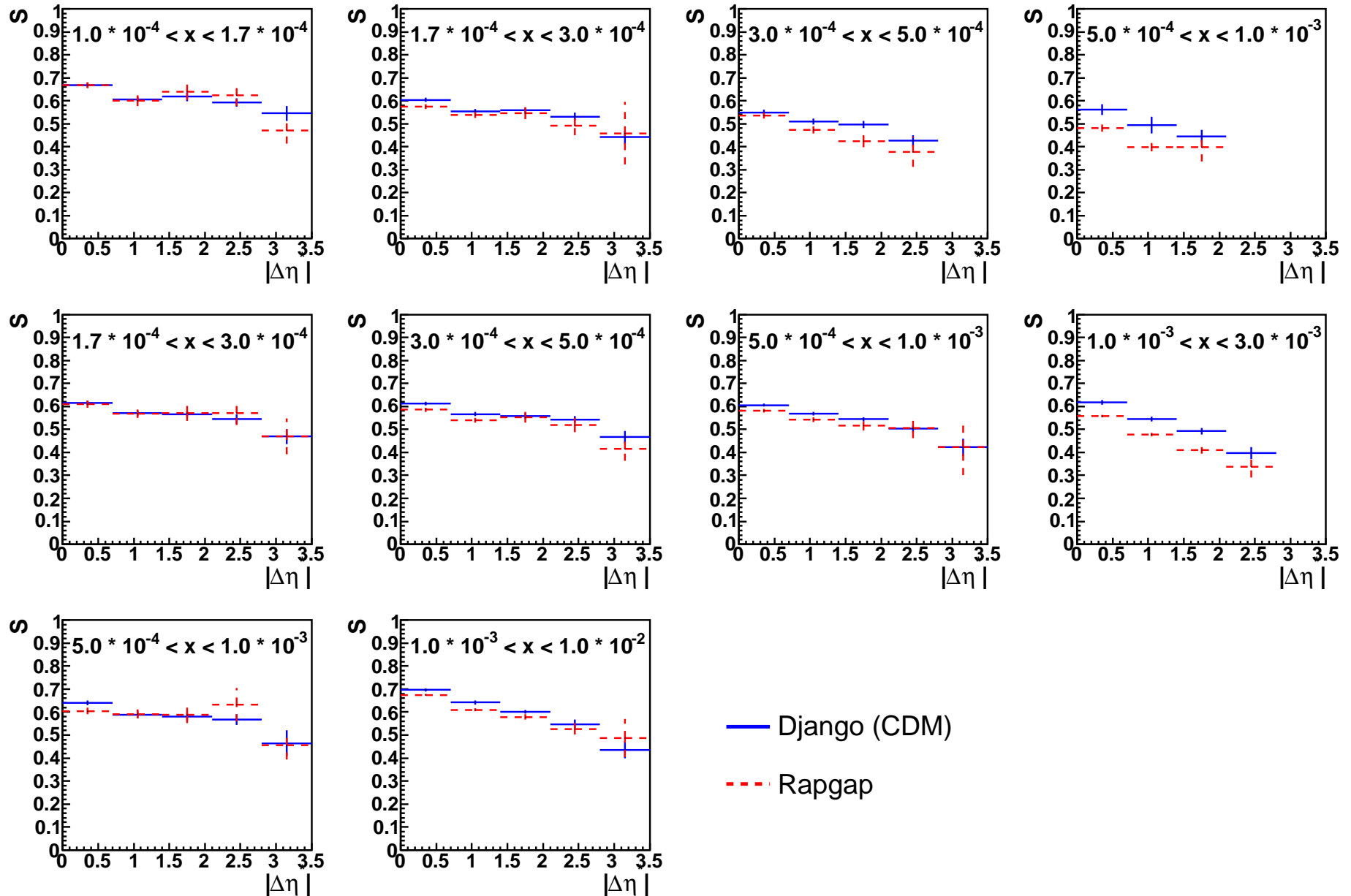
$d\sigma/dQ^2 dx dE_{T,max}$ 9900 vs. 9697



