φ-meson Global Spin Alignment Update

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Deriving 4th Order Acceptance Correction

$$\left[\frac{dN}{d\cos\theta^* d\beta}\right]_{|\eta|} = \frac{dN}{d\cos\theta^* d\beta} \times g(\theta^*, \beta).$$

$$g(\theta^*, \beta) = 1 + F\cos^2\theta + G\cos^4\theta$$

$$= 1 + \left(\frac{4F+3G}{8}\right) - \left(\frac{2F+3G}{4}\right)\cos^2\theta^* + \frac{3G}{8}\cos^4\theta^*$$

$$-\frac{\cos 2\beta}{2}\left[F(1-\cos^2\theta^*) + G(1-\cos^2\theta^*+\cos^4\theta^*)\right]$$

$$+\frac{G\cos 4\beta}{8}\left[1-\cos^2\theta^*+\cos^4\theta^*\right],$$

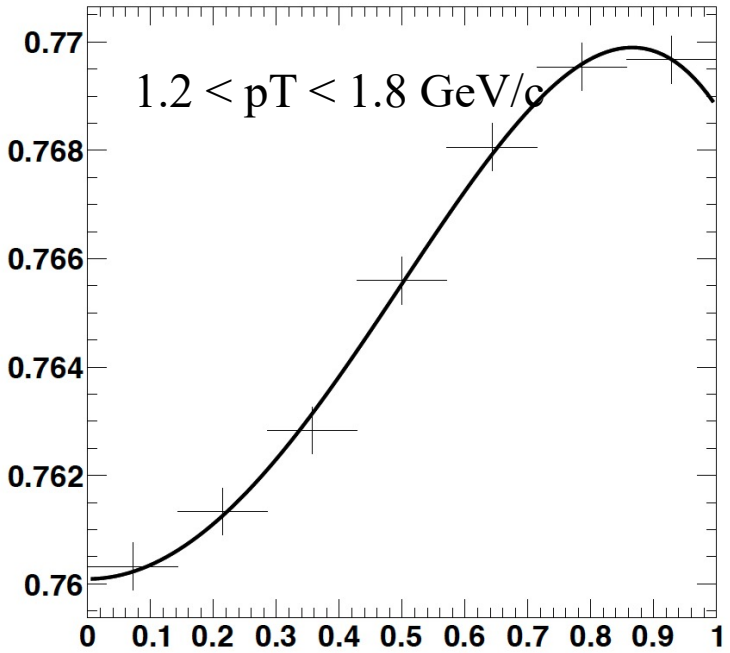
$$\int_0^{2\pi} d\beta\, g(\theta^*, \beta) = g(\theta^*) \propto 1 + \left(\frac{4F+3G}{8}\right) - \left(\frac{2F+3G}{4}\right)\cos^2\theta^* + \frac{3G}{8}\cos^4\theta^*.$$

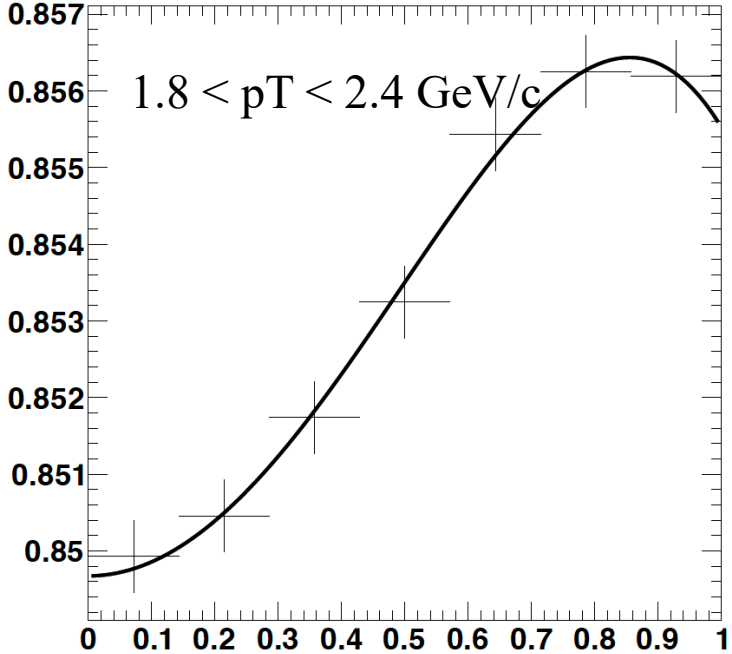
Deriving 4th Order Acceptance Correction

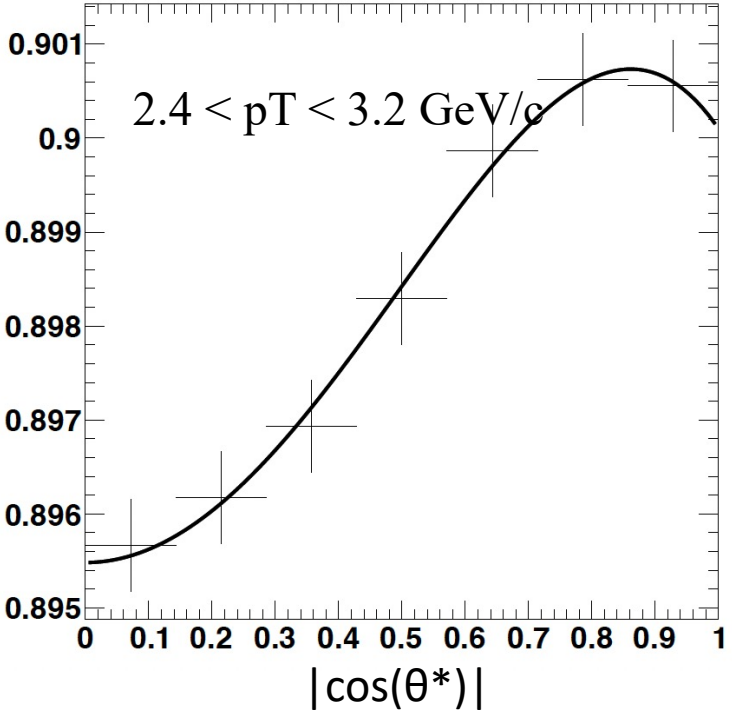
$$\frac{dN}{d\cos\theta^* d\beta} \propto 1 + A\cos^2\theta^* + B\sin^2\theta^*\cos 2\beta + C\sin 2\theta^*\cos\beta\,.$$

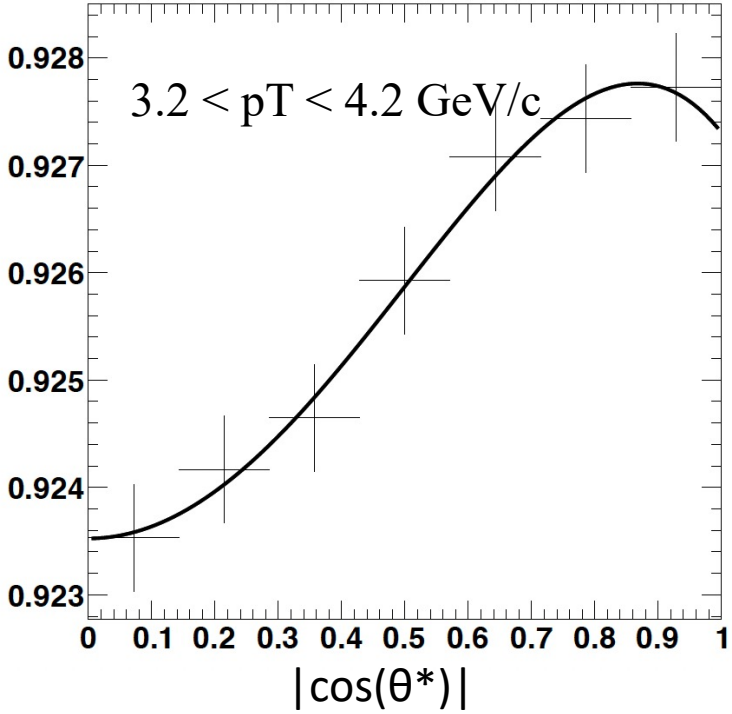
$$\left[\frac{dN}{d\cos\theta^* d\beta}\right]_{|\eta|} \propto 2 + F - \frac{BF}{2} + \frac{3G}{4} - \frac{BG}{2}$$
$$+ \left[2A - F(1 - A - B) - G\left(\frac{3}{2} - \frac{3A}{4} - \frac{3B}{2}\right)\right]\cos^2\theta^*$$
$$+ \left[-F\left(A + \frac{B}{2}\right) + G\left(\frac{3}{4} - \frac{3A}{2} - \frac{3B}{2}\right)\right]\cos^4\theta^*$$
$$+ \left[G\left(\frac{3A}{4} + \frac{B}{2}\right)\right]\cos^6\theta^*\,.$$

$$A = \frac{A'(1+3R)}{4 + A'(1-R)}\,, \qquad B = \frac{A'(1-R)}{4 + A'(1-R)}\,, \qquad A' = \frac{3\rho_{00} - 1}{1 - \rho_{00}}$$

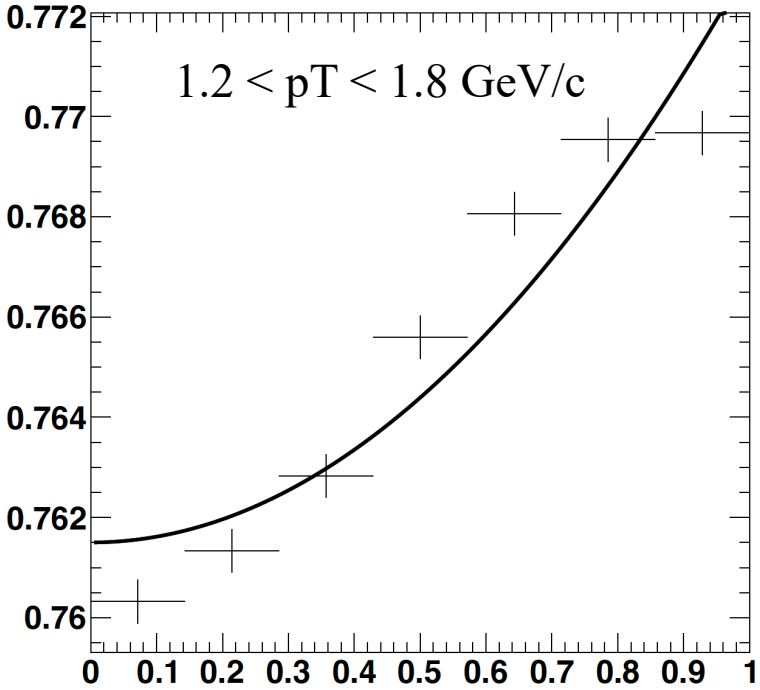

1.2 < pT < 1.8 GeV/c
0.77
0.768
0.766
0.764
0.762
0.76
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

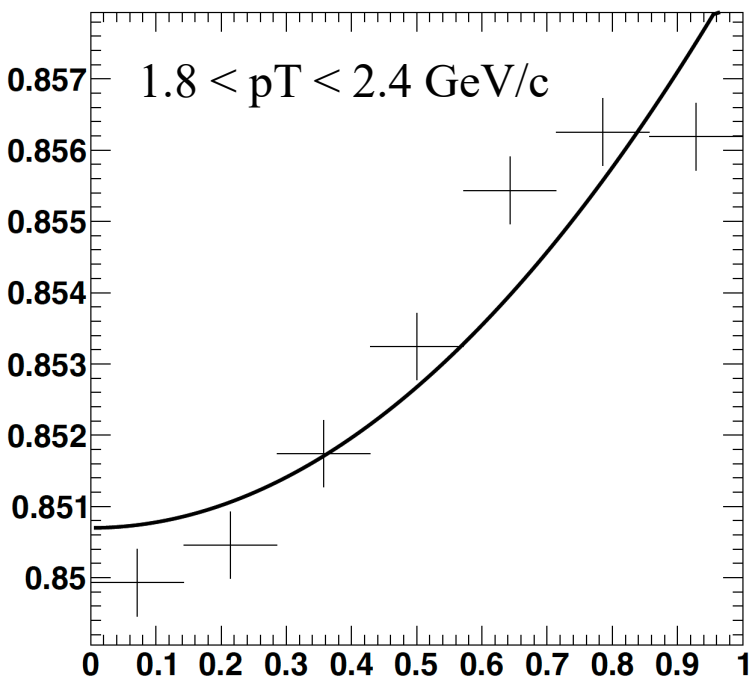

1.8 < pT < 2.4 GeV/c
0.857
0.856
0.855
0.854
0.853
0.852
0.851
0.85
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

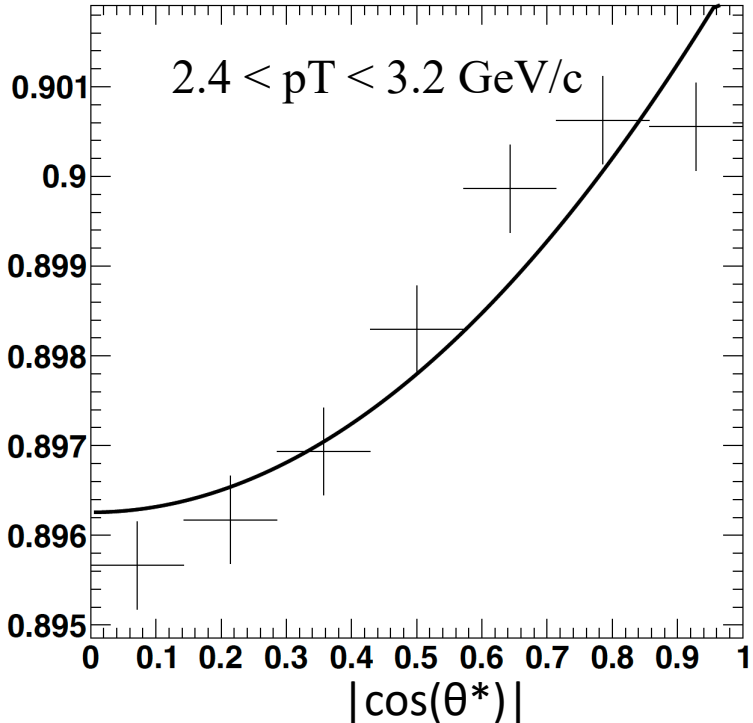

2.4 < pT < 3.2 GeV/c
0.901
0.9
0.899
0.898
0.897
0.896
0.895
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
|cos(θ*)|

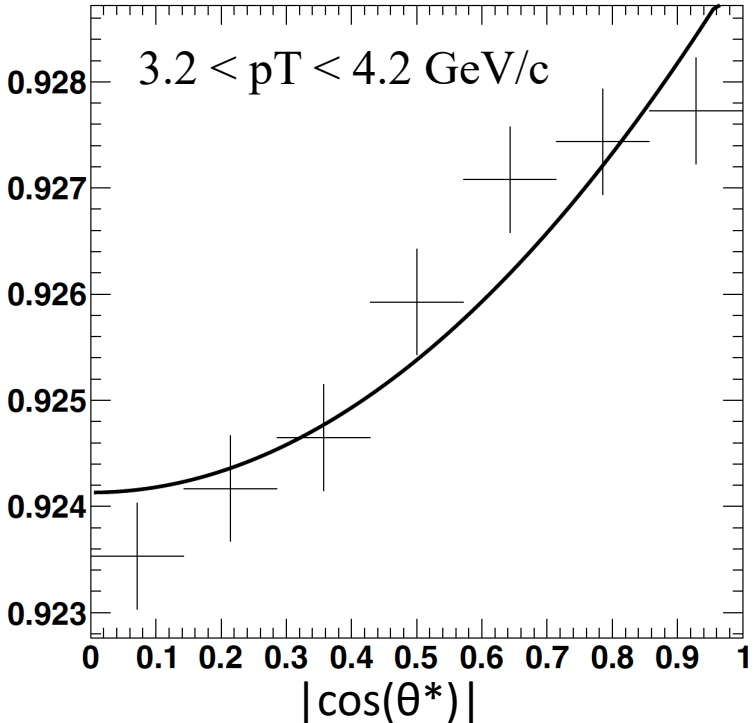

3.2 < pT < 4.2 GeV/c
0.928
0.927
0.926
0.925
0.924
0.923
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
|cos(θ*)|

4th Order


1.2 < pT < 1.8 GeV/c
0.772
0.77
0.768
0.766
0.764
0.762
0.76
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1


1.8 < pT < 2.4 GeV/c
0.857
0.856
0.855
0.854
0.853
0.852
0.851
0.85
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1


2.4 < pT < 3.2 GeV/c
0.901
0.9
0.899
0.898
0.897
0.896
0.895
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
|cos(θ*)|

