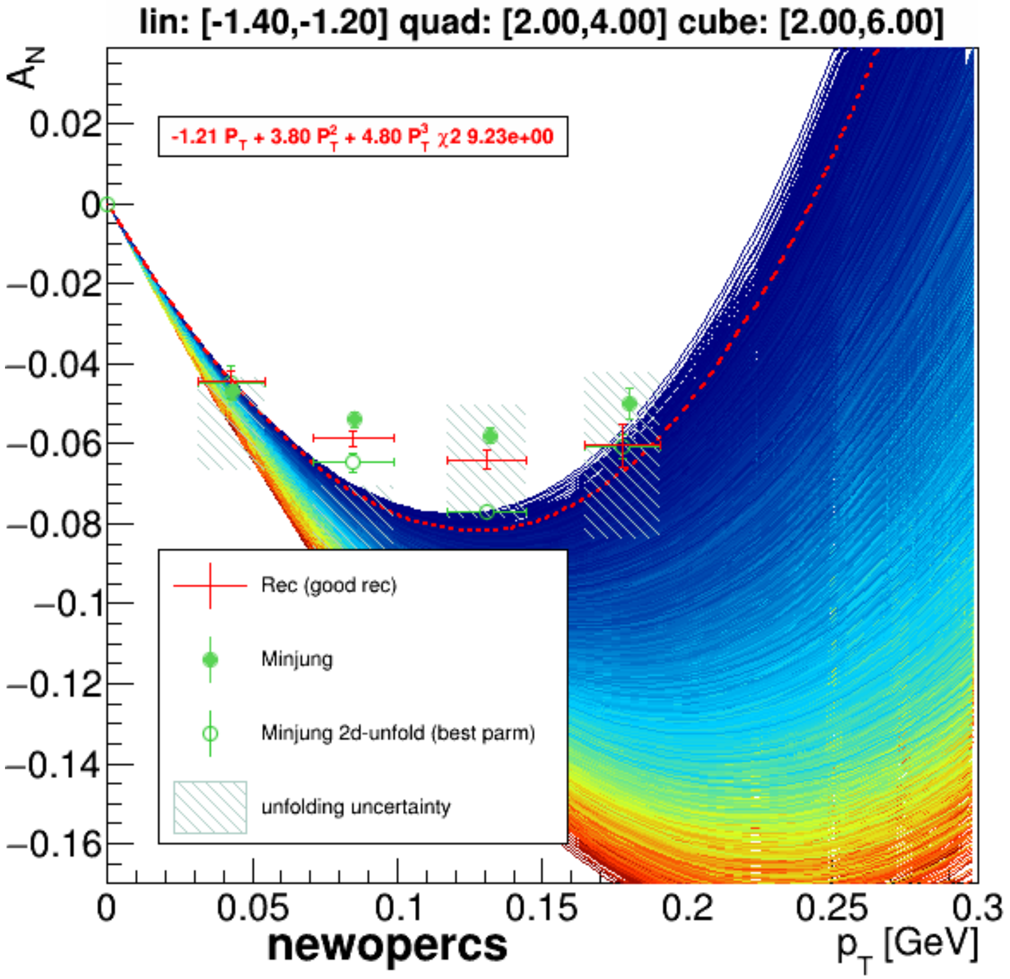
Unfolding of A_N versus P_T

RadLab Meeting
2020/08/05
9:00 PM (JST/KST)

