

Dijets and Azimuthal Correlations

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Physics Plenary March 24, 2006

Outline

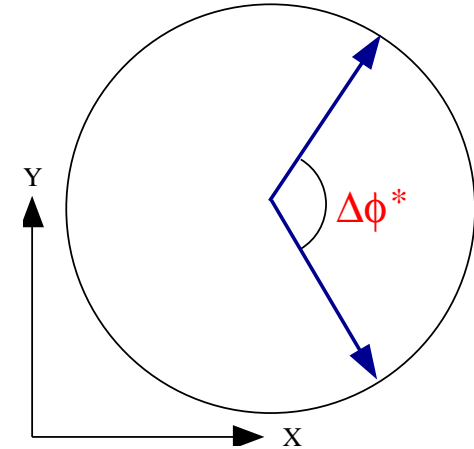
- Motivation
- Selection and Control Plots
- $\frac{d^2\sigma}{dQ^2 d\Delta\phi^*}$: P, S, C, Systematic Uncertainties
- $\frac{d^2\sigma}{dx_{B_j} d\Delta\phi^*}$: P, S, C, Systematic Uncertainties
- Comparison to Published Data
- Summary & Plans

Motivation

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

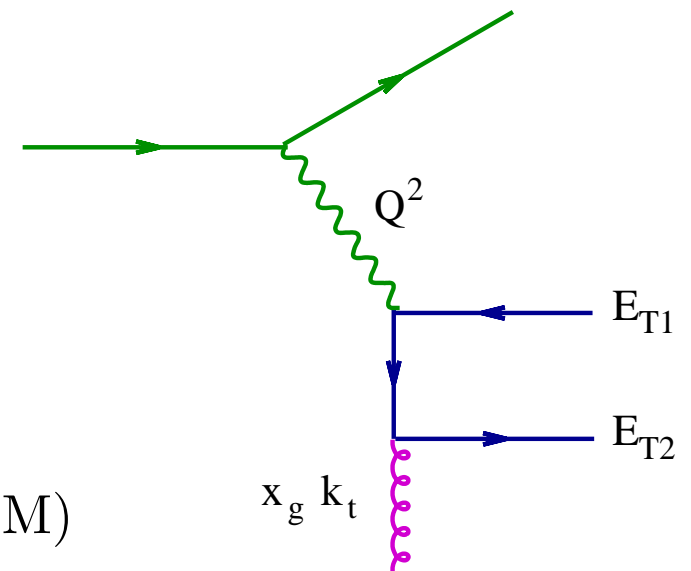
$$k_t^{*2} = E_{T1}^{*2} + E_{T2}^{*2} + 2|E_{T1}^*||E_{T2}^*|\cos\Delta\phi^*$$

Sensitive to unintegrated gluon density.



- DGLAP: Back-to-back jets in LO
 $\Rightarrow \Delta\phi^* < 180^\circ$ from higher order QCD

- Small x: non-ordering in k_t
 $\Rightarrow \Delta\phi^* < 180^\circ$ already in LO (e.g. BFKL, CCFM)



Selection and Control Plots

Using 1999/2000 e^+ , excluding shifted vertex runs

	DIS Cuts		Dijet Cuts
5 GeV ² <	Q^2	< 100 GeV ²	-1 < η_j < 2.5
0.1 <	y	< 0.7	5 GeV < $E_{\perp j1,2}^*$
9 GeV <	E_e		Sort in η : $\eta_1 < \eta_2$
156° <	θ_e	< 175°	
35 GeV <	$E - p_z$	< 70 GeV	
	$ z_{vtx} $	< 35 cm	
	R_{clus}	< 4 cm	
	E_{had}	< 0.5 GeV	
	E_{veto}	< 1.0 GeV	
	Trigger	S0 OR S61	

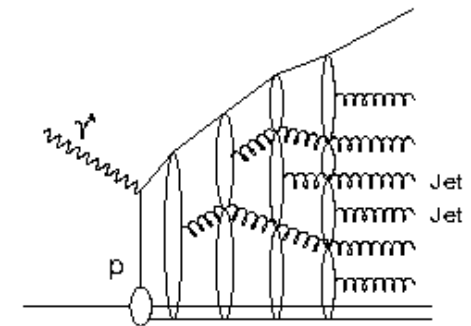
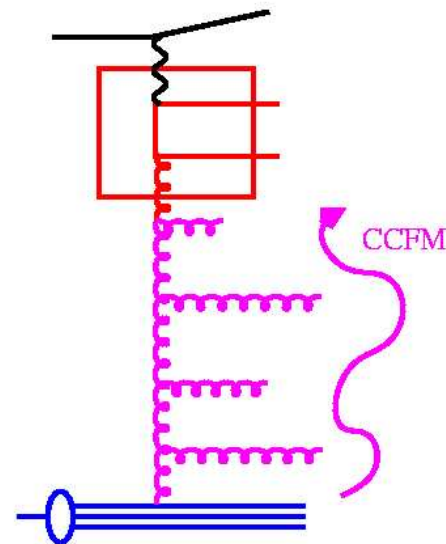
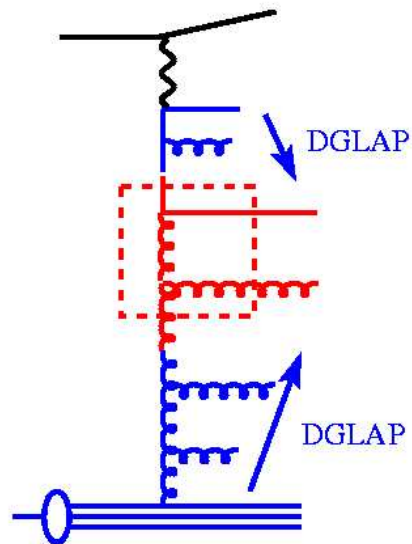
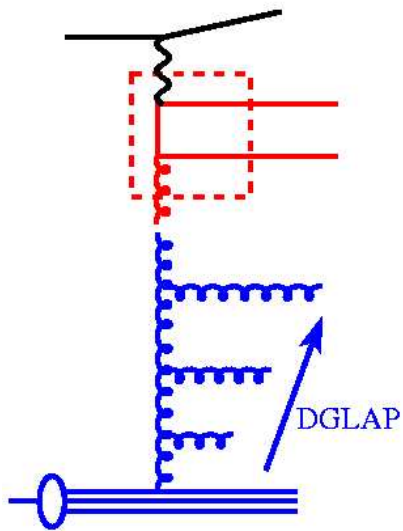
Selection and Control Plots

Rapgap (Dir)

Rapgap (Dir + Res)

Cascade

Lepto (CDM)

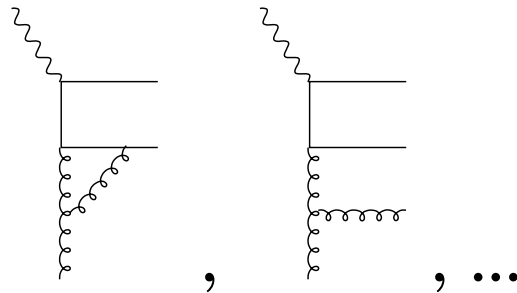


Rapgap (Dir) and Django (CDM) are used for corrections

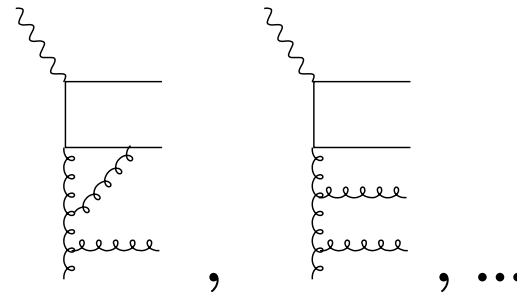
Selection and Control Plots

NLOJET++

NLO di-jet (α_s^2)



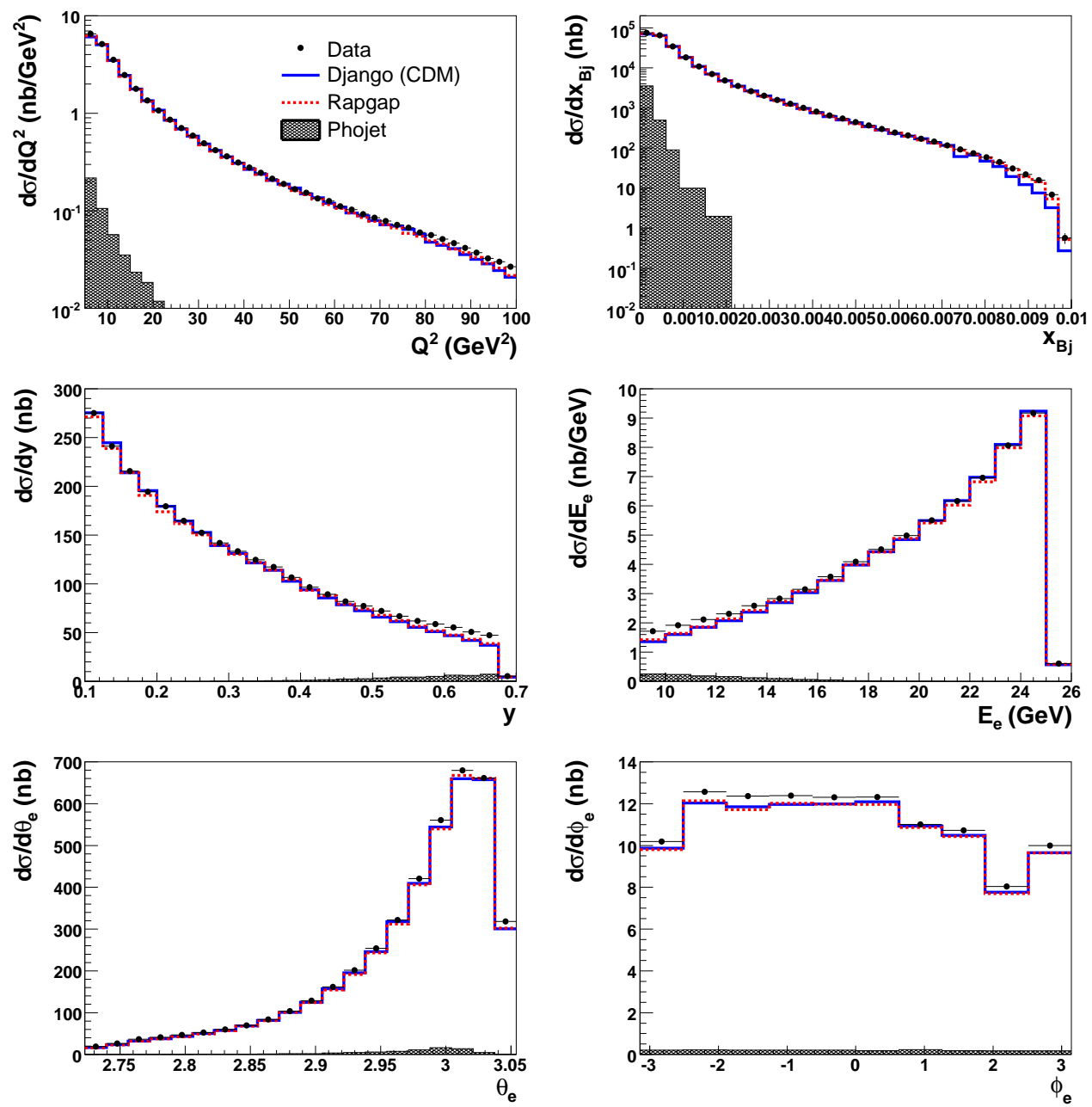
NLO 3-jet (α_s^3)



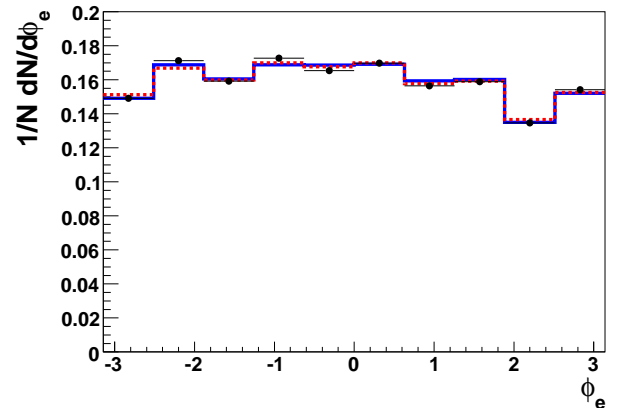
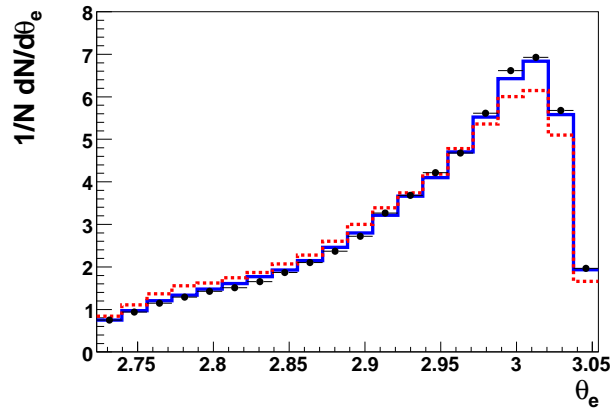
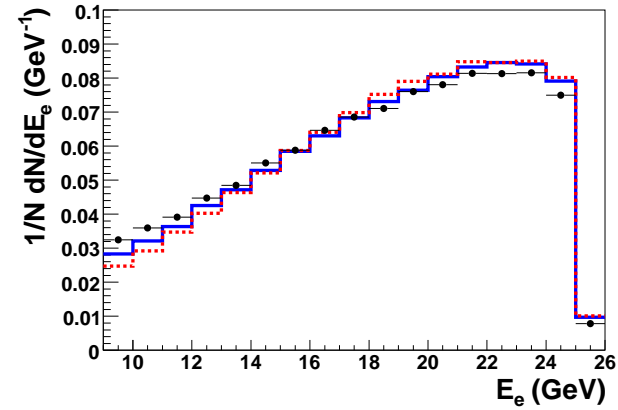
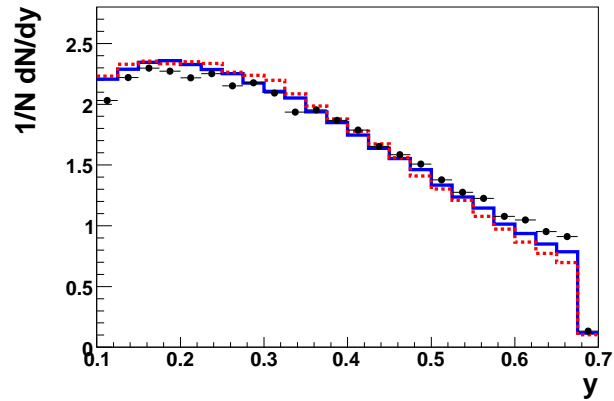
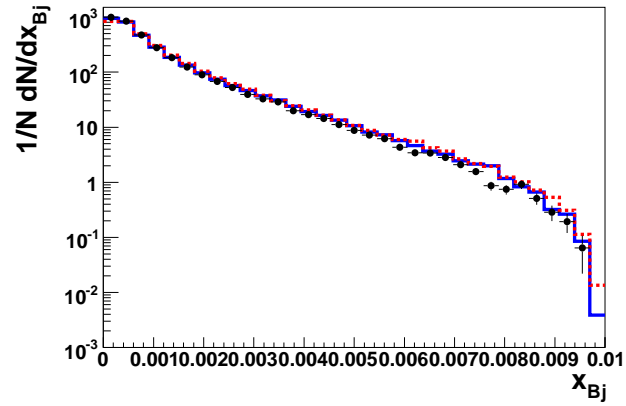
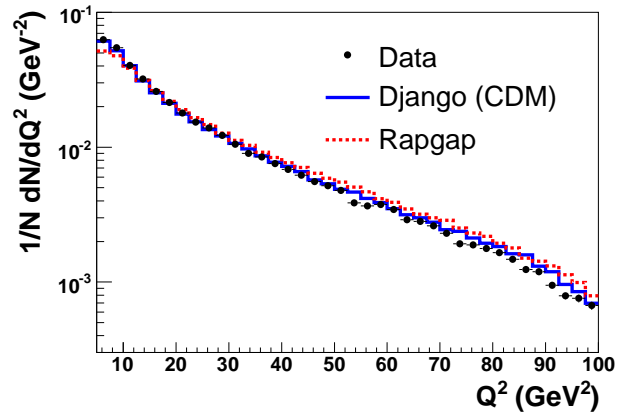
$$\mu_r = \mu_f = \left(\frac{E_{T1} + E_{T2}}{2} \right)$$

Hadronization Correction Using Cascade

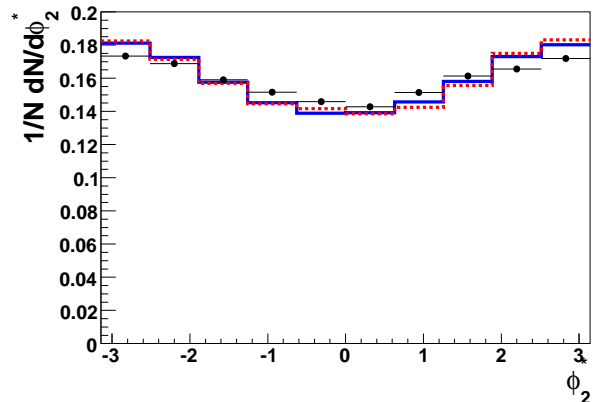
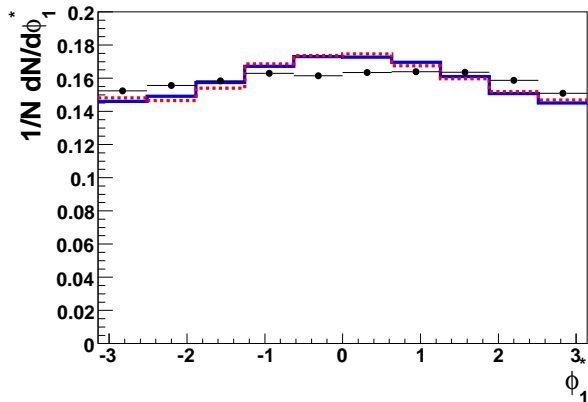
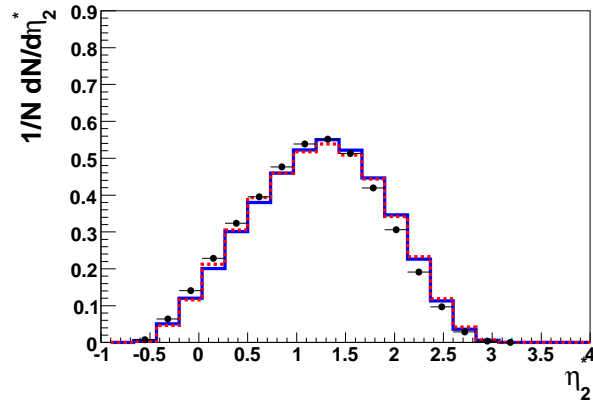
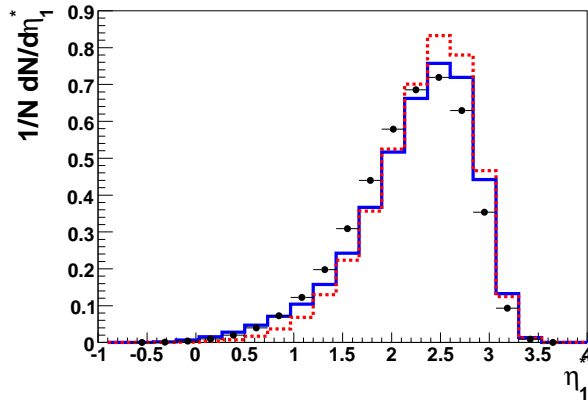
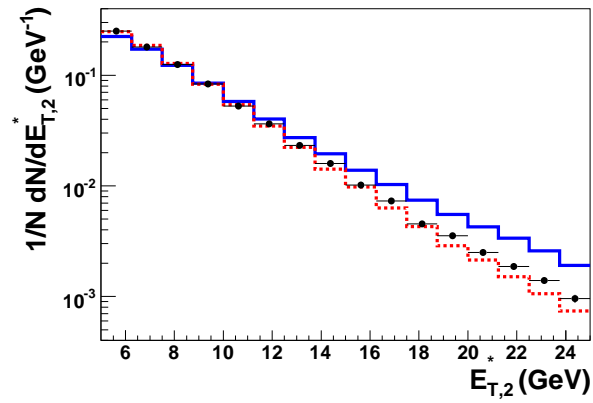
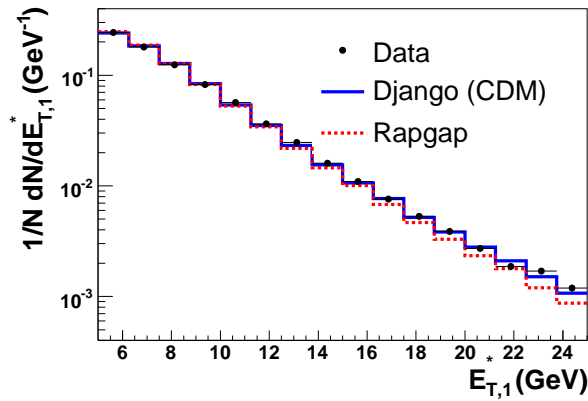
Control Plots DIS Sample