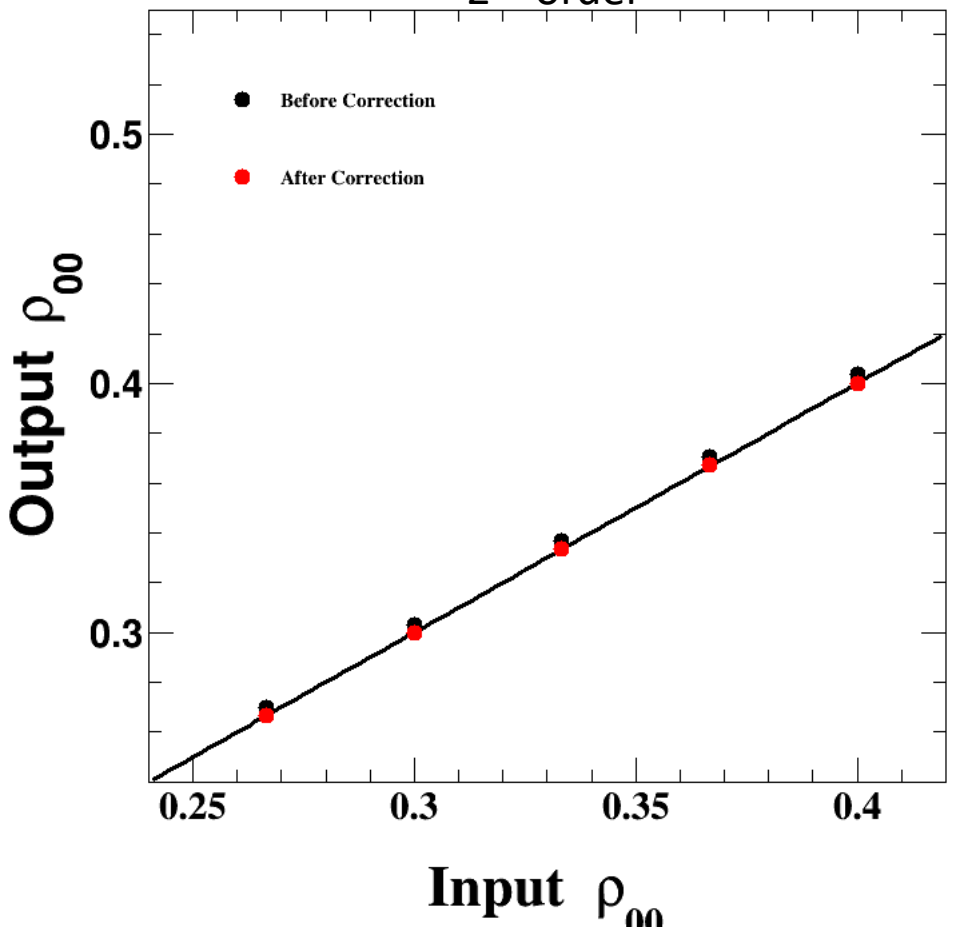

3.2 < pT < 4.2 GeV/c
0.928
0.927
0.926
0.925
0.924
0.923
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
|cos(θ*)|

2nd Order

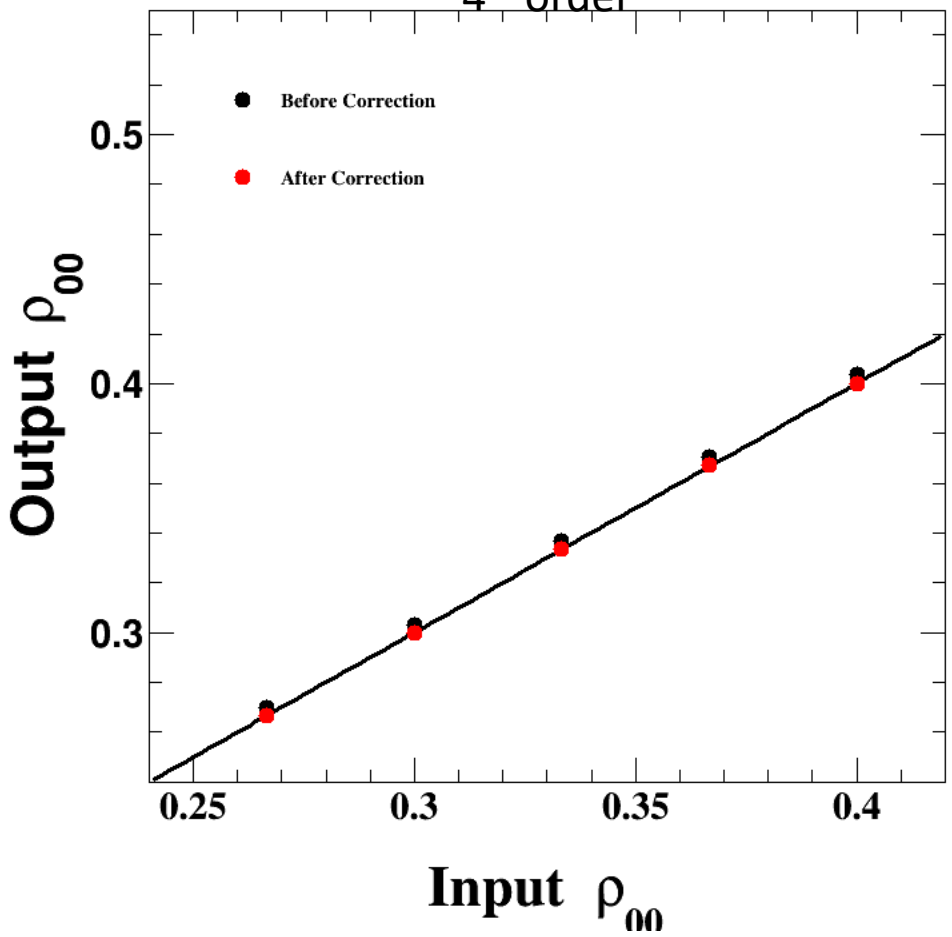
Acceptance Correction QA (pT dependence)

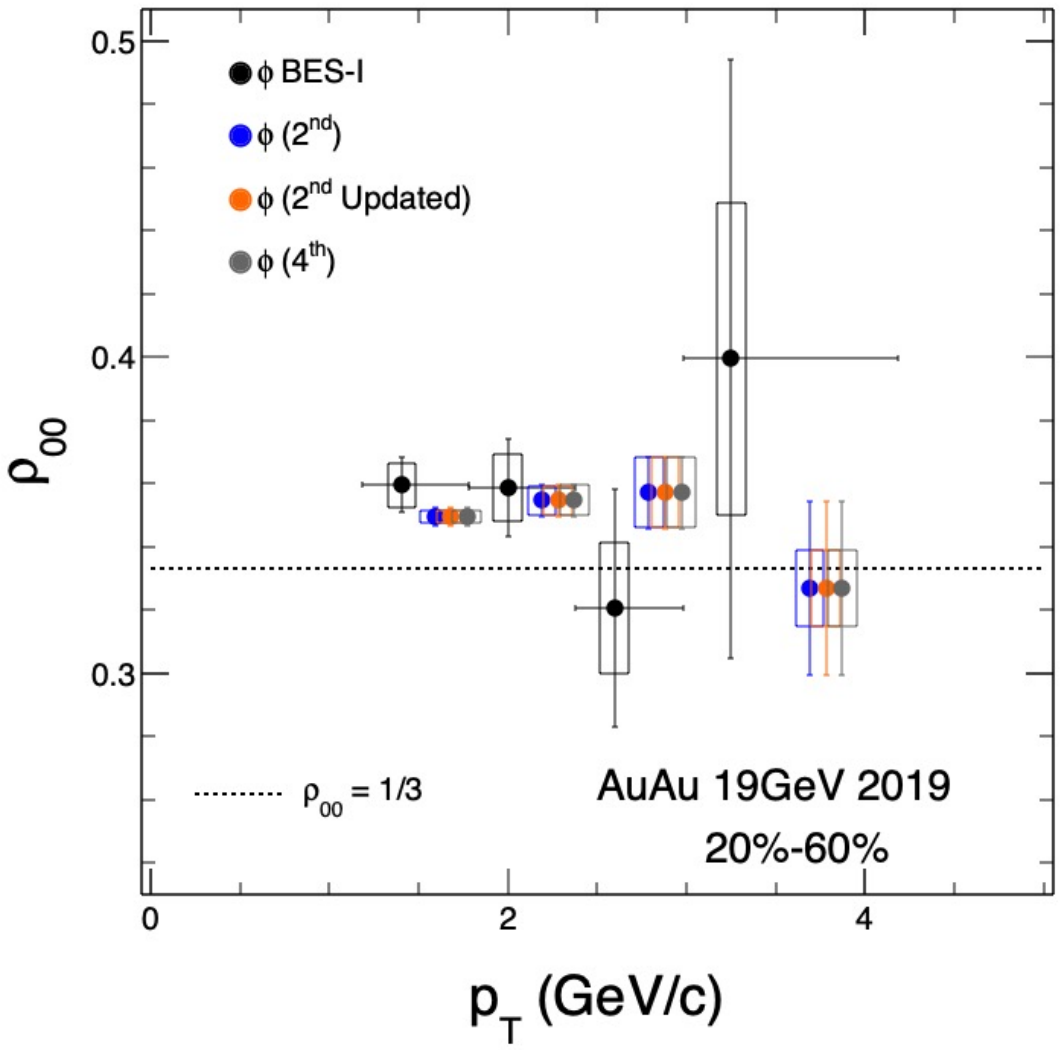
1.2 < pT < 1.8 GeV/c

2nd order



4th order



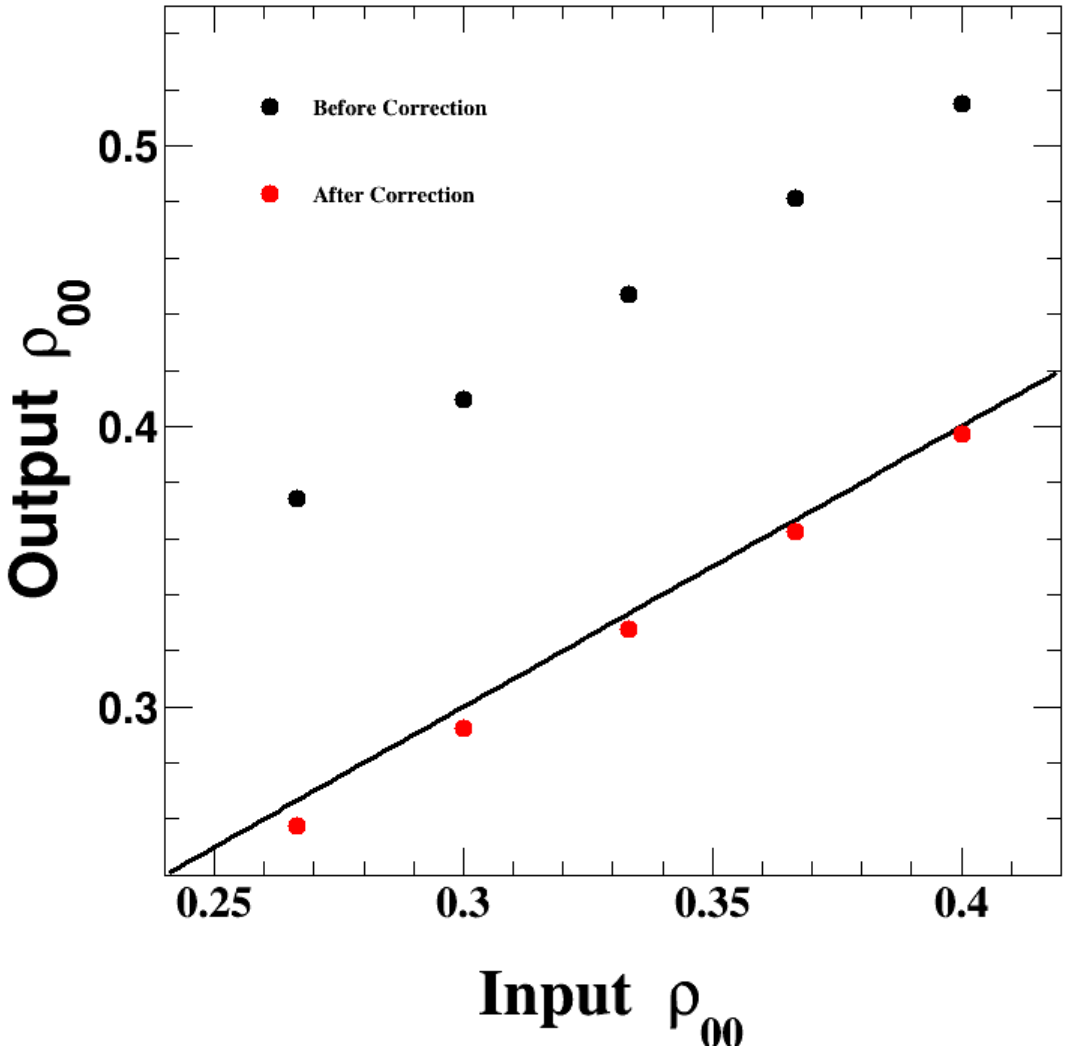


Correction	ρ00	stat	sys	σ from 1/3
2nd	0.3505	0.0024	0.0025	4.92
2nd Updated	0.3505	0.0024	0.0025	4.92
4th	0.3507	0.0024	0.0025	4.96

