A_N vs. P_T Unfolding

RadLab Meeting
2020/06/24
9:00 PM (KST/JST)

Benard Mulilo (KU/RIKEN)

Run 15 neutron asymmetry for inclusive pp collisions in the ZDC – 2D Unfolding

Strategy

Using Minjung's ZDC neutron asymmetry for run 15 inclusive pp data, the strategy is to:

- Translate the pt dependent A_N's into yields.
- Apply the 2D unfolding in P_T and azimuth, Φ
- Extract the unfolded asymmetries (A_N's)

The strategy requires extraction of asymmetries and reweighting procedures for pp monte carlo samples: pythia, dpmjet and the one pion exchange (OPE).

Algorithm

Asymmetry extraction algorithm is:

Algorithm

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

2. Create spin depended weight according to Taylor series of a polynomial in the form:

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

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…

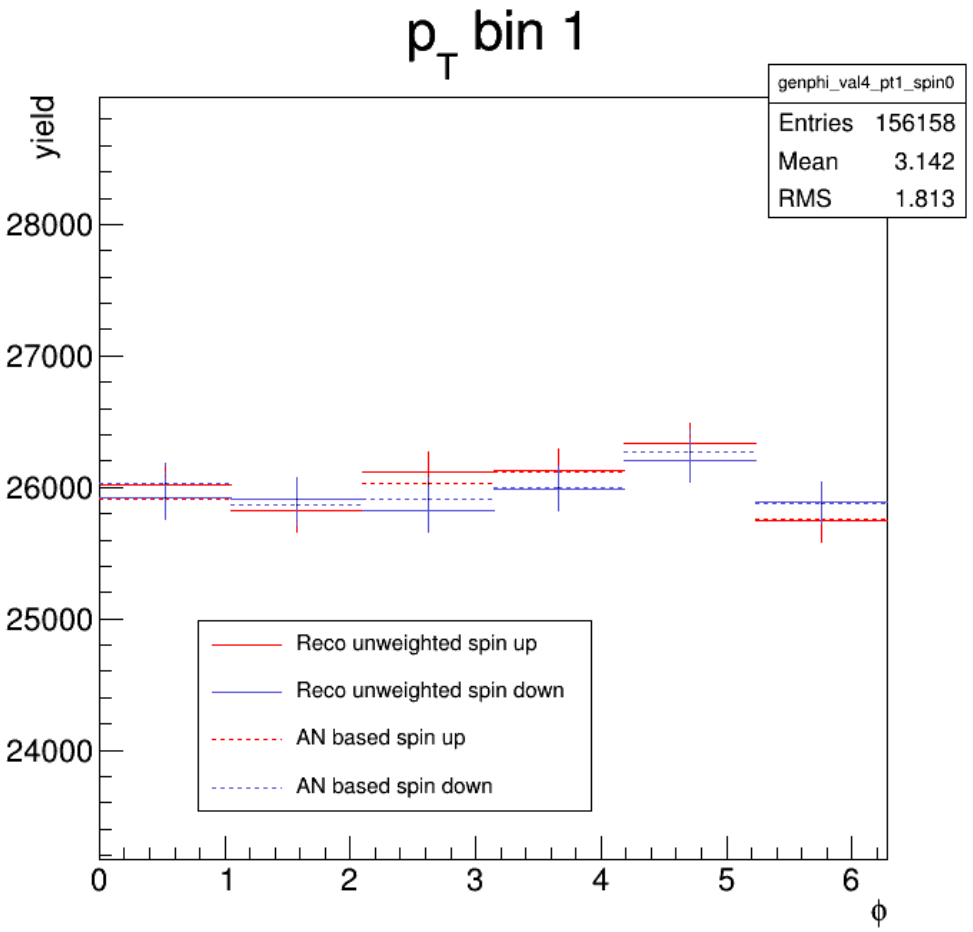
3. Scan parameters for different functional forms over a wide range using chi-square based on the reconstructed asymmetries from pp collision monte carlo samples and run 15 pp asymmetry results (Minjung's result) to find the best parameter, i.e. parameter with lowest,