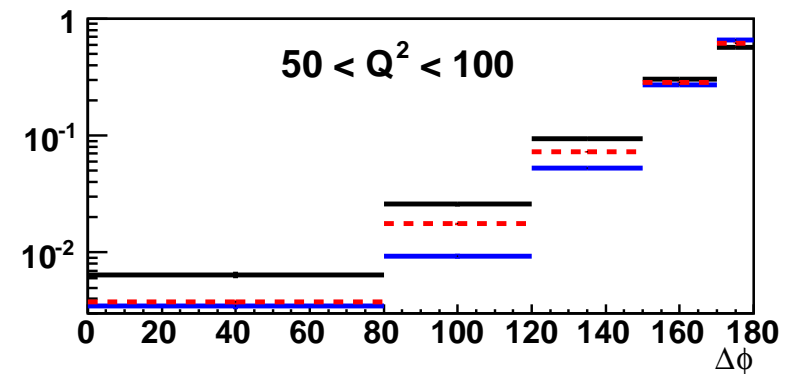
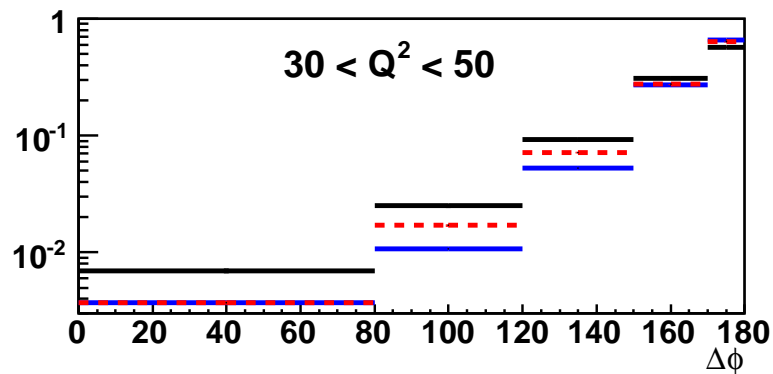
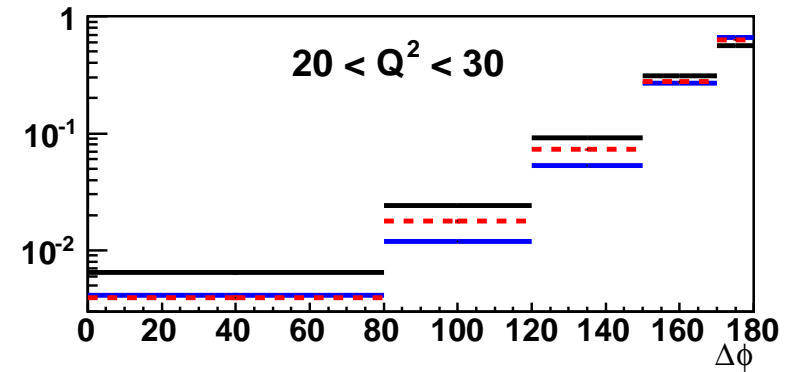
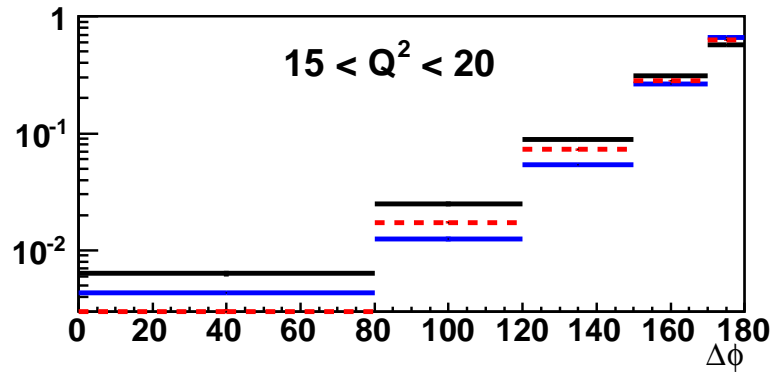
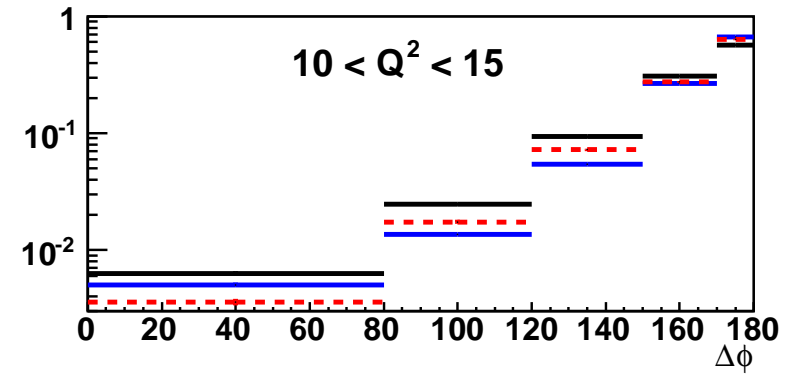
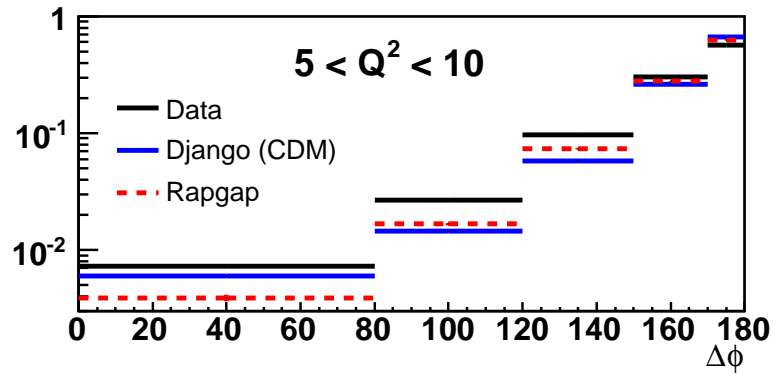
Control Plots Dijet Sample



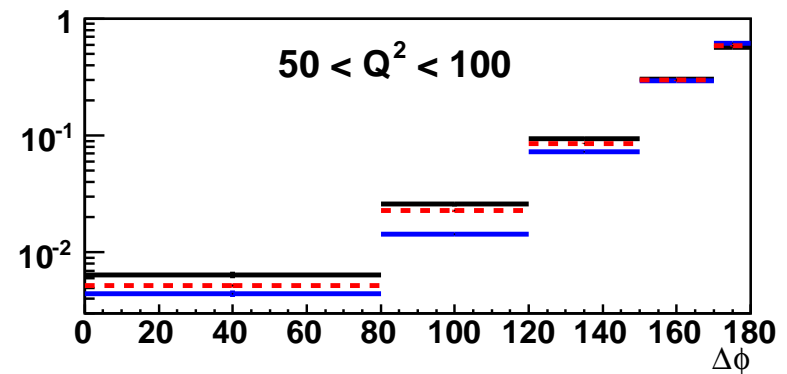
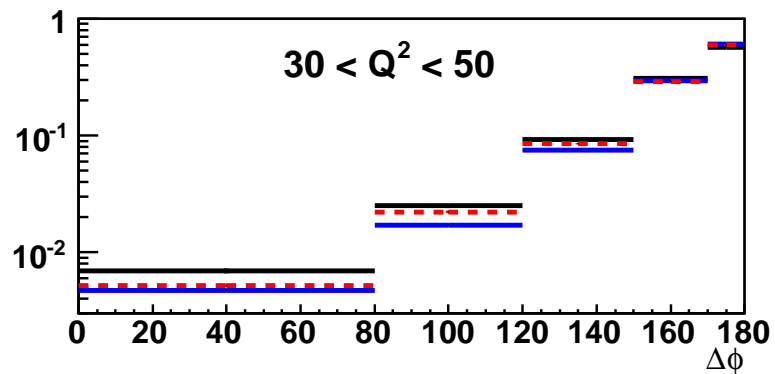
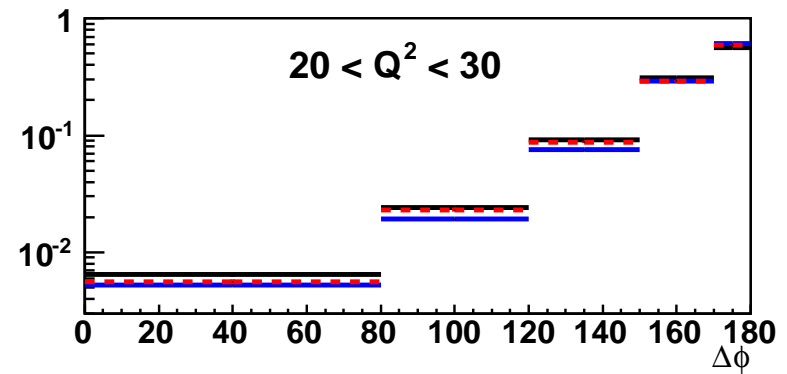
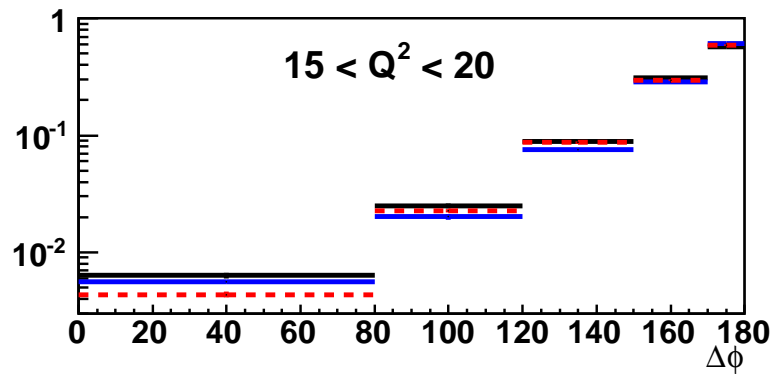
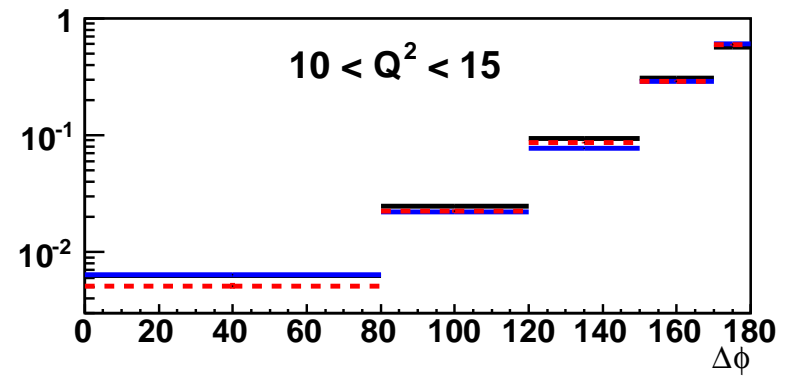
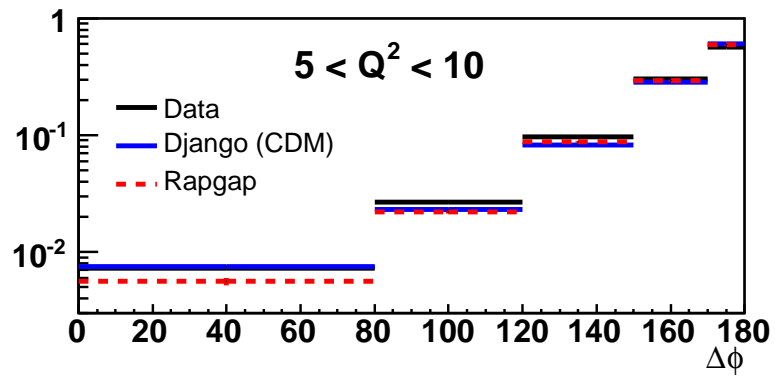
Control Plots Dijets



Detector Level (Shape) Before $\Delta\phi^*$ Reweighting

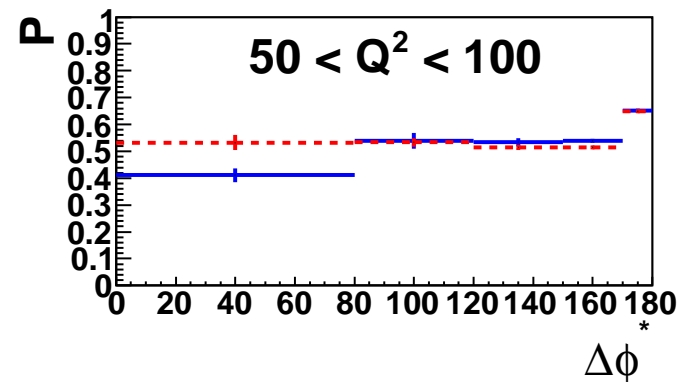
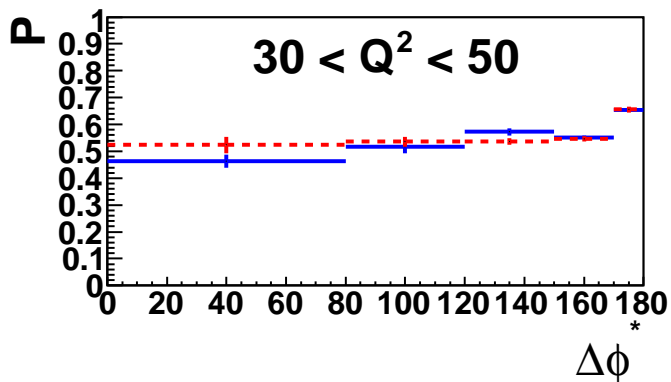
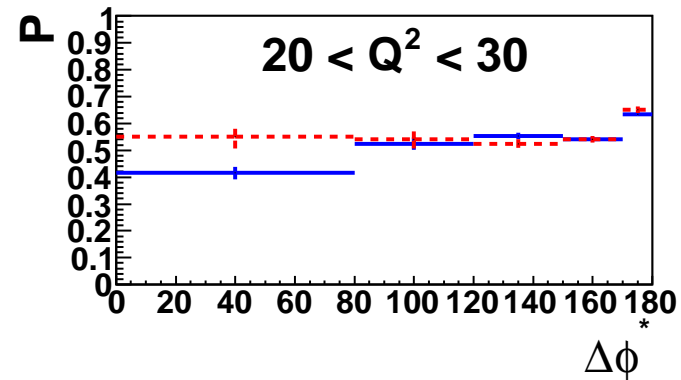
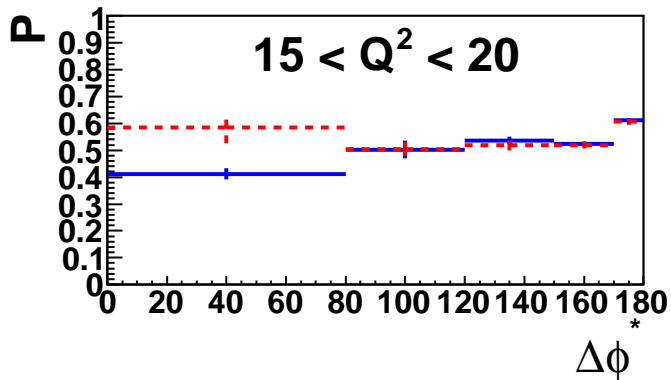
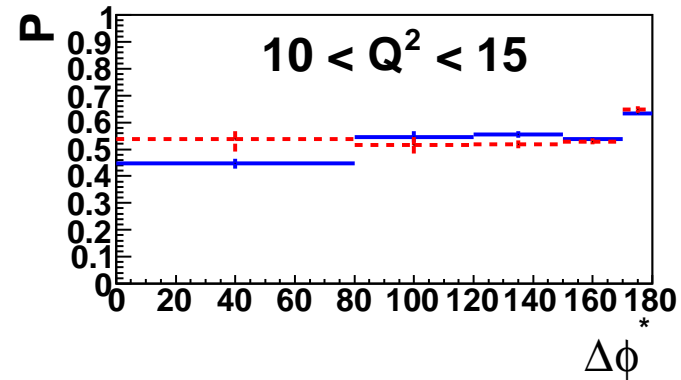
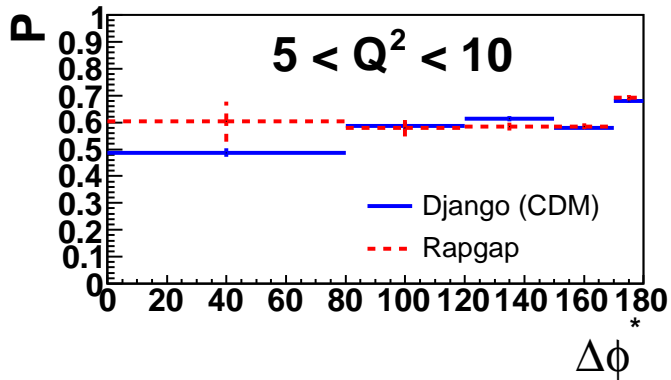


Detector Level (Shape) After $\Delta\phi^*$ Reweighting



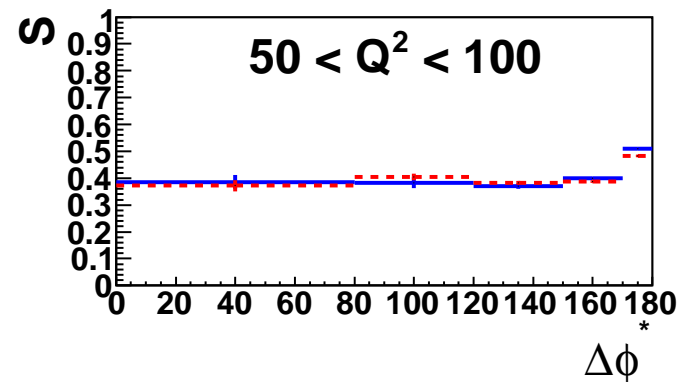
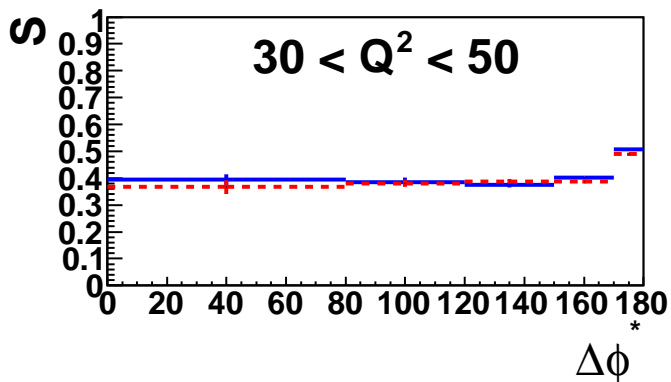
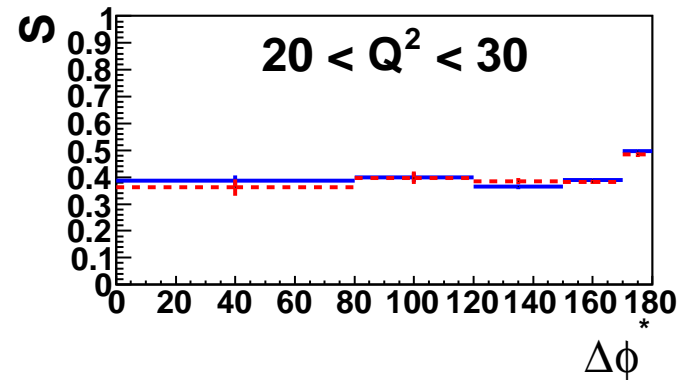
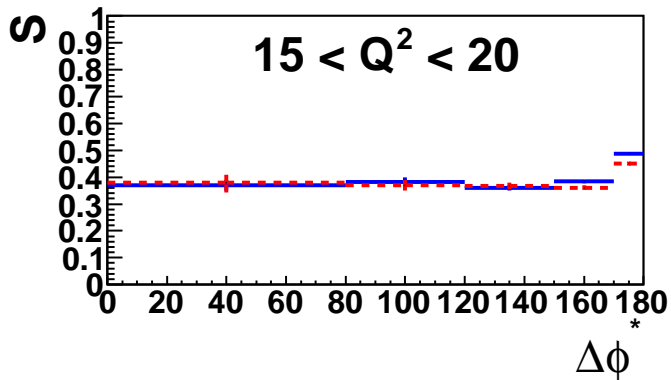
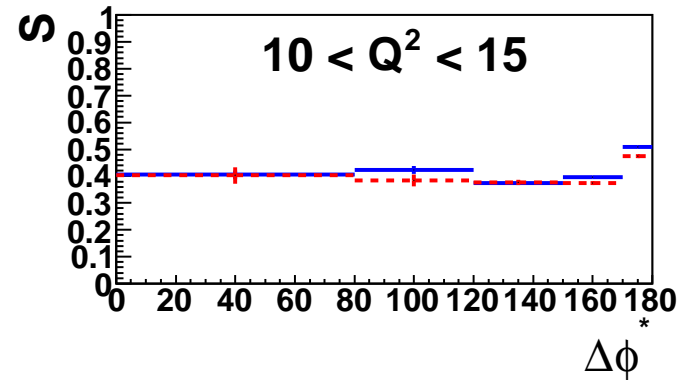
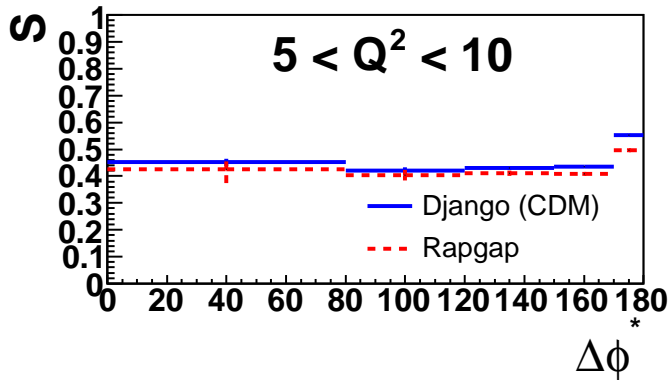
$d^2\sigma/dQ^2 d\Delta\phi^*$ Purity

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



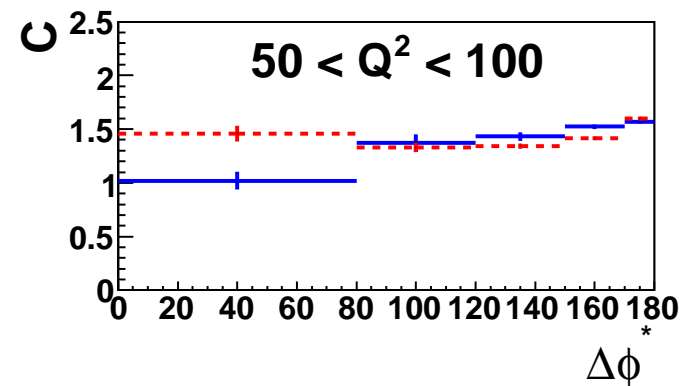
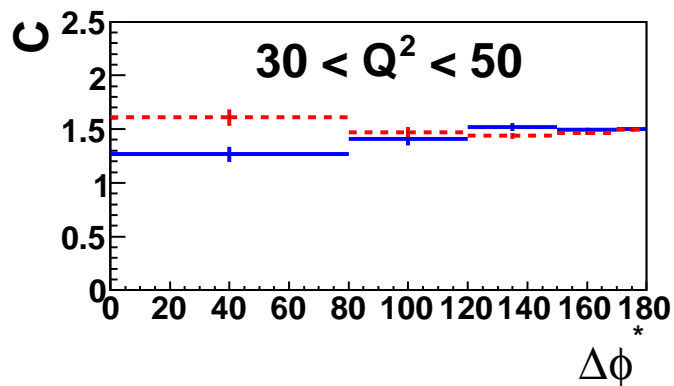
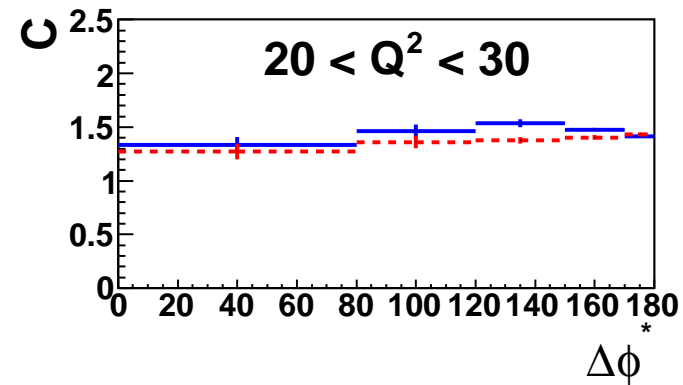
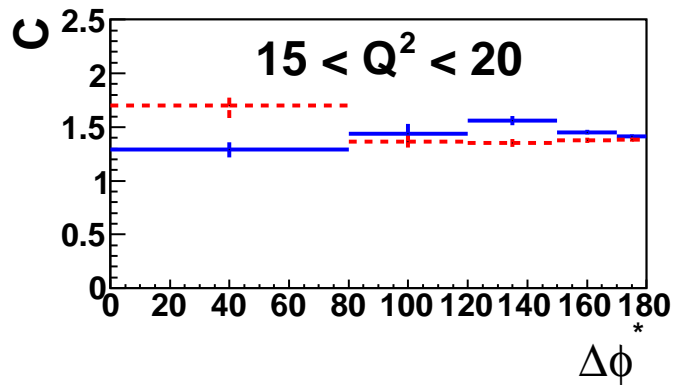
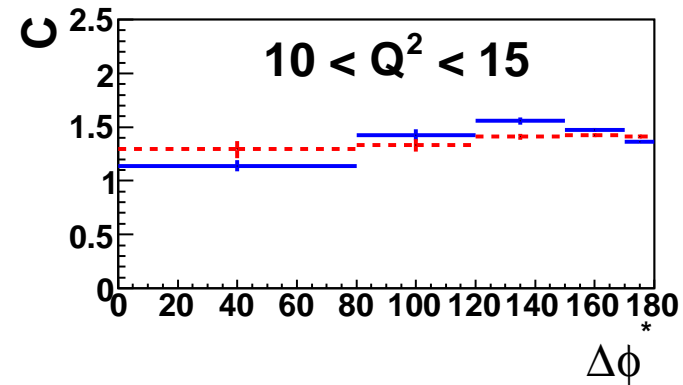
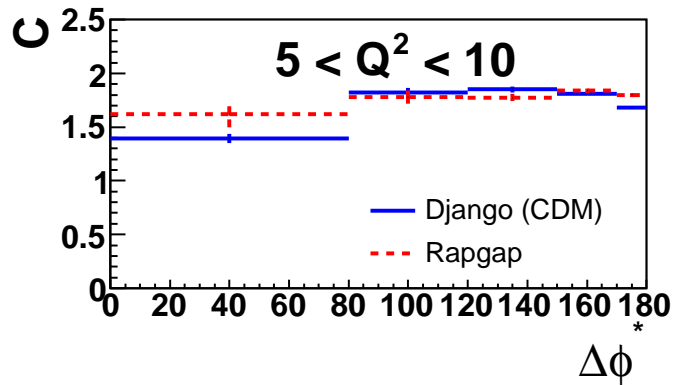
$d^2\sigma/dQ^2 d\Delta\phi^*$ Stability