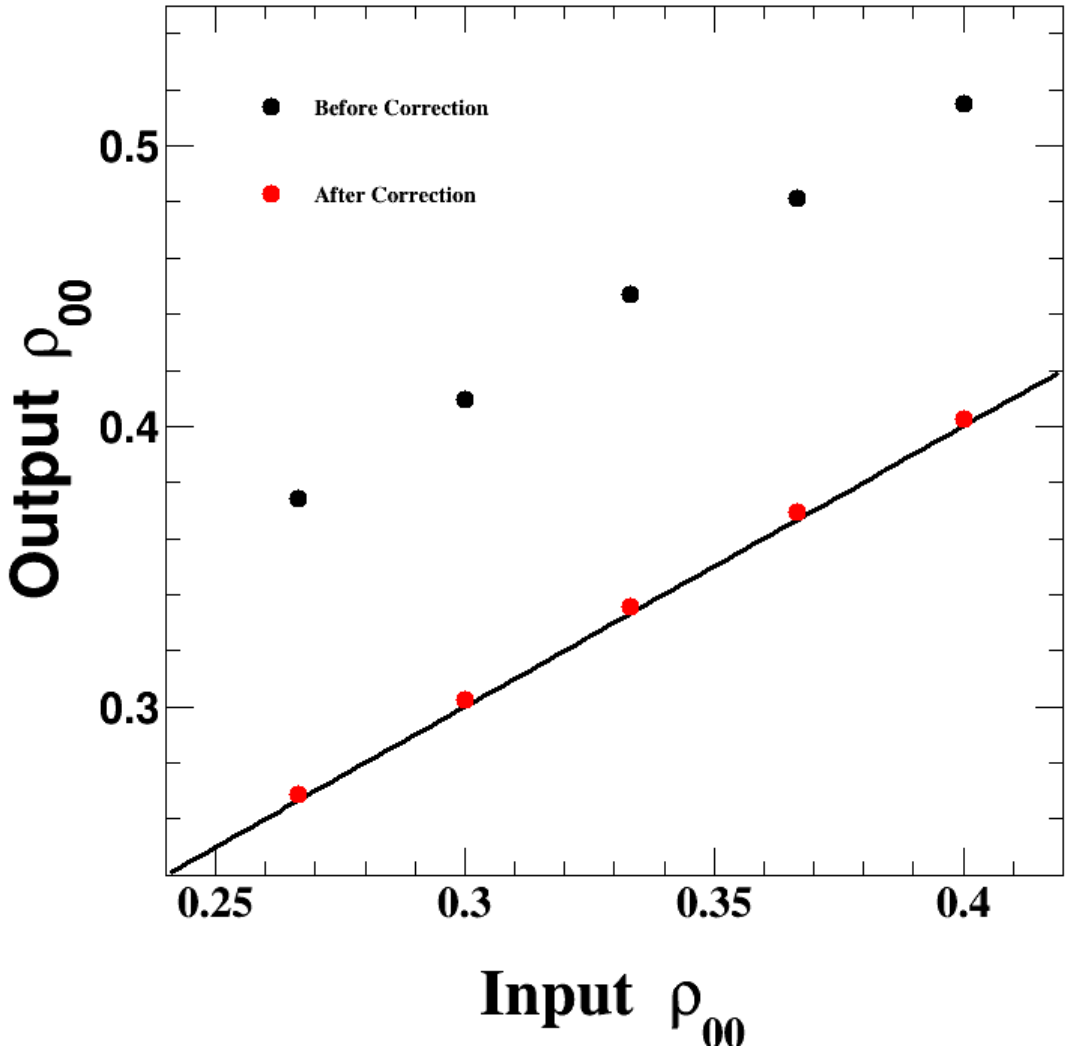
Acceptance Correction QA Comparison

$0.8 < y < 1.0$
$1.0 < pT < 1.8$ GeV/c

2nd Order



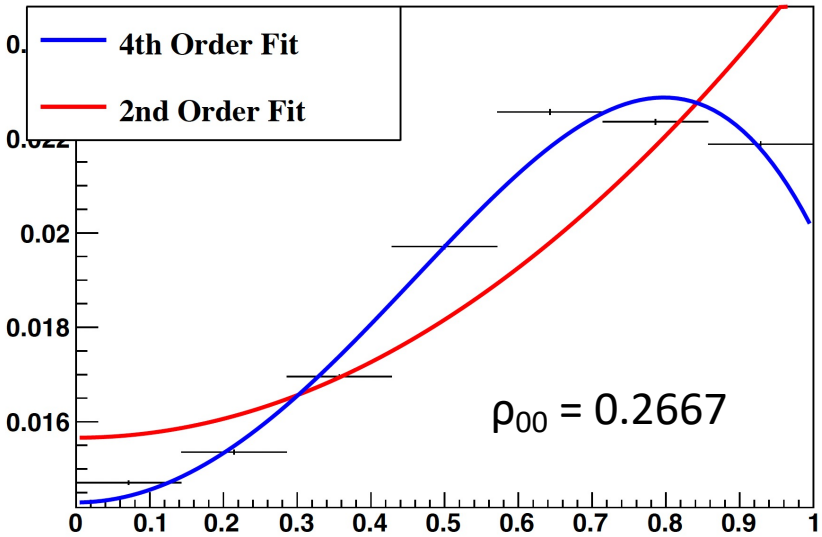
4th Order

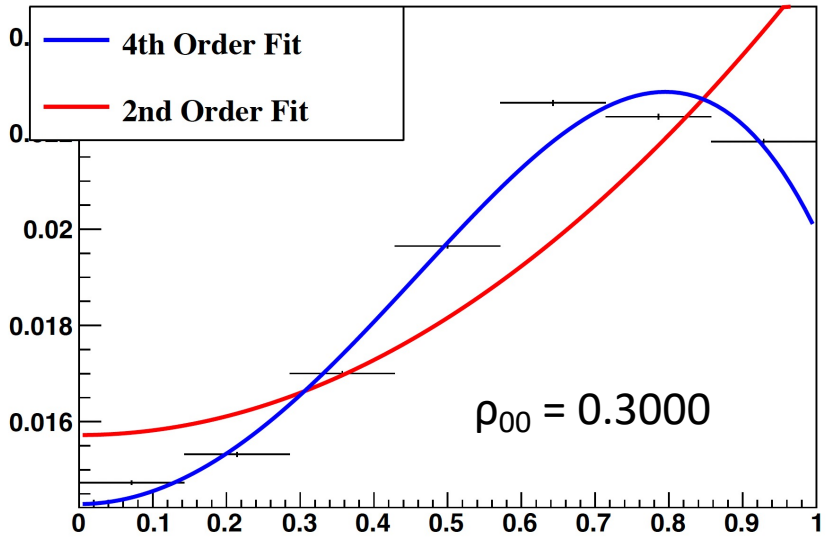


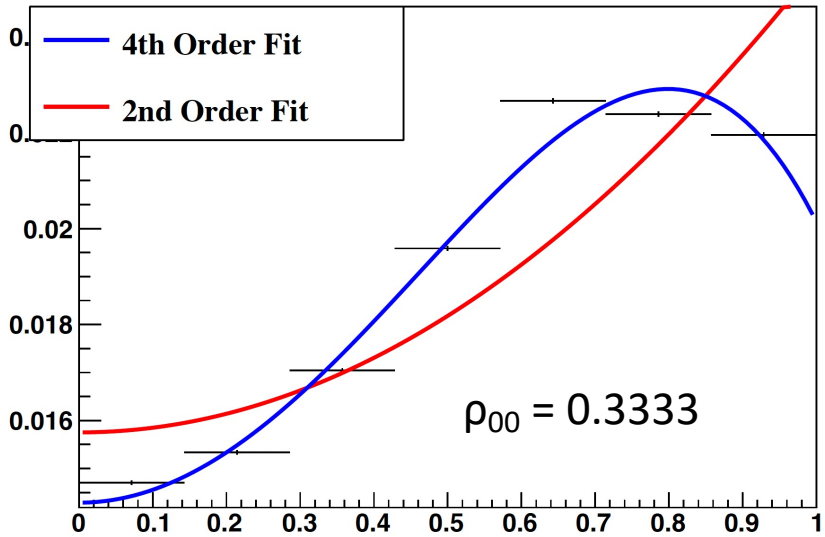
Acceptance Correction QA Comparison

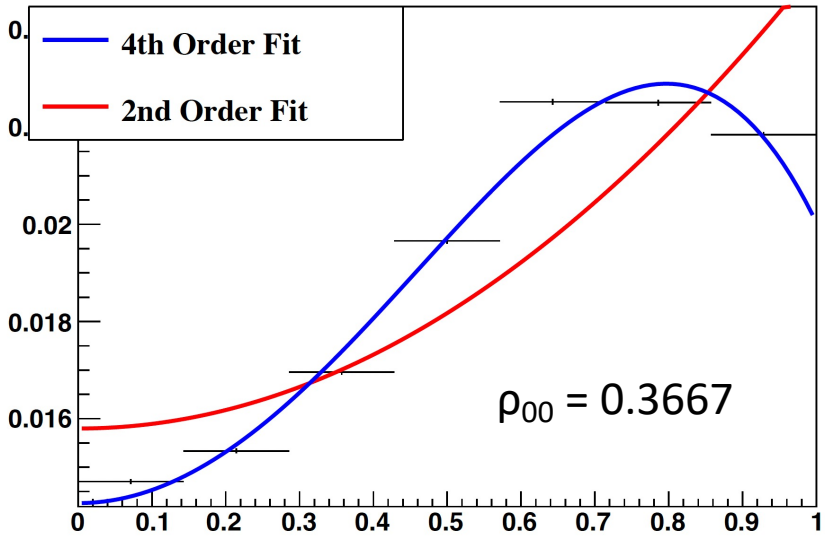
$0.8 < y < 1.0$

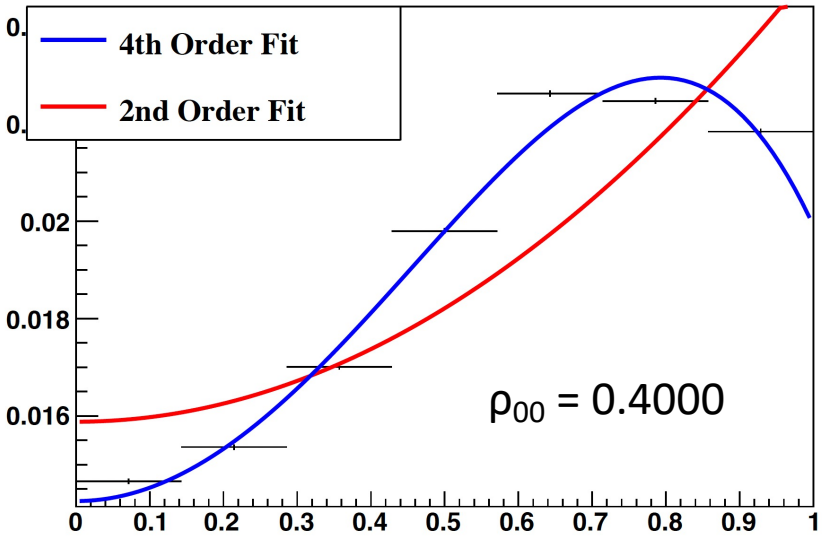
$1.0 < pT < 1.8$ GeV/c



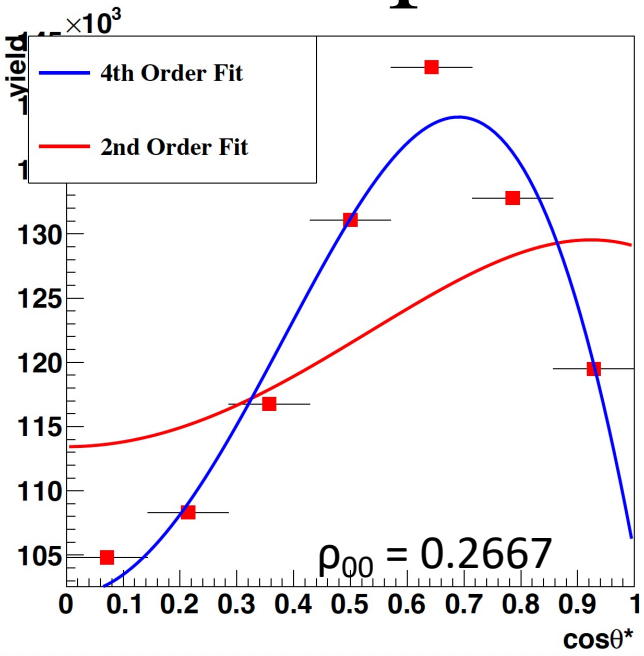


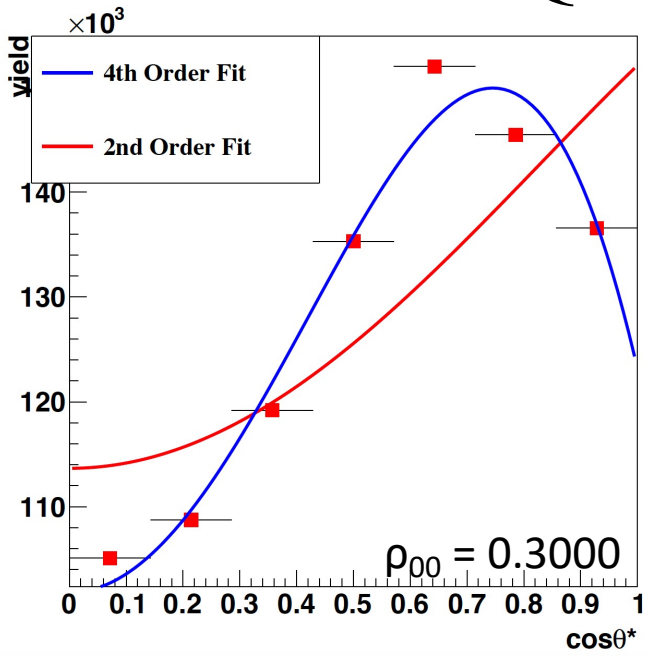


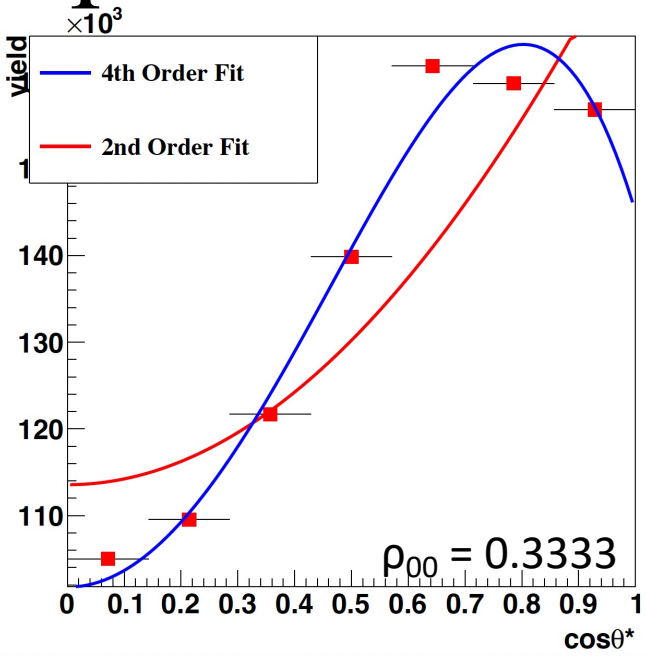




Acceptance Correction QA Comparison

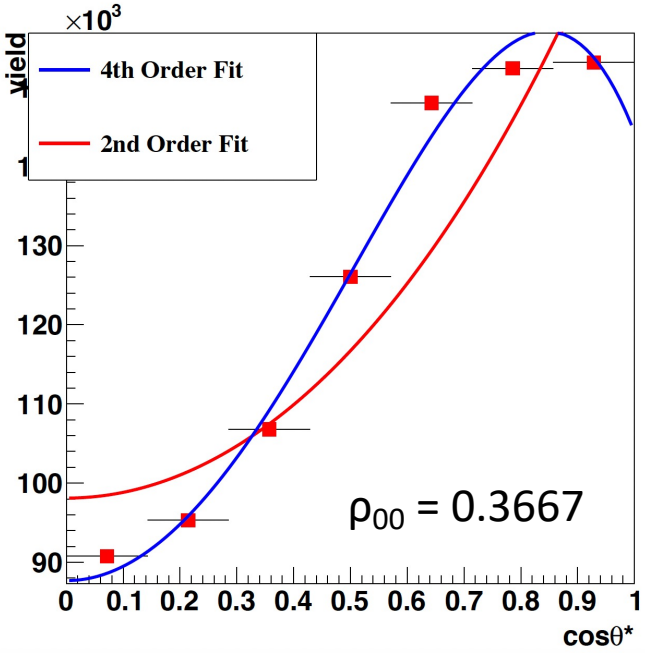


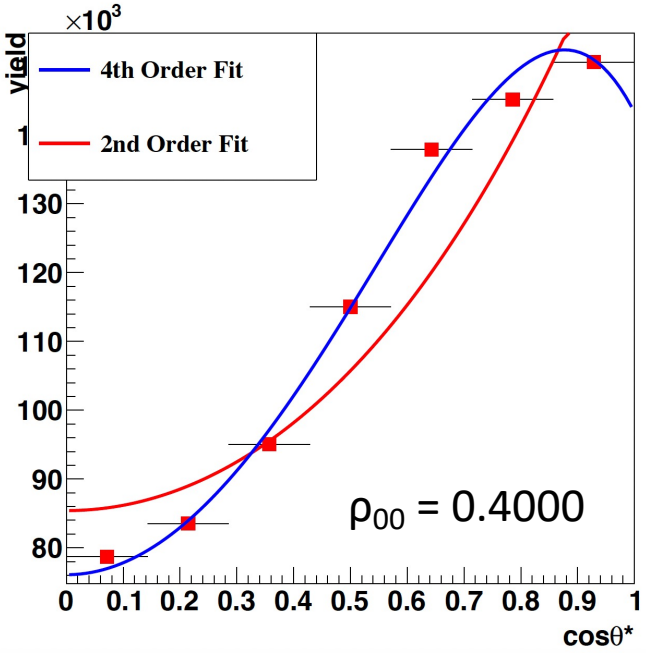




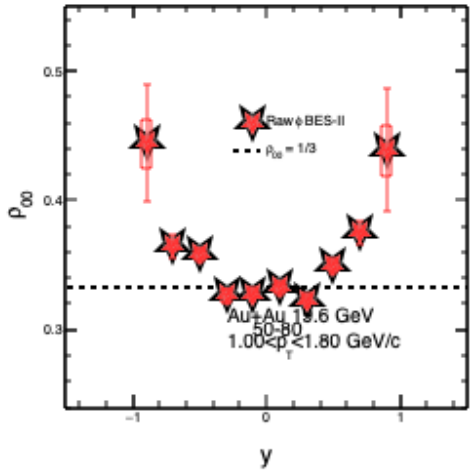
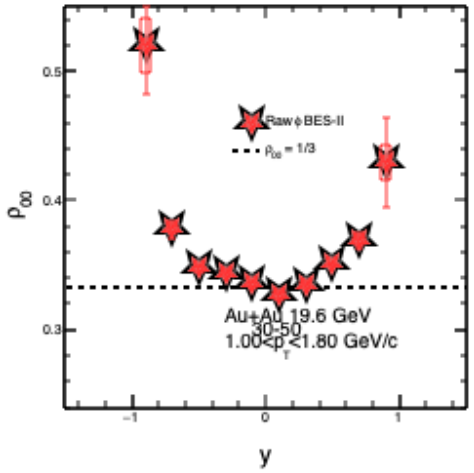
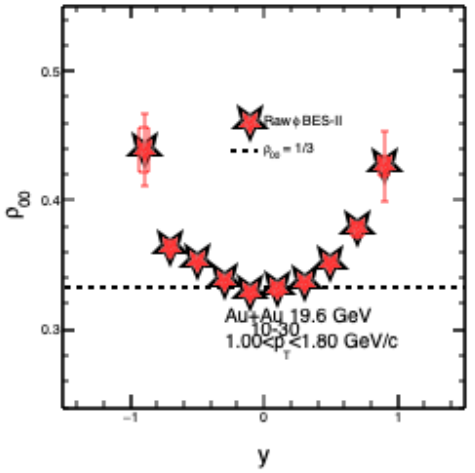
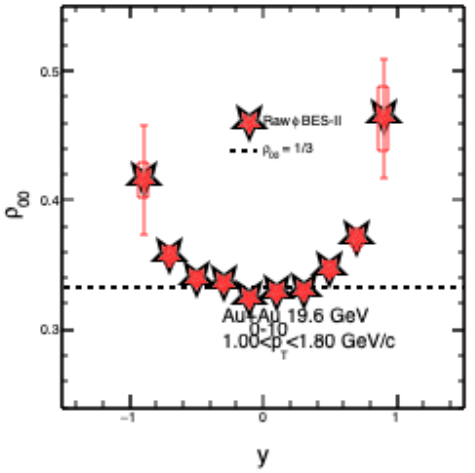
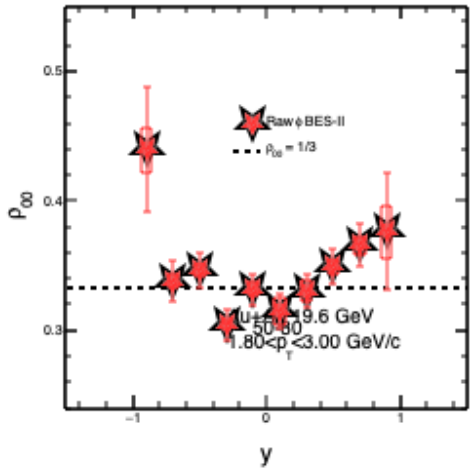
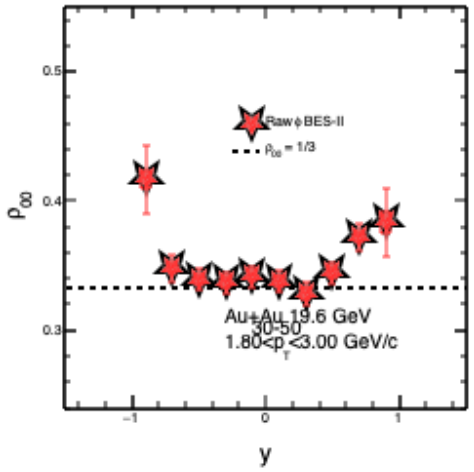
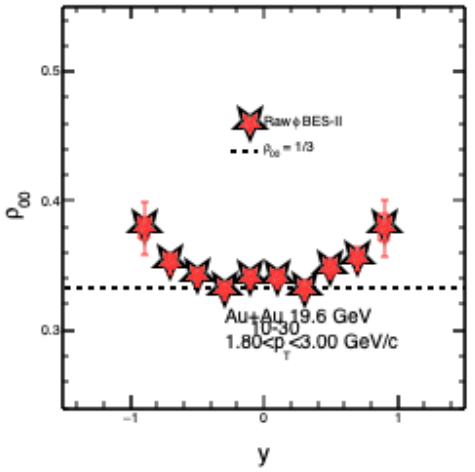
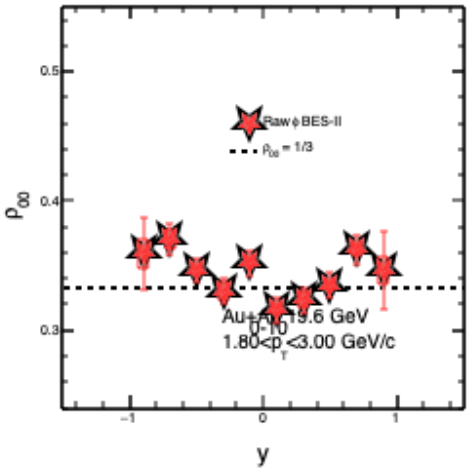
$0.8 < y < 1.0$

$1.0 < pT < 1.8$ GeV/c





Rapidity Dependence |η| < 1.0 (Raw)

	50-80%	30-50%	10-30%	0-10%
1.0 < pT < 1.8 Gev/c				
1.8 < pT < 3.0 Gev/c				

Rapidity Dependence |η| < 1.0 (Corrected)