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

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

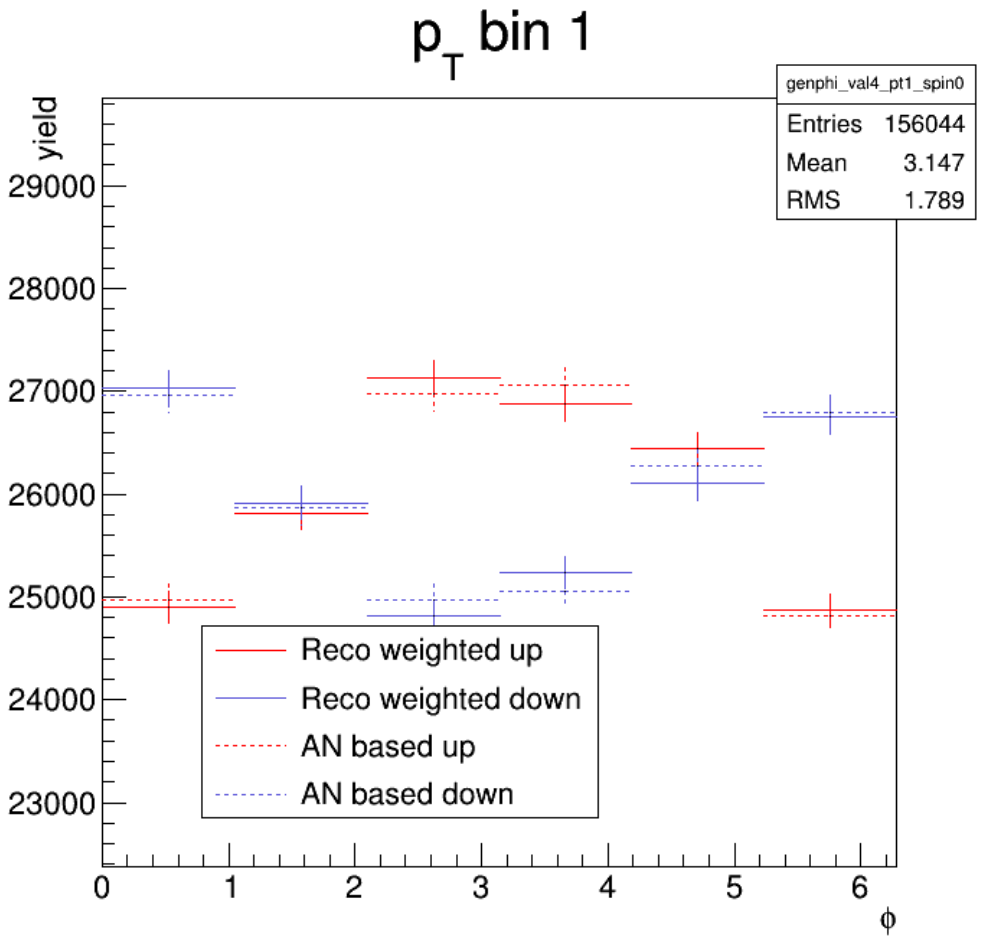
$$A_N = \frac{N_{\Phi\uparrow} - N_{\Phi\downarrow}}{N_{\Phi\uparrow} + N_{\Phi\downarrow}}$$

OPE Monte Carlo (Not weighted)