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



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

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



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

Systematic Uncertainties

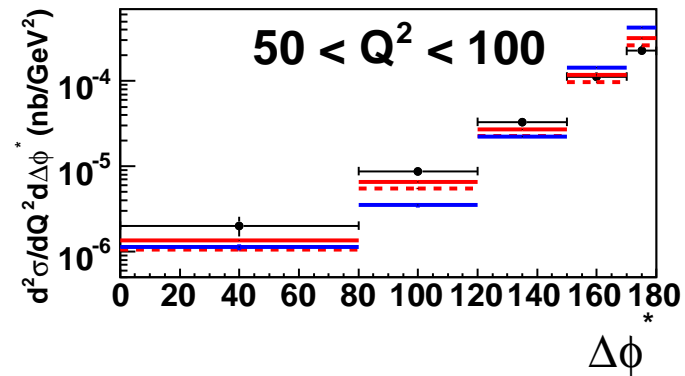
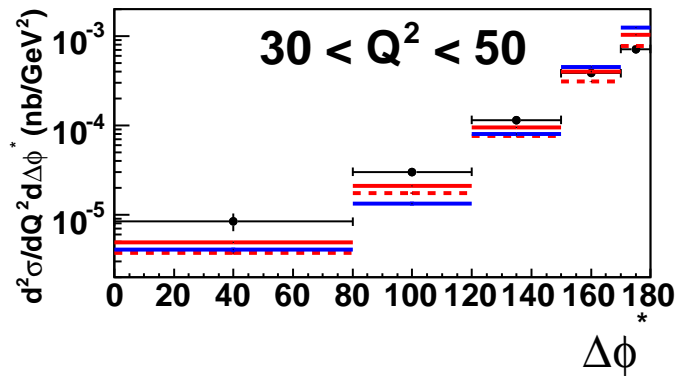
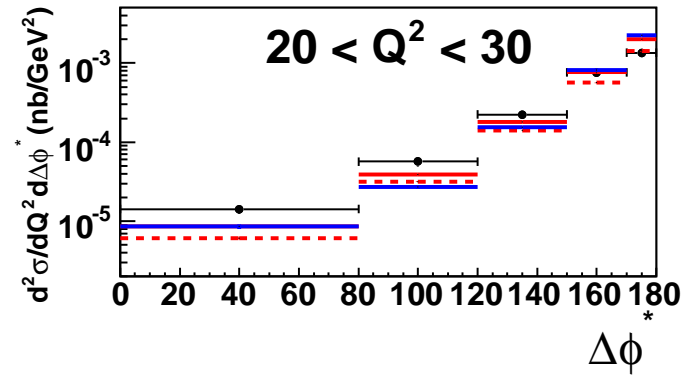
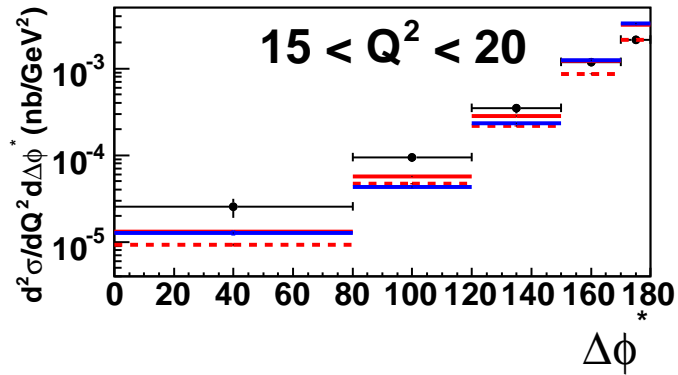
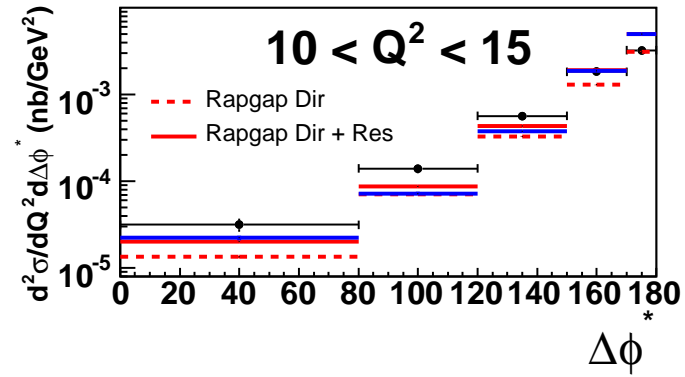
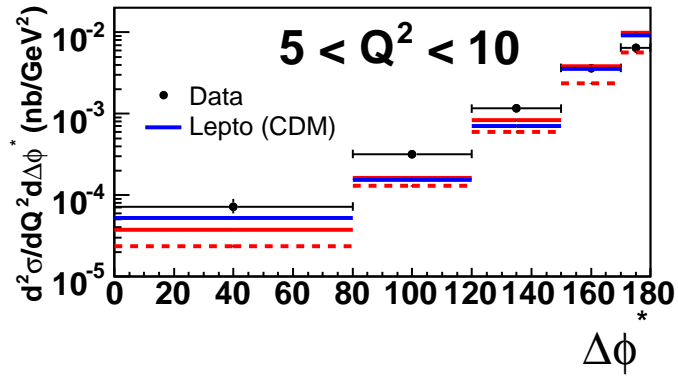
Estimated using Rapgap

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

Source		Typical Uncertainty
Electron Energy	$\pm 1\%$	0.5 - 1.7 %
Electron Polar Angle θ_e	± 1 mrad	0.3 - 0.9 %
LAr Hadronic Energy	$\pm 4\%$	5 - 10 %
Track Momentum	$\pm 3\%$	≈ 0
Luminosity	$\pm 1.5\%$	1.5 %
Photoproduction		≈ 0
Model Dependence		2 - 10 %

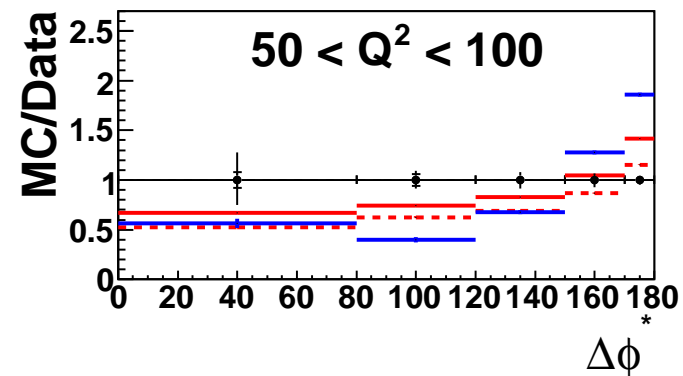
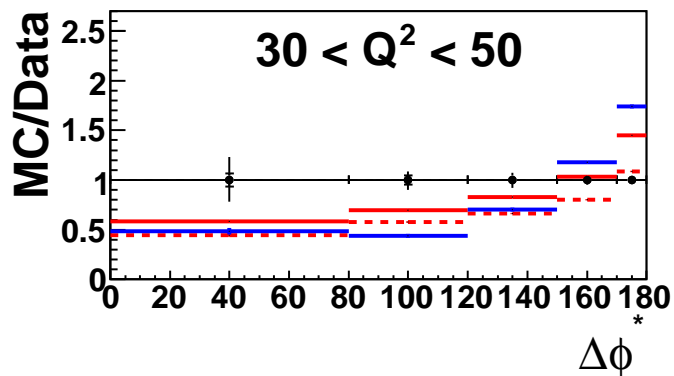
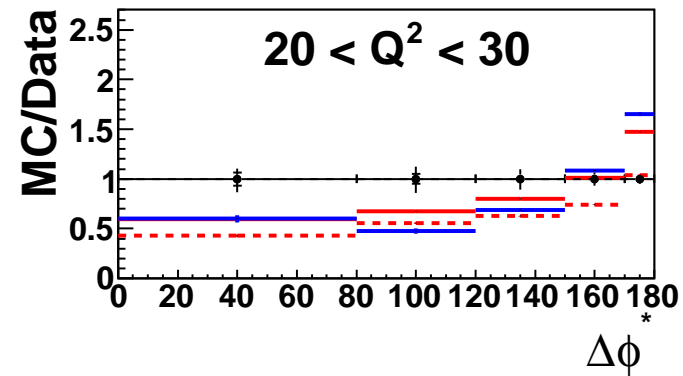
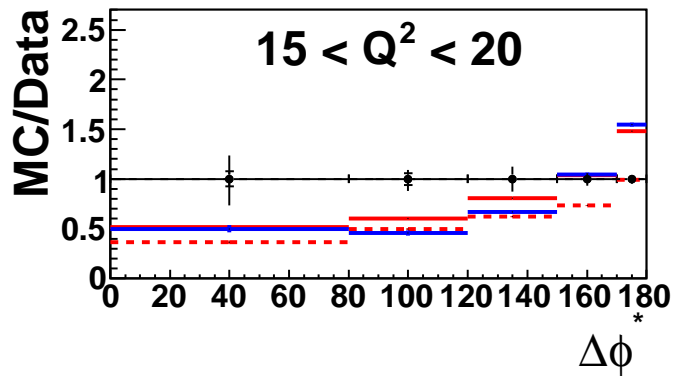
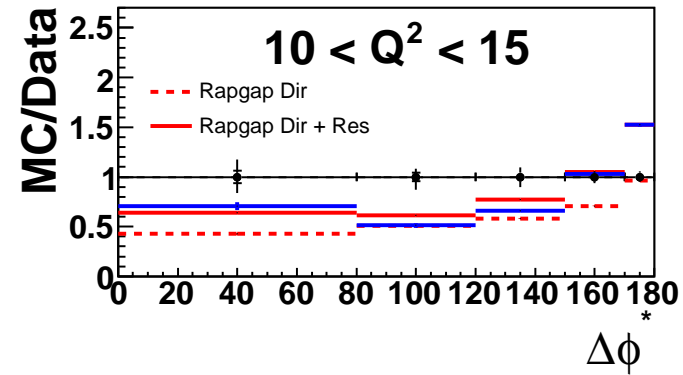
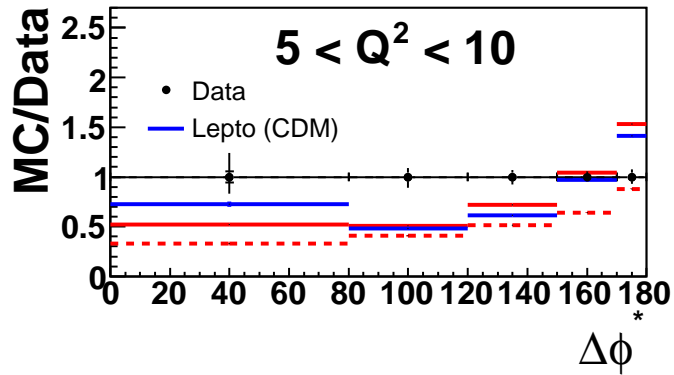
$$d^2\sigma/dQ^2 d\Delta\phi^*$$

Preliminary?



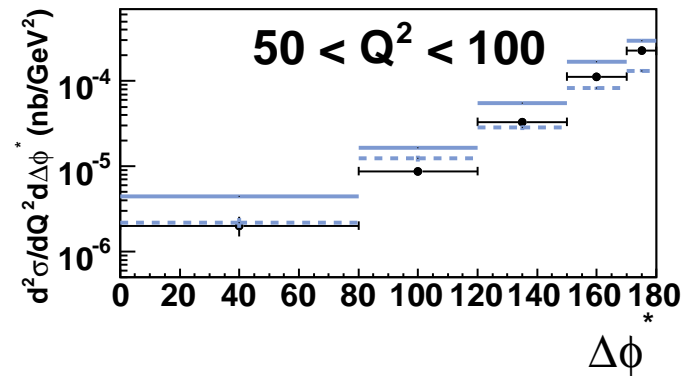
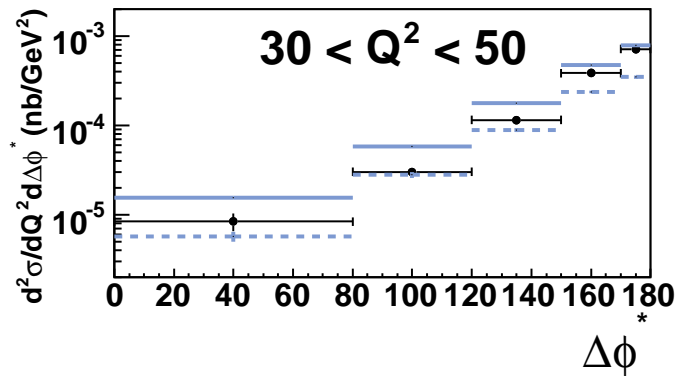
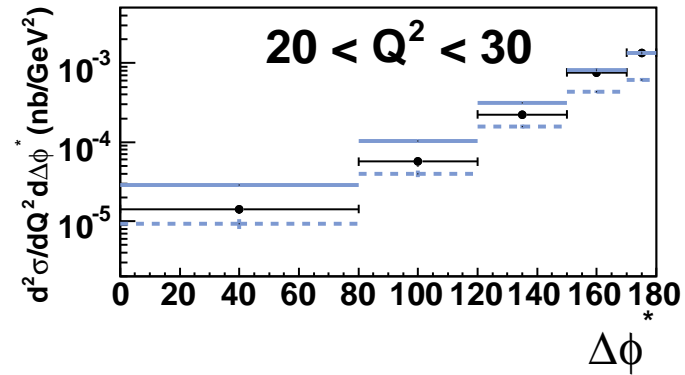
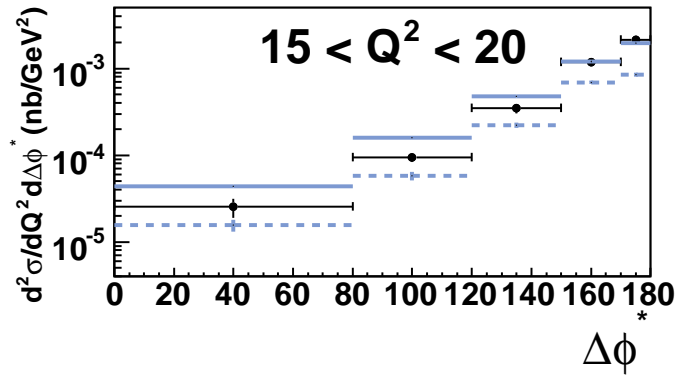
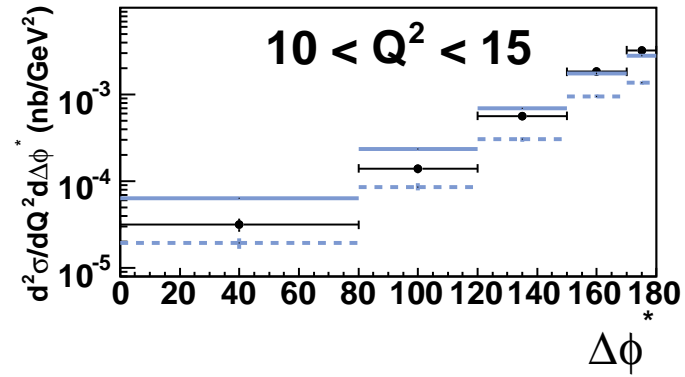
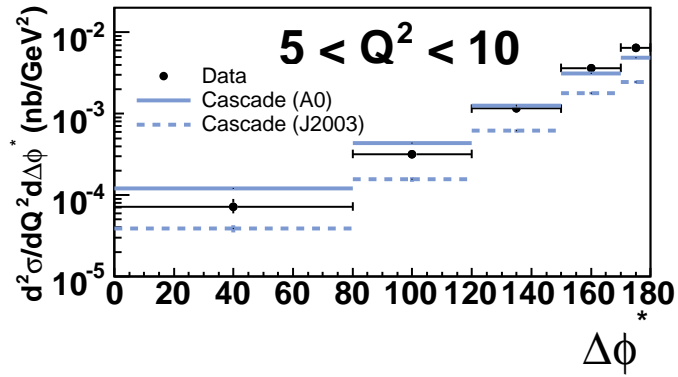
$d^2\sigma/dQ^2 d\Delta\phi^*$ Ratio

Preliminary?



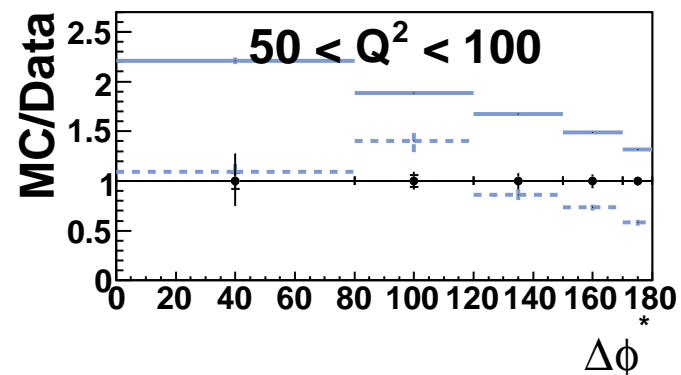
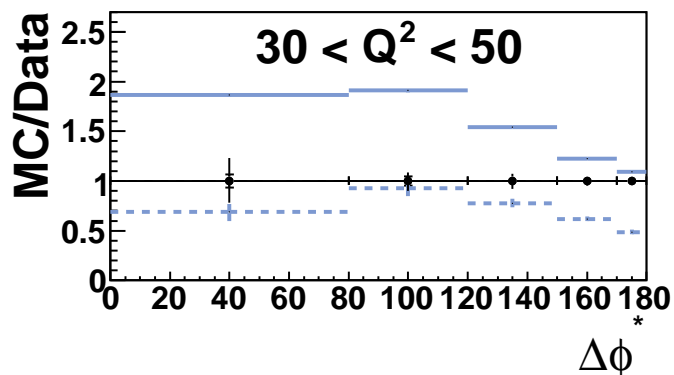
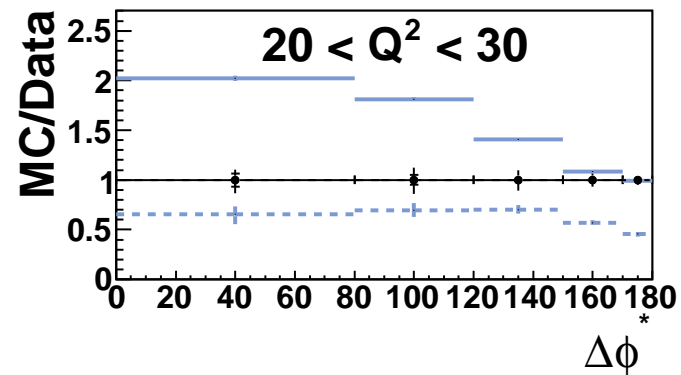
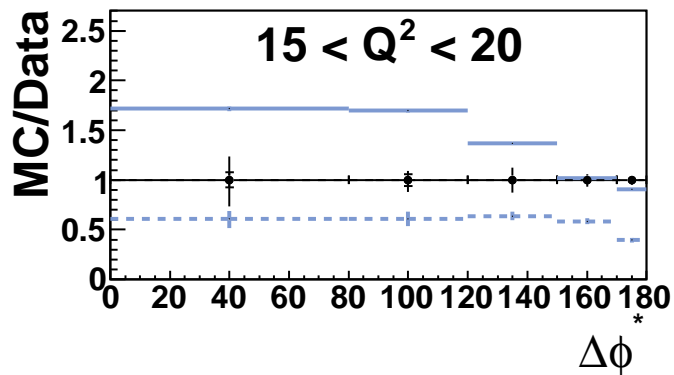
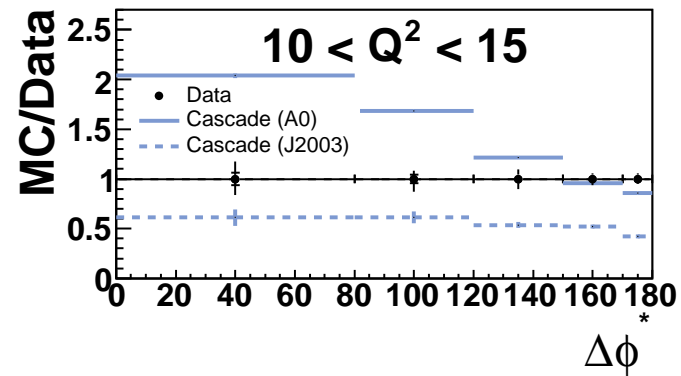
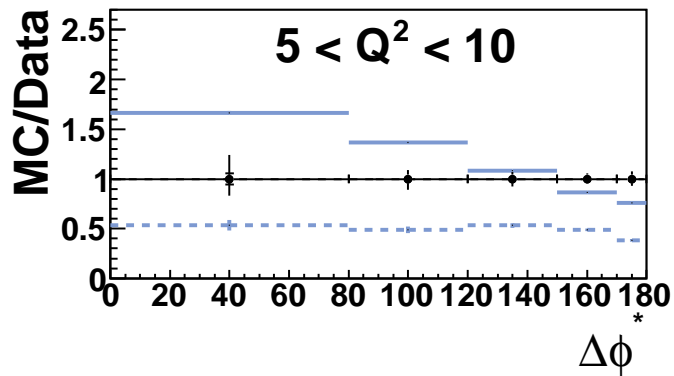
$$d^2\sigma/dQ^2 d\Delta\phi^*$$

Preliminary?