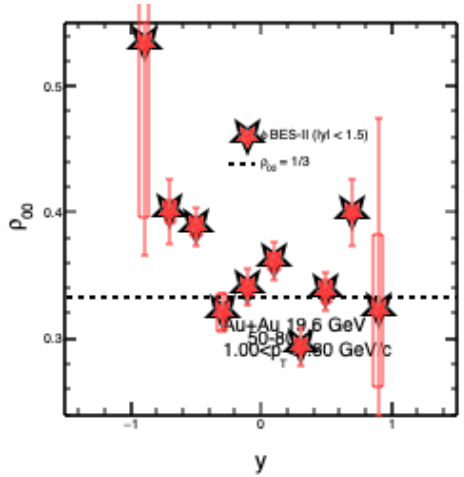
50-80%

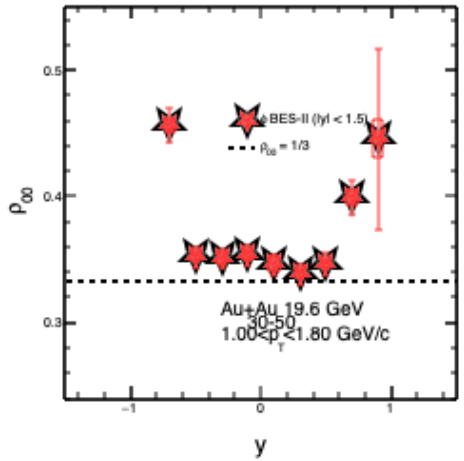
30-50%

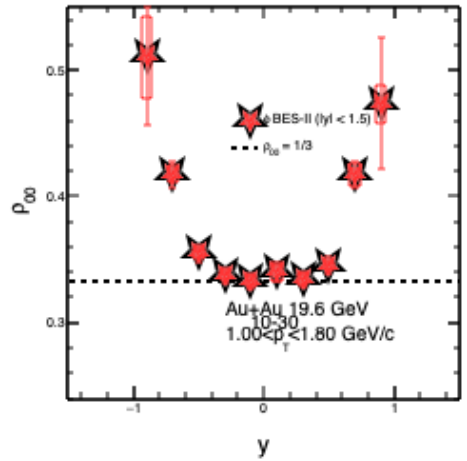
10-30%

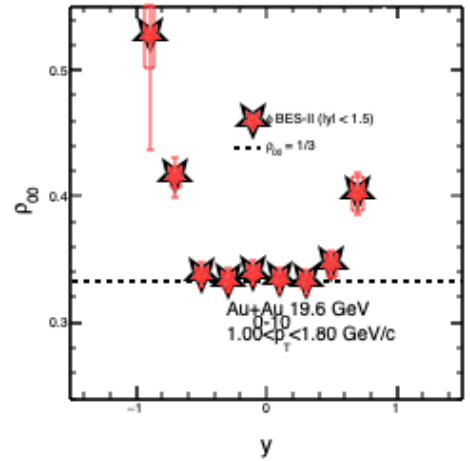
0-10%

1.0 < pT < 1.8 Gev/c

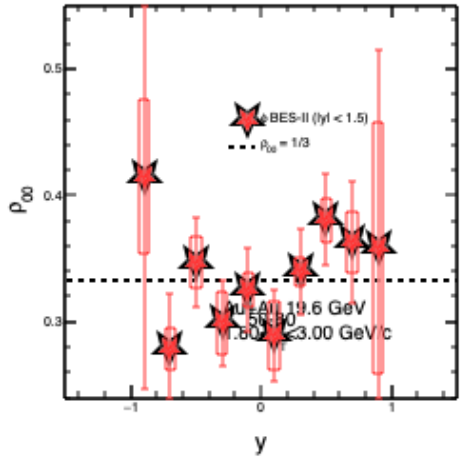


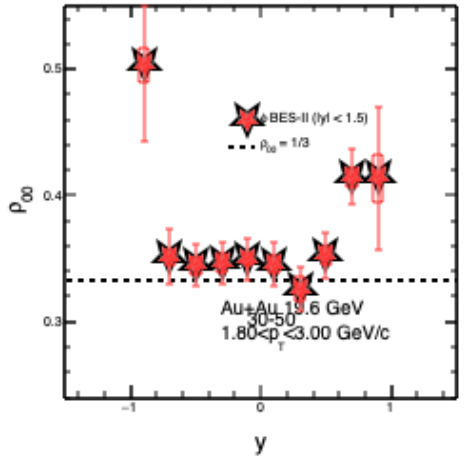


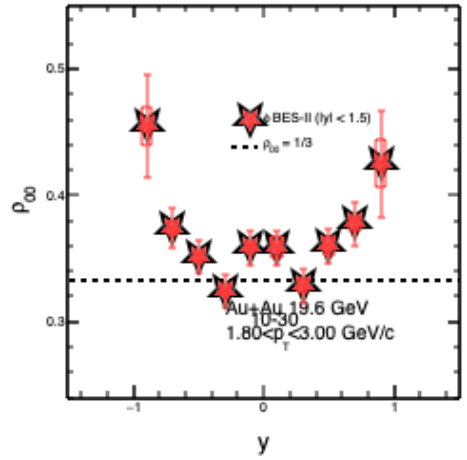


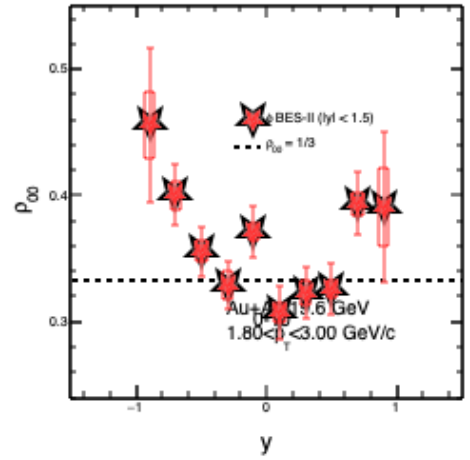


1.8 < pT < 3.0 Gev/c



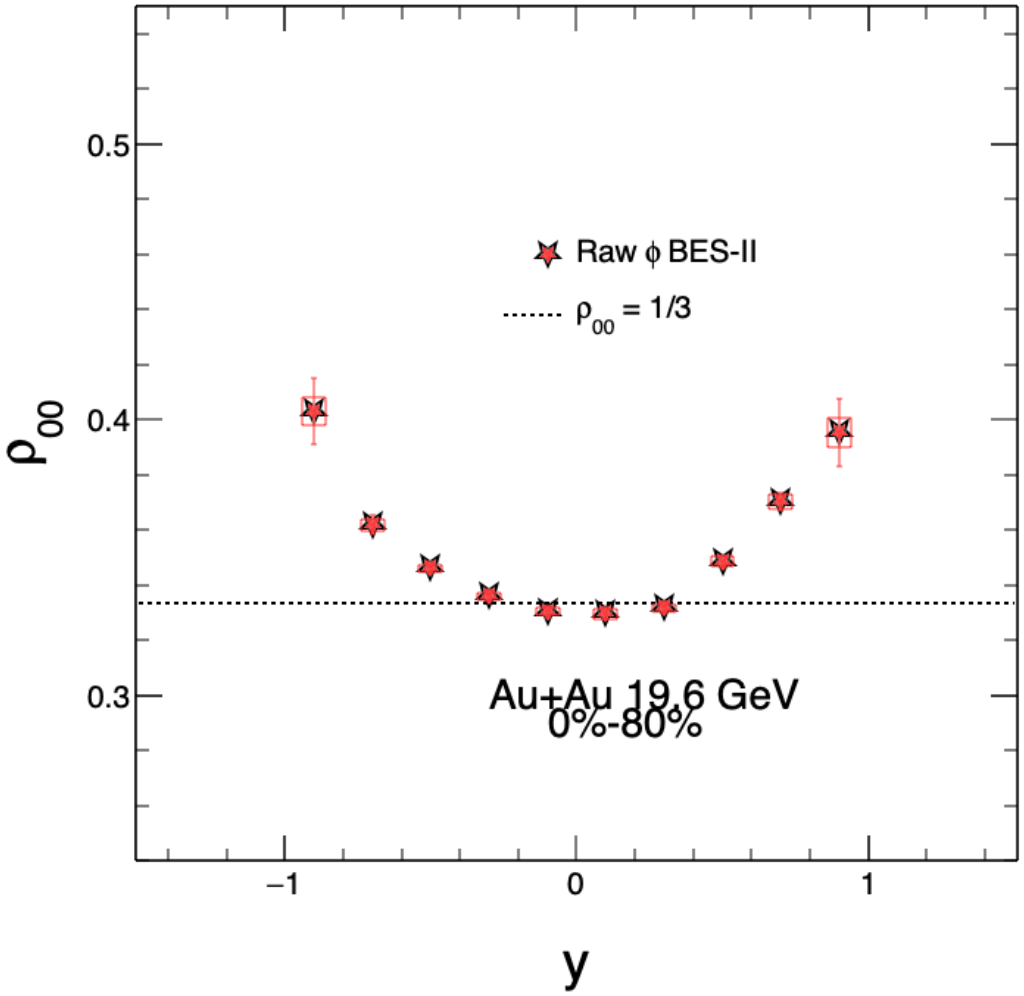




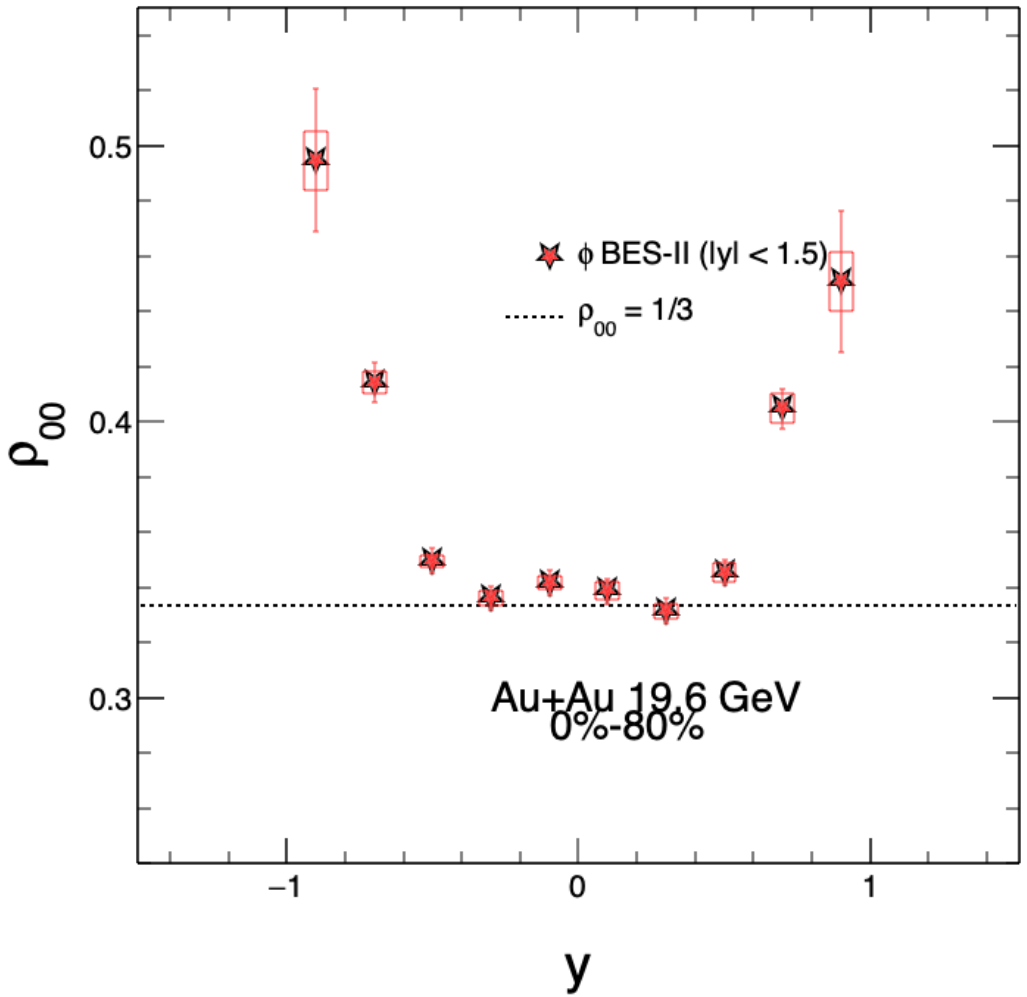


Rapidity Dependence $|\eta| < 1.0$

Raw

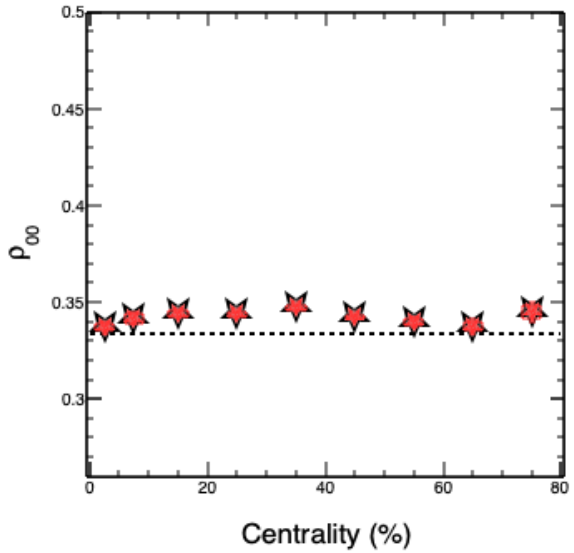


Fully Corrected

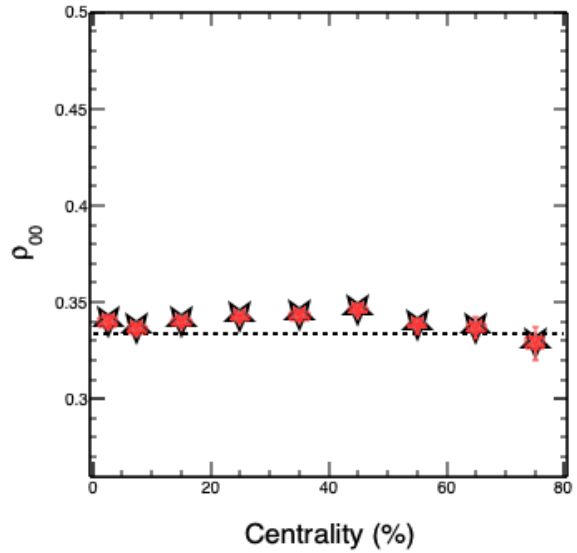


Rapidity Dependence $|\eta| < 1.0$ (Raw)

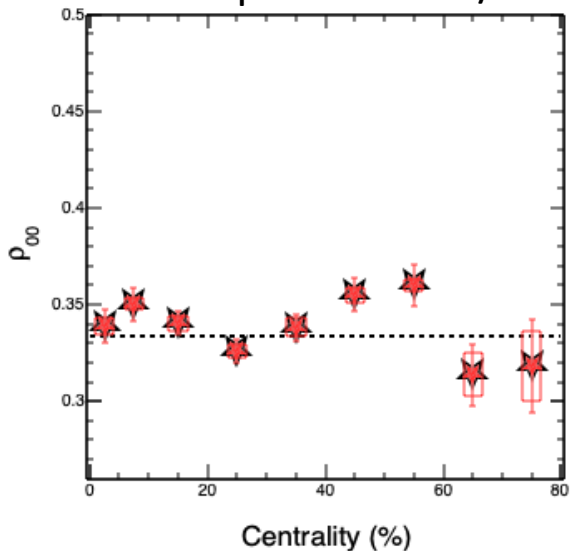
1.0 < pT < 1.6 Gev/c



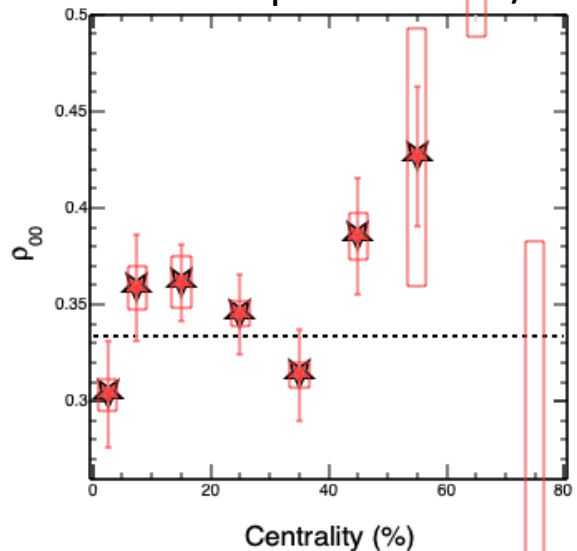
1.6 < pT < 2.4 Gev/c



2.4 < pT < 3.4 Gev/c

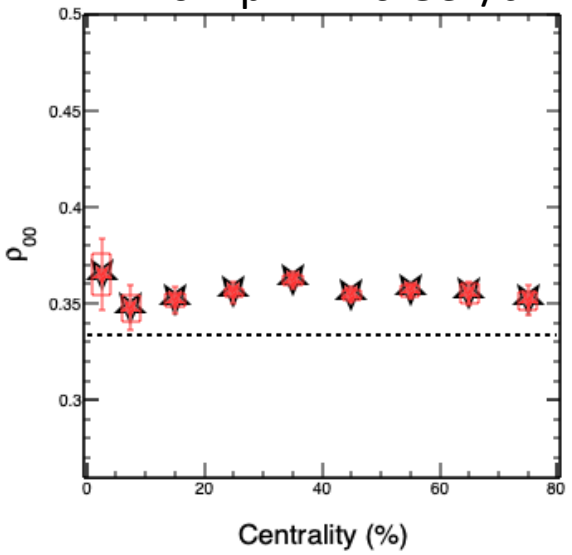


3.4 < pT < 5.0 Gev/c

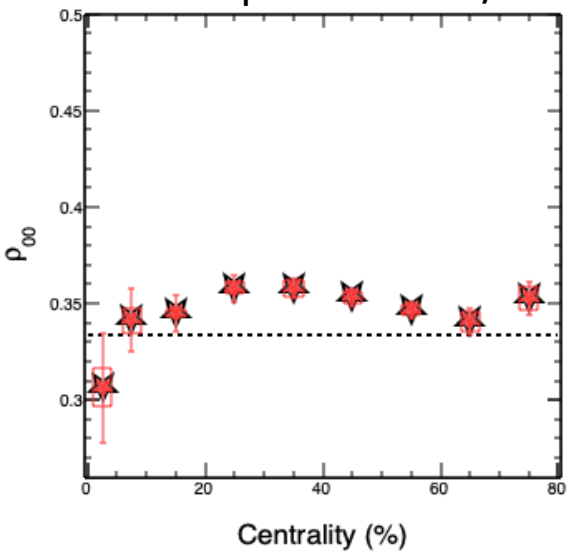


Rapidity Dependence $|\eta| < 1.0$ (Corrected)