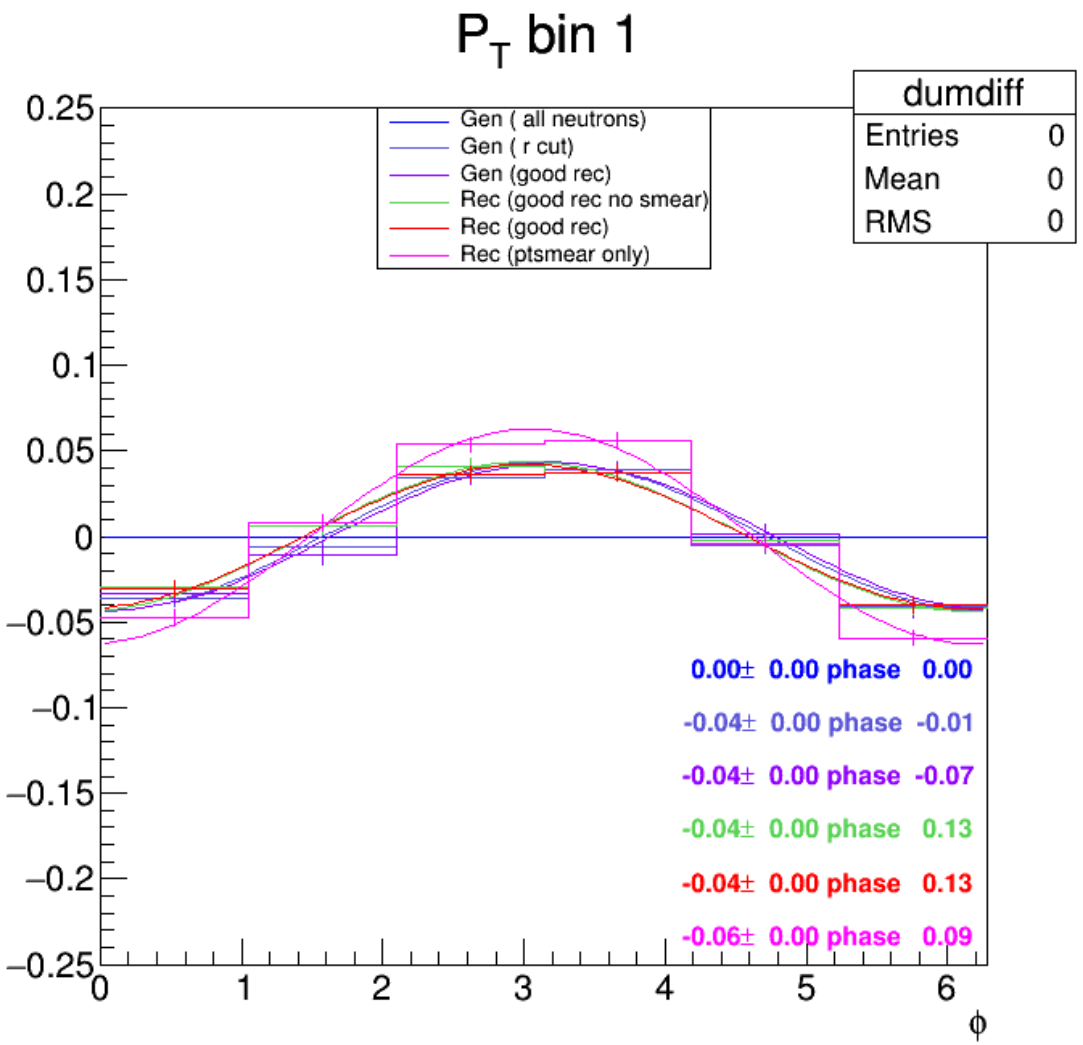
- Reconstructed azimuthal without weight
- Reconstructed azimuthal angle without weight
- Neutron asymmetry (A_N) without weight
- Neutron asymmetry (A_N) without weight

OPE Monte Carlo (Weighted Up or Down)



- Reconstructed azimuthal angle weighted up
- Reconstructed azimuthal angle weighted down
- Neutron asymmetry (A_N) based up
- Neutron asymmetry (A_N) based down

OPE Monte Carlo (Weighted)



To Do List

Condor Jobs for best Chi-square scan of best parameters.

- Need to use condor as chi-square scan of best parameters is a large computing job.
- Currently setting environment variables for the condor jobs to scan the best chi-squares parameters.