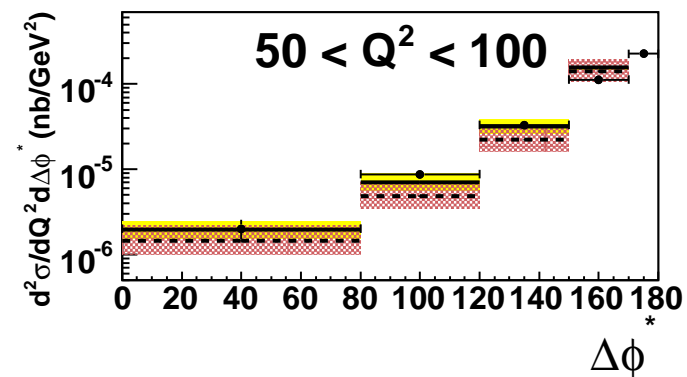
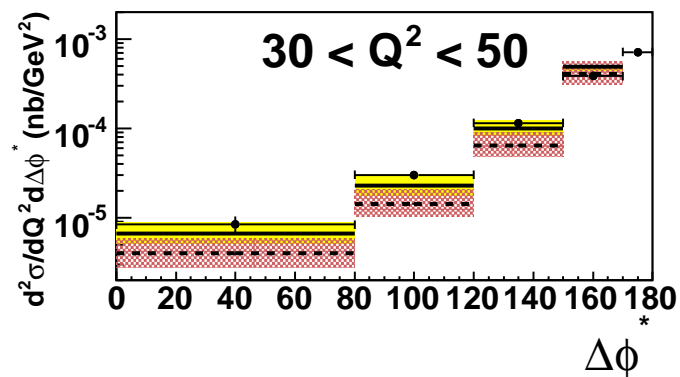
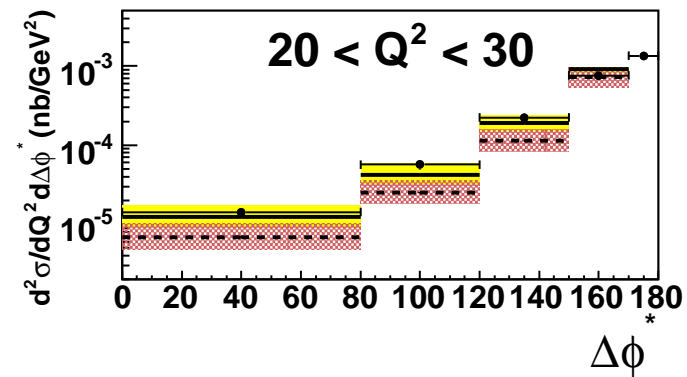
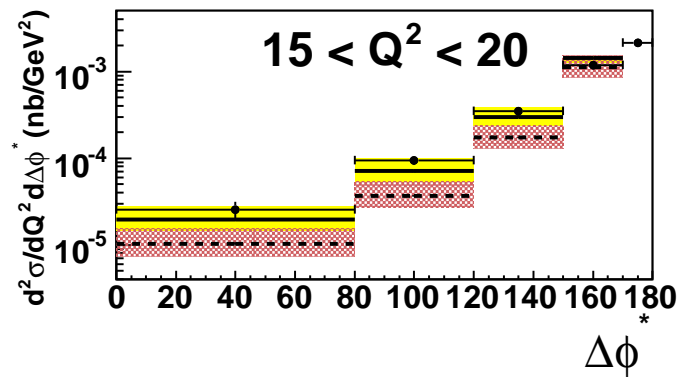
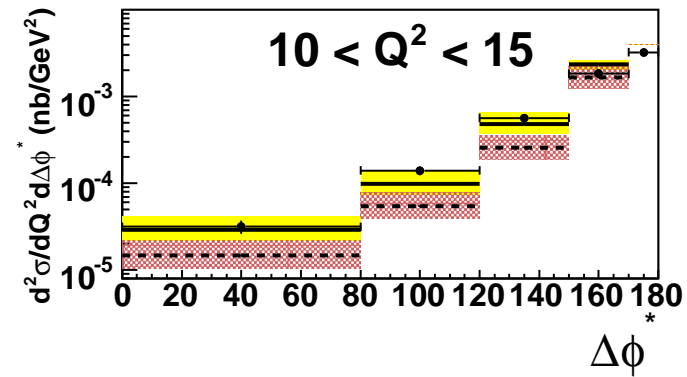
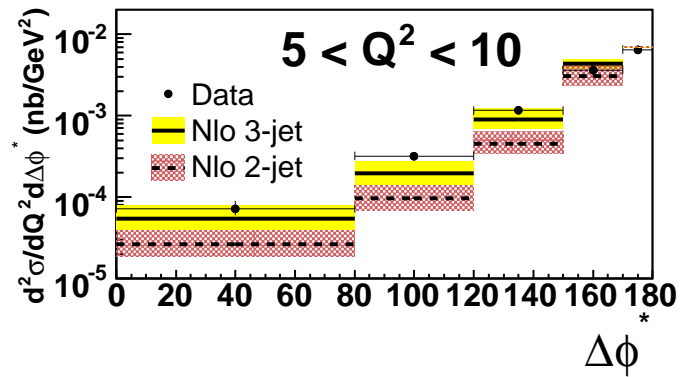
$d^2\sigma/dQ^2 d\Delta\phi^*$ Ratio

Preliminary?



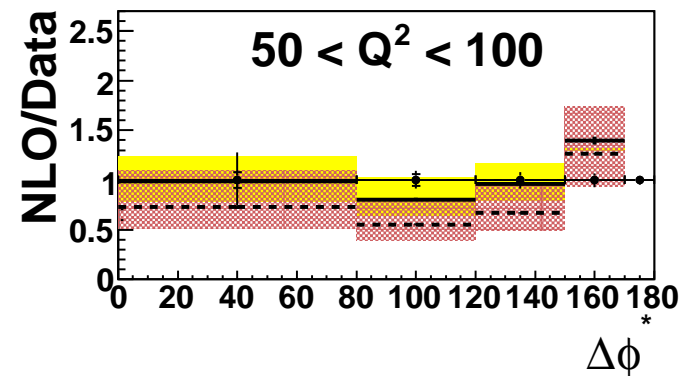
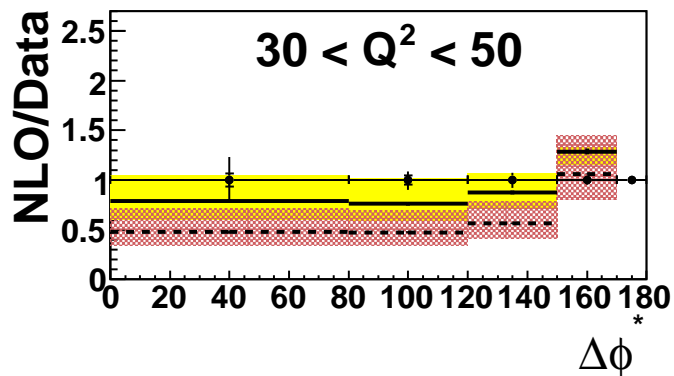
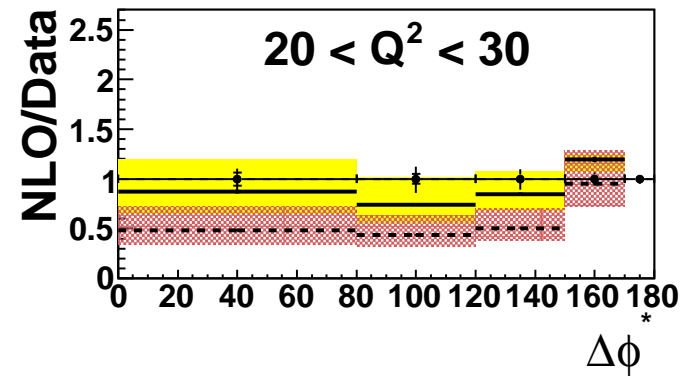
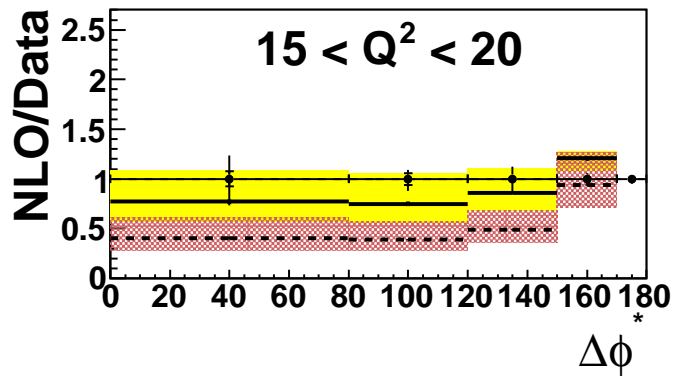
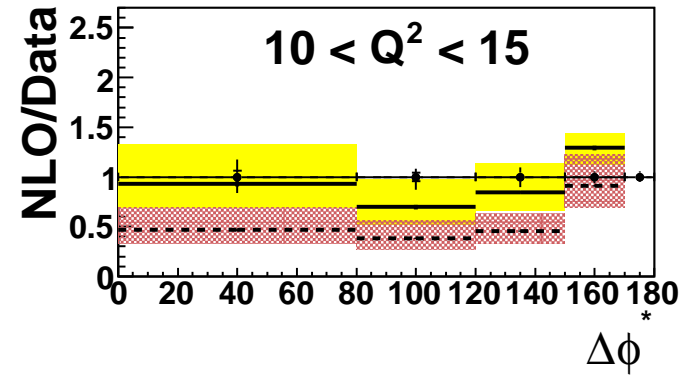
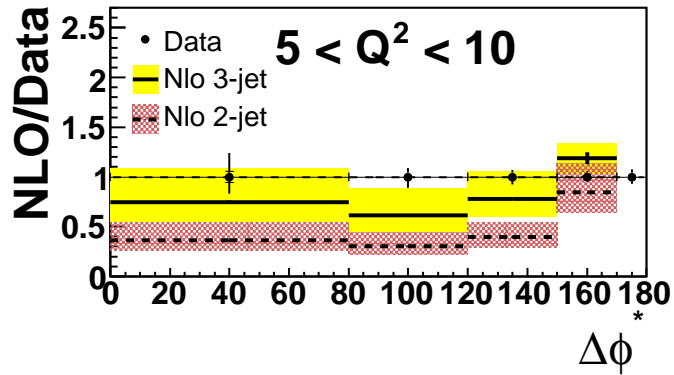
$$d^2\sigma/dQ^2 d\Delta\phi^*$$

Preliminary?

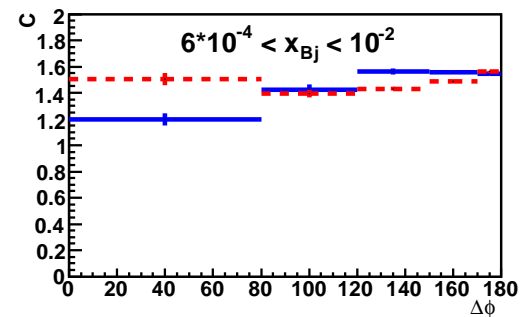
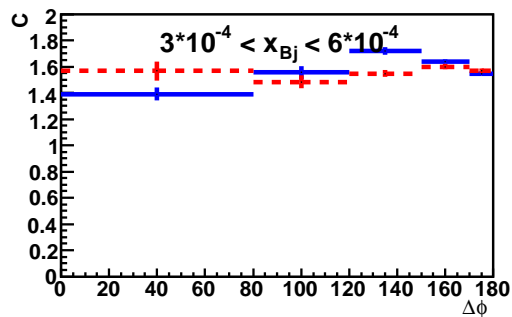
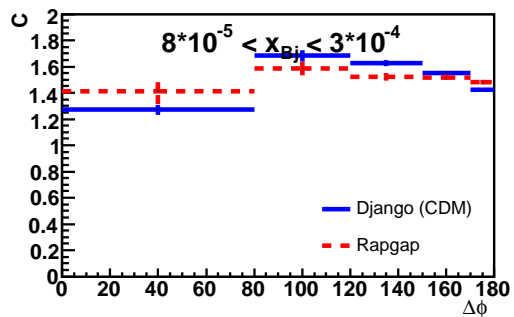
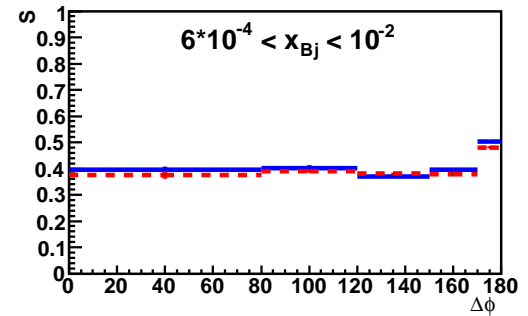
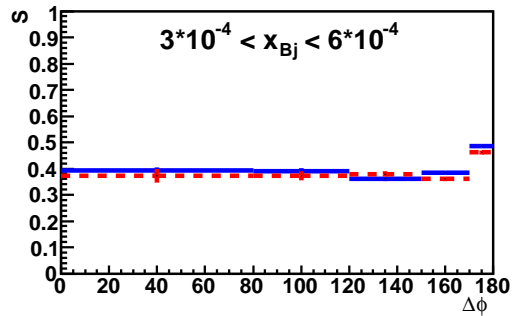
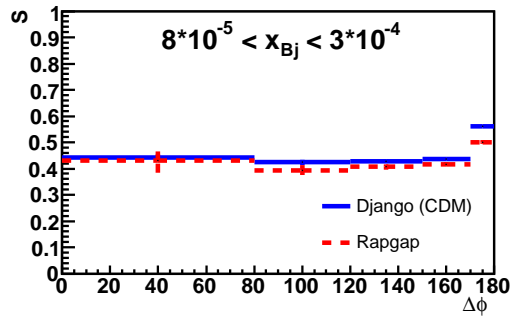
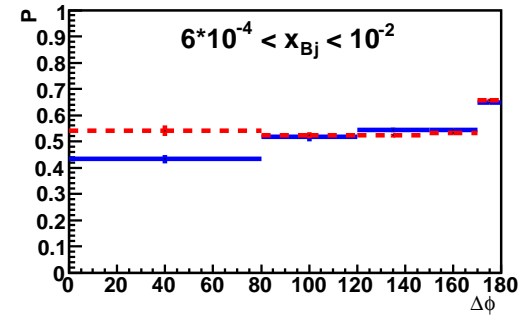
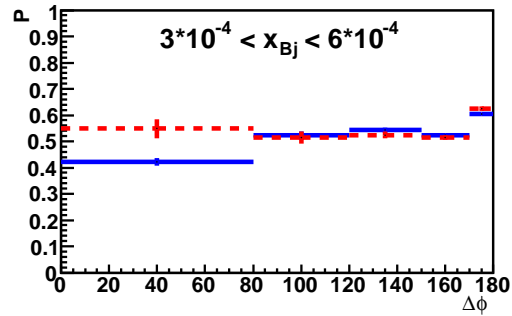
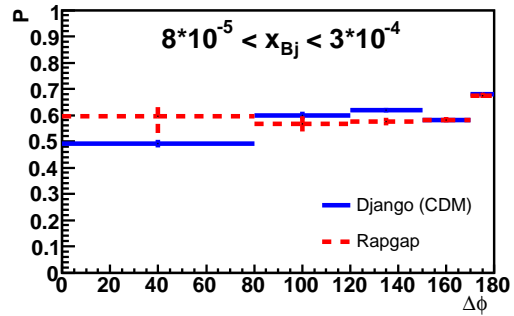


$d^2\sigma/dQ^2 d\Delta\phi^*$ Ratio

Preliminary?



$d^2\sigma/dx_{bj}d\Delta\phi^*$ Purity and Stability



$$d^2\sigma / dx_{bj} d\Delta\phi^*$$

Systematic Uncertainties

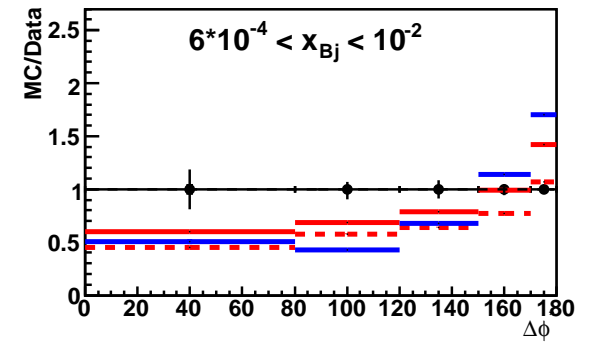
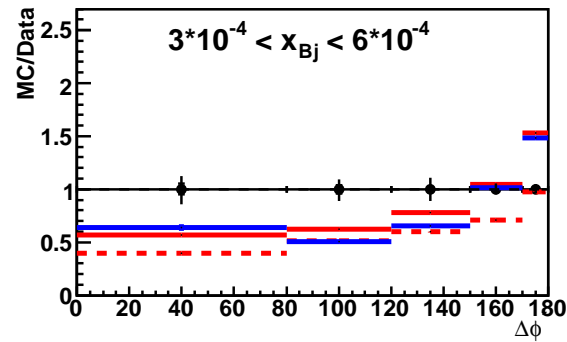
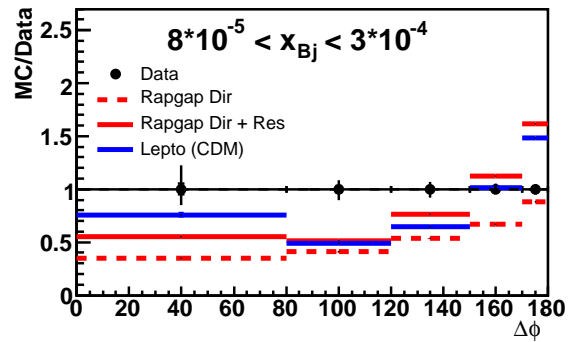
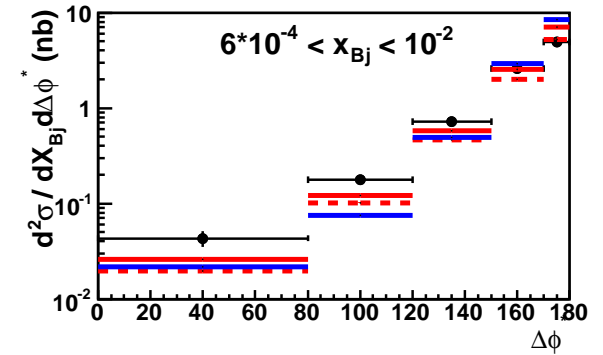
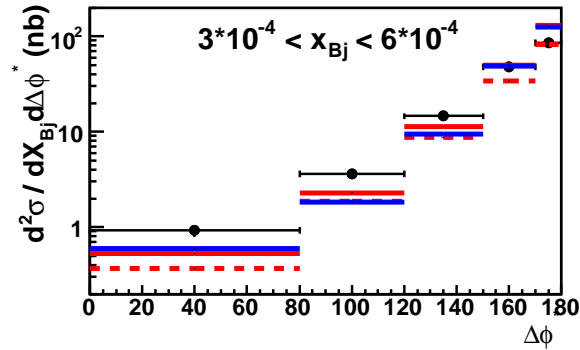
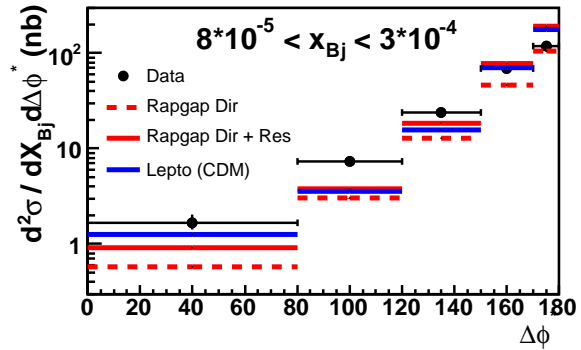
Estimated using Rapgap

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

Source		Typical Uncertainty
Electron Energy	$\pm 1\%$	0.5 - 1.7 %
Electron Polar Angle θ_e	± 1 mrad	0.3 - 0.9 %
LAr Hadronic Energy	$\pm 4\%$	5 - 10 %
Track Momentum	$\pm 3\%$	≈ 0
Luminosity	$\pm 1.5\%$	1.5 %
Photoproduction		≈ 0
Model Dependence		2 - 10 %

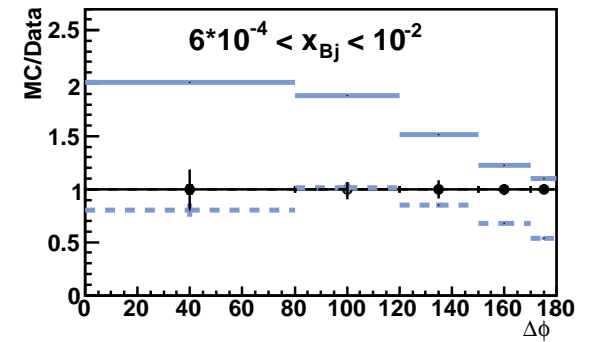
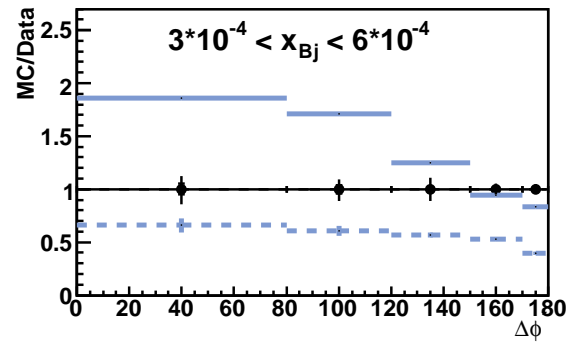
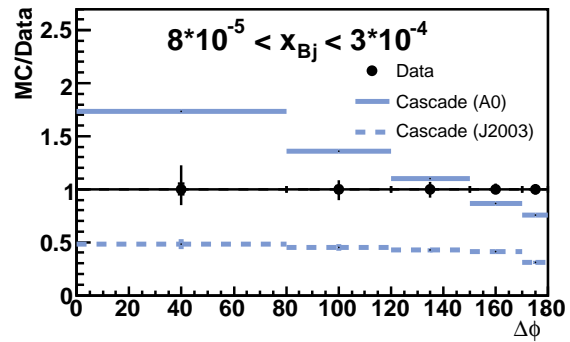
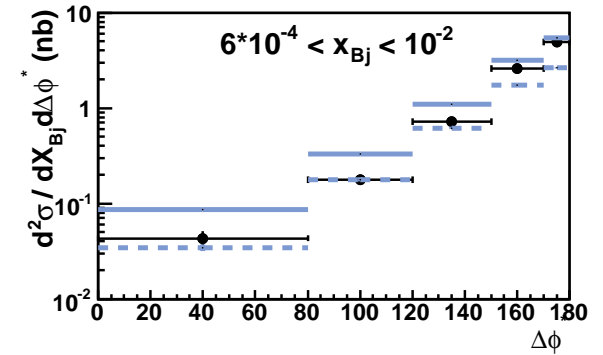
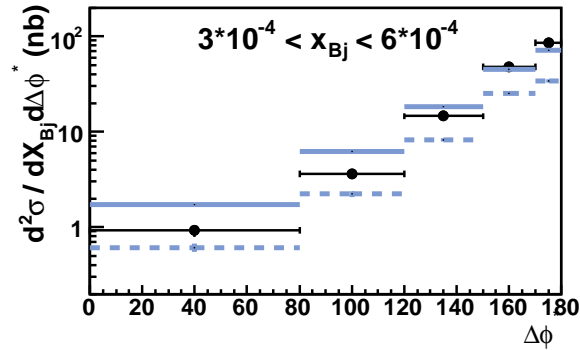
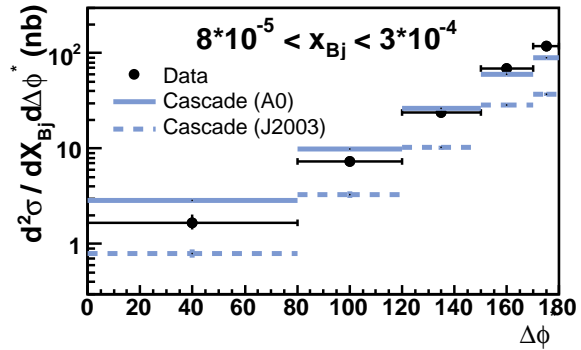
$$d^2\sigma/dx_{Bj}d\Delta\phi^*$$

Preliminary?