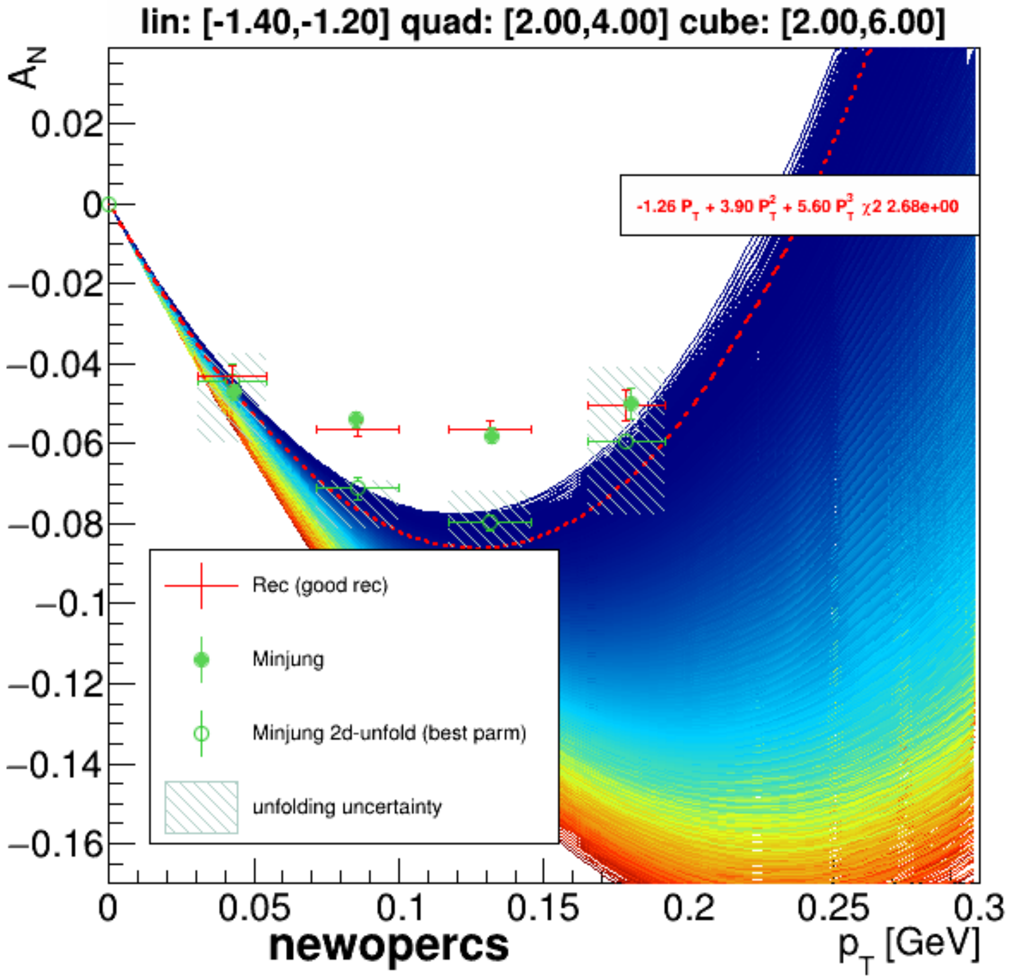
Benard Mulilo (KU/RIKEN)

Asymmetries based on a 3rd order polynomial (pol3) function – Coarse Scanning

Expt A_N Data with Systematic Uncertainty (Current)



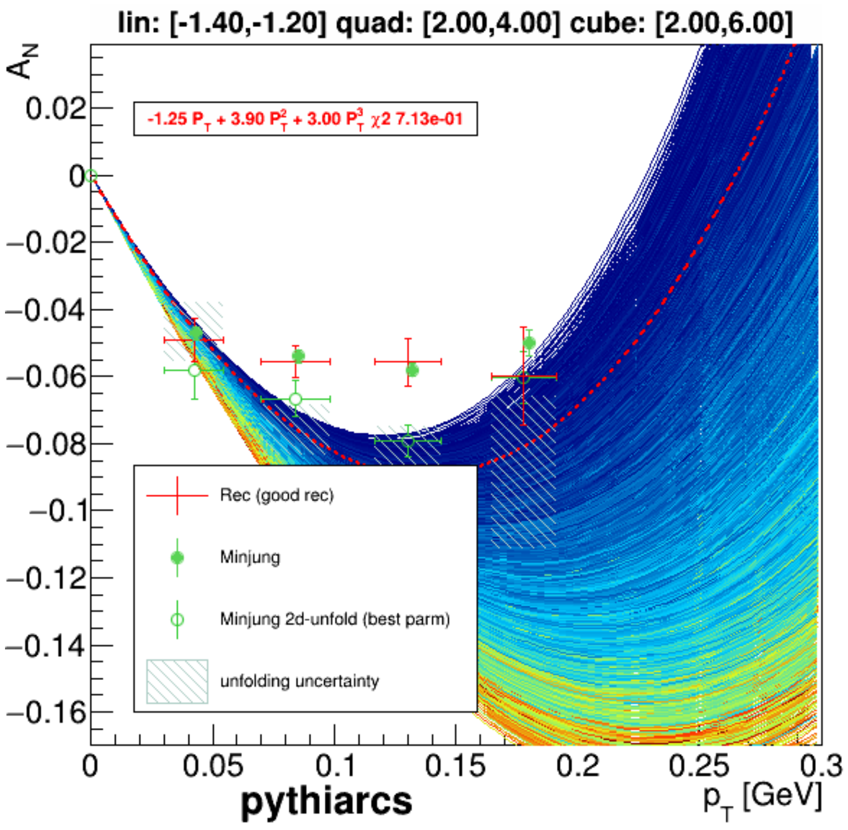
Expt A_N Data without Systematic Uncertainty (Previous)