Period	Task
June 25 ~ June 30	▪ Set environment variables for condor jobs and start scanning of the best chi-square parameters.
July 01 ~ July 05	▪ Apply best parameters and mimic pp data asymmetries

BACKUP

A Quick Scan of Created Asymmetries – Pythia, Dpmjet and OPE

Scanned neutron asymmetries based on the following functions;

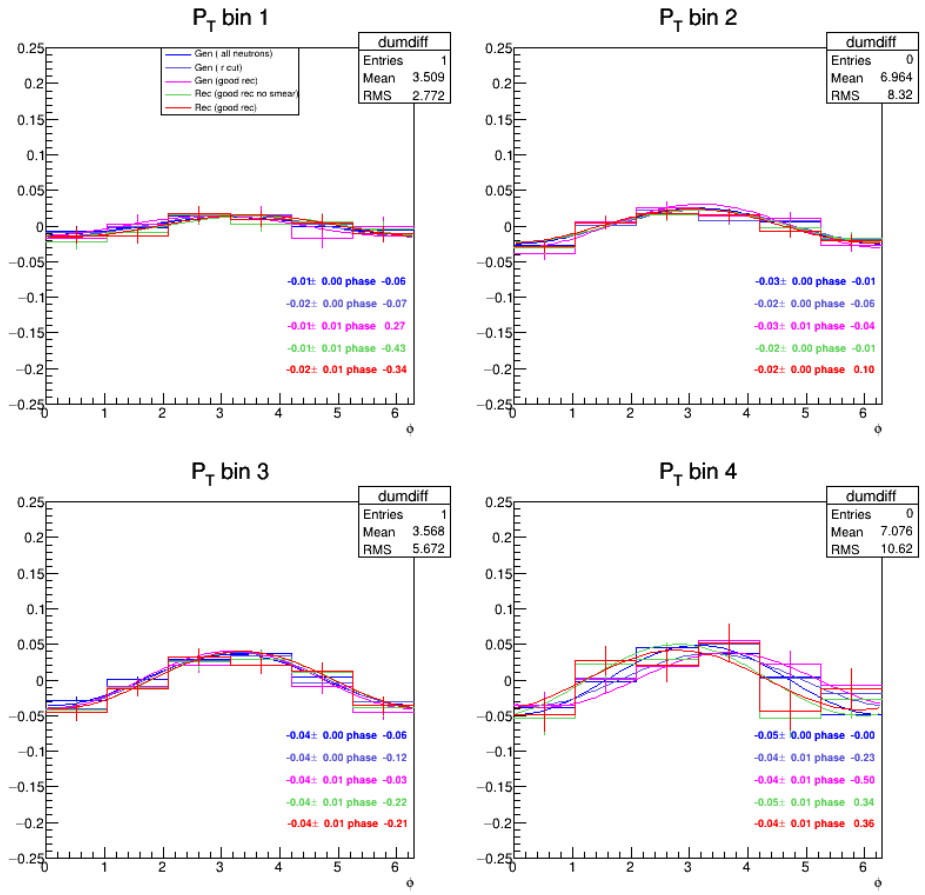
- Quadratic function
- Linear function

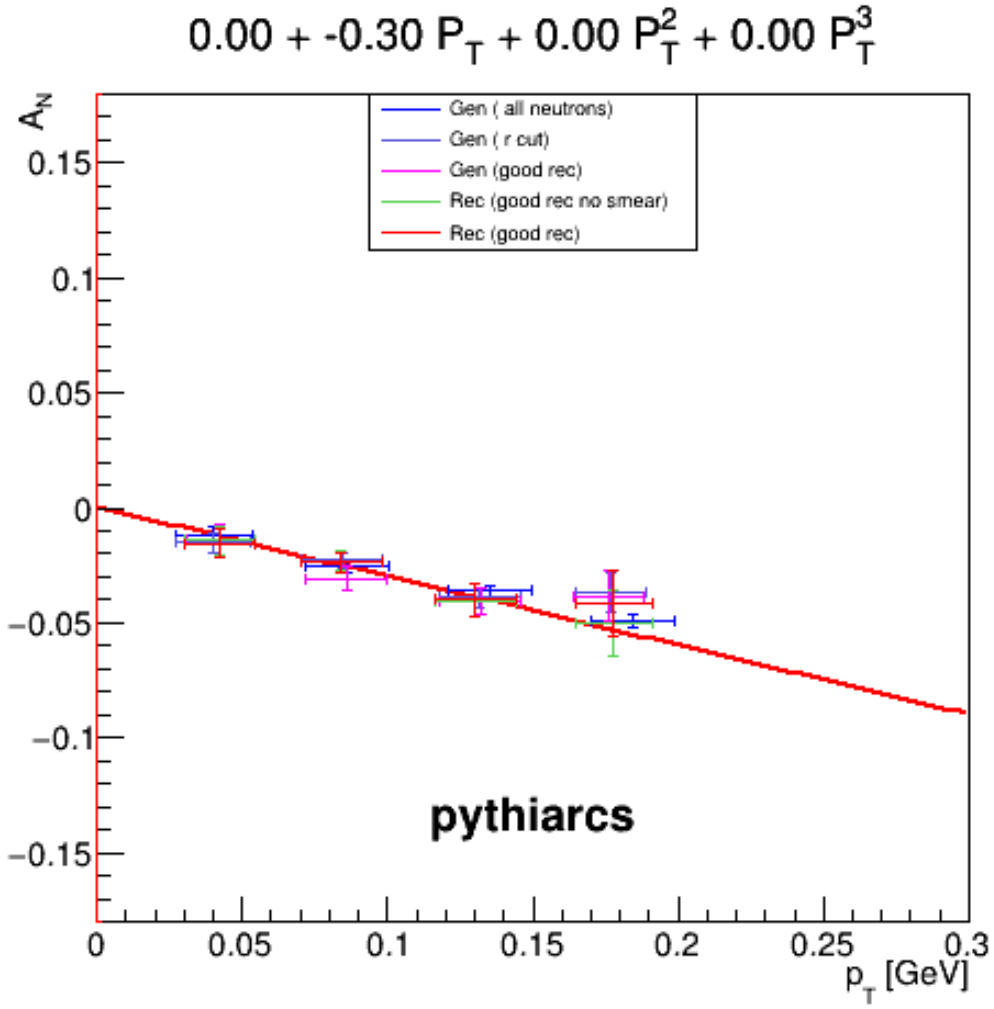
Based on Minjung's Pt binning:

- (0, 0.01) , (0.01, 0.06), (0.06, 0.11), (0.11, 0.16), (0.16, 0.21), (0.21, 0.40)
- First and last bins are ignored. Hence,
- (0.01, 0.06), (0.06, 0.11), (0.11, 0.16), (0.16, 0.21)