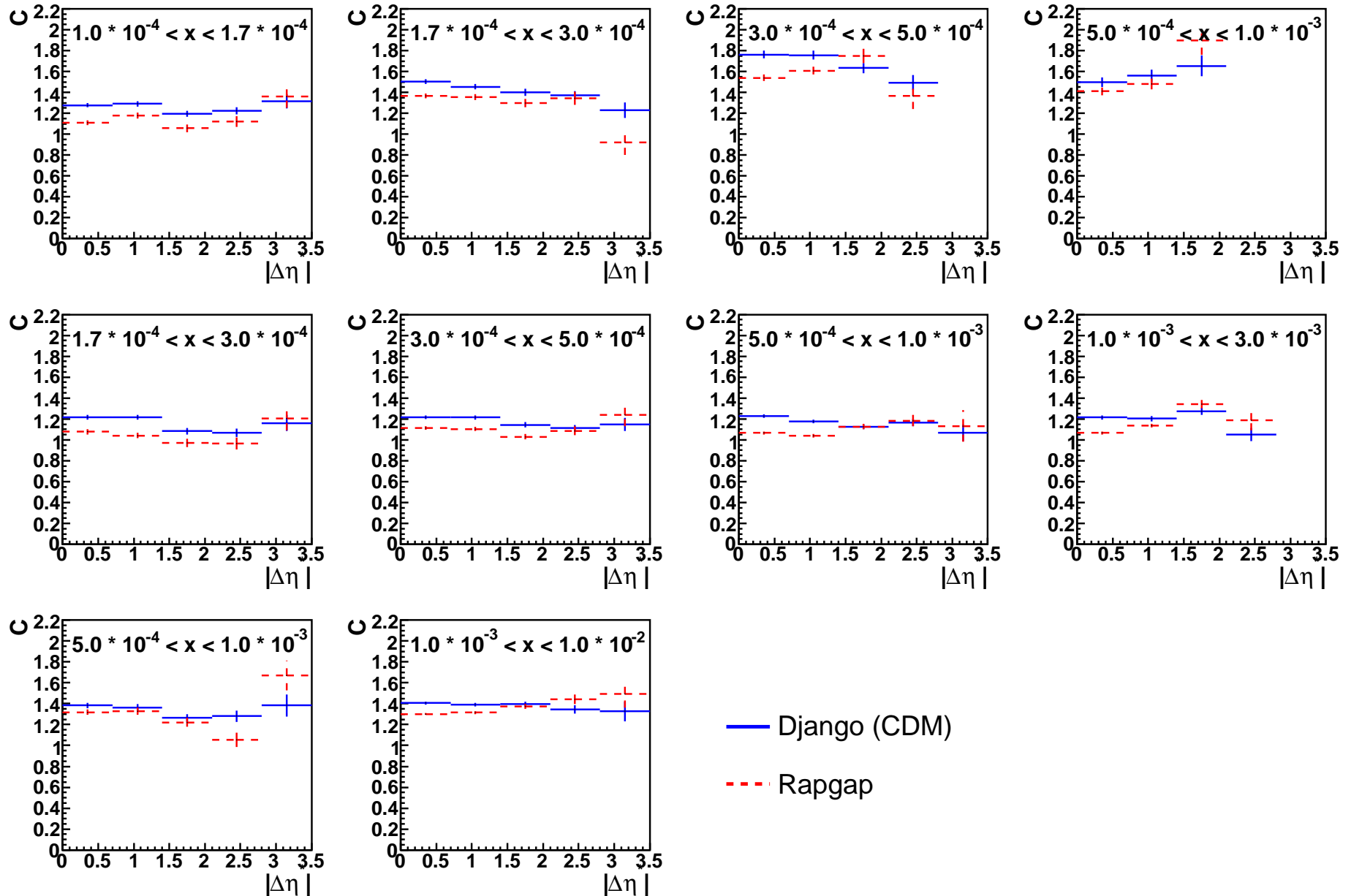
$d\sigma/dQ^2 dx d|\Delta\eta^*|$ Purity