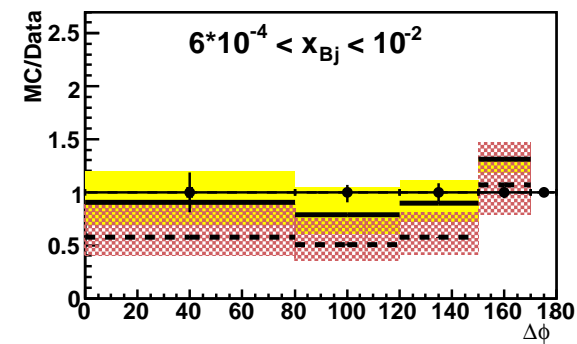
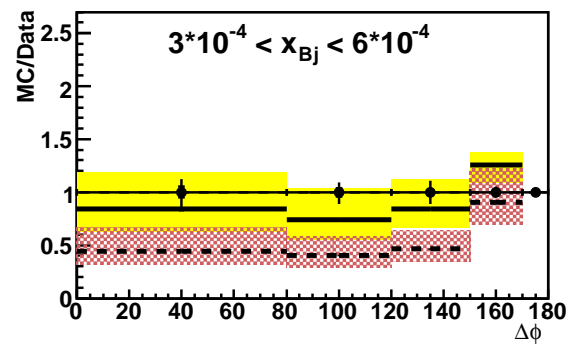
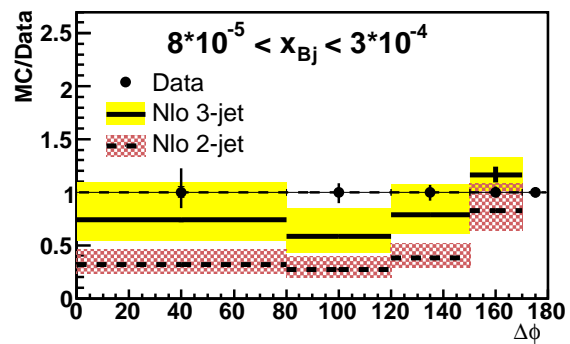
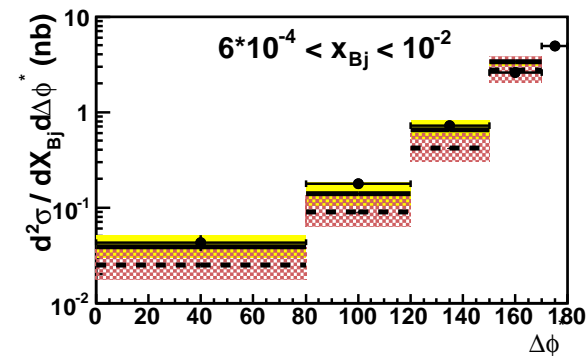
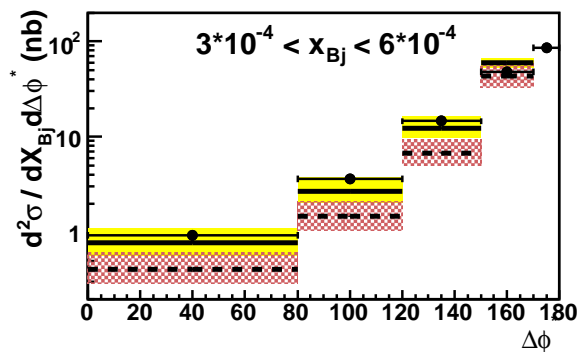
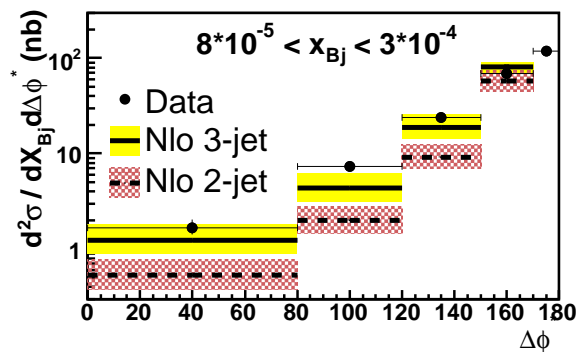
$$d^2\sigma / dx_{bj} d\Delta\phi^*$$

Preliminary?



$$d^2\sigma/dx_{bj}d\Delta\phi^*$$

Preliminary?

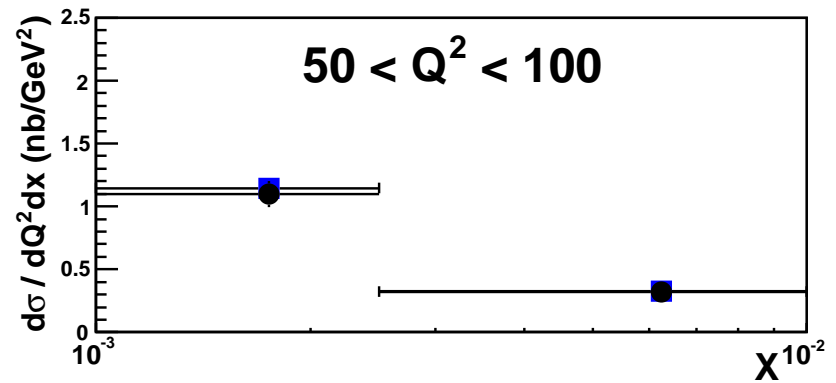
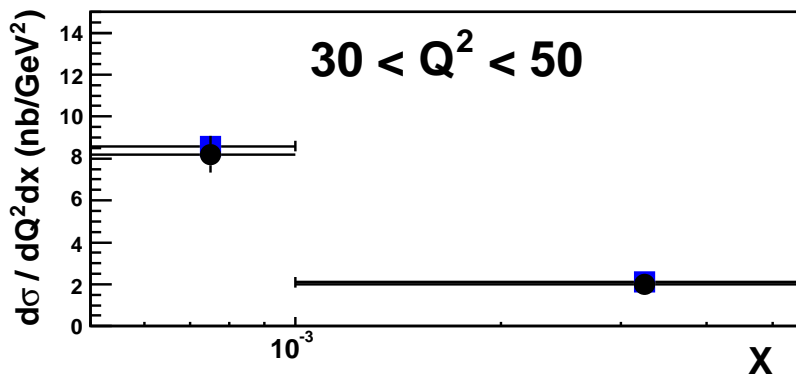
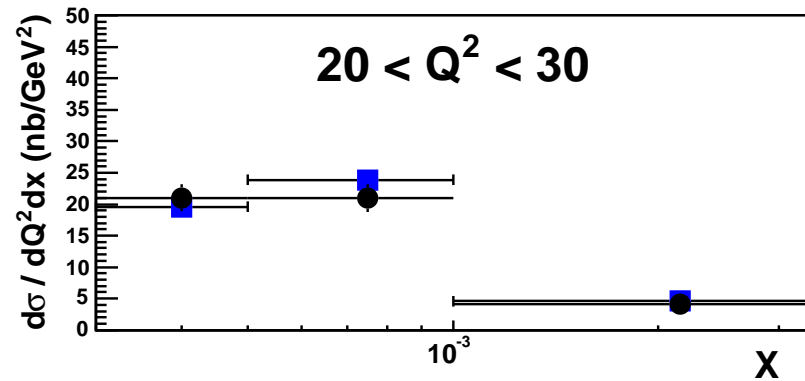
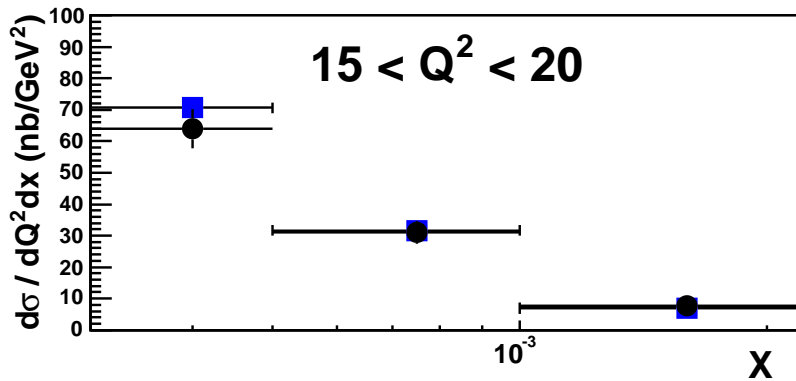
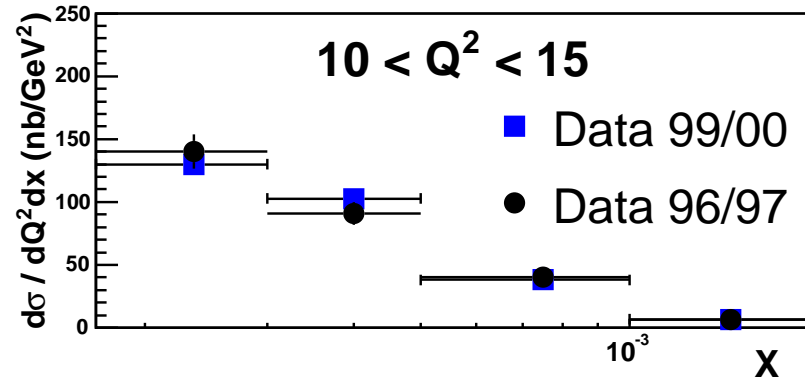
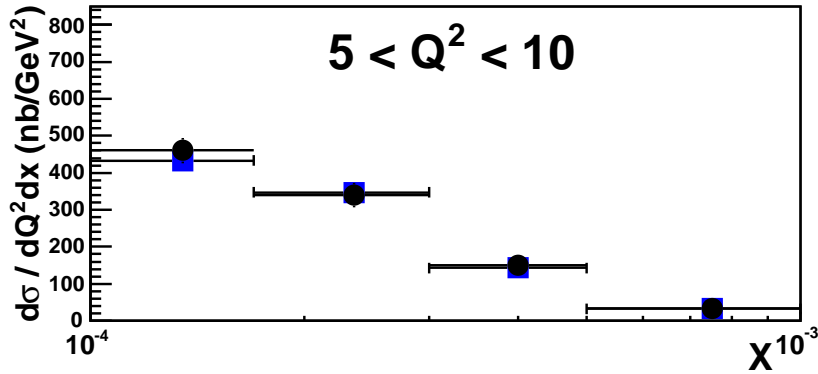


Comparison to Published Data

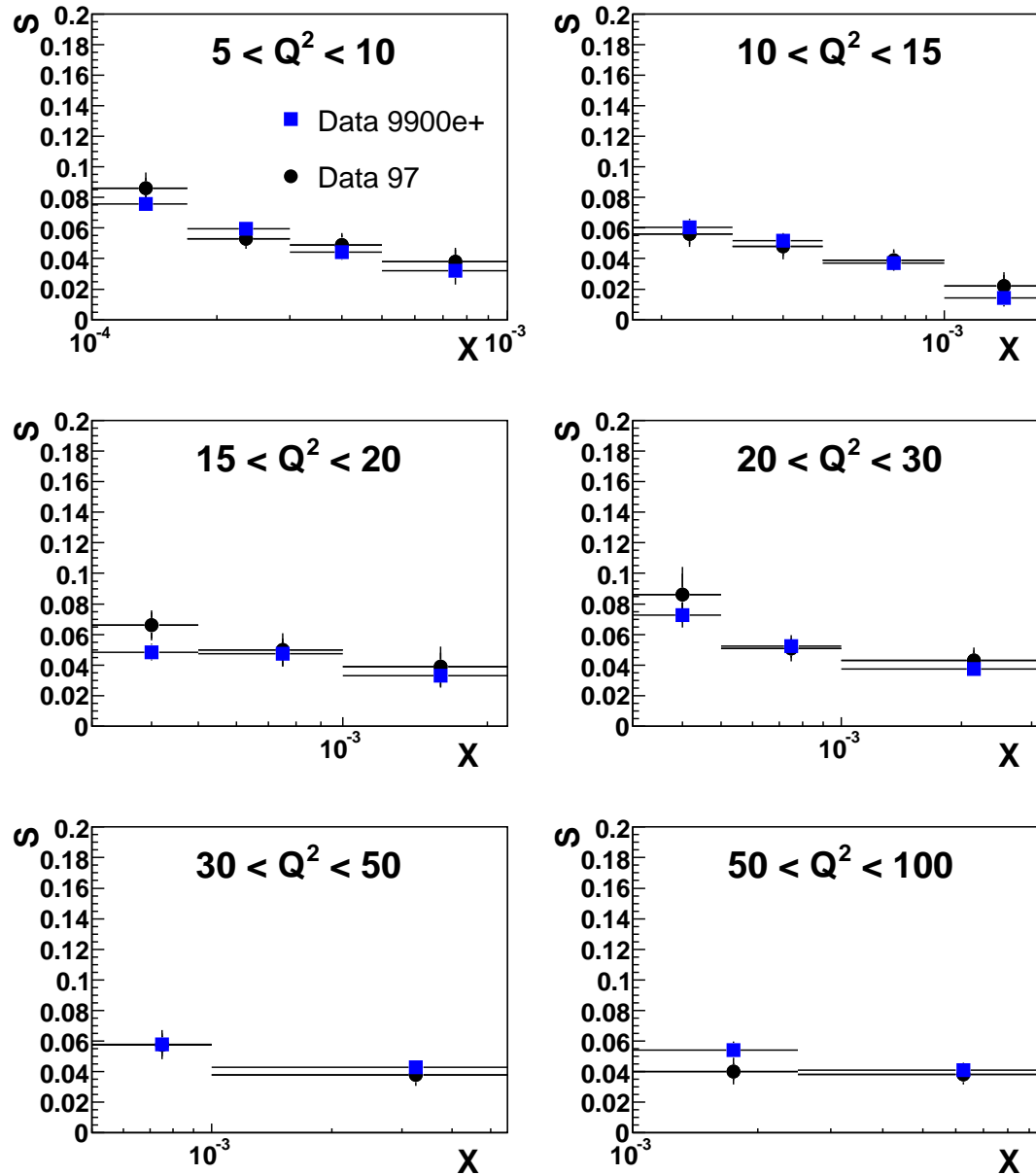
Inclusive Dijet Production at Low Bjorken- x in Deep Inelastic Scattering
Eur.Phys.J.C33:477-493,2004 (hep-ex/0310019)

- 96/97 H1 Data
- Dijets are two hardest jets in HCM
- Asymmetric cuts: $E_{T1}^* > 7 \text{ GeV}$, $E_{T2}^* > 5 \text{ GeV}$
- Cross Section: $\frac{d^2\sigma}{dQ^2 dx}$
- Azimuthal Jet Separation: $S = \frac{\int_0^{120^\circ} N_{dijet}(\Delta\phi^*, x, Q^2) d\Delta\phi^*}{\int_0^{180^\circ} N_{dijet}(\Delta\phi^*, x, Q^2) d\Delta\phi^*}$

Dijet Cross Sections: 9697 comp. to 9900



Azimuthal Jet Separation: 9697 comp. to 9900



Summary

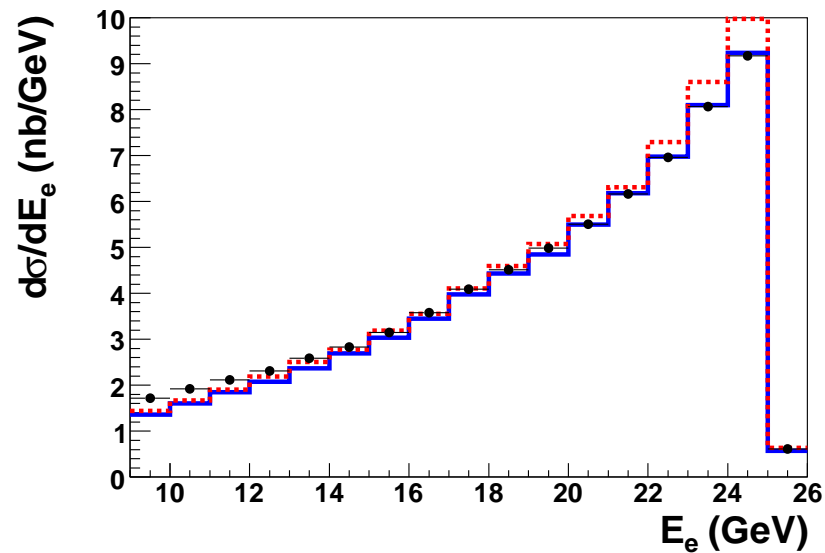
- Azimuthal correlations measured in bins of Q^2 and in bins of x_{Bj}
- Rapgap (Dir+Res) and Lepto(CDM) undershoots the data at small $\Delta\phi^*$ and overshoots at $\Delta\phi^* \sim 180^\circ$
- Data shows large sensitivity to the unintegrated gluon density (Cascade A0 and J2003)
- NLO 2-jet undershoot data except at high Q^2 and high x
- NLO 3-jet describes the data everywhere
- Data is consistent with published 96/97 data
- Preliminary for DIS06 ?

**BACKUP
PLOTS**

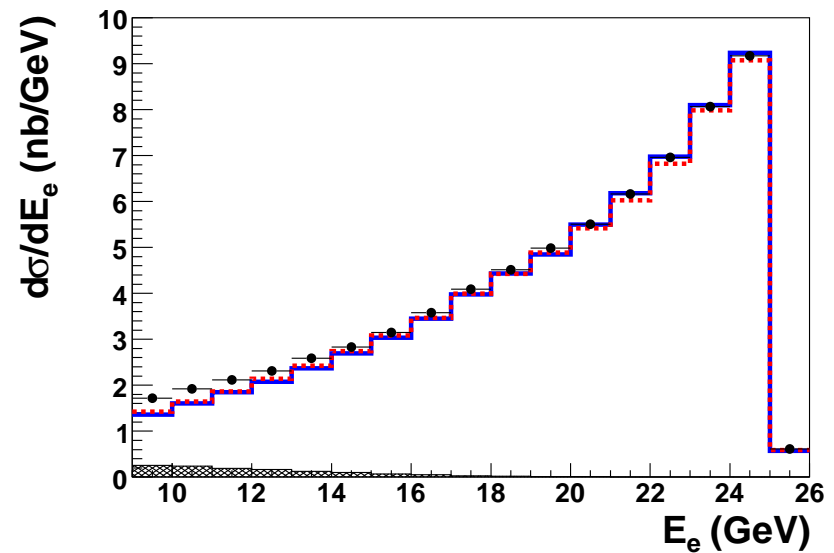
Electron Calibration for Rapgap

Apply 2.8.18 Calibration for Rapgap
(Django already calibrated)

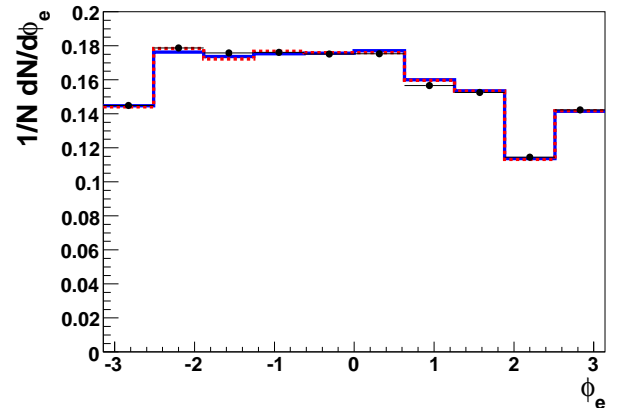
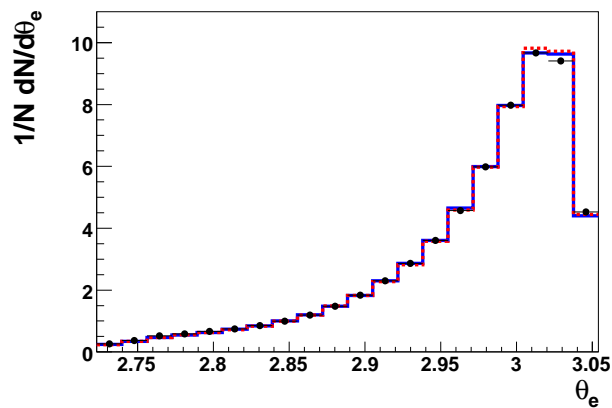
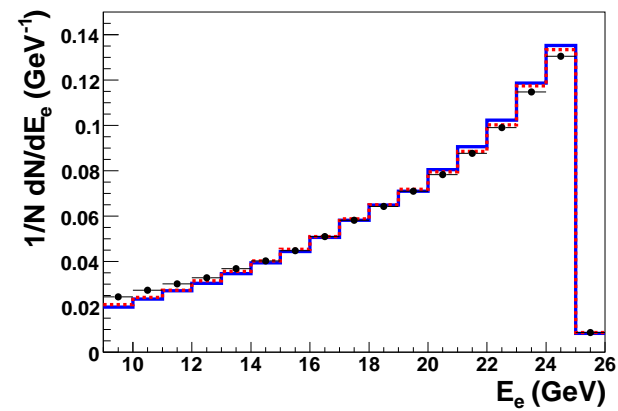
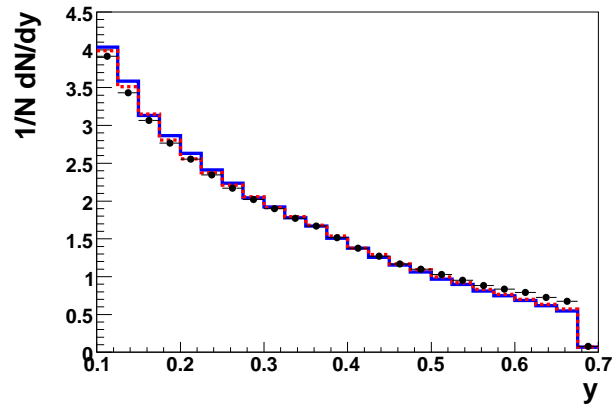
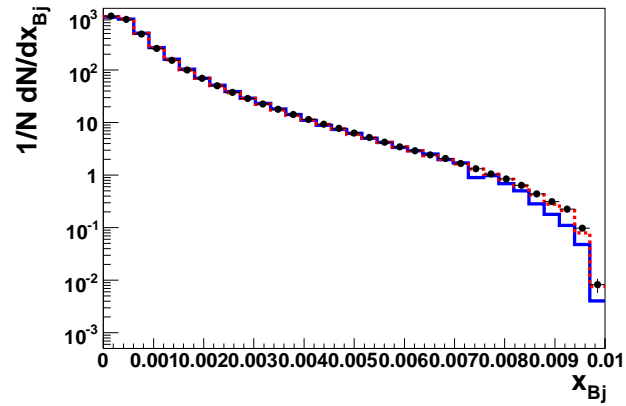
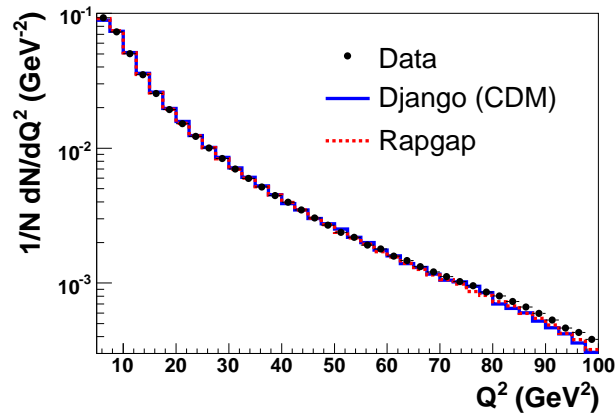
2.8.15 Original