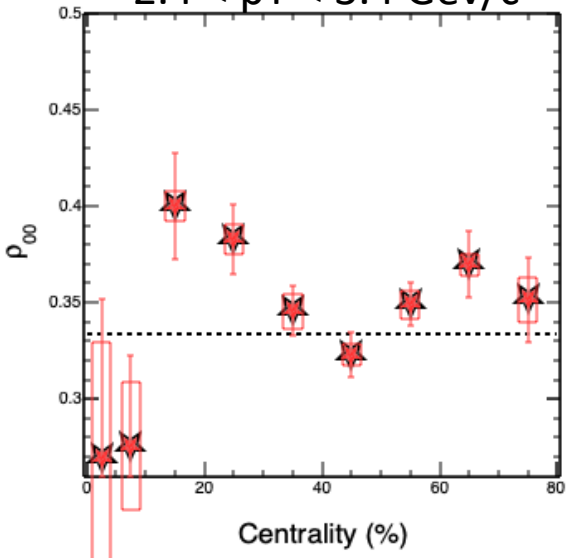
1.0 < pT < 1.6 Gev/c



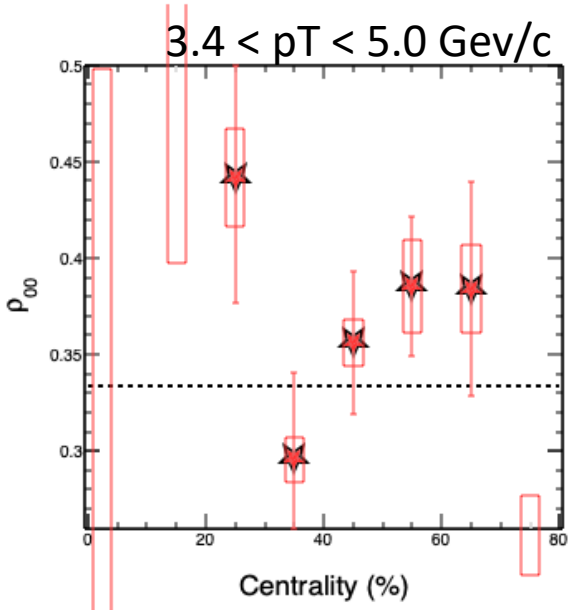
1.6 < pT < 2.4 Gev/c



2.4 < pT < 3.4 Gev/c

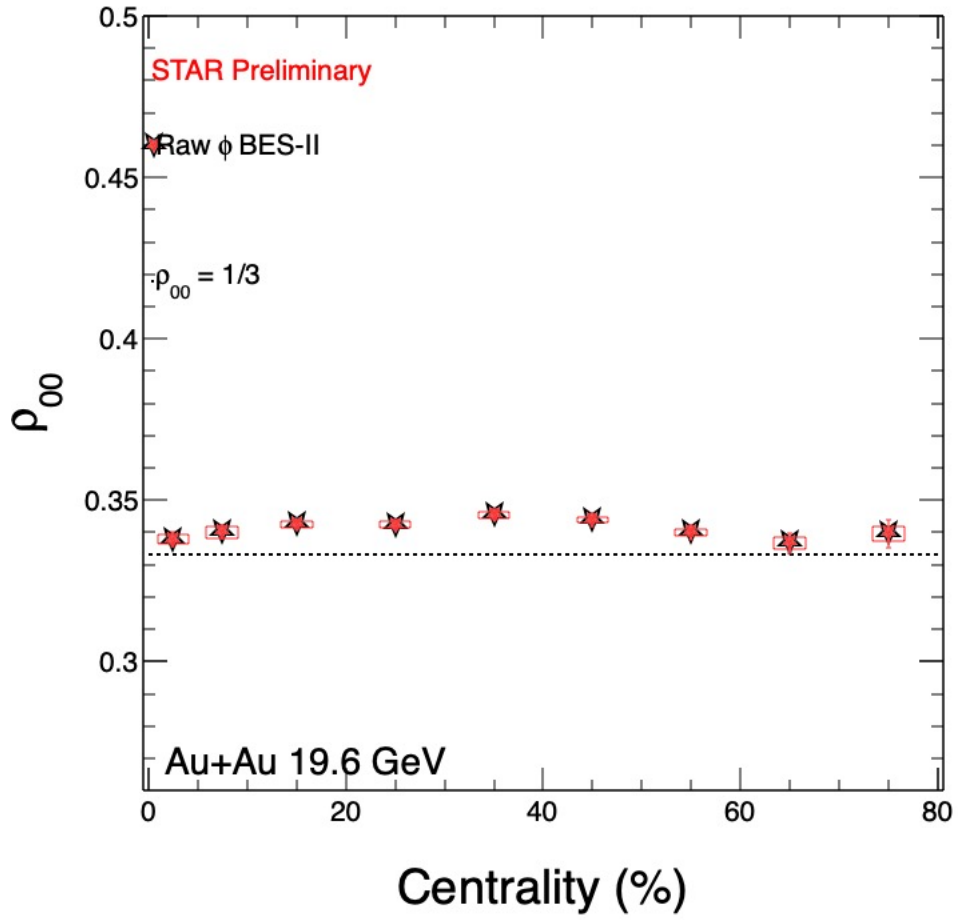


3.4 < pT < 5.0 Gev/c

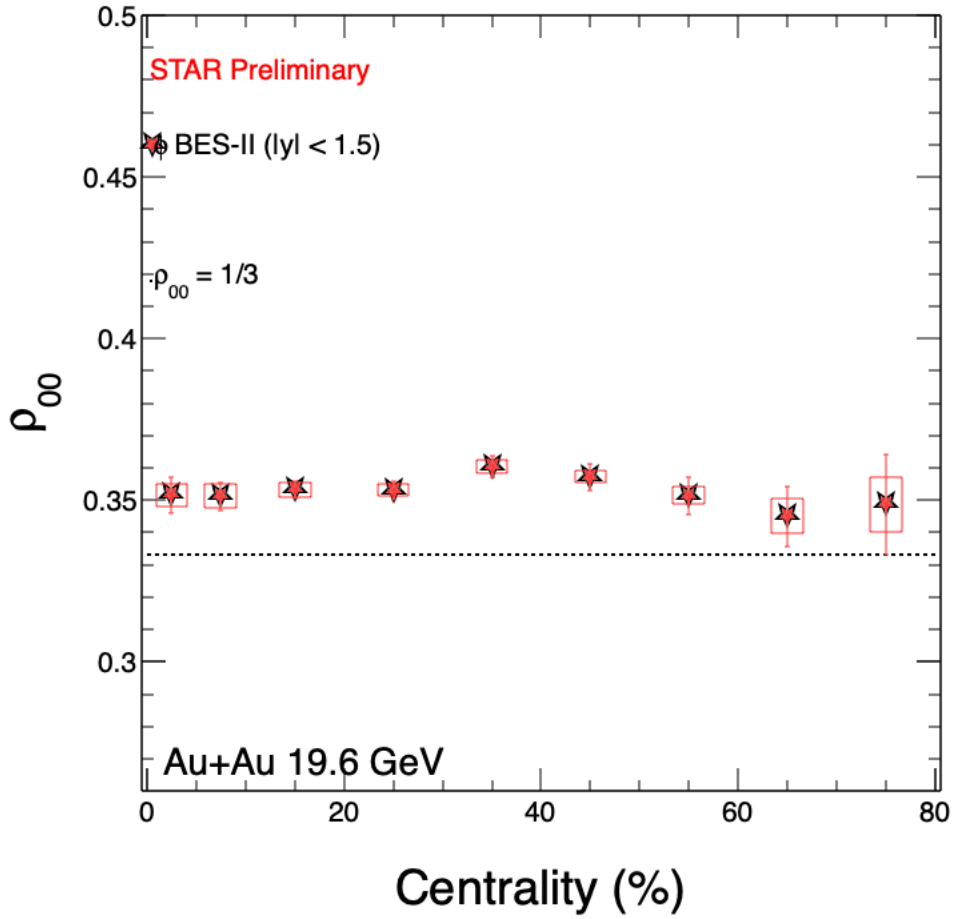


Rapidity Dependence $|\eta| < 1.0$

Raw



Fully Corrected

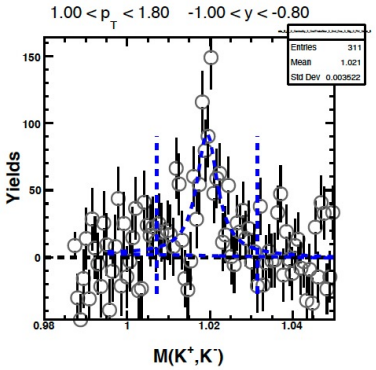


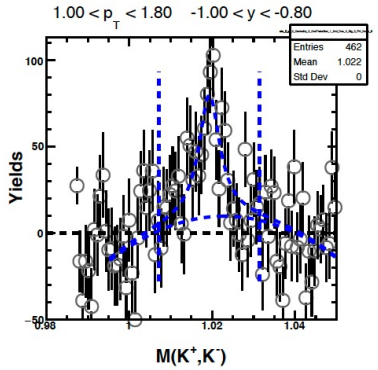
Summary and Outlook

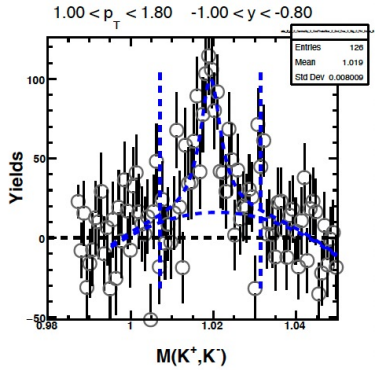
- 4^{th} order acceptance correction derived and in place for all studies.
  - Does not significantly change the result for BES-II pT dependence.
  - Is important for rapidity dependence (did not do QA study for centrality yet).
- Rapidity dependence code in place for $1.0 < pT < 3.0$ GeV/c.
  - Very low yield in edge bins for $3.0 < pT < 5.0$ GeV/c, specifically for the 50-80% centrality bin which causes error in yield extraction on edge bins.
  - Consider rebinning in rapidity, centrality, and/or pT (2 pT bins, very wide second bin, or increase edge rapidity bin width).
- Centrality dependence code in place for $1.0 < pT < 5.0$ GeV/c.
  - Very low yield in 70-80% centrality, $3.4 < pT < 5.0$ GeV/c bin.
  - Consider rebinning slightly in pT (3 bins, very wide 3^{rd} bin).
- Show efficiency correction step (will do first thing tomorrow).
- Repeatedly attempted to perform event mixing for TPC only $|\eta| < 1.0$ with subset of files in from BES-II 19.6GeV, but they keep failing.
  - Going to try with very small number of files per job, maybe 1 or 2. I believe I was using 5 files per job previously and many jobs failed or were held.