Other MC's 3rd order polynomial (pol3) function – Coarse Scanning

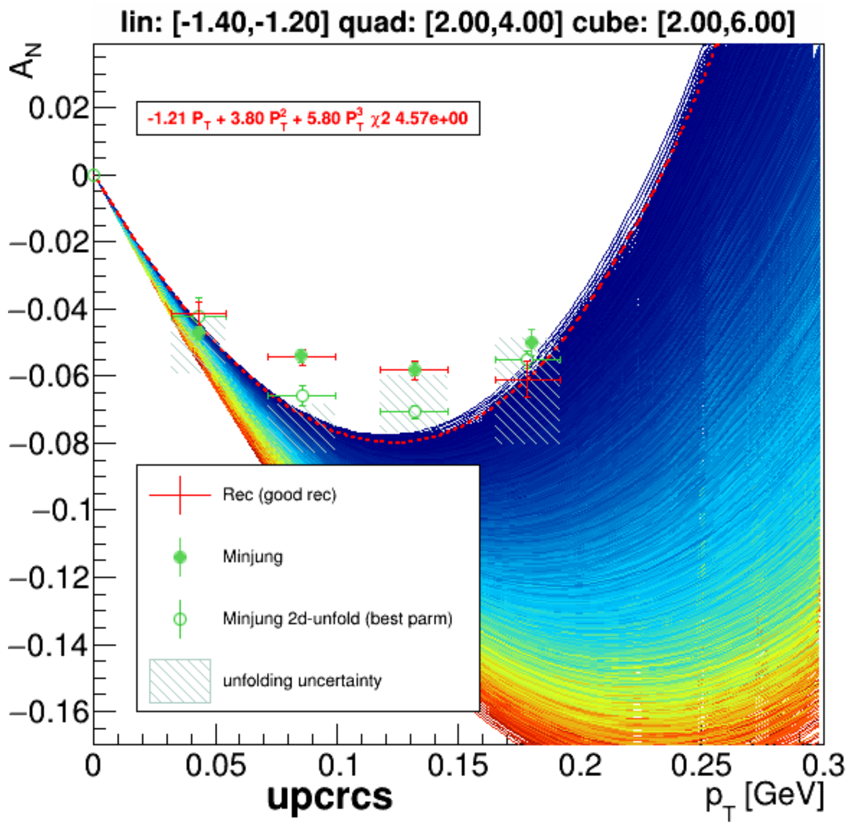
Expt A_N Data with Systematic Uncertainty (Current)

PYTHIA6



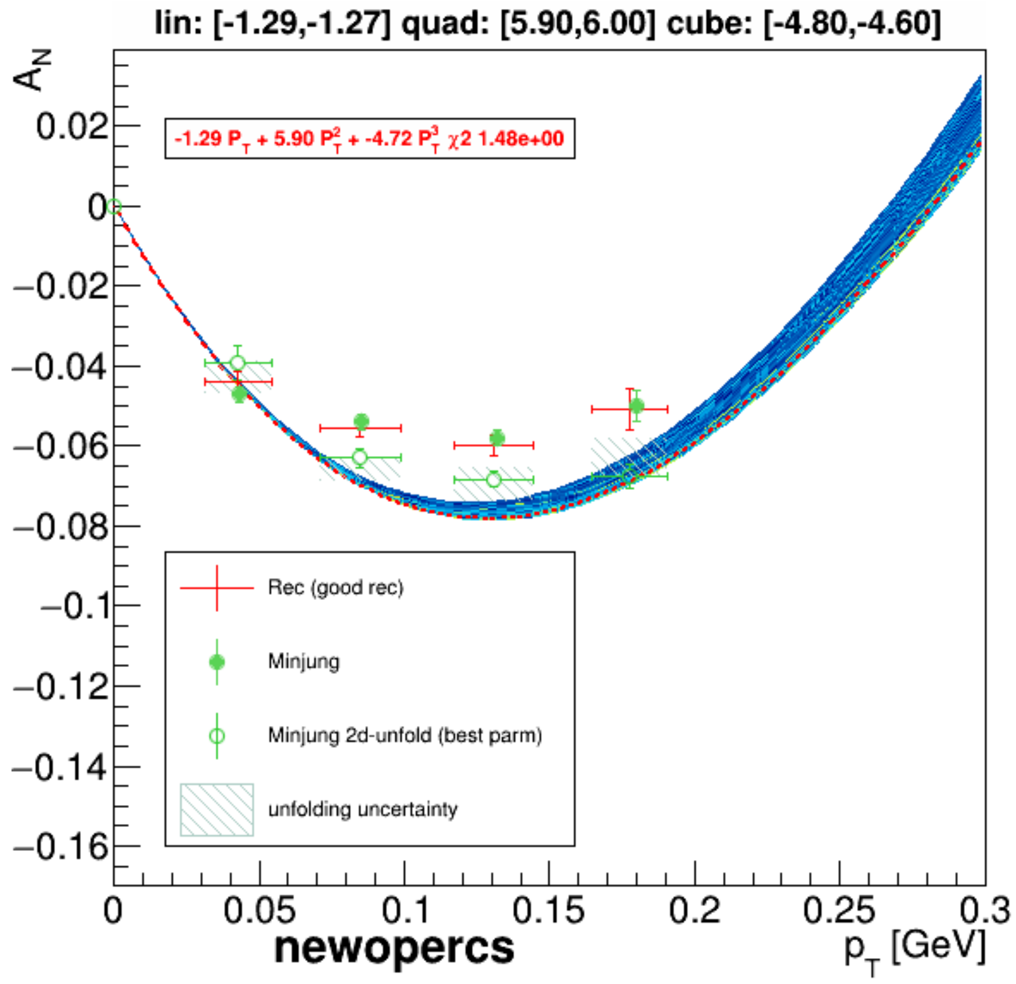
Expt A_N Data with Systematic Uncertainty (Current)