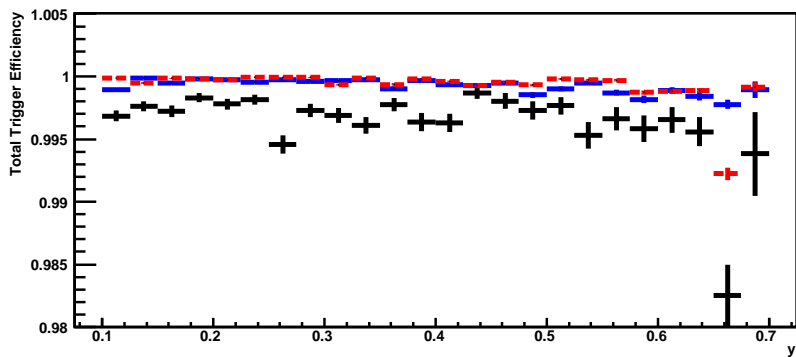
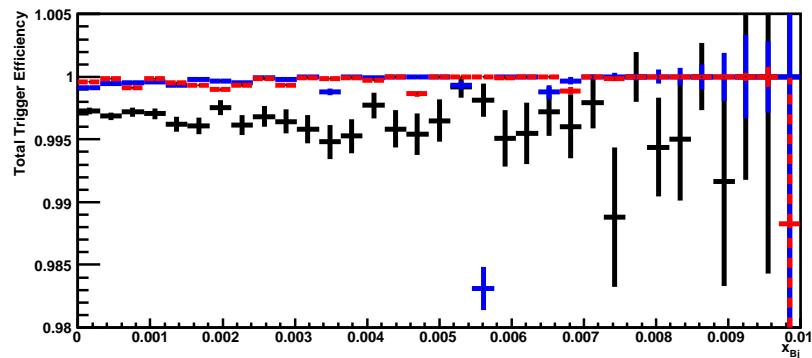
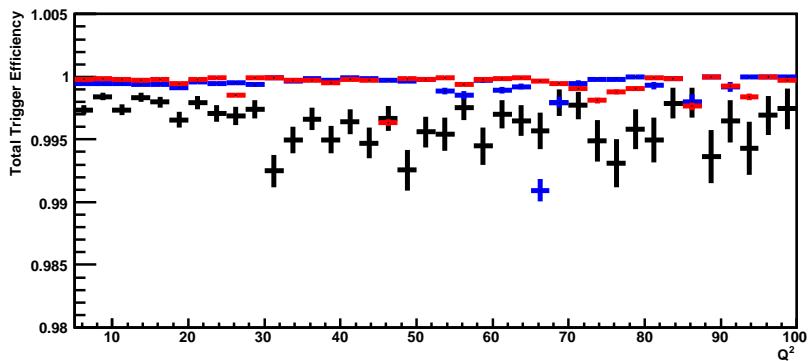
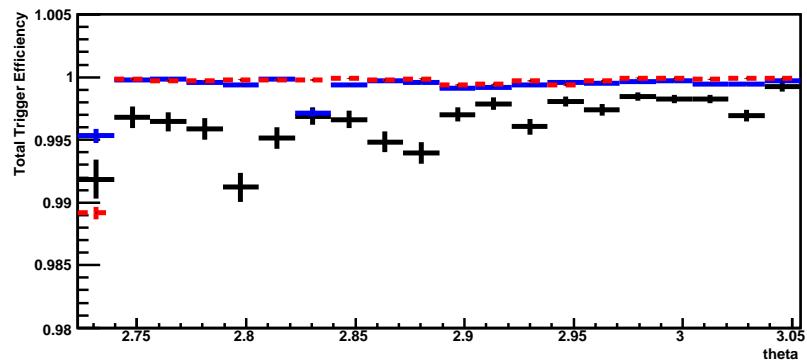
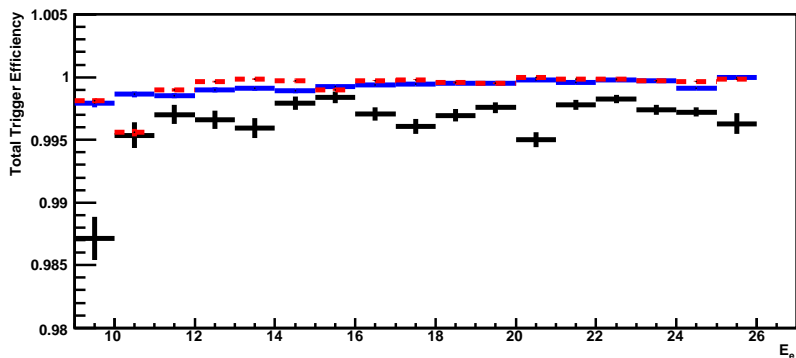
2.8.15 with Elec Calib



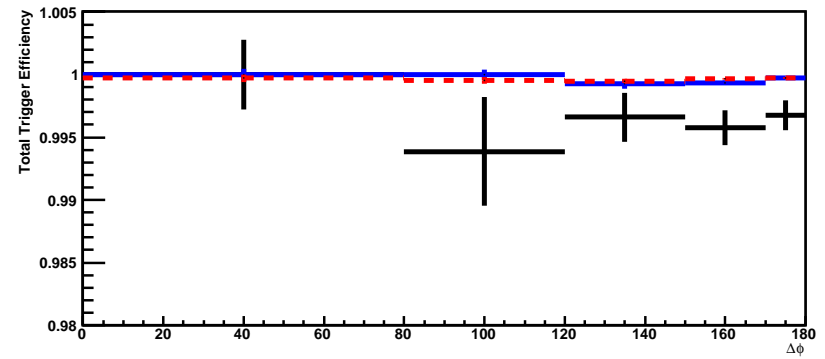
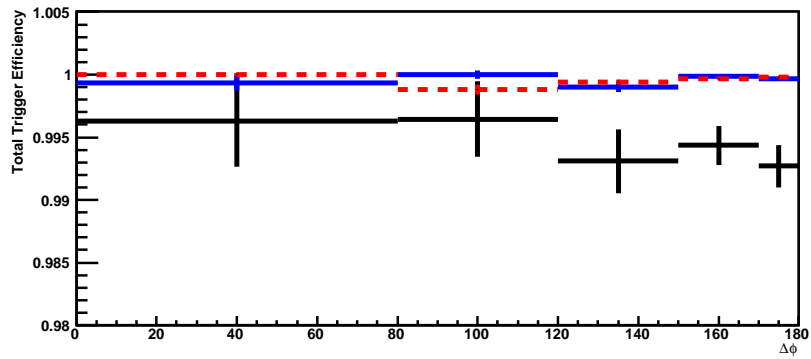
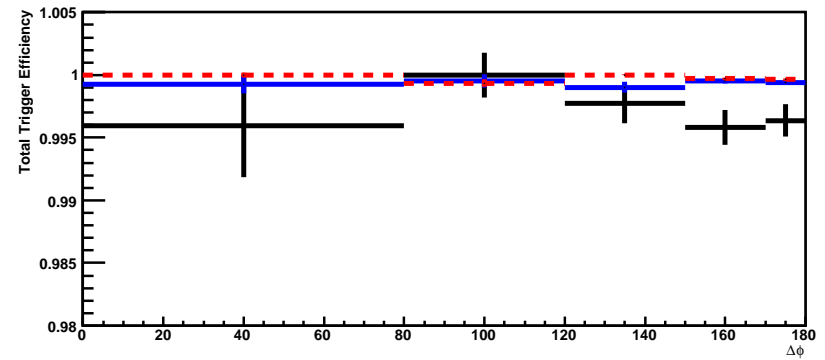
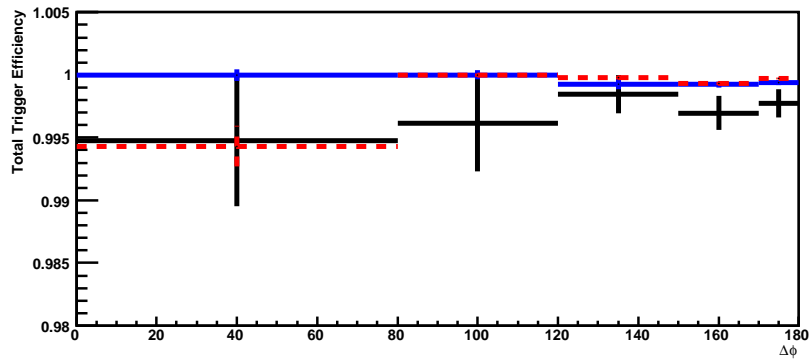
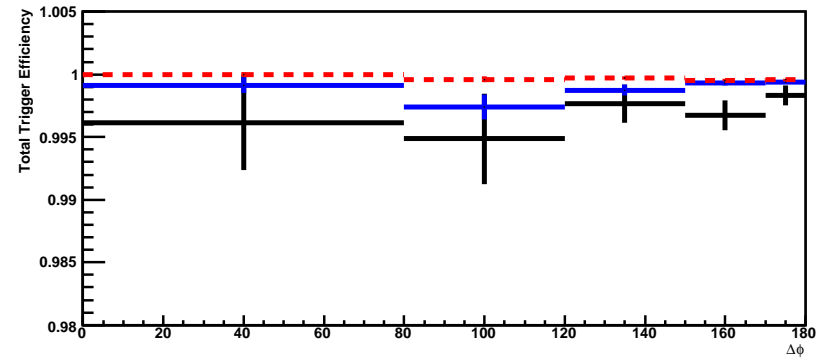
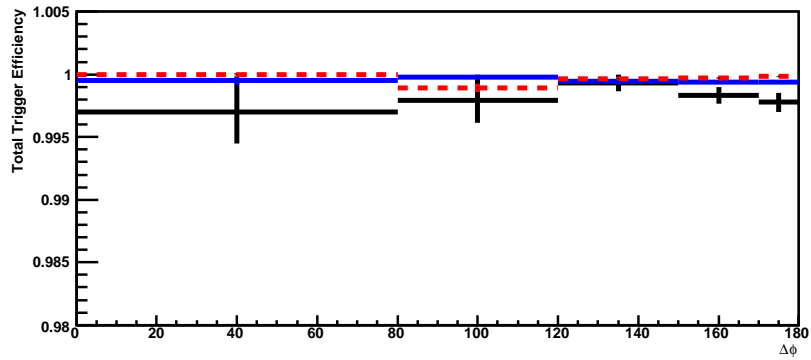
Control Plots DIS Sample



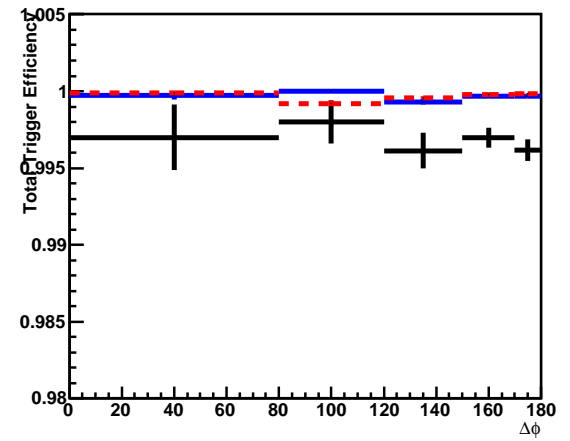
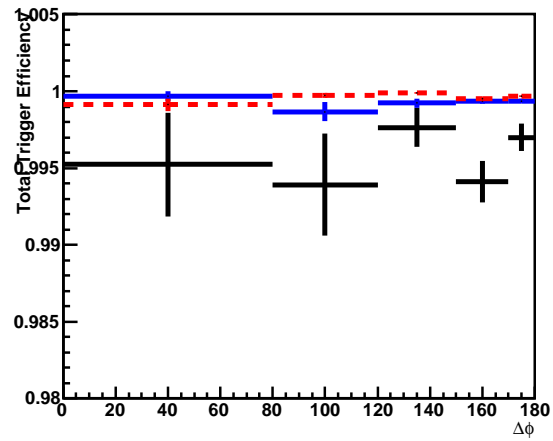
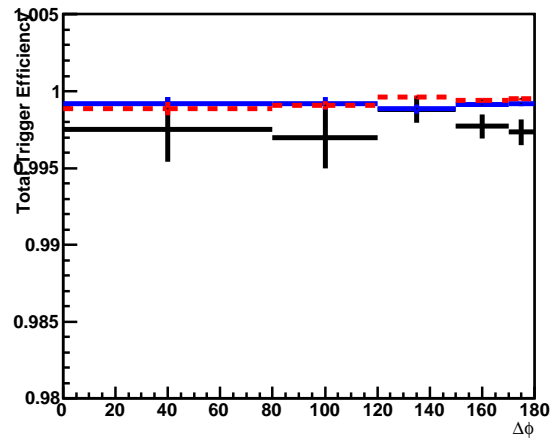
Trigger Efficiency (S0 OR S61) DIS



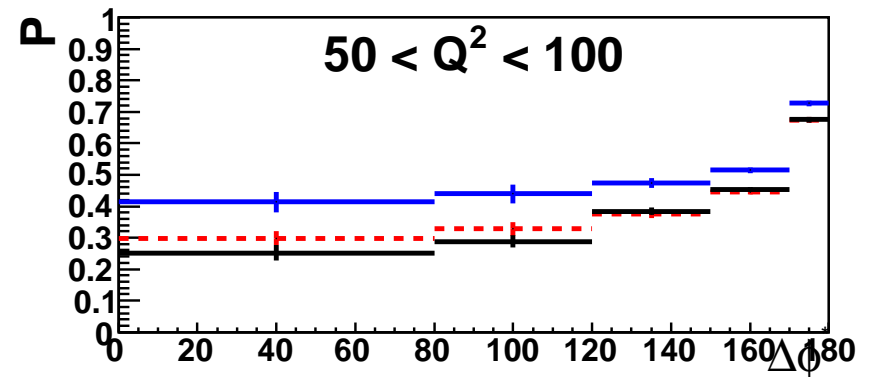
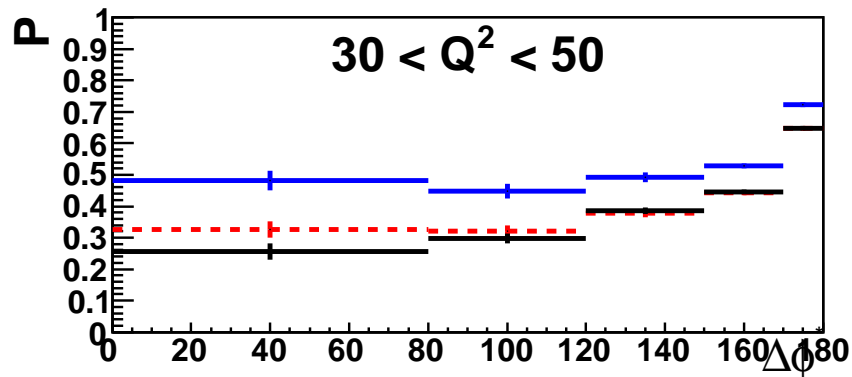
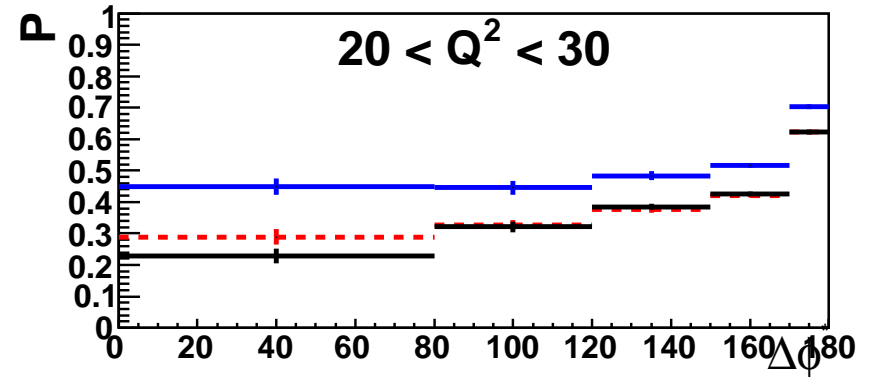
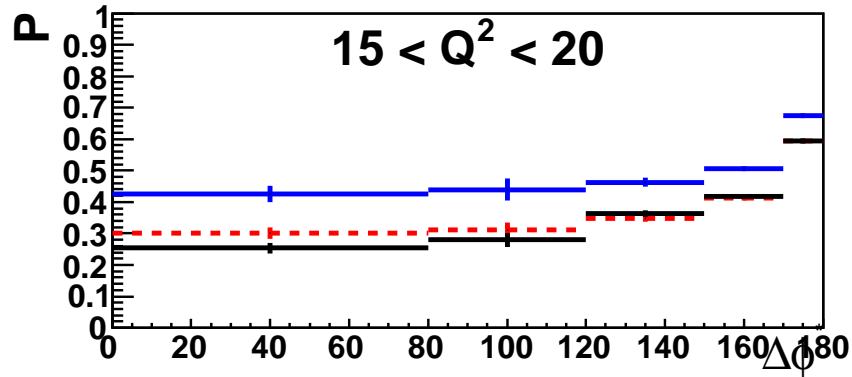
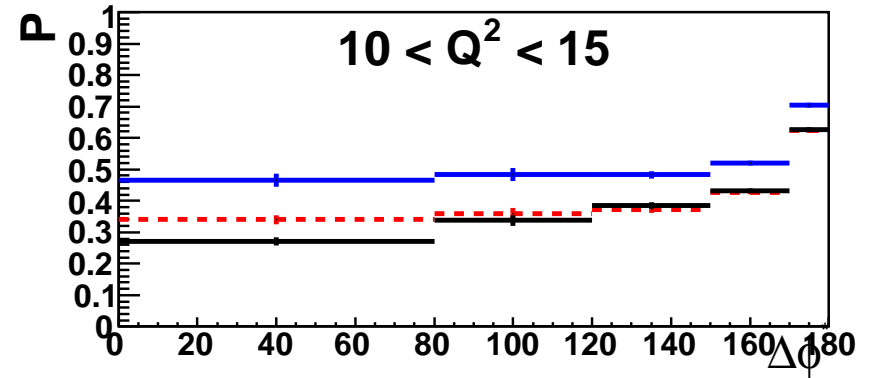
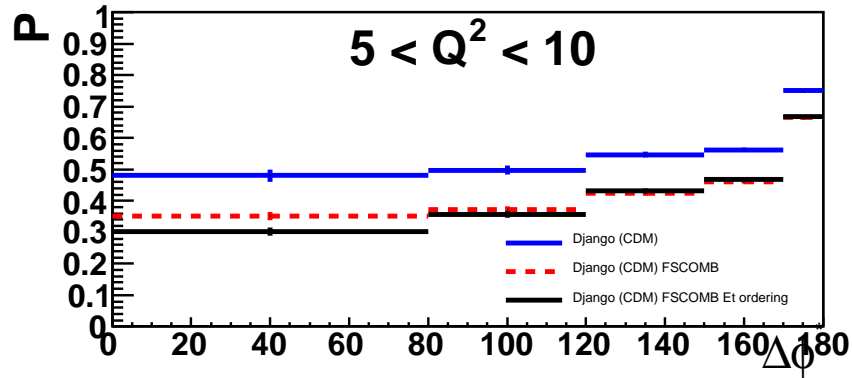
Trigger Efficiency (S0 OR S61) in Q^2 bins



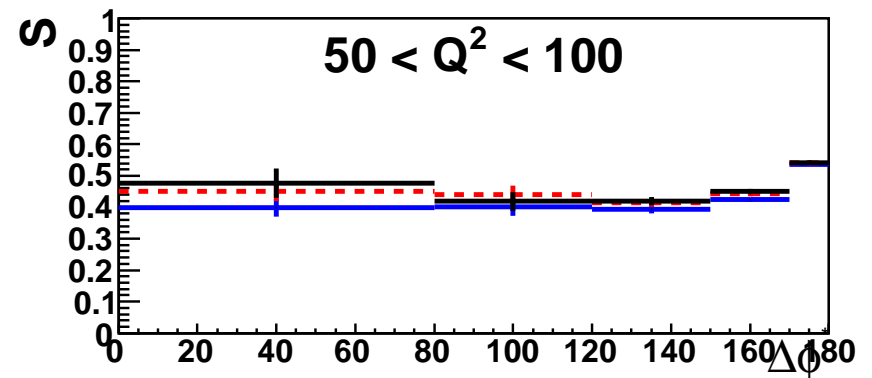
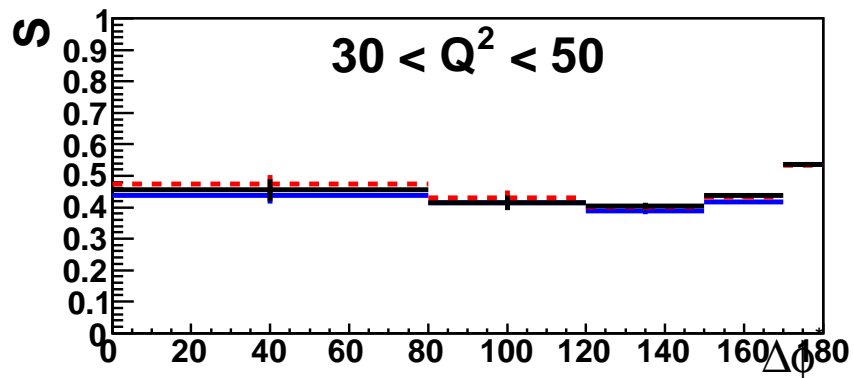
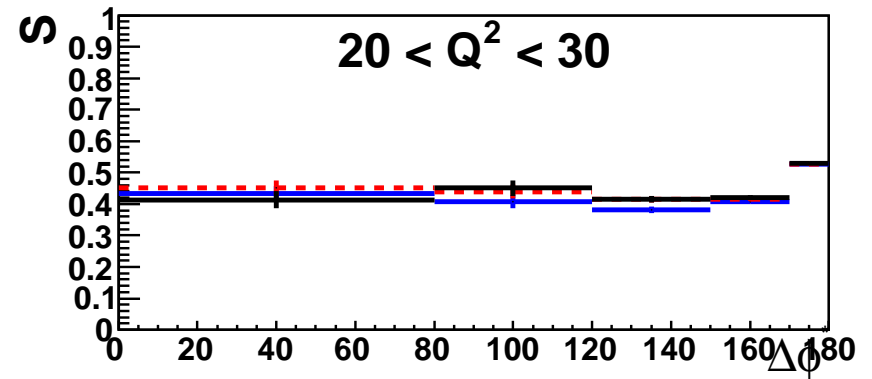
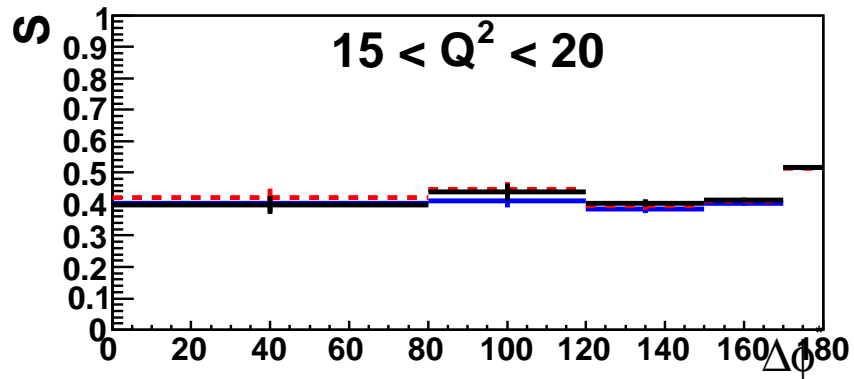
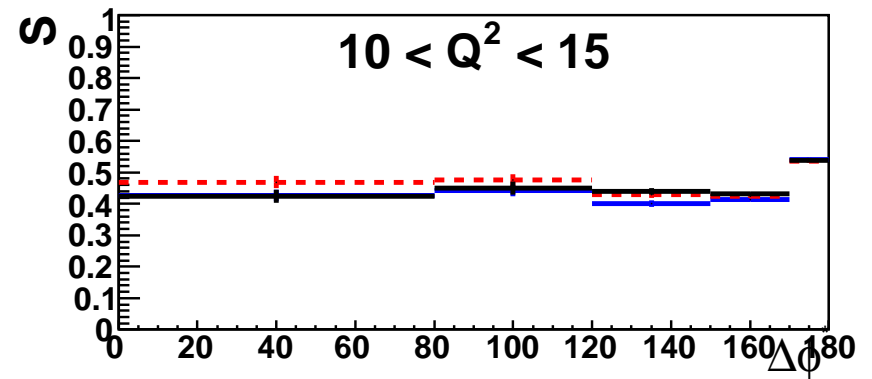
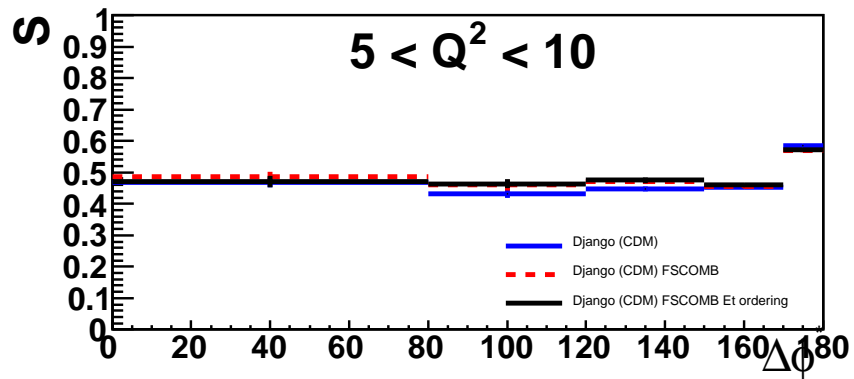
Trigger Efficiency (S0 OR S61) in x_{Bj} bins



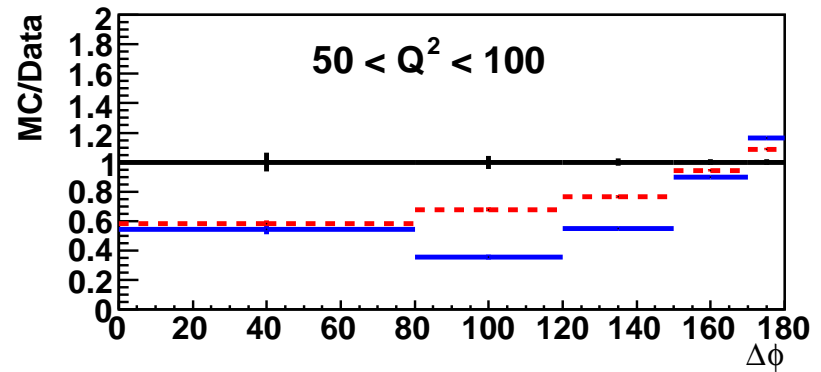
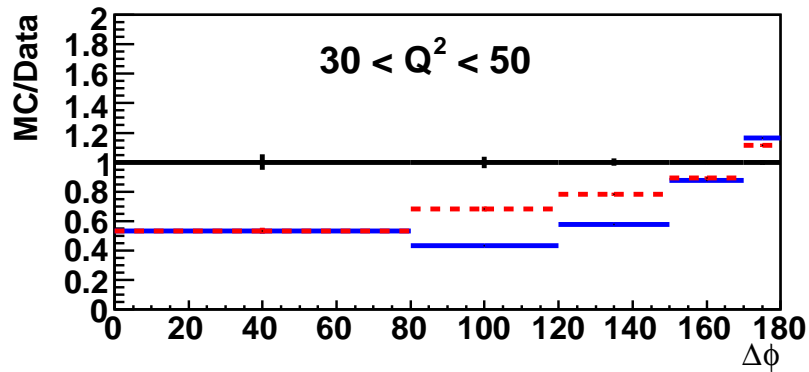
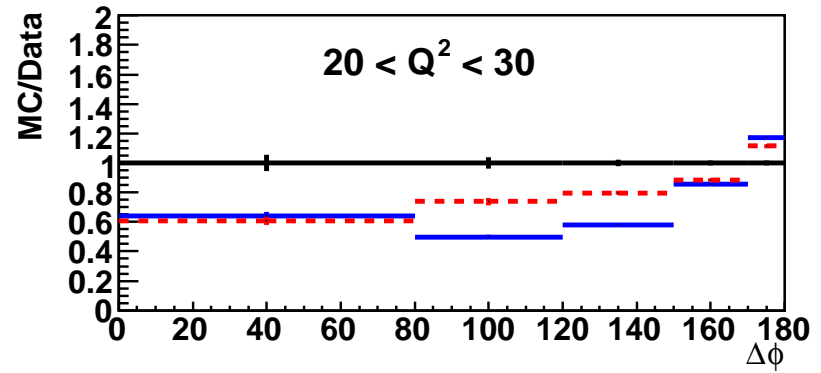
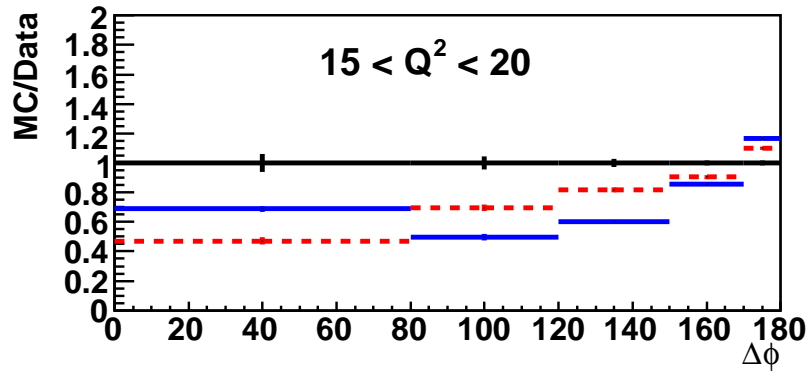
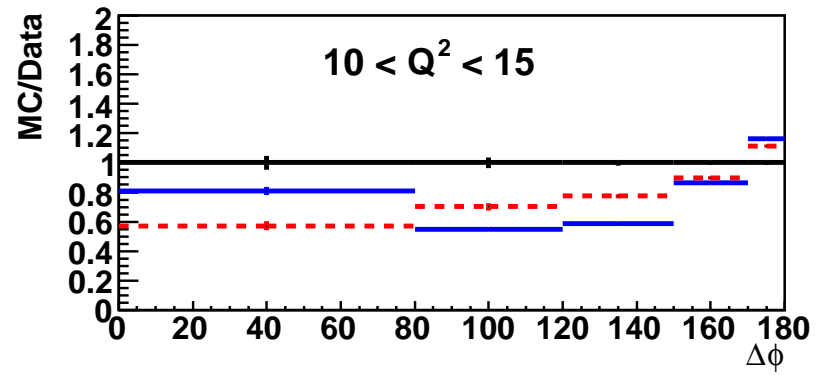
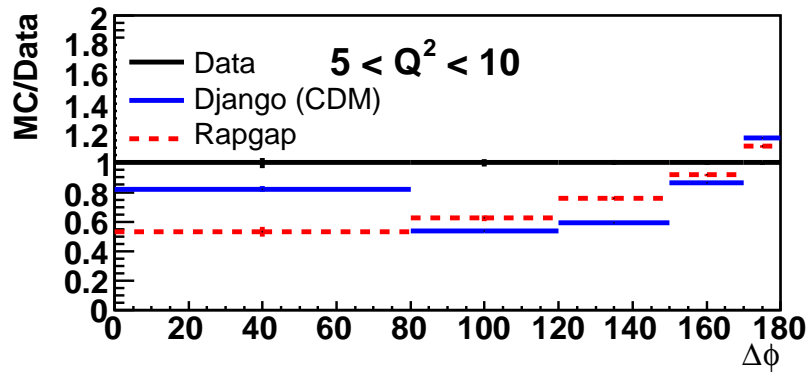
Hadroo2 Vs Fscomb. Romans cuts.



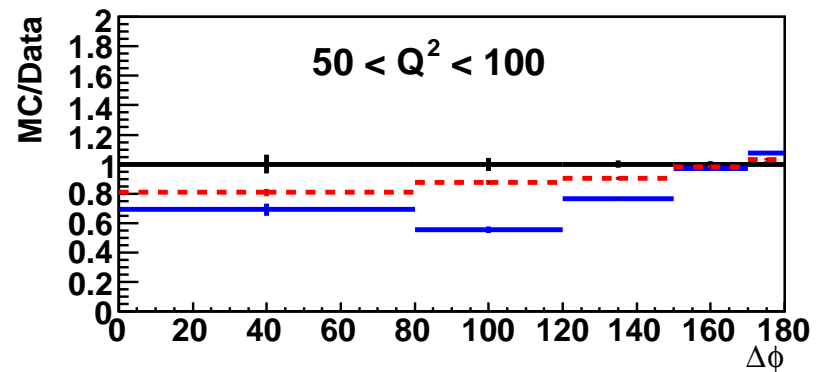
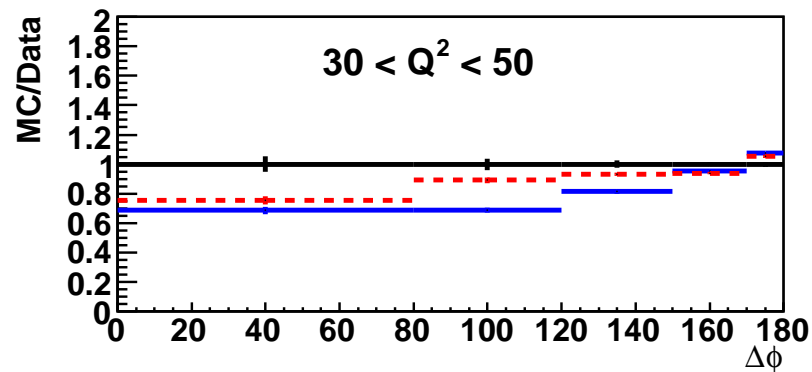
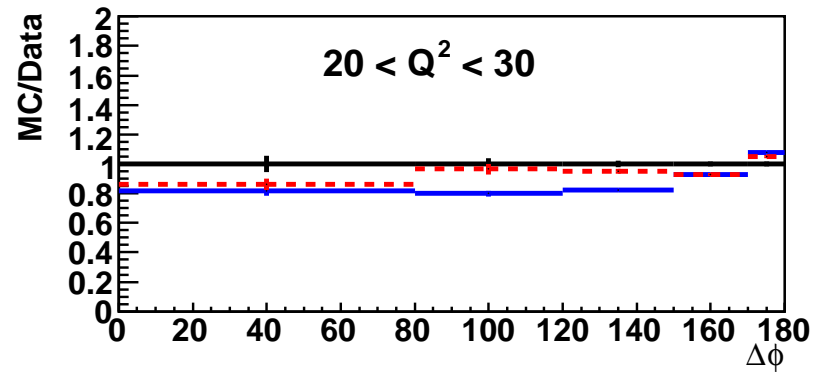
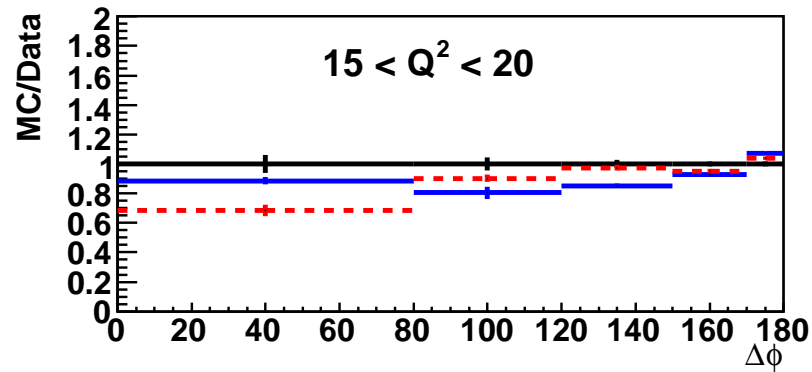
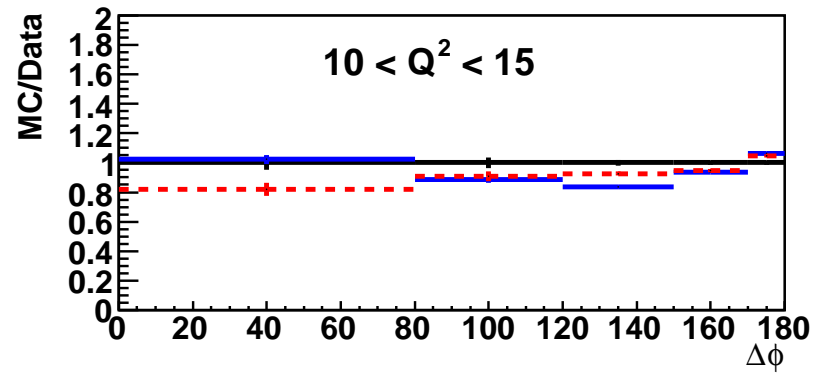
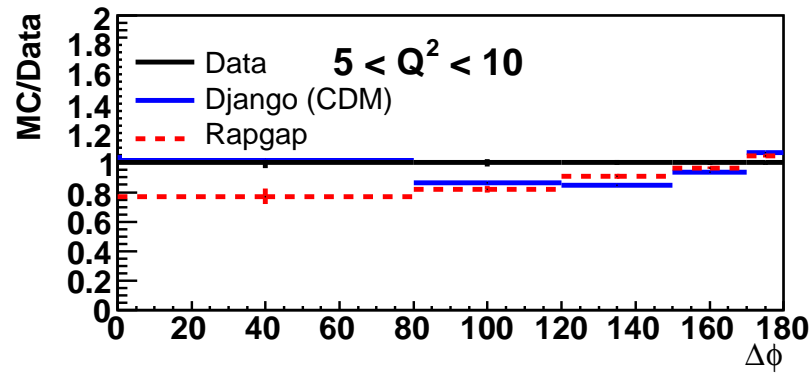
Hadroo2 Vs Fscomb. Romans cuts.



MC/Data, Detector Level Before $\Delta\phi^*$ Reweighting

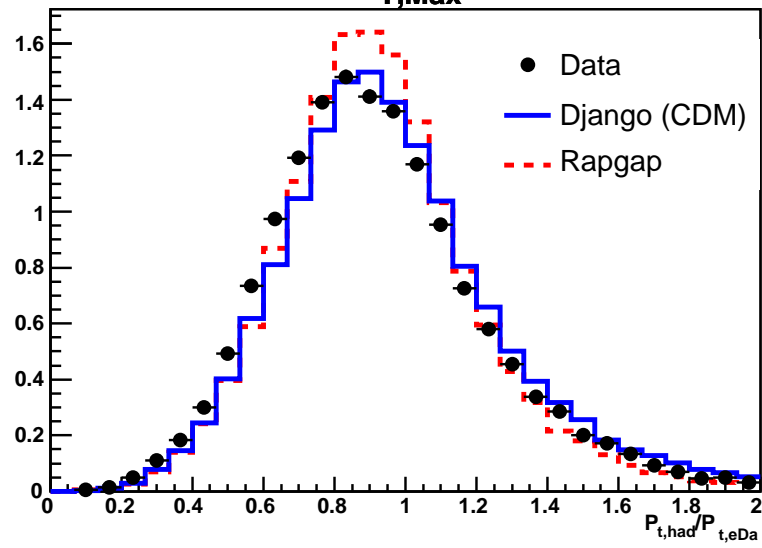


MC/Data, Detector Level After $\Delta\phi^*$ Reweighting

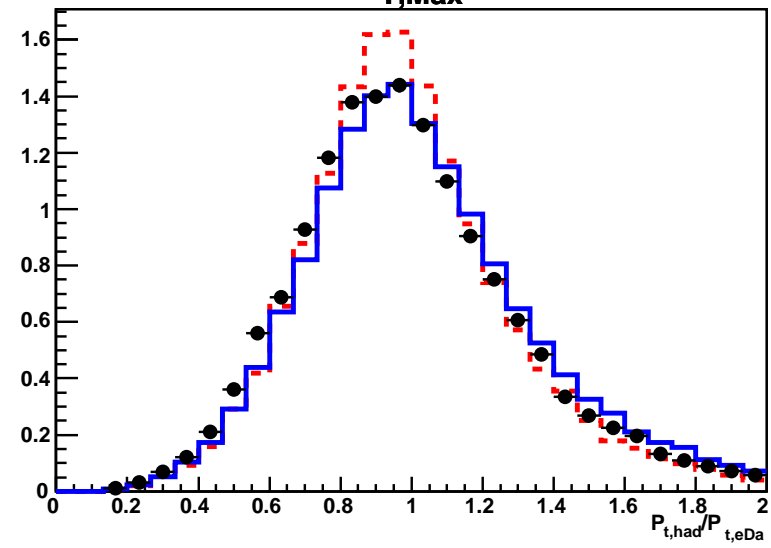


Pt Balance

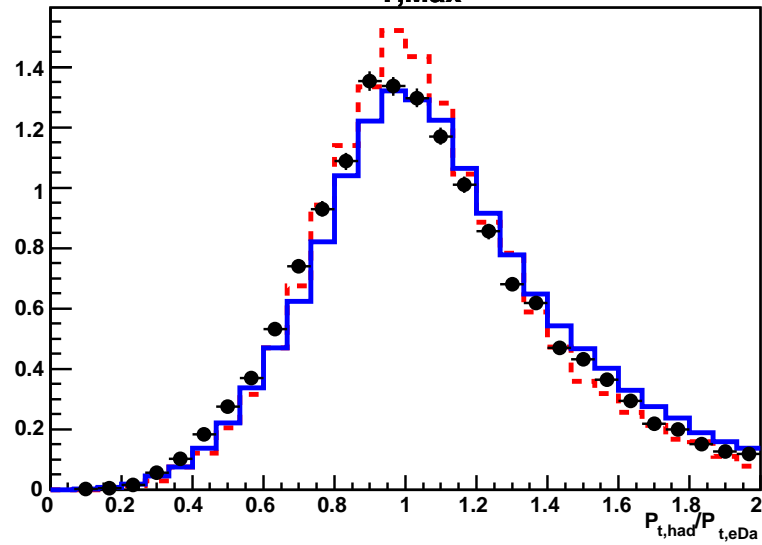
$5.0 < E_{T,Max} < 7.5$



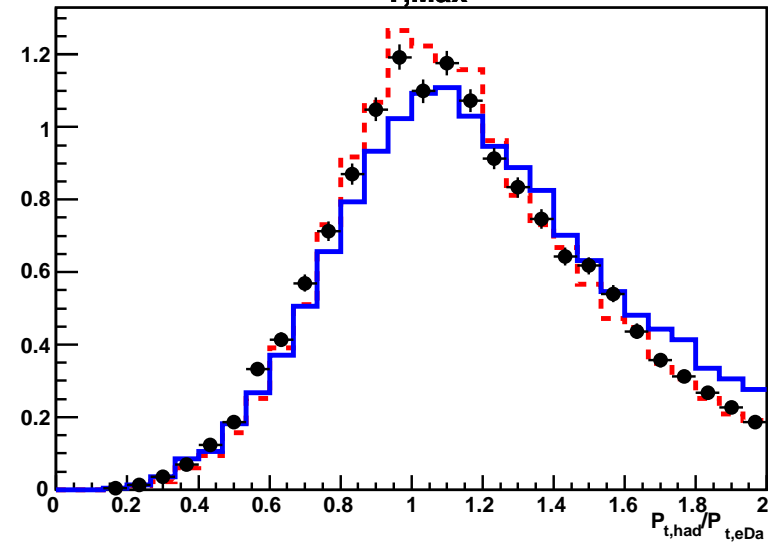
$7.5 < E_{T,Max} < 10.0$



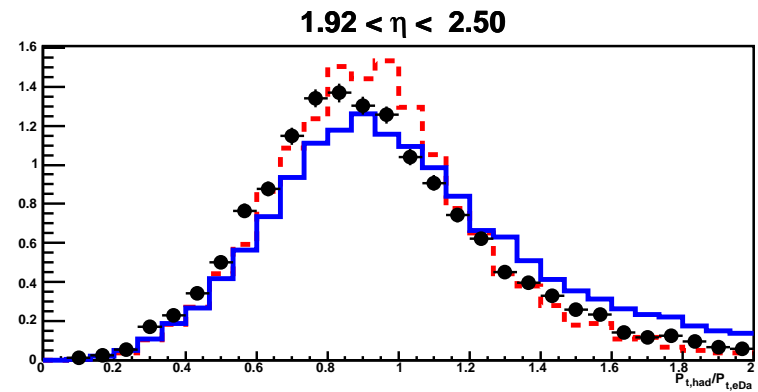
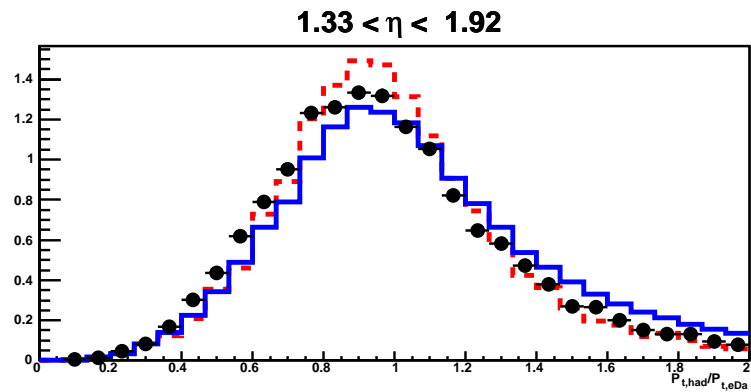
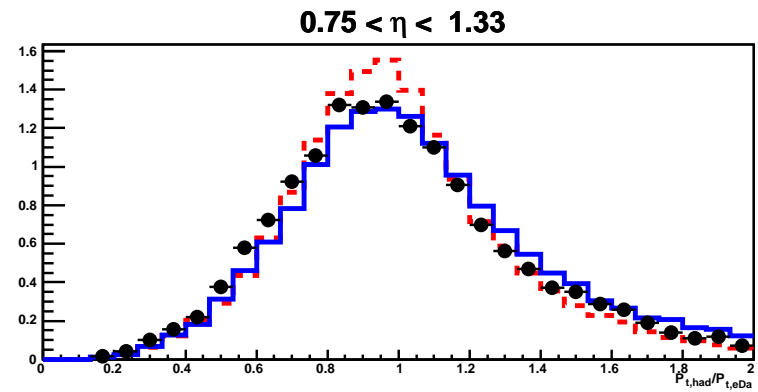
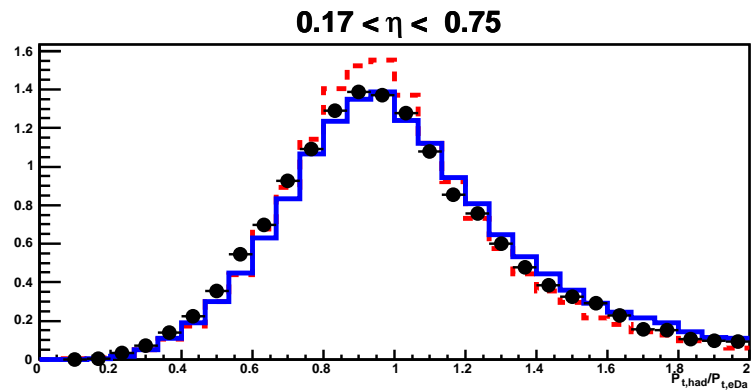
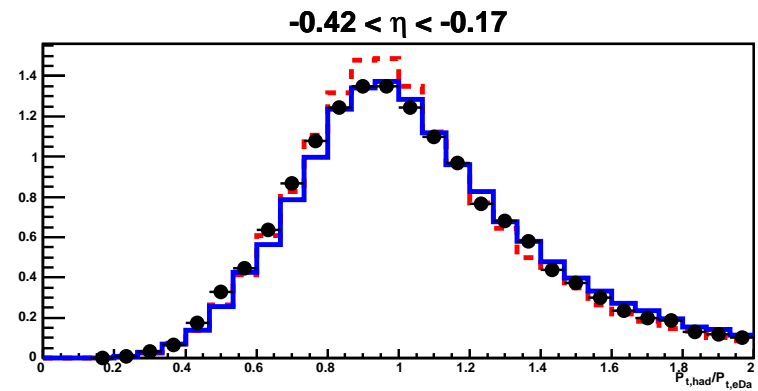
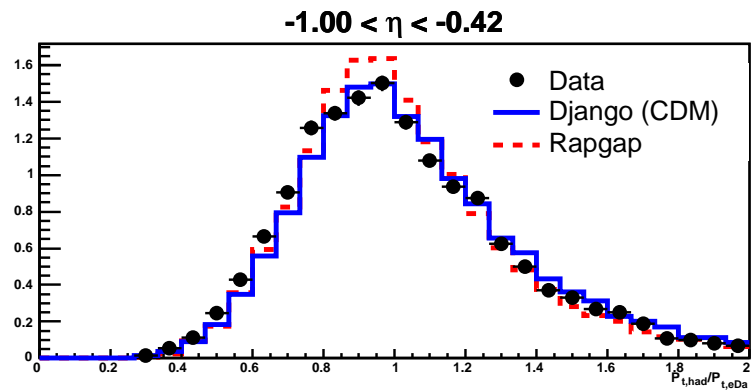
$10.0 < E_{T,Max} < 12.5$



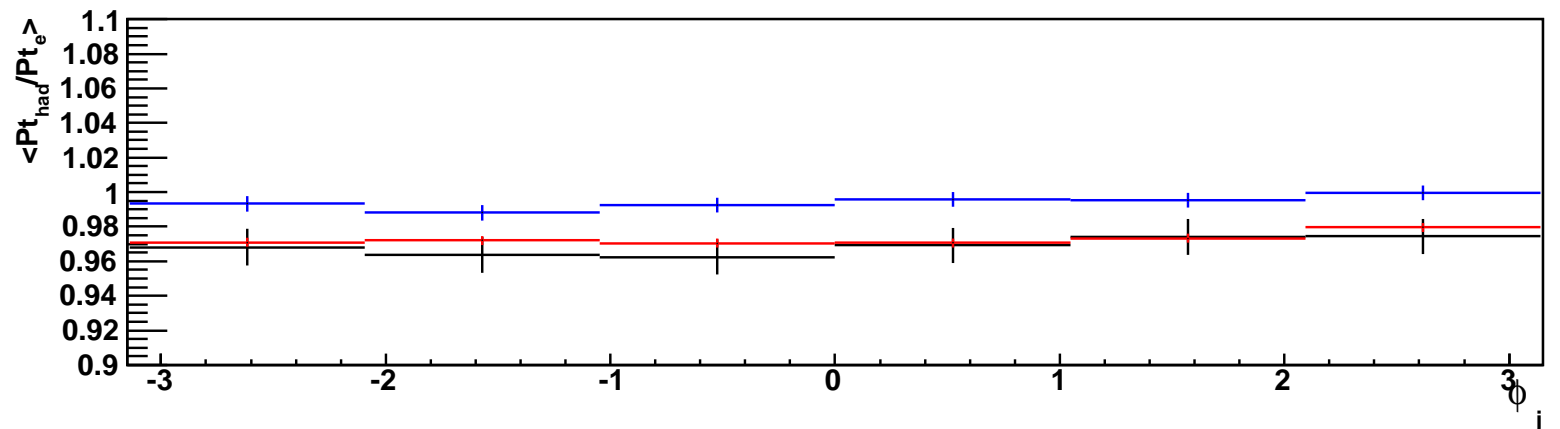
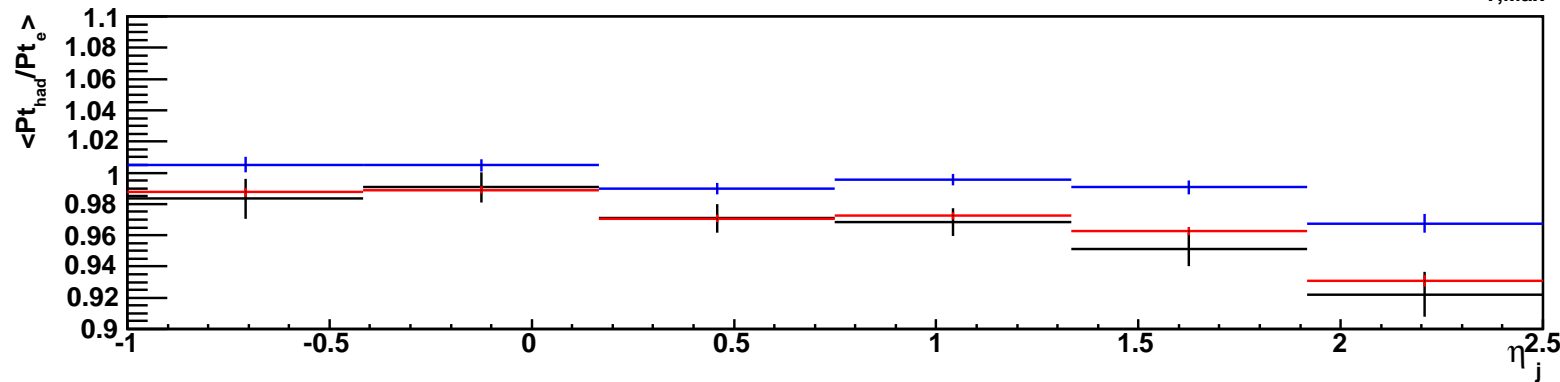
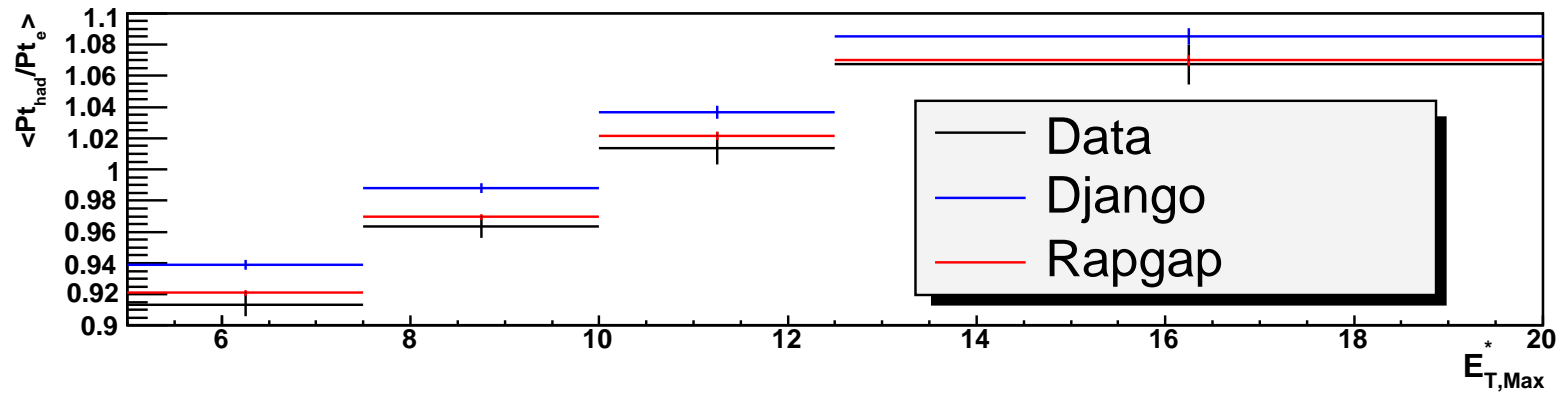
$12.5 < E_{T,Max} < 15.0$



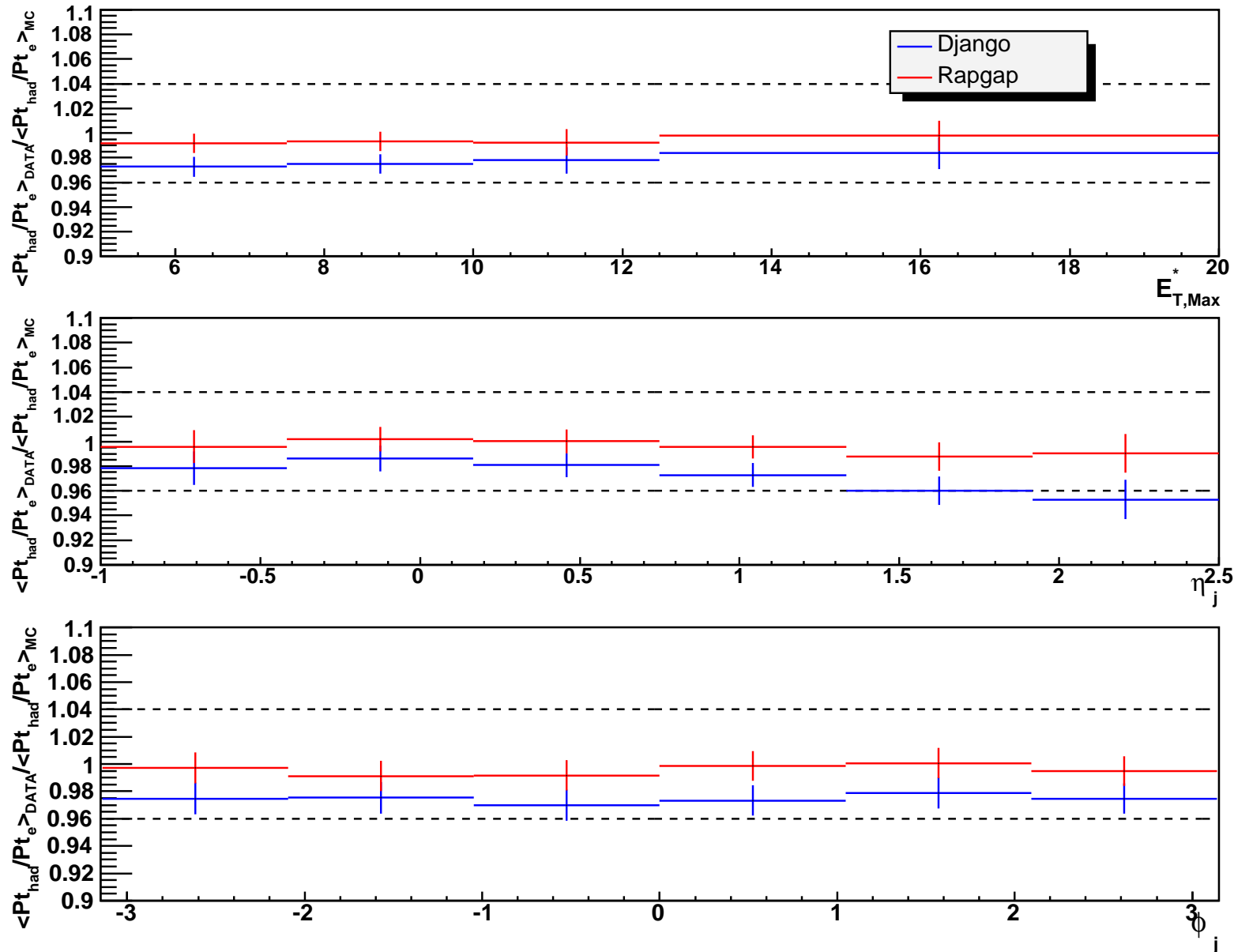
Pt Balance



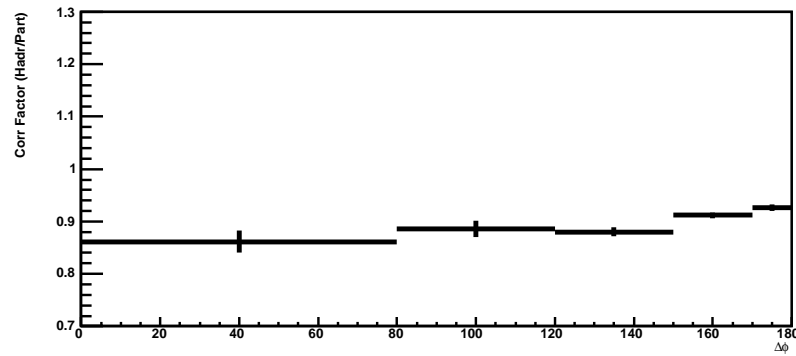
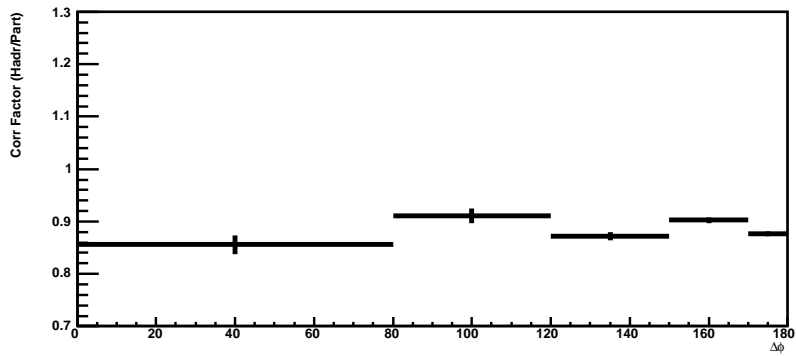
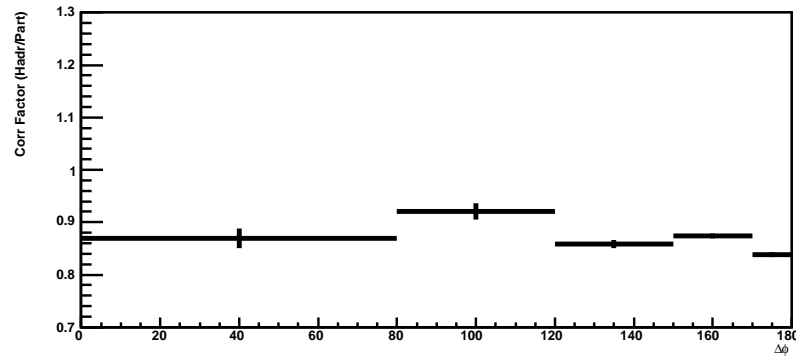
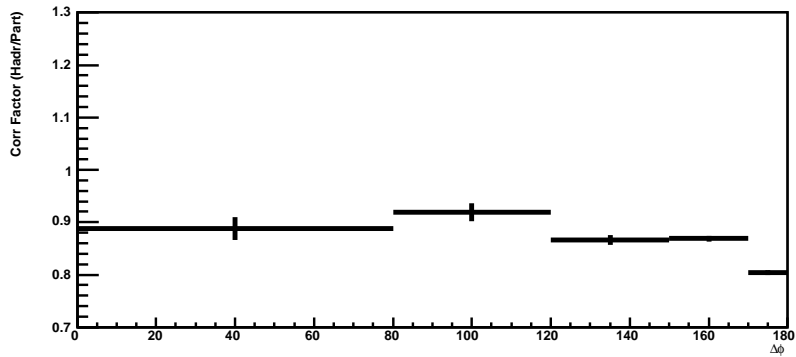
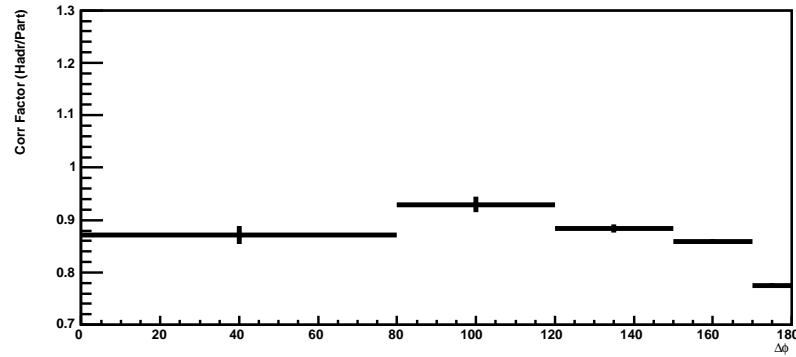
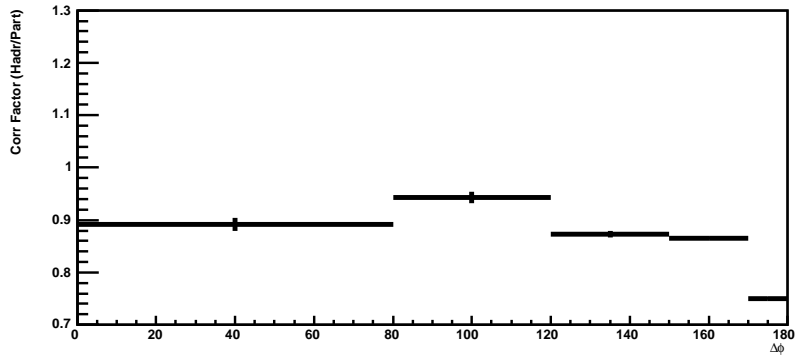
Pt Balance Mean Values



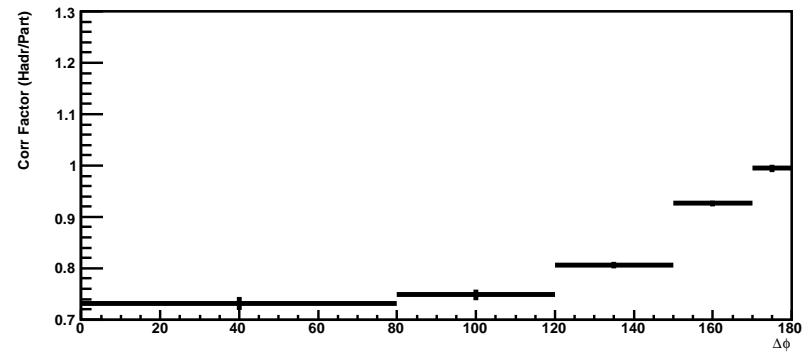
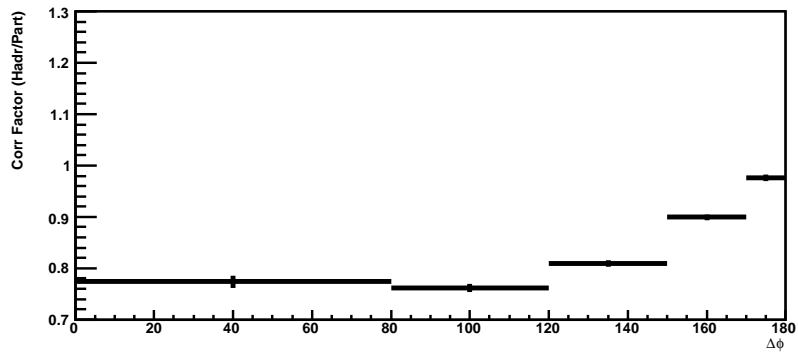
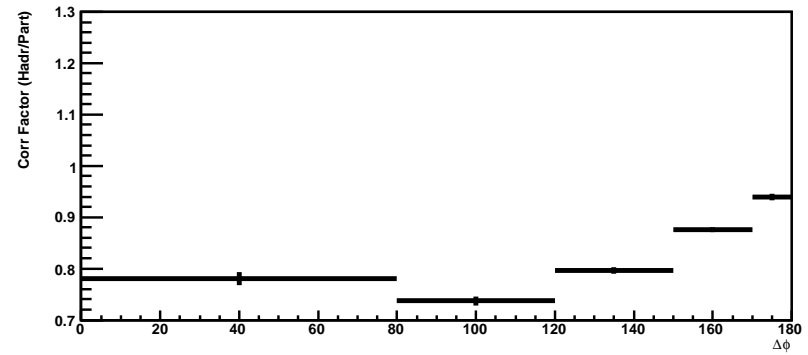
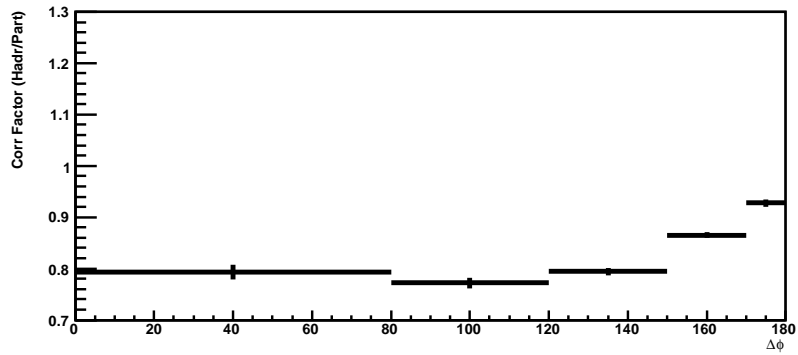
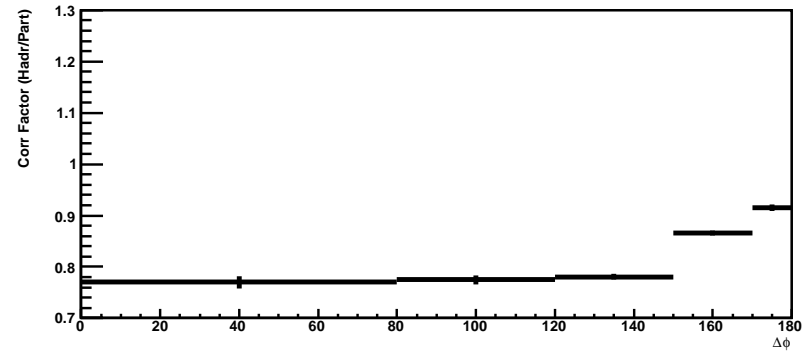
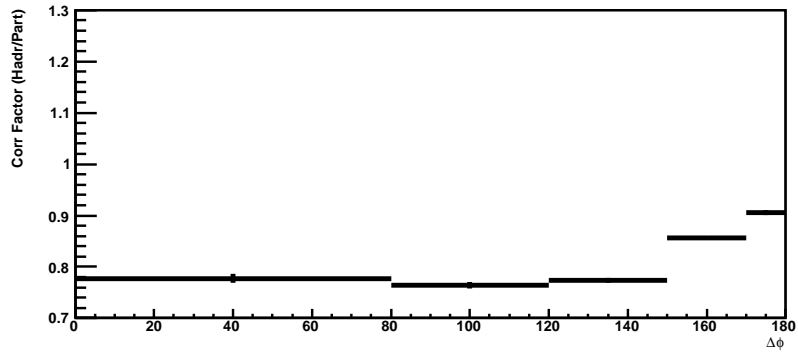
Pt Balance Double Ratio



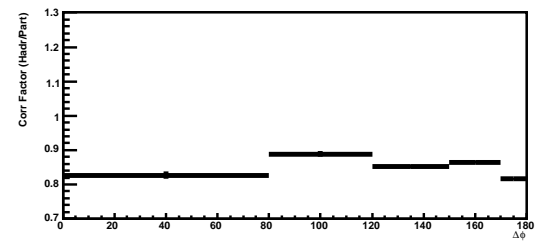
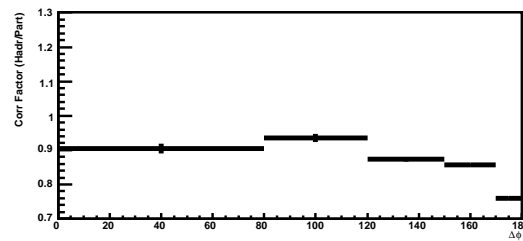
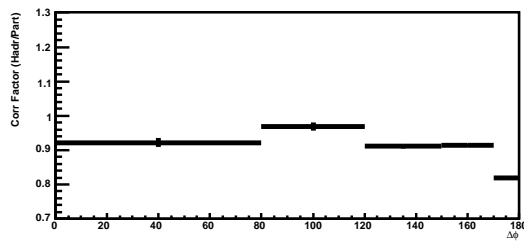
NLO 2-jet Corrections (Cascade KMR)



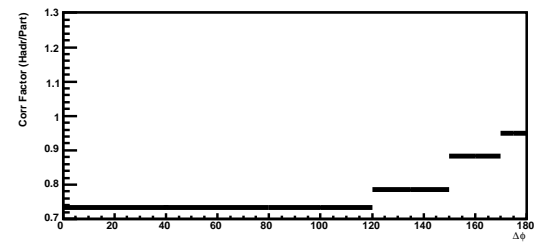
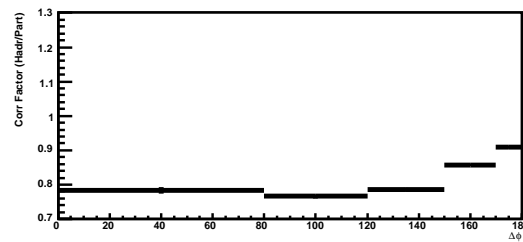
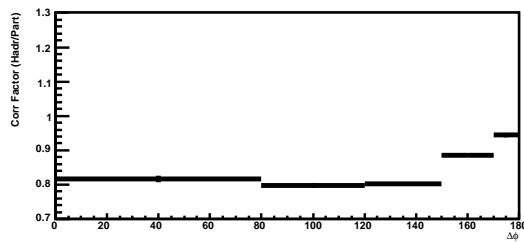
NLO 3-jet Corrections (Cascade A0)



NLO 2-jet Corrections (Cascade KMR)



NLO 3-jet Corrections (Cascade A0)



DPhi Migrations (Symm. Cuts., Diagonal = Stability)