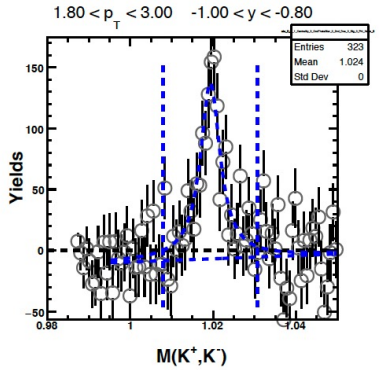
BACKUP

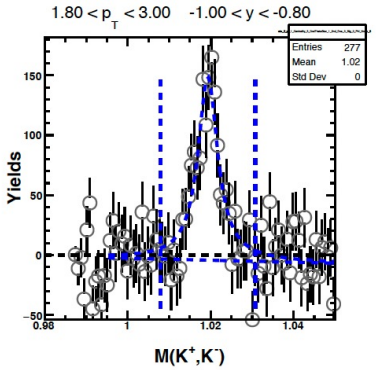
Centrality 0-10% -1.0 < |y| < -0.8

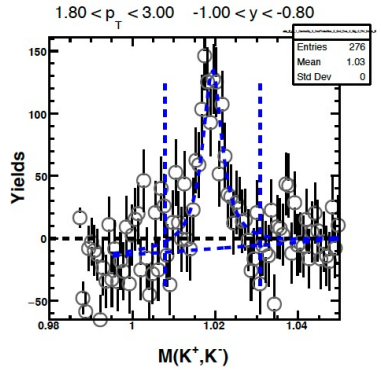


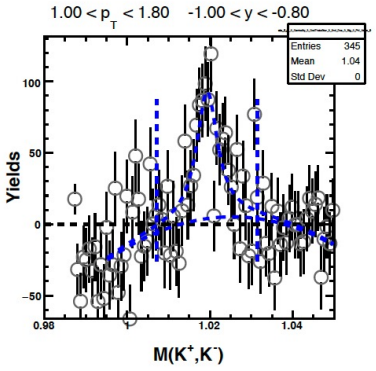


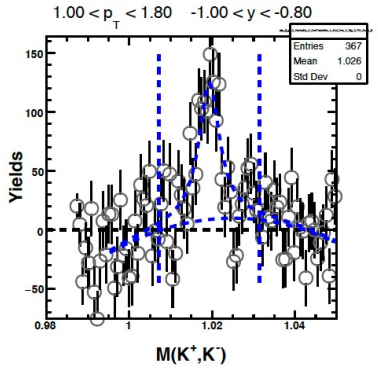


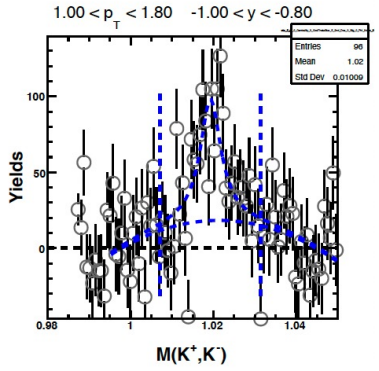


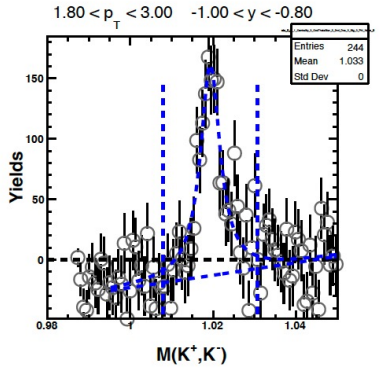


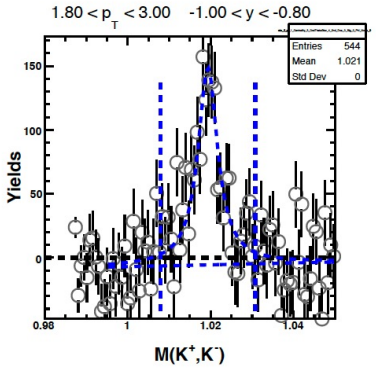


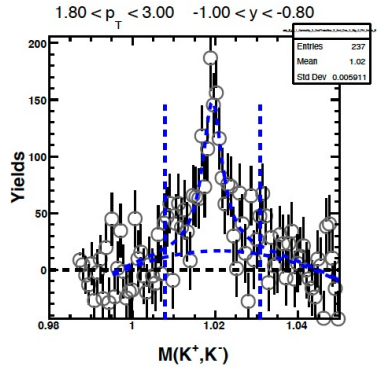


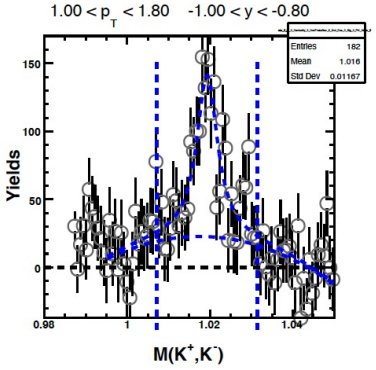


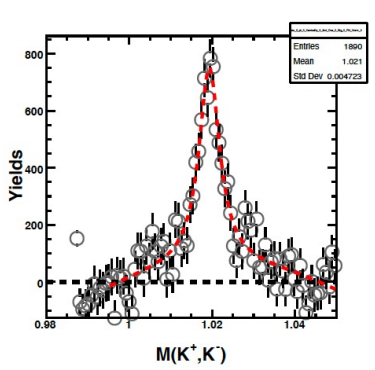


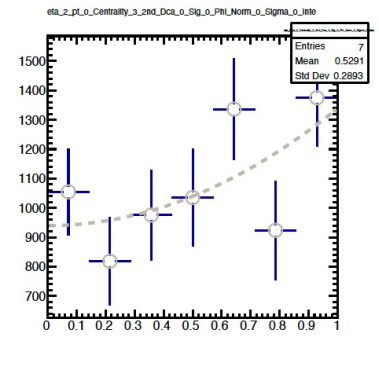


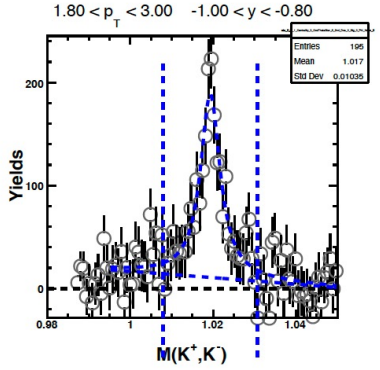


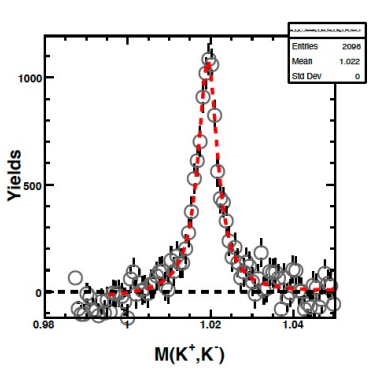


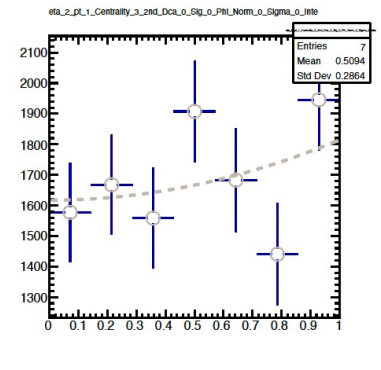




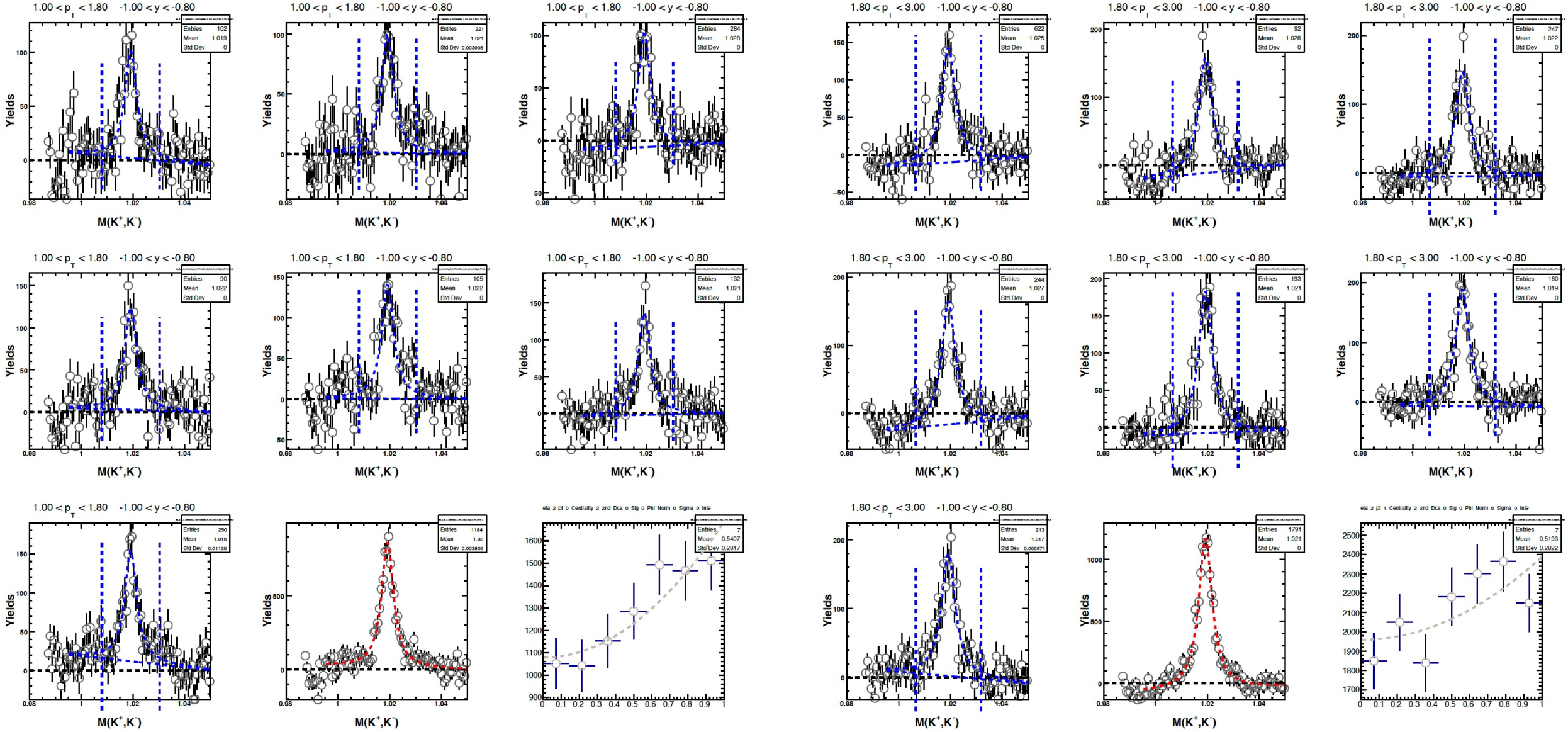




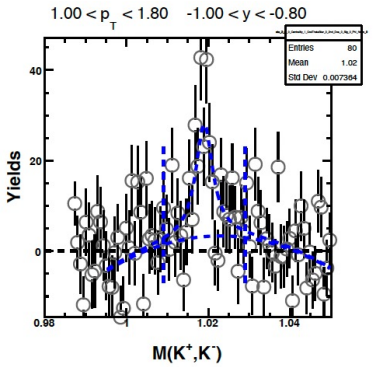


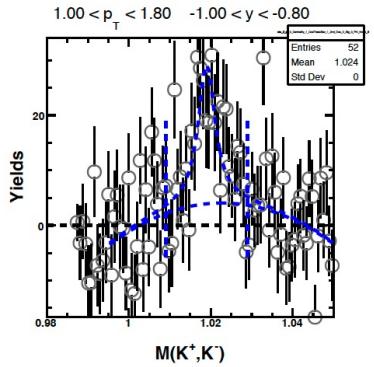


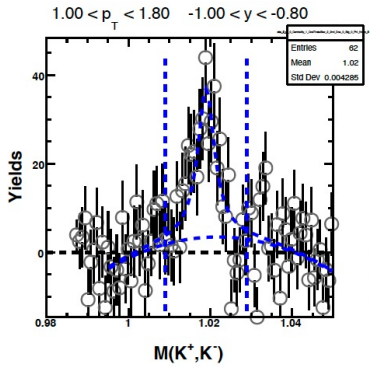
Centrality 10-30% -1.0 < |y| < -0.8

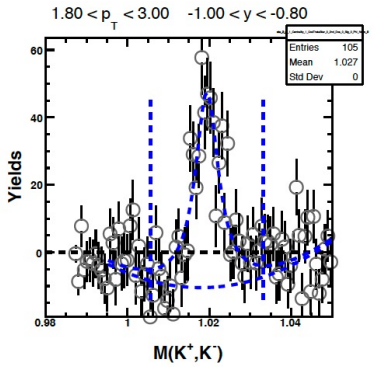


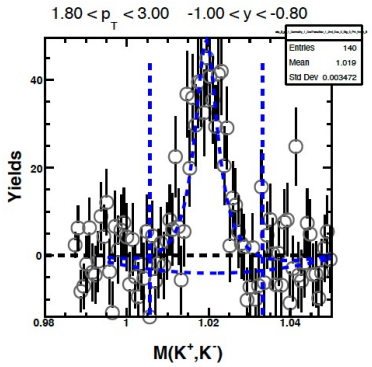
Centrality 30-50% -1.0 < |y| < -0.8

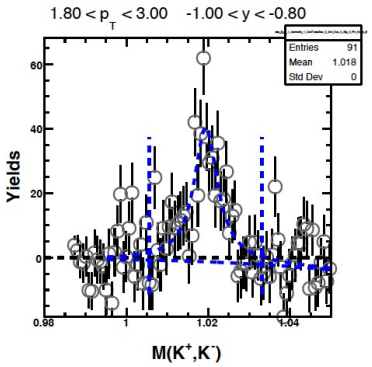


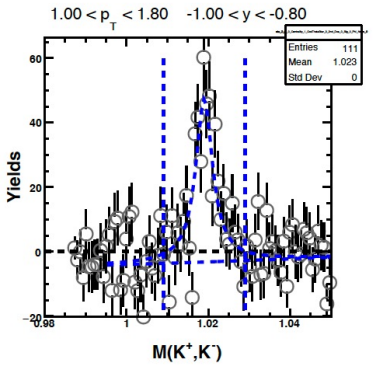


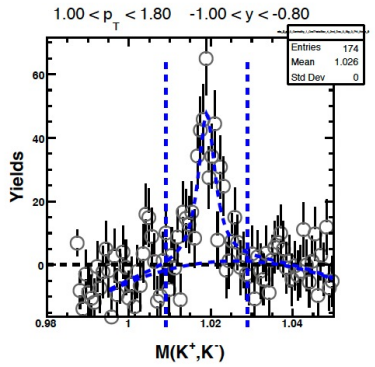


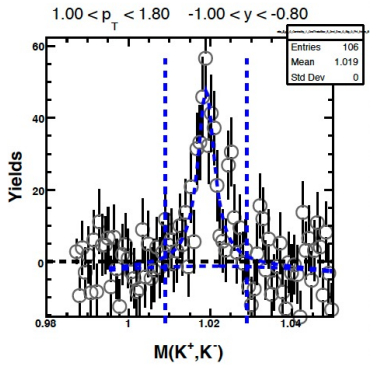


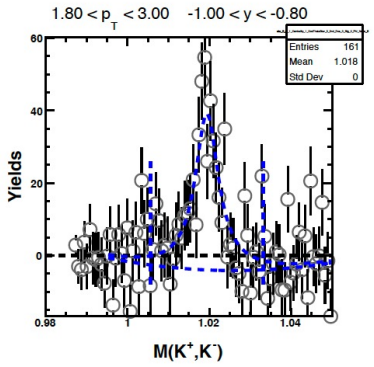


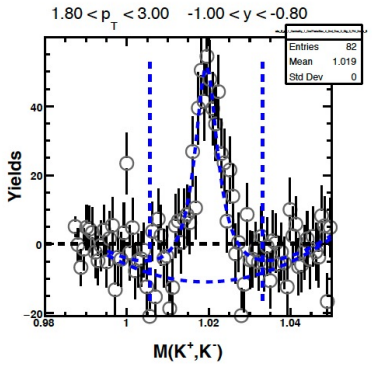


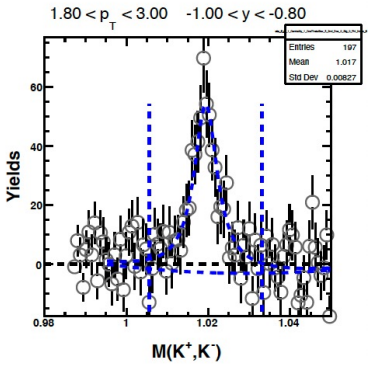


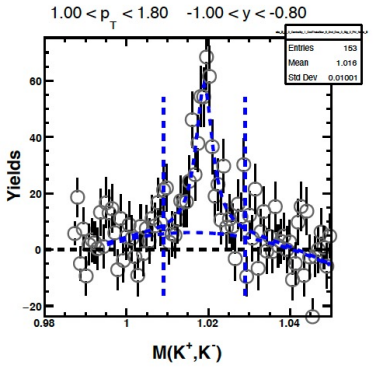


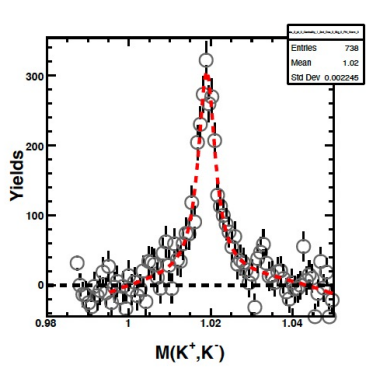


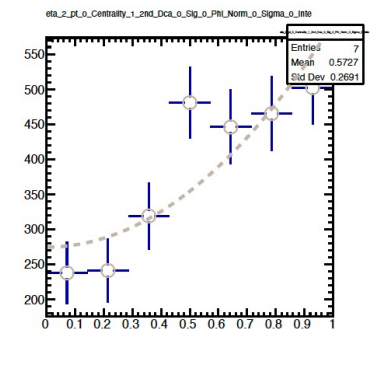