UPC

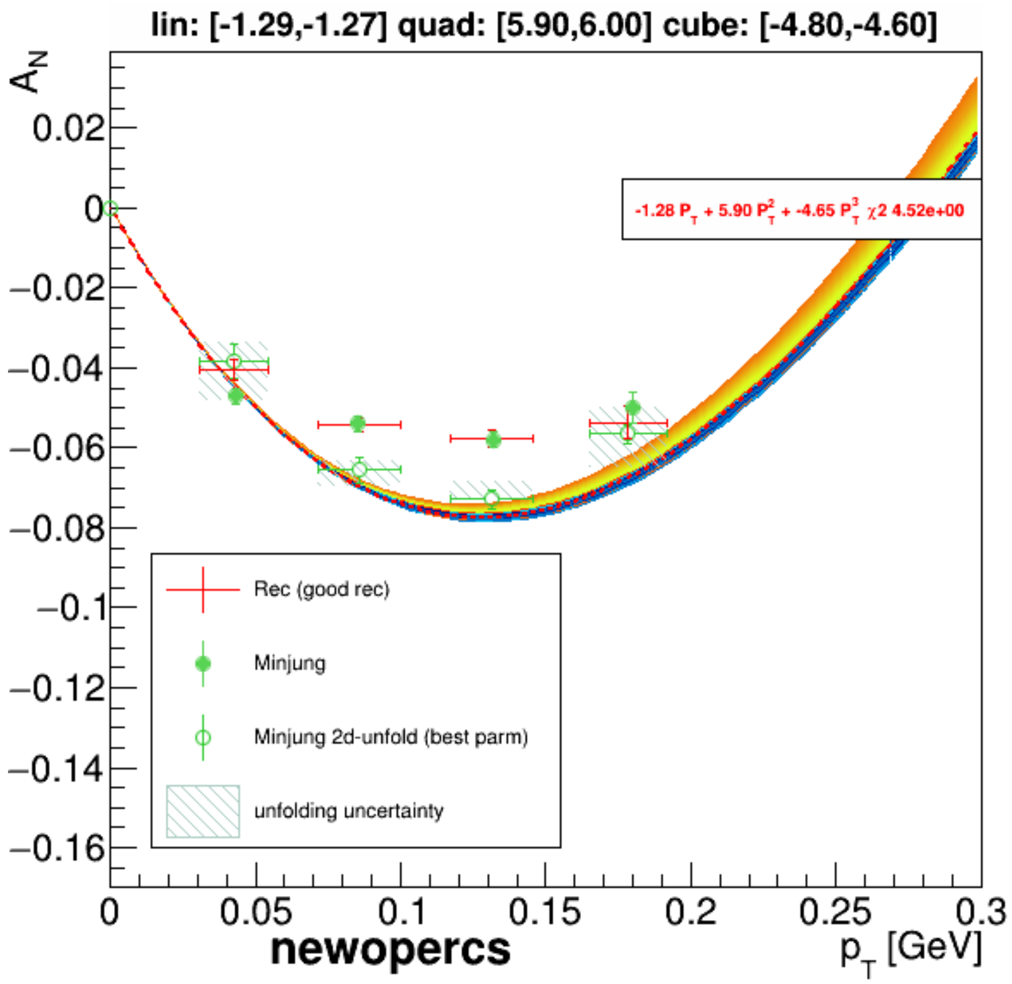


Asymmetries based on a 3rd order polynomial (pol3) function – Fine Scanning

Expt A_N Data with Systematic Uncertainty (Current)



Expt A_N Data without Systematic Uncertainty (Previous)



Summary

- So far the unfolding trend for the current A_N data is somewhat similar to the unfolded trend of the A_N data without systematic uncertainty. Certainly there is change of Chi2 values.