$d\sigma/dQ^2 dx d|\Delta\eta^*|$ Stability



$d\sigma/dQ^2 dx d|\Delta\eta^*|$ Correction factors



$$d\sigma / dQ^2 dx d|\Delta\eta^*|$$

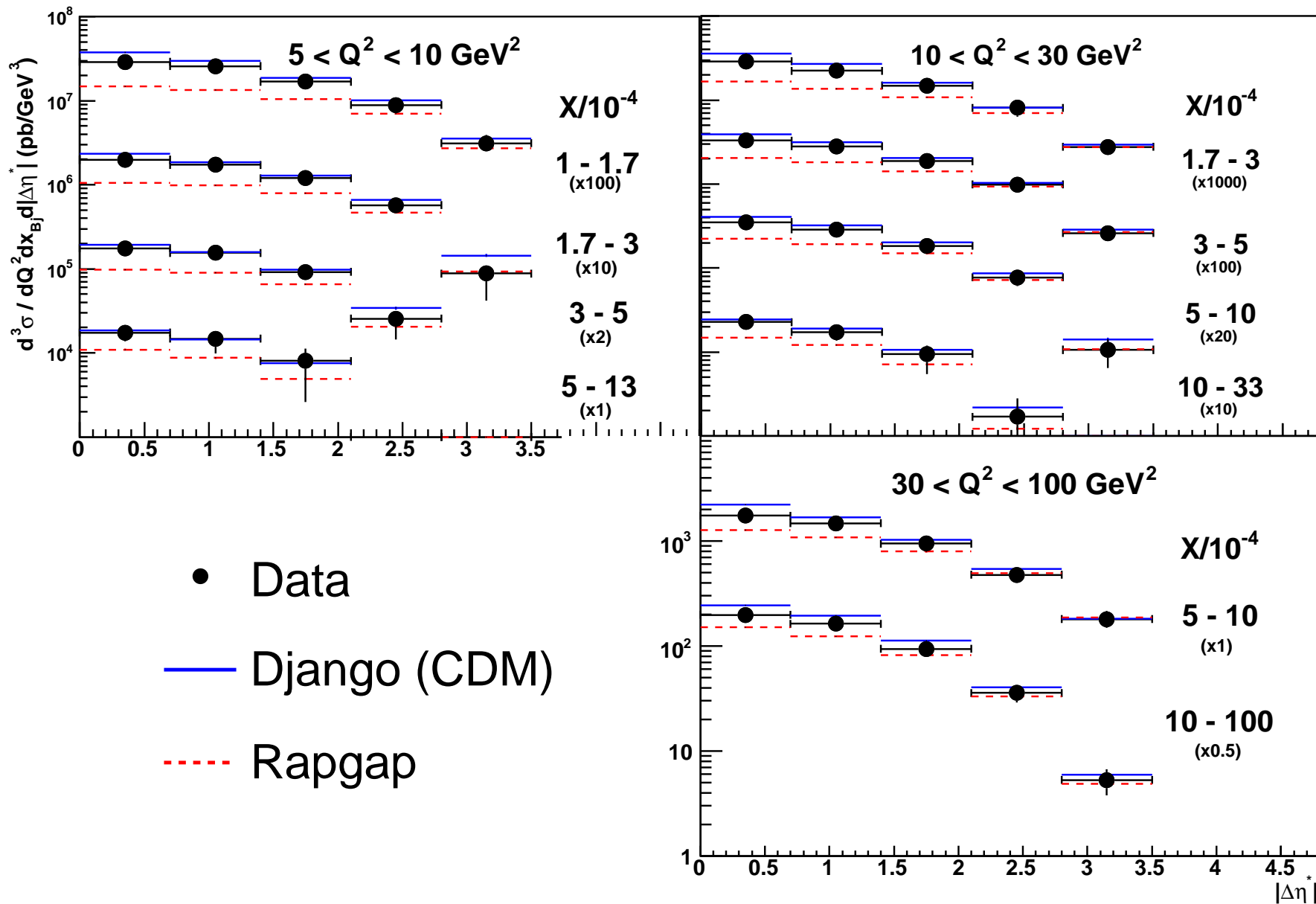