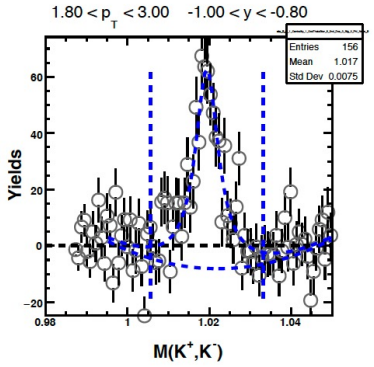


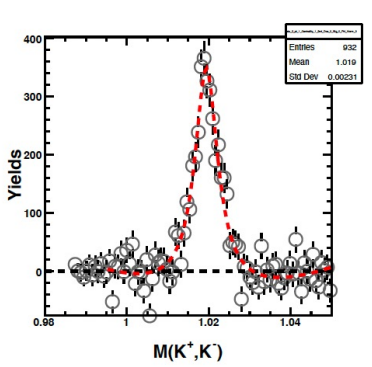


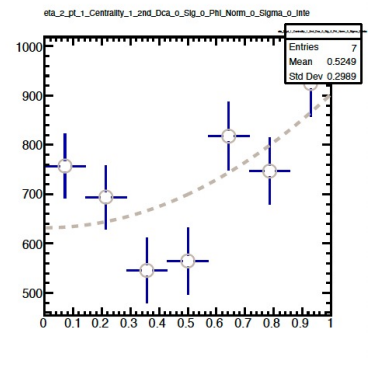




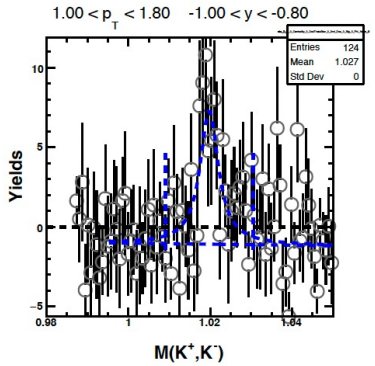


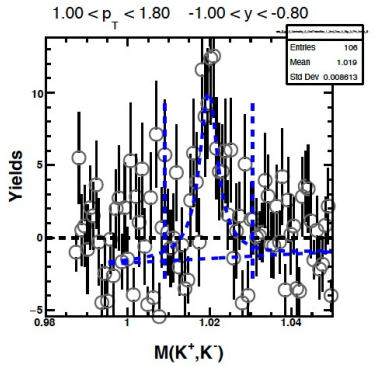


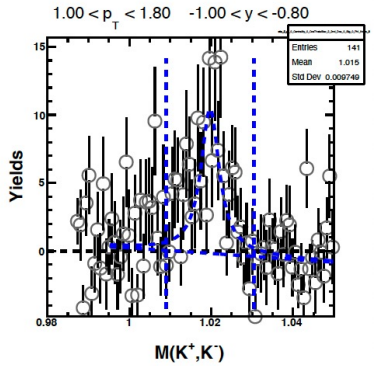


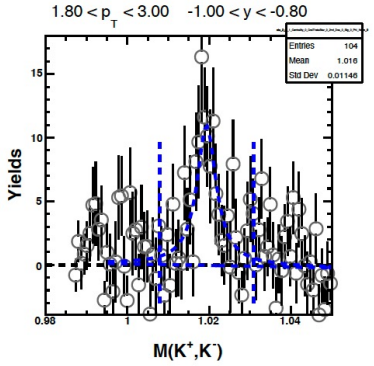


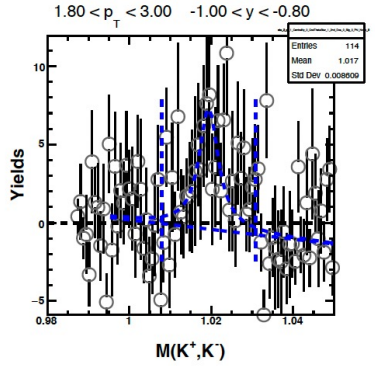
Centrality 50-80% -1.0 < |y| < -0.8

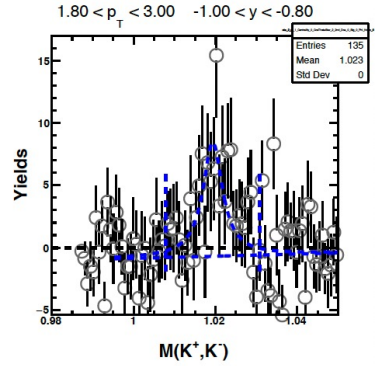


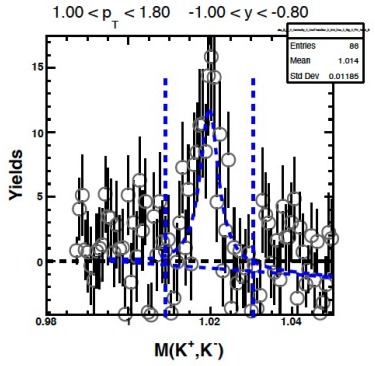


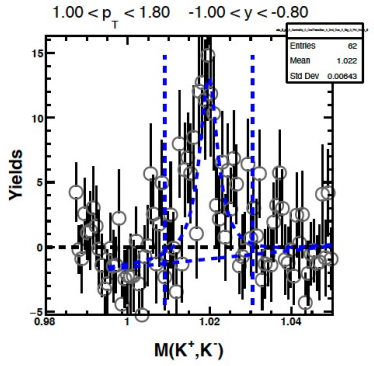


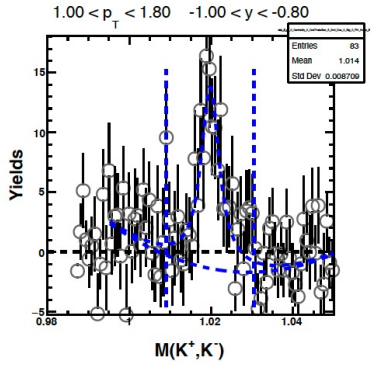


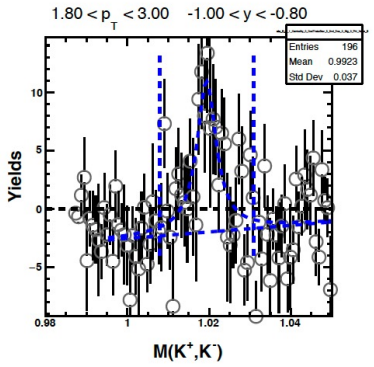


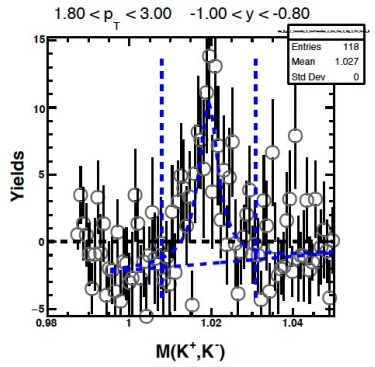


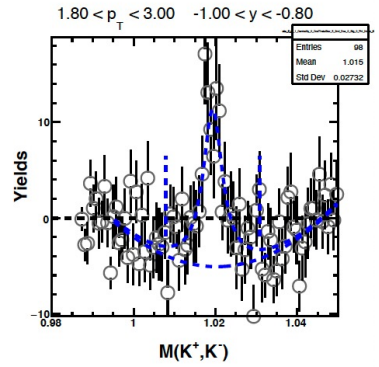


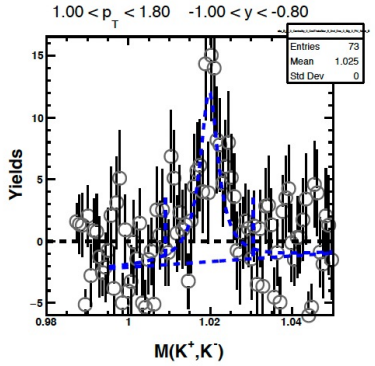


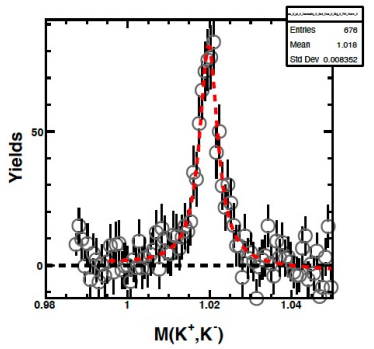


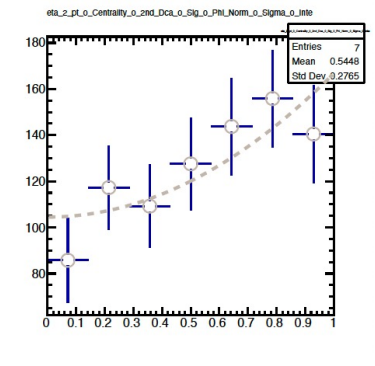


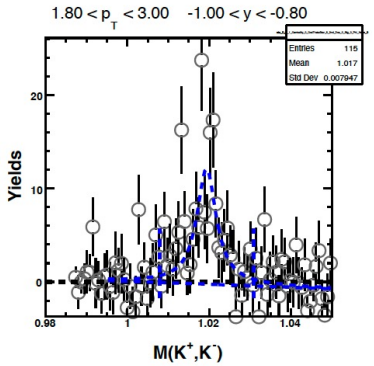


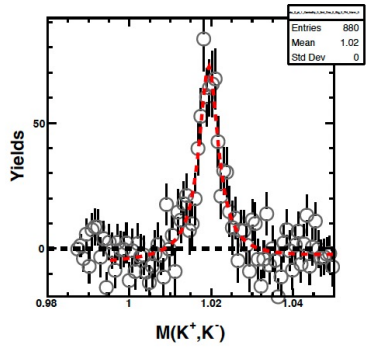


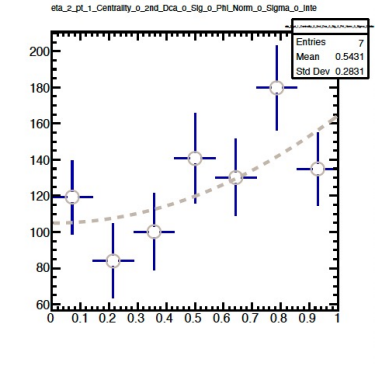




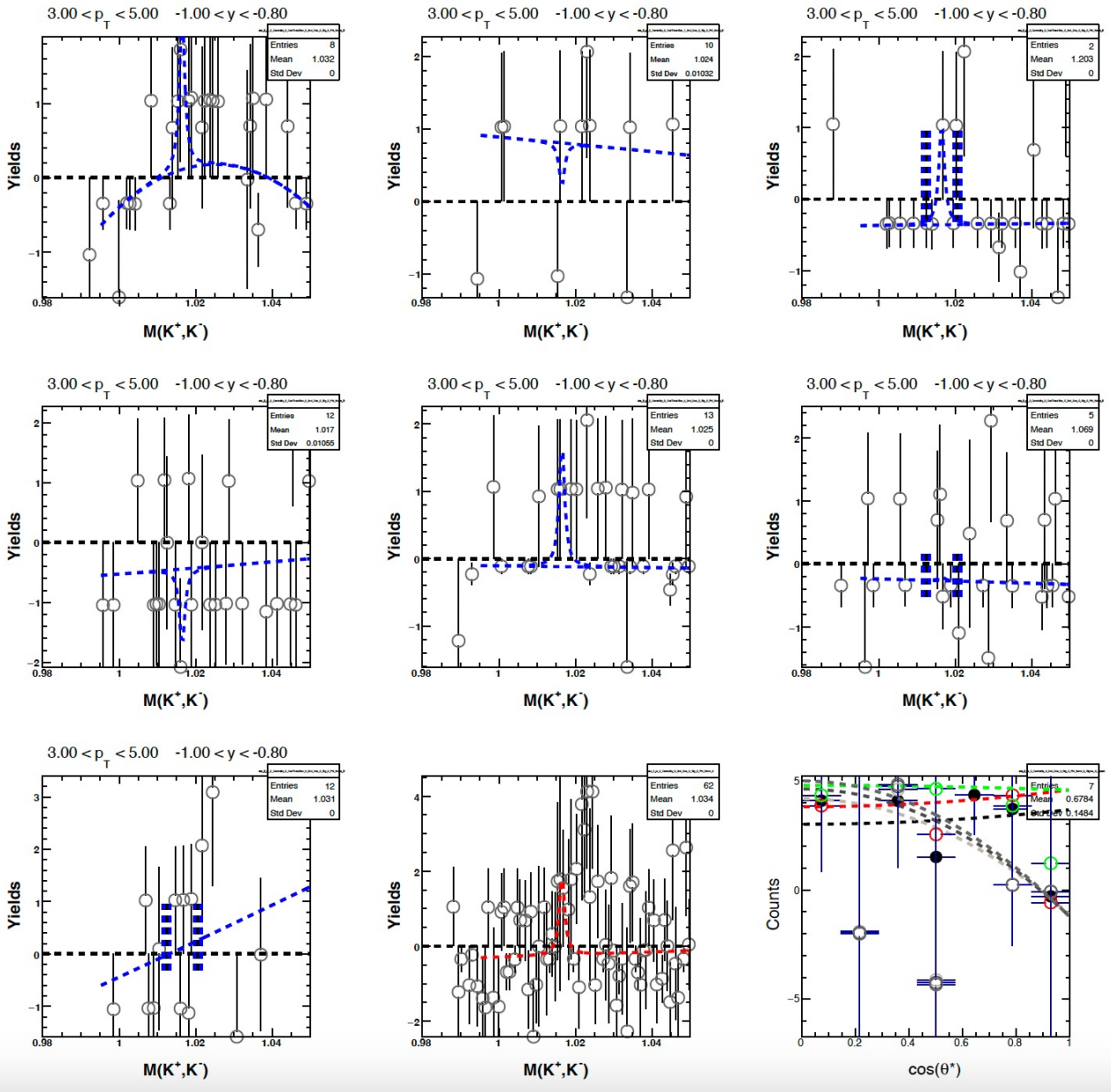




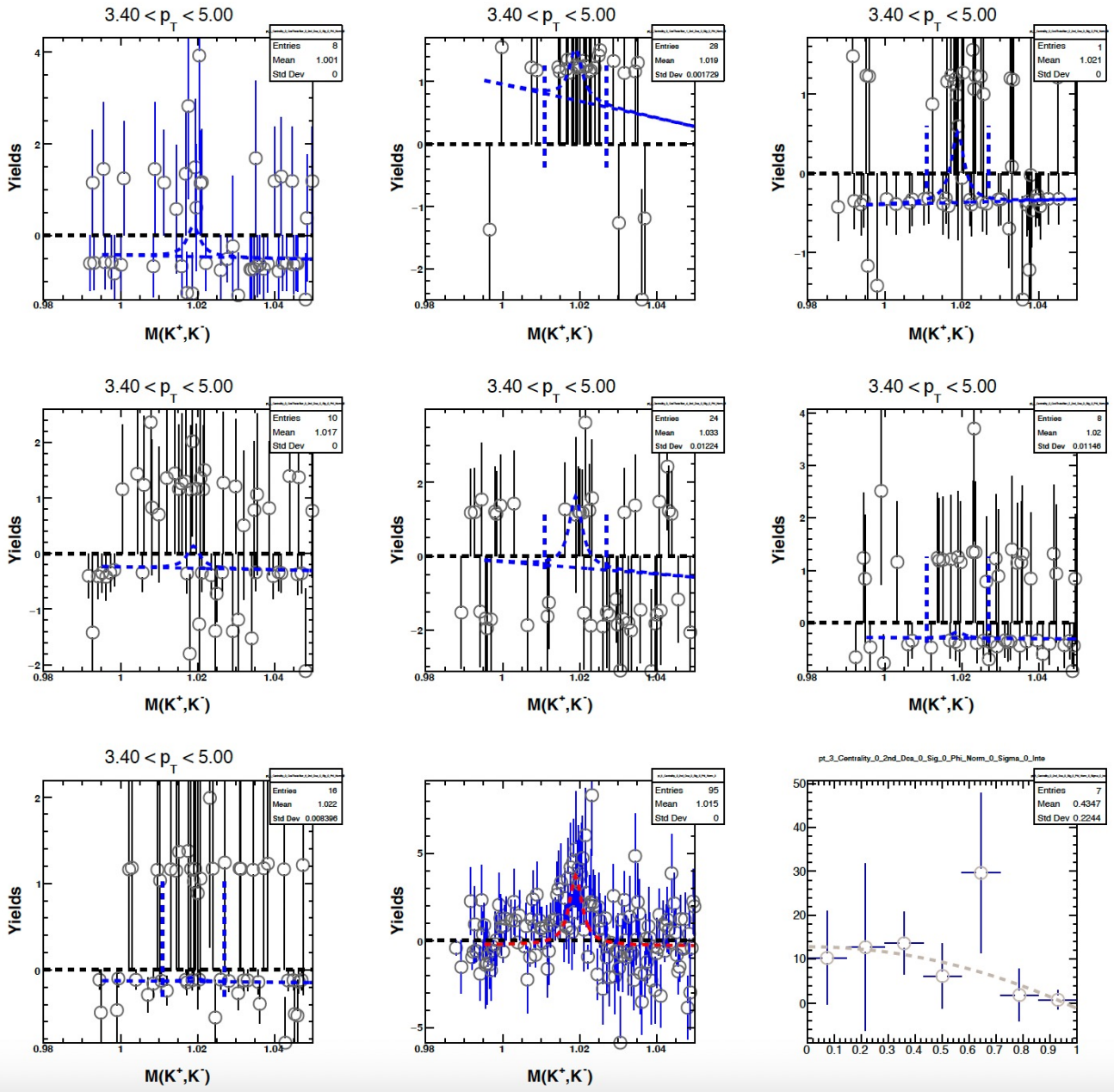




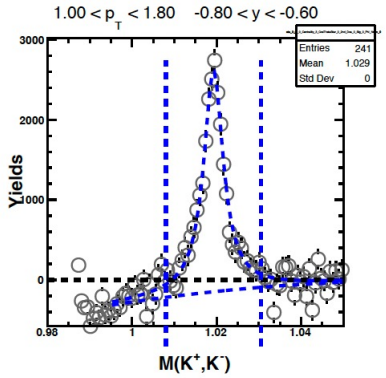
Centrality 50-80% -1.0 < |y| < -0.8

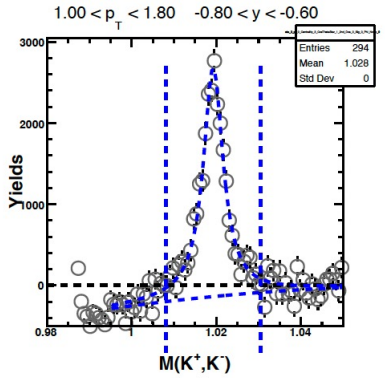


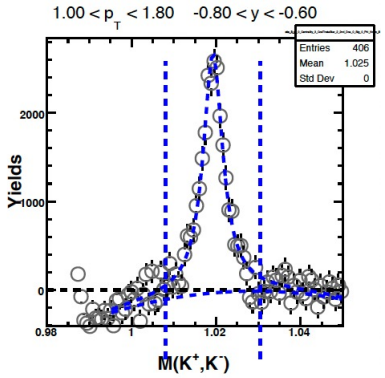
70-80% Centrality

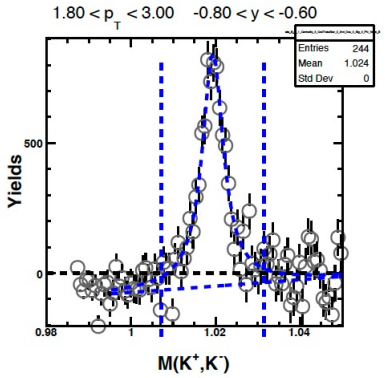


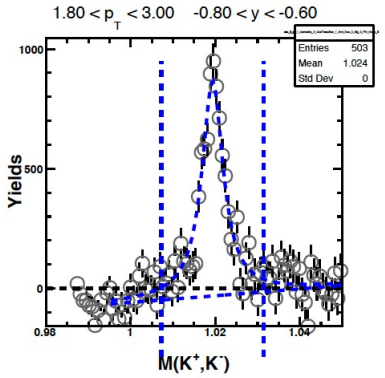
Centrality 0-10% -0.8 < |y| < -0.6

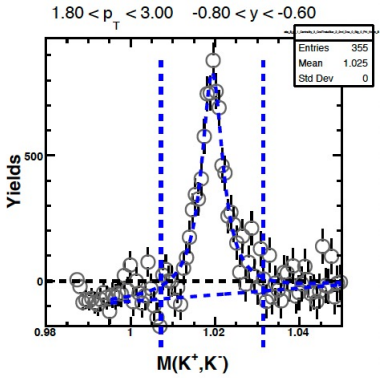


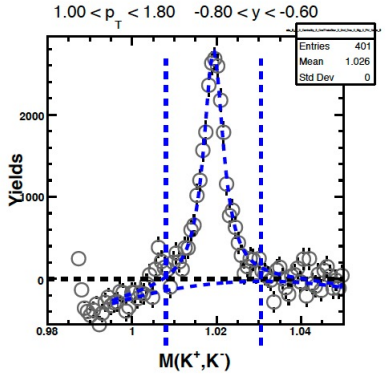


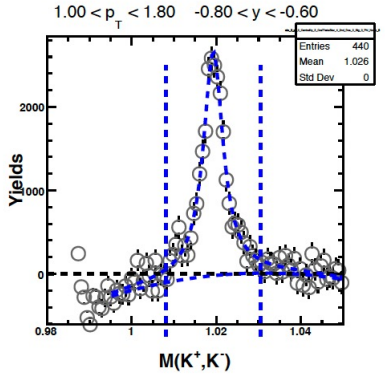