- Dpmjet and Pythia8 are running and will finish tomorrow. (Some runs froze perhaps because of the rebooting of ssh03 yesternight or probably running out of disk space).

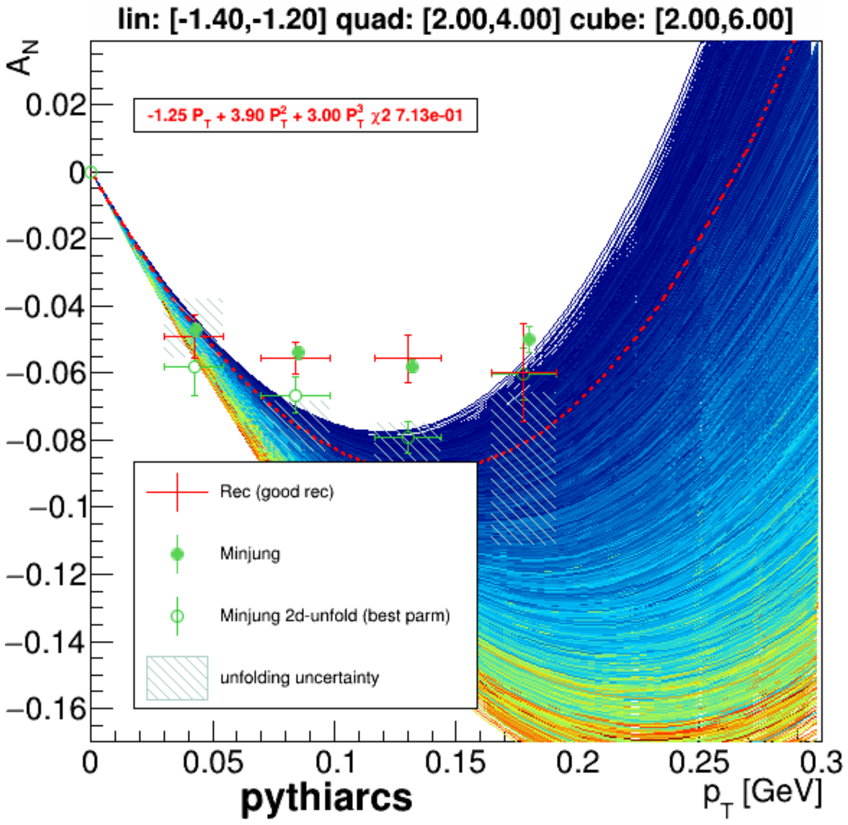
- Scanning of all MC's for the other two parameterizations (i.e. power law and saturation functions) will start tomorrow.

- By end of next week, hope to see a summary result of the unfolded A_N using A_N data with systematic uncertainty as we saw a summary result of the unfolded A_N using A_N data without systematic uncertainty.

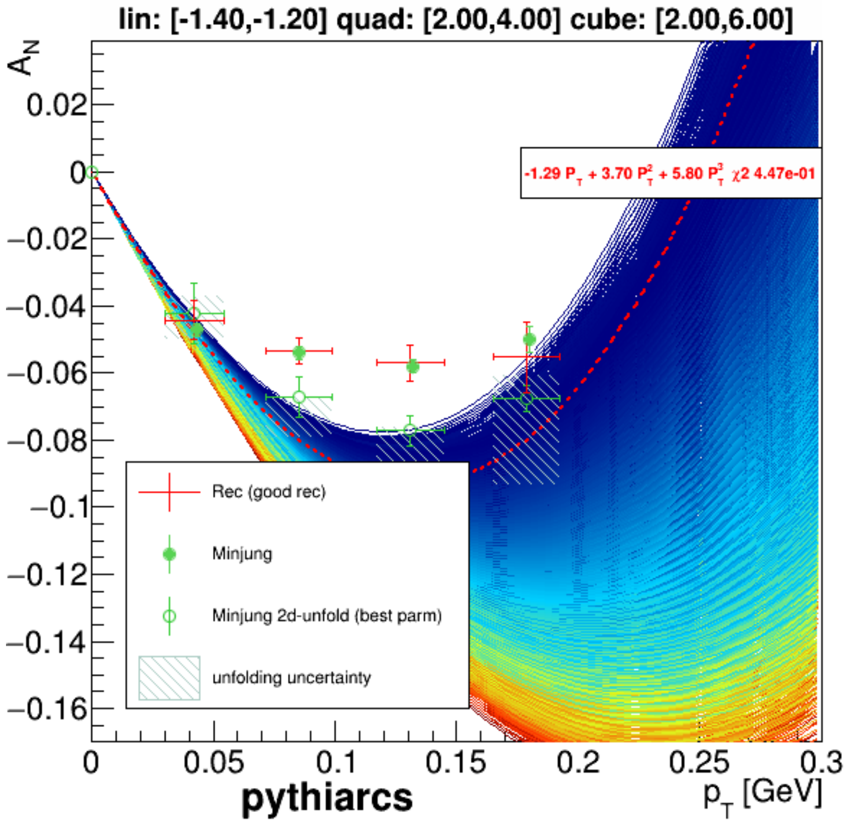
BACKUP

Other MC's 3rd order polynomial (pol3) function – Coarse Scanning

Expt A_N Data with Systematic Uncertainty (Current)