Systematic Uncertainties

Estimated using Rapgap

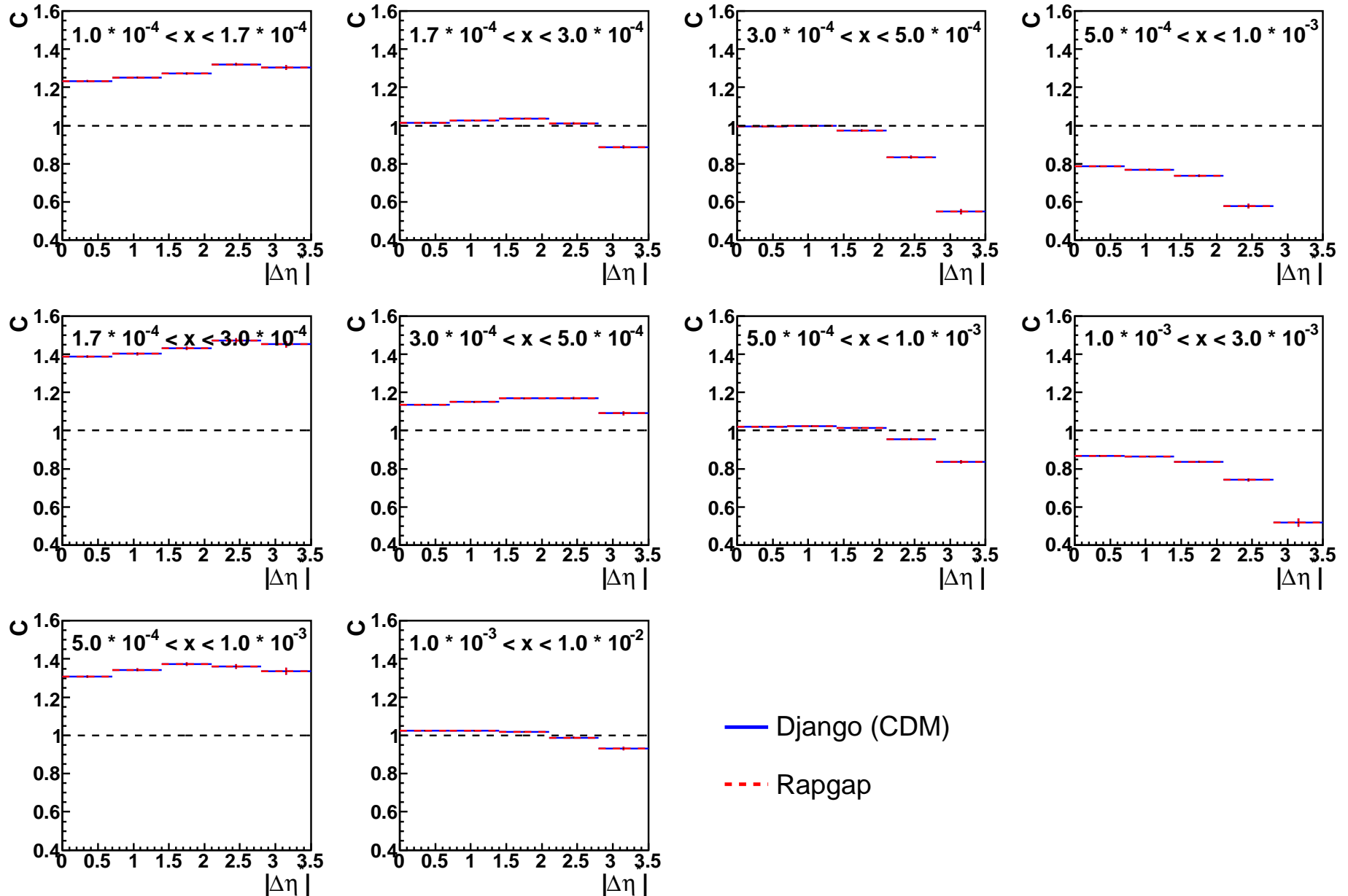
...except model dependence: $\frac{|C_{Rapgap} - C_{Django}|}{2}$

Source		Uncertainty
Electron Energy E'_e	$\pm 1\%$	0 - 22 (!) %
Electron azimuthal angle θ_e	± 1 mrad	0 - 4 %
LAr Hadronic Energy	$\pm 4\%$	} 0 - 65 (!) %
SPACAL Hadronic Energy	$\pm 5\%$	
Track Energy	$\pm 3\%$	
Model dependence		0 - 10 %

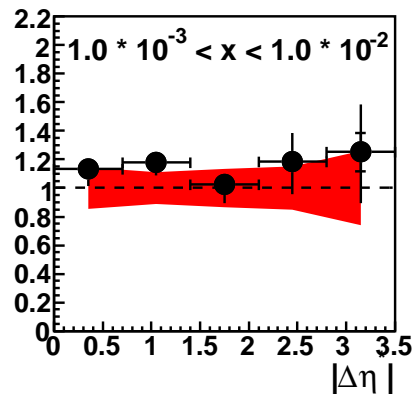
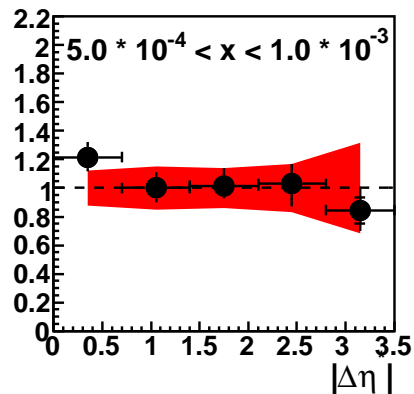
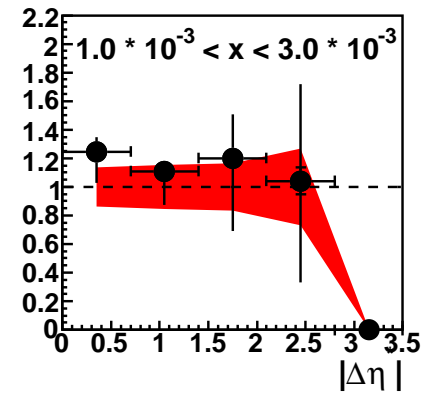
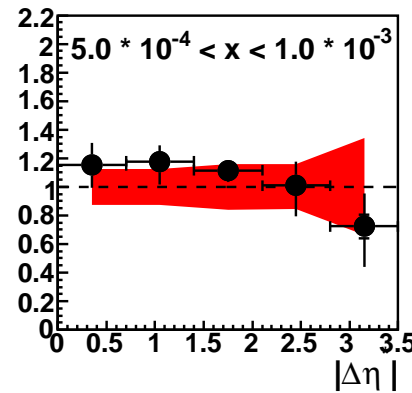
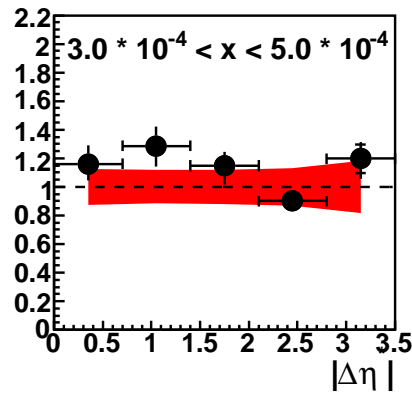
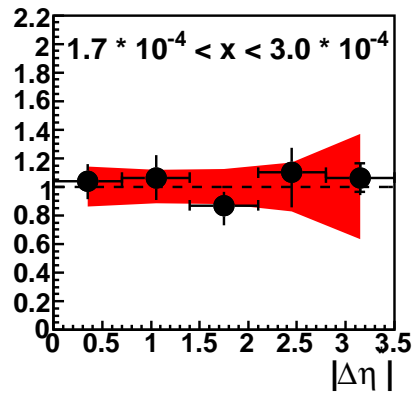
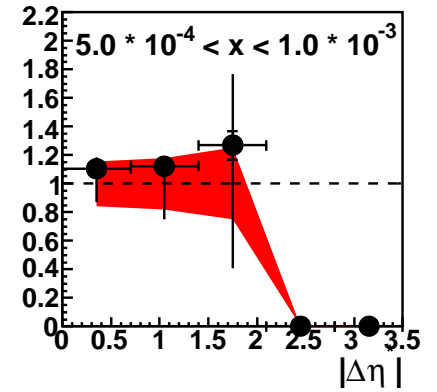
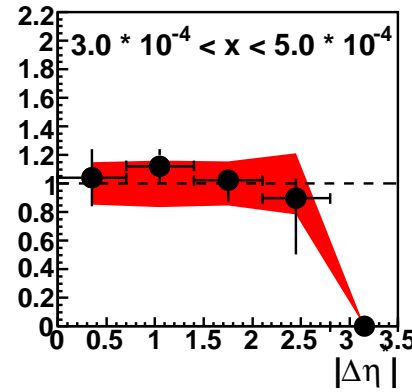
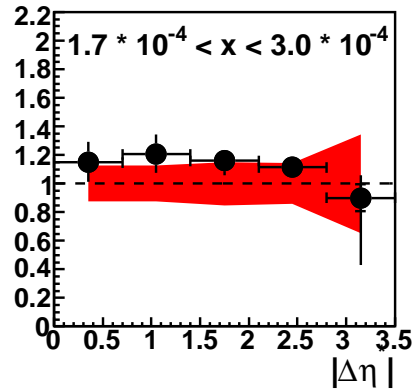
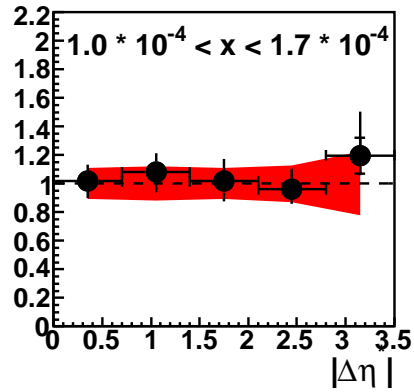
$$d\sigma / dQ^2 dx d|\Delta\eta^*|$$



$d\sigma/dQ^2 dx d|\Delta\eta^*|$ Corr. for $E_p = 920$ GeV



$d\sigma/dQ^2 dx d|\Delta\eta^*|$ 9900 vs. 9697



Summary

- New OO-version: control plots a bit worse
- $d\sigma/dQ^2 d\Delta\phi^*$: $P > 0.3$, $S > 0.4$, $0.9 < C < 1.7$. Uncertainties mostly $< 10\%$
- $d\sigma/dQ^2 dx$: P, S mostly > 0.5 , $1 < C < 1.7$.
Pretty good agreement with 9697 data
- $d\sigma/dQ^2 dx dE_{T,max}^*$: $P > 0.3$, $S > 0.4$.
Large model dependence and systematic errors at high E_T^*
- $d\sigma/dQ^2 dx d|\Delta\eta^*|$: $P > 0.3$, $S > 0.4$, $1 < C < 1.7$.
Large systematic errors at high $|\Delta\eta^*|$. Pretty good agreement with 9697 data

Next:

- More MC statistics
- Compare to NLO calculations
- Need to work (a lot) on systematic errors...