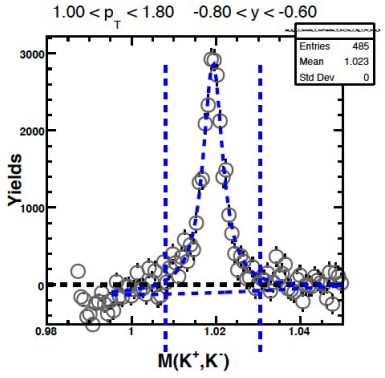


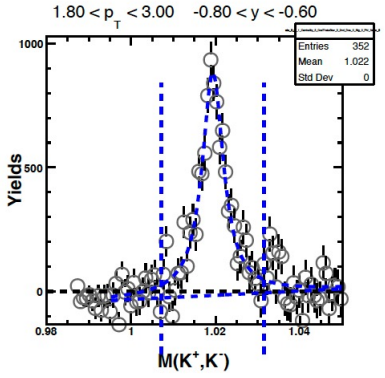


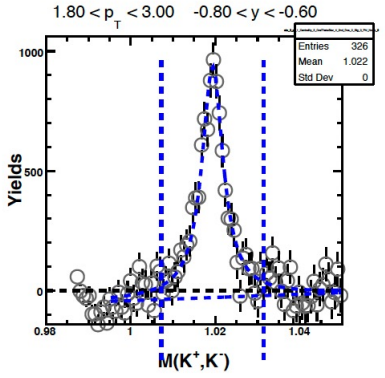


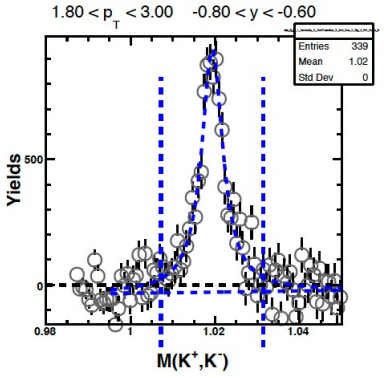


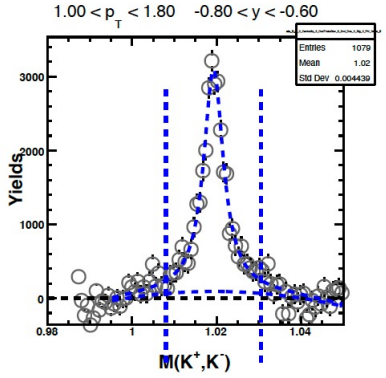


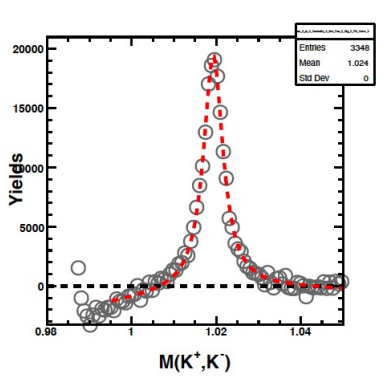


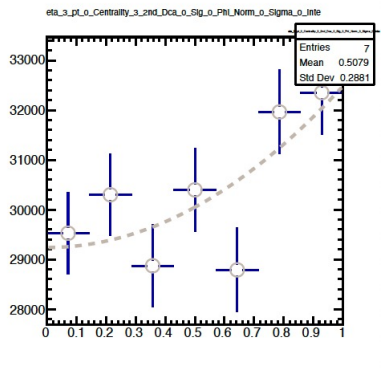


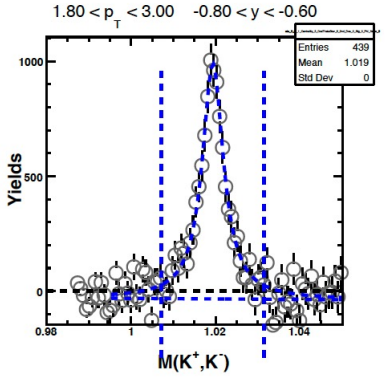


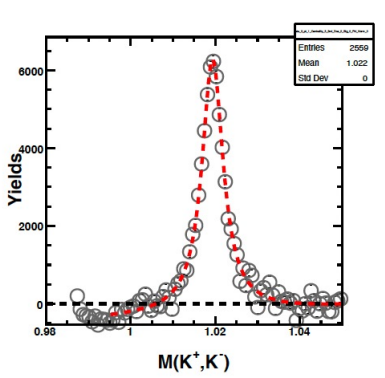


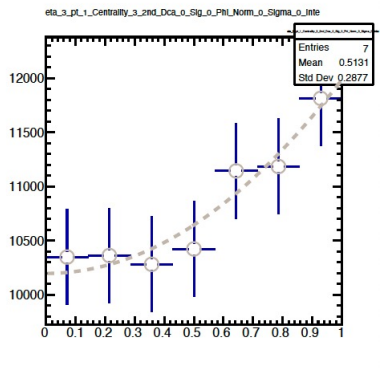




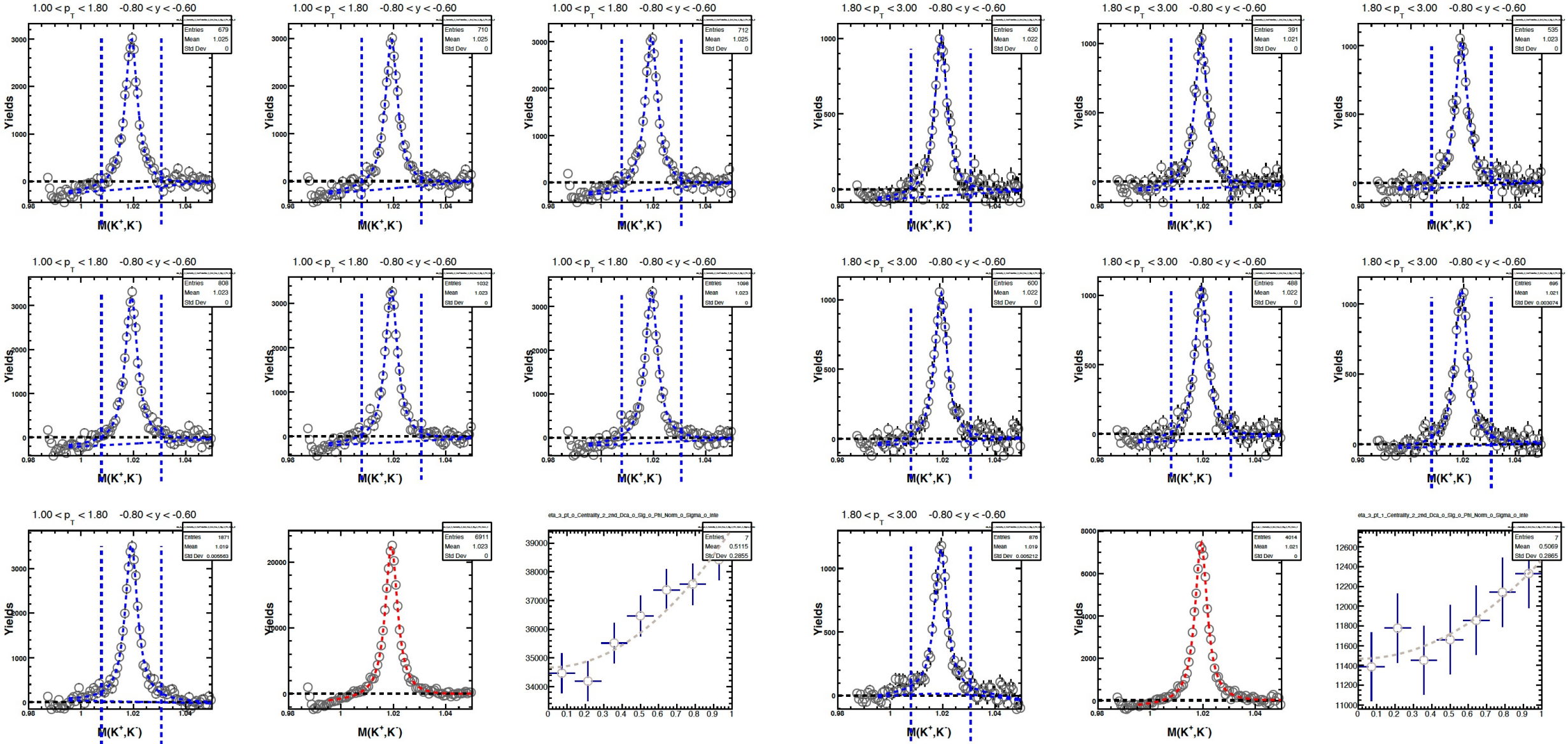




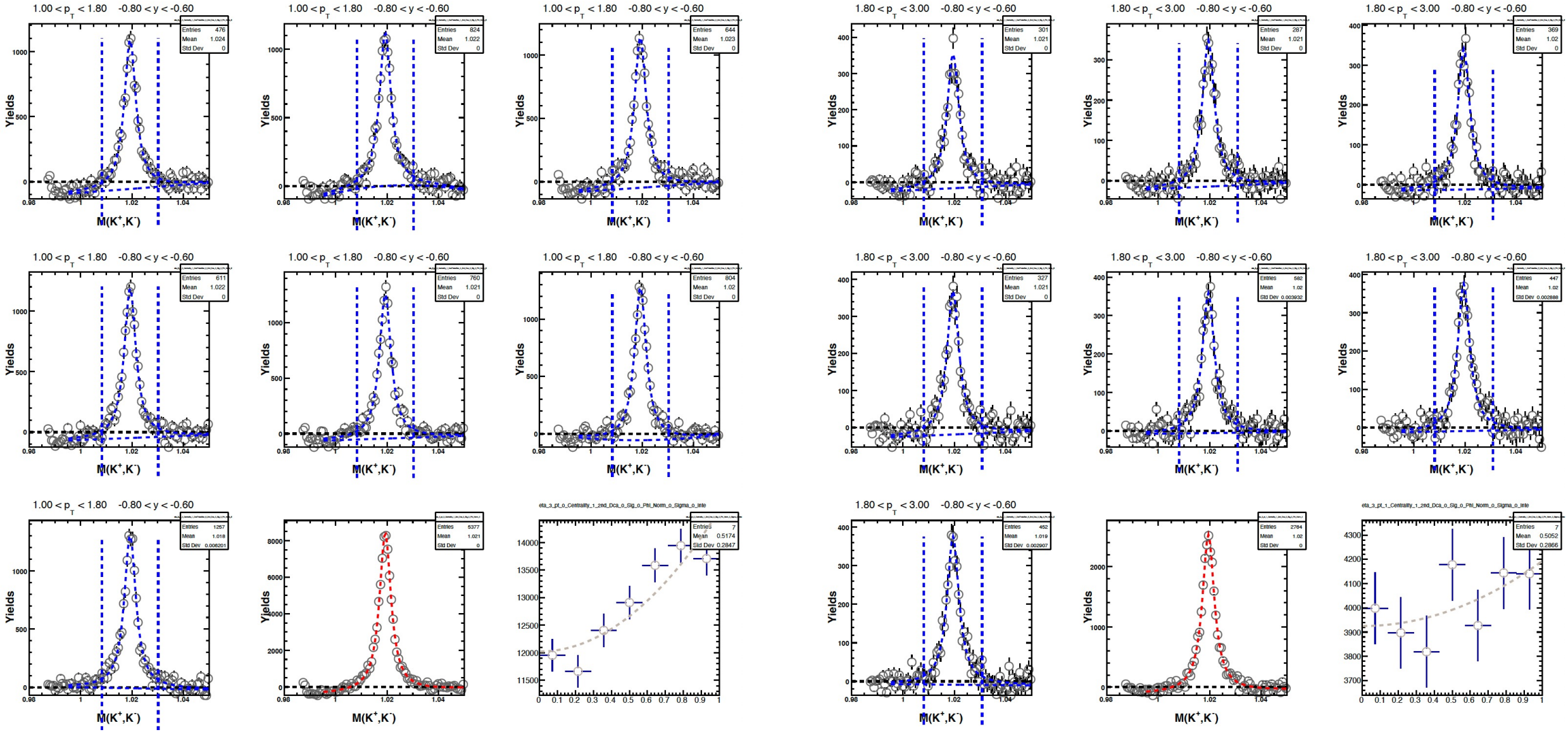




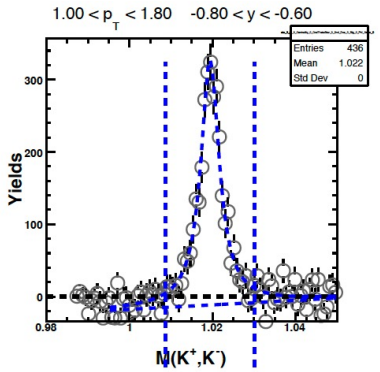
Centrality 10-30% -0.8 < |y| < -0.6

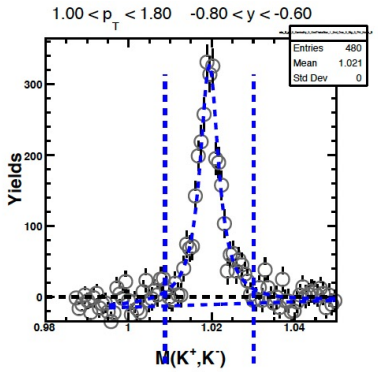


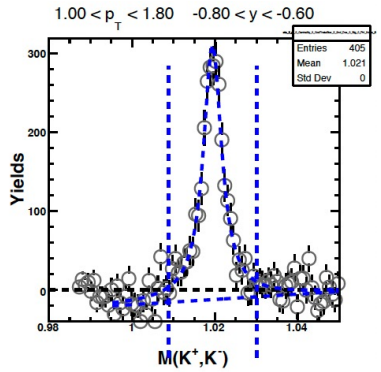
Centrality 30-50% -0.8 < |y| < -0.6

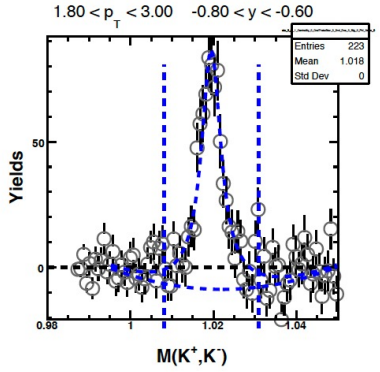


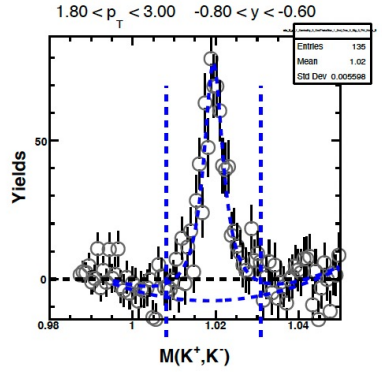
Centrality 50-80% -0.8 < |y| < -0.6

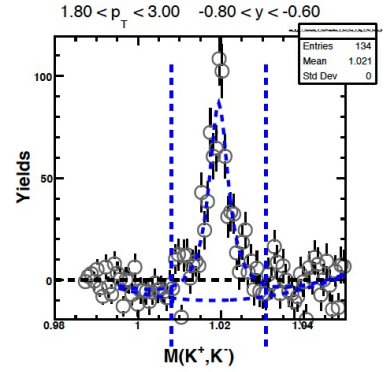


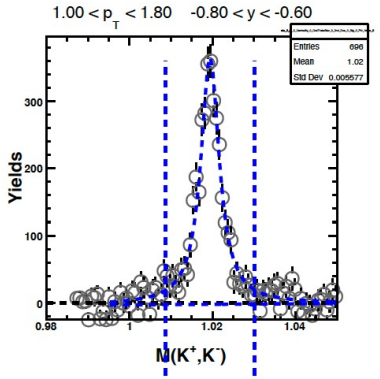


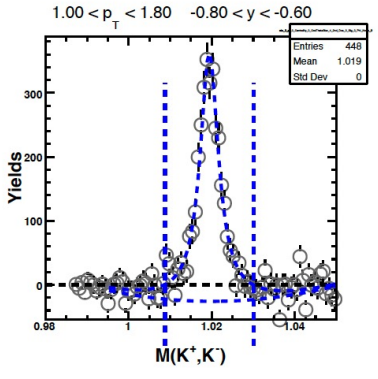


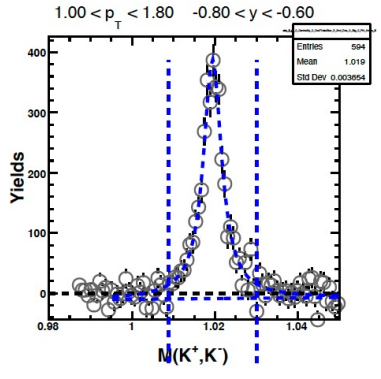


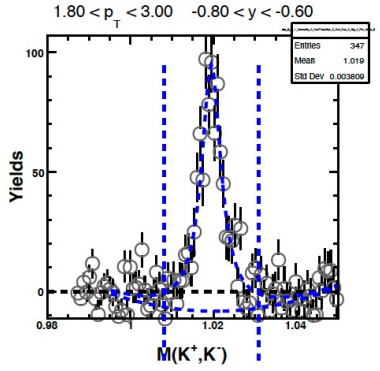


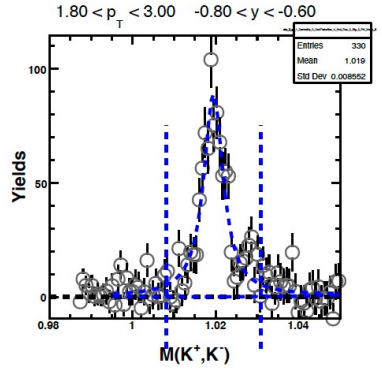


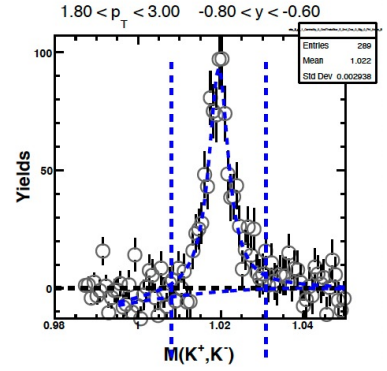


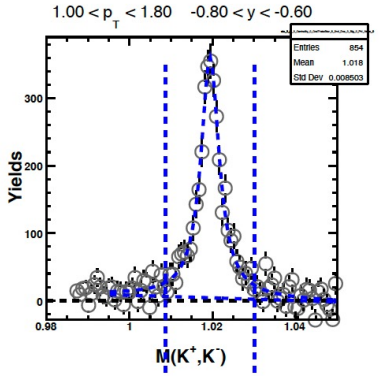


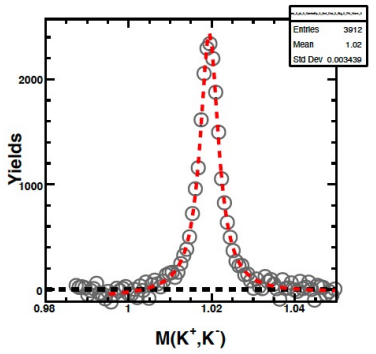


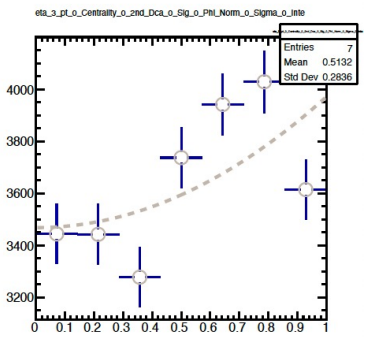


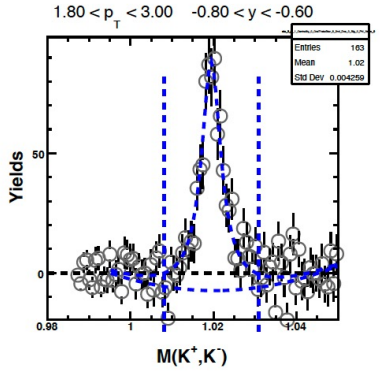


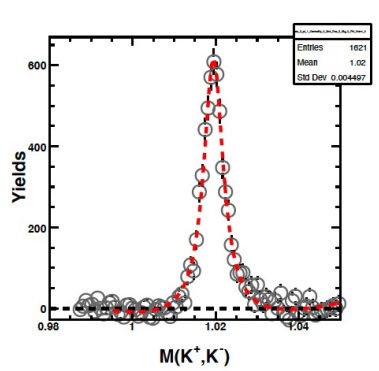


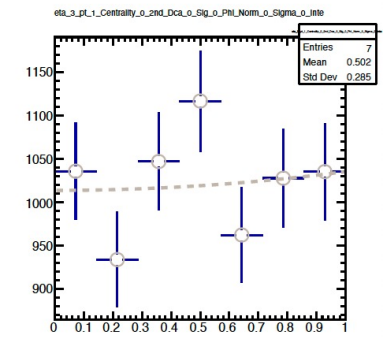












Centrality 50-80% -0.8 < |y| < -0.6