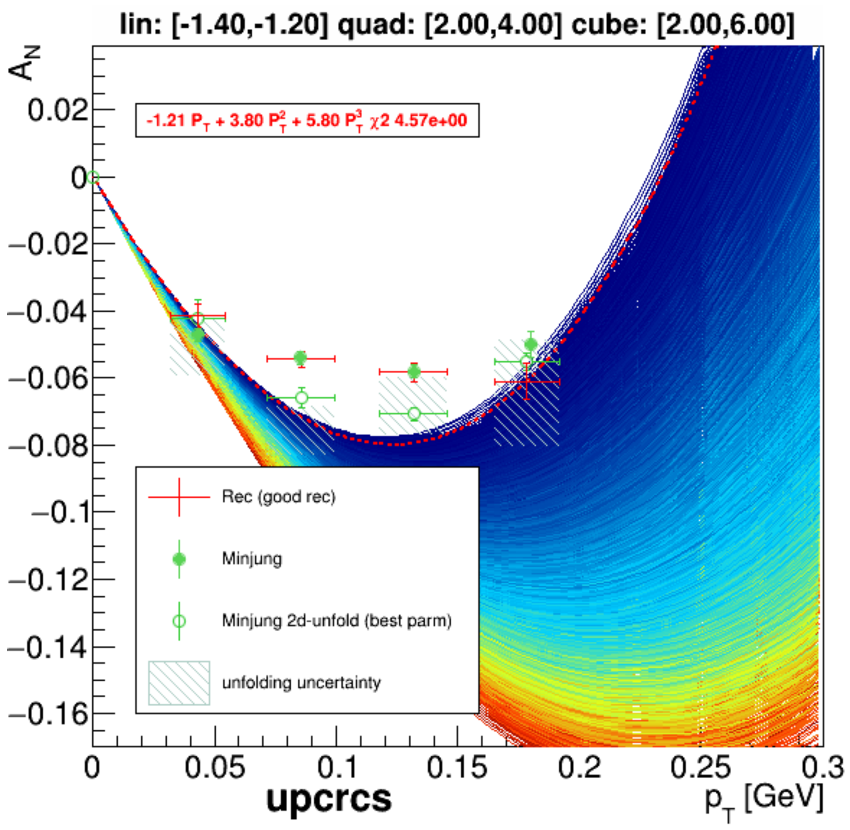


Expt A_N Data without Systematic Uncertainty (Previous)