A Quick Scan of Created Asymmetries – Pythia Monte Carlo Sample

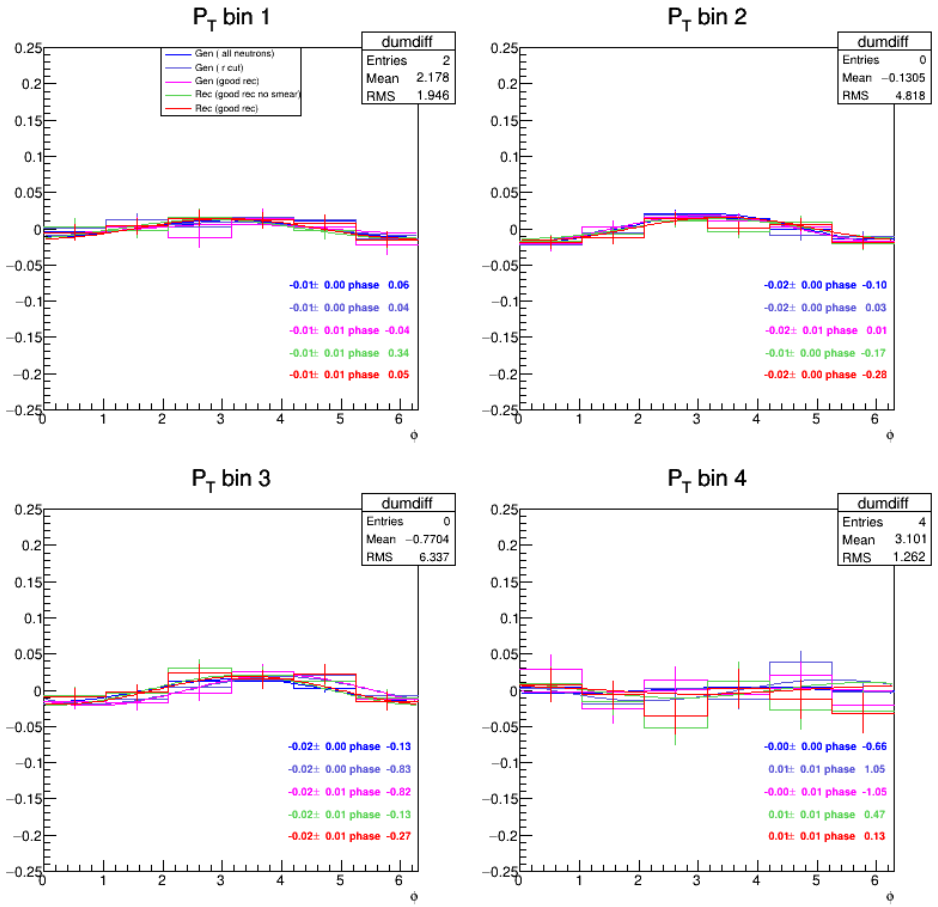
Asymmetry based on linear function

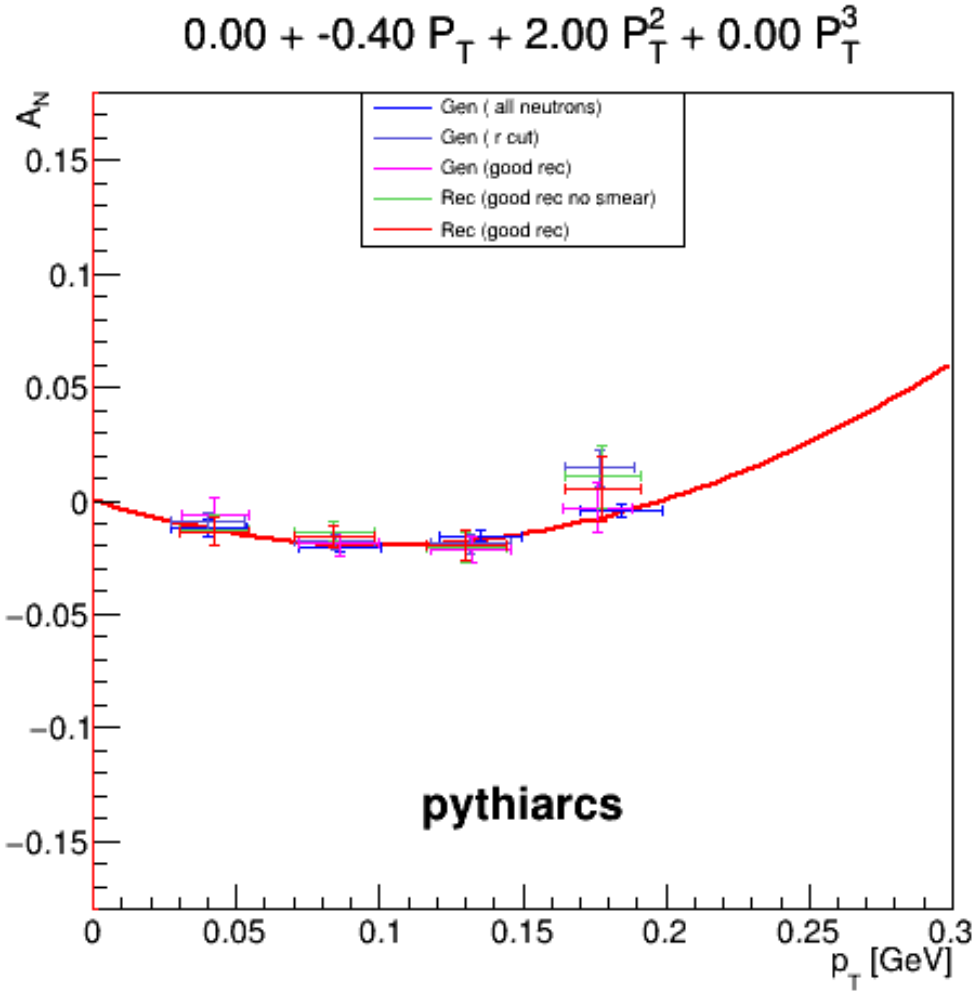




A Quick Scan of Created Asymmetries – Pythia Monte Carlo Sample