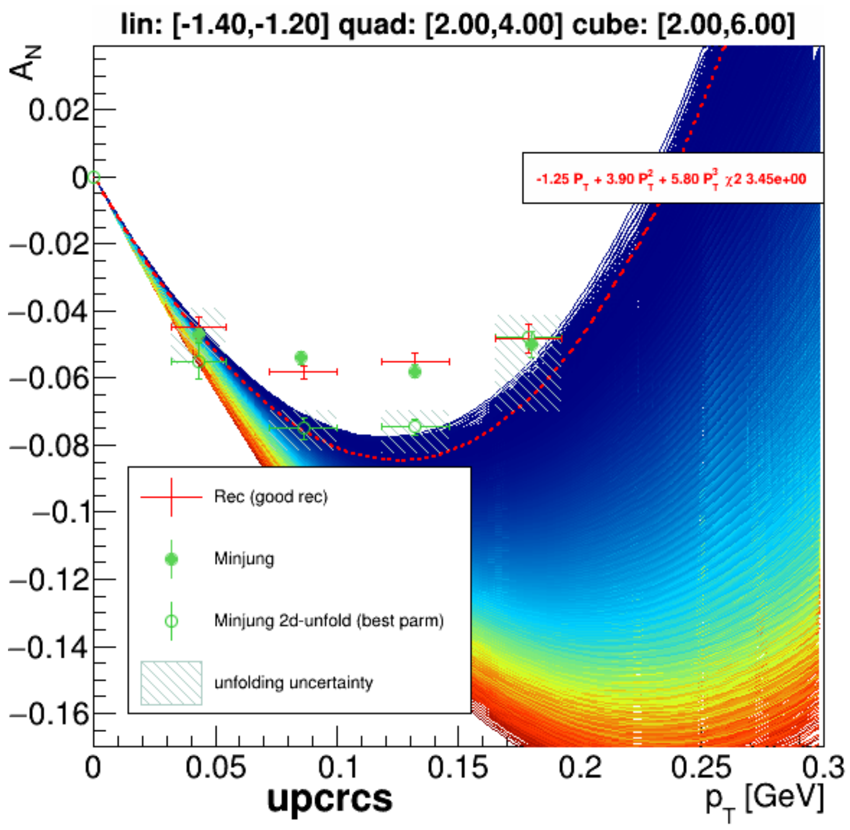


Other MC's 3rd order polynomial (pol3) function – Coarse Scanning

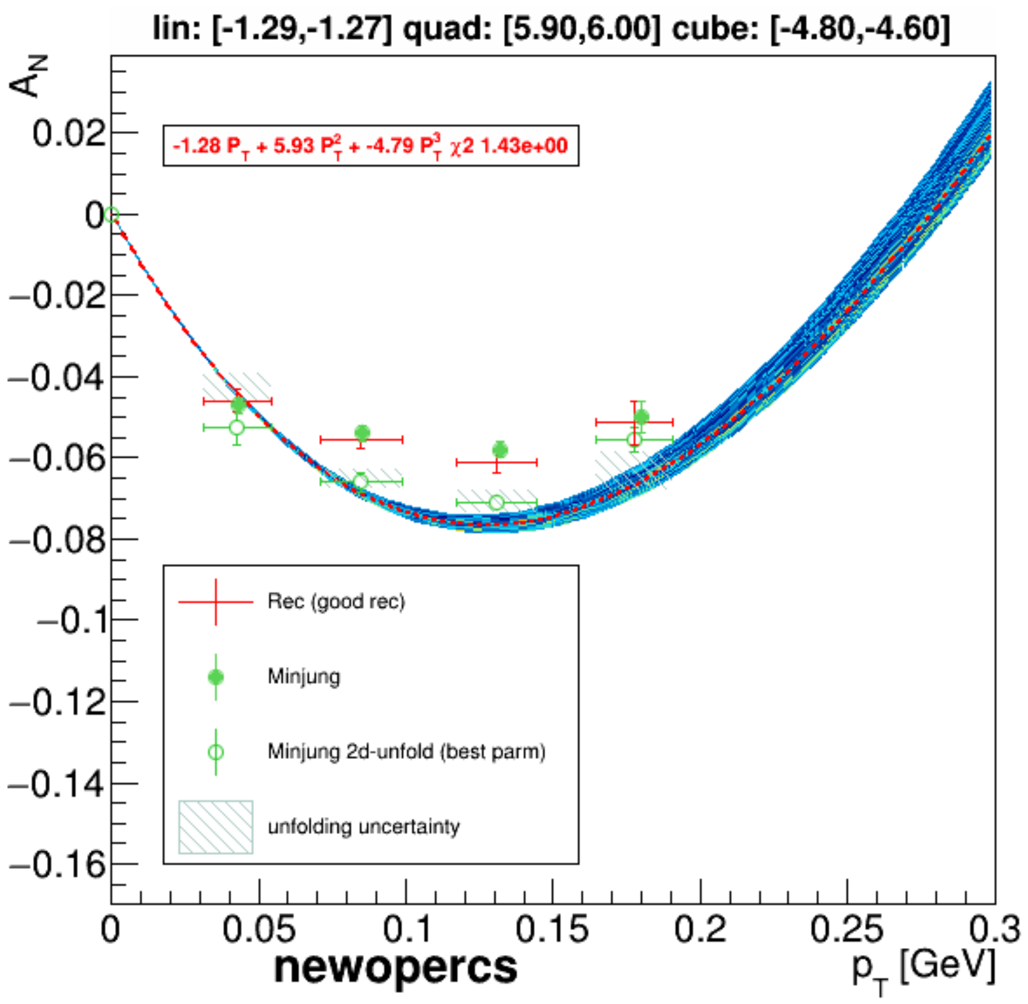
Expt A_N Data with Systematic Uncertainty (Current)



Expt A_N Data without Systematic Uncertainty (Previous)



Asymmetries based on a 3rd order polynomial (pol3) function – Fine Scanning

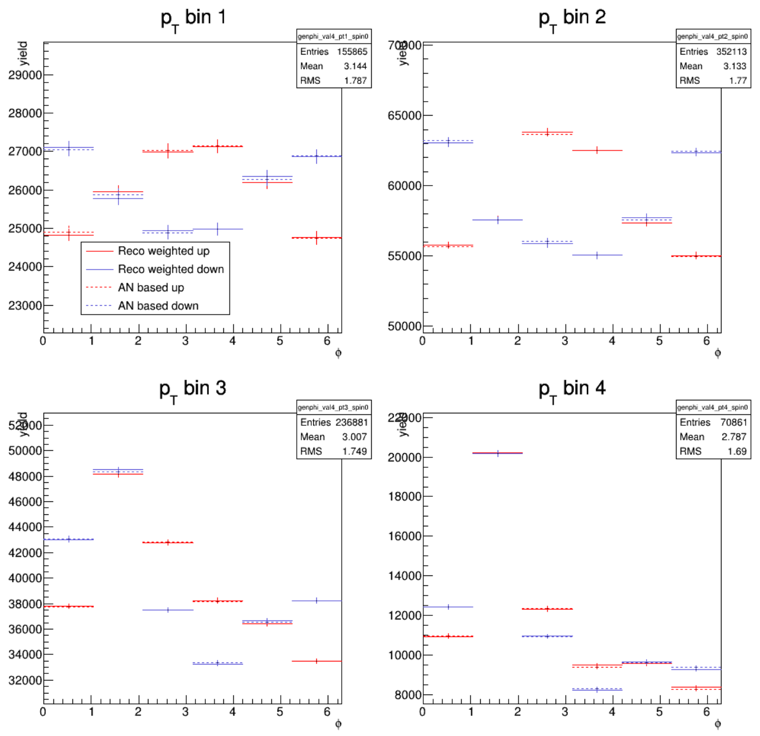


- Fine scanning around best value based on Pol3.
- Shaded curve obtained from the spread of all unfolded A_N's
- Red broken line is best parametrization in range used for the unfolding (input curve).

Last Update in Spin PWG Meeting - Asymmetry Extraction Strategy

[2020-06-18 (9 AM, JST/KST)]

- Translation: Measured Asymmetries (Minjung) are translated into 2D yields.
- Unfolding: Unfolding of the two-dimensional yields is executed.
- Extraction: Unfolded asymmetries obtained based on the unfolded yields by calculating asymmetries.



(Minjung's)

P_T dependent A_N's → translate into 2D yields → Unfold → Get unfolded A_N's

Asymmetry Weighting and Extraction - Different Functional Forms

For MC sample:

- Create spin up or down state (ispin 0, 1) for each event.

Create spin dependent weight according to some functional form:

- Polynomial (w_{pol3}) function:

$$w_{pol3} = 1 + \left(a + b * P_{T,T} + c * P_{T,T}^2 + d * P_{T,T}^3\right) * \cos(\Phi_{T,T} + spin * \pi)$$

- Power function (w_{pow}) :

$$w_{pow} = 1 + \left(\alpha + \beta * P_{T,T}^{\gamma}\right) * \cos(\Phi_{T,T} + spin * \pi)$$

- Exponential function (w_{exp}):

$$w_{exp} = 1 + \left(\omega + \sigma * \left(1 - \exp\left(\eta * P_{T,T}\right)\right)\right) * \cos(\Phi_{T,T} + spin * \pi)$$

a = constant part

b = linear part scanned over a wide range $b_{min} < b < b_{max}$

c = quadratic part scanned over a wide range between $c_{min} < c < c_{max}$

d = cubic part scanned over a wide range between $d_{min} < d < d_{max}$

s = spin (↑↓)

$P_{T,T}$ is the true transverse momentum and $\Phi_{T,T}$ is the true azimuthal angle distributions.

f = α, β, γ, ω, σ, η are parameters.

Use these weights based on generated variables in all events and reconstructed variables, etc.…

Algorithm

1. Create two spin states using TRandom Number Generator:
   Spin up (0)
   Spin down (1)

2. Create spin depended weight:

$$w = 1 + \left(a + b * P_{T,T} + c * P_{T,T}^2 + d * P_{T,T}^3\right) cos(\varphi_T + spin * \pi)$$

the parameters are:
a = constant
b = linear
c = quadratic
d = cube
spin * pi = phase shift
spin = 0 (up)
1 (down)

Note: Other functional forms can also be scanned and tried to describe data asymmetries.

Algorithm…

3. Scan parameters for different functional forms over a wide range using chi-square based on the reconstructed asymmetries from pp collision monte carlo samples and run 15 pp asymmetry results (Minjung's result) to find the best parameter, i.e. parameter with lowest,

$$\chi^2 = \sum_i \frac{\left(A_{N,i}^{Minjung} - A_{N,i}^{w,reco}\right)^2}{\left(\Delta A_{N,i}^{2,Minjung} + \Delta A_{N,i}^{2,w,reco}\right)}$$

4. Extract the asymmetry using the best Chi-squared parameters,

$$A_N = \frac{N_{\Phi\uparrow} - N_{\Phi\downarrow}}{N_{\Phi\uparrow} + N_{\Phi\downarrow}}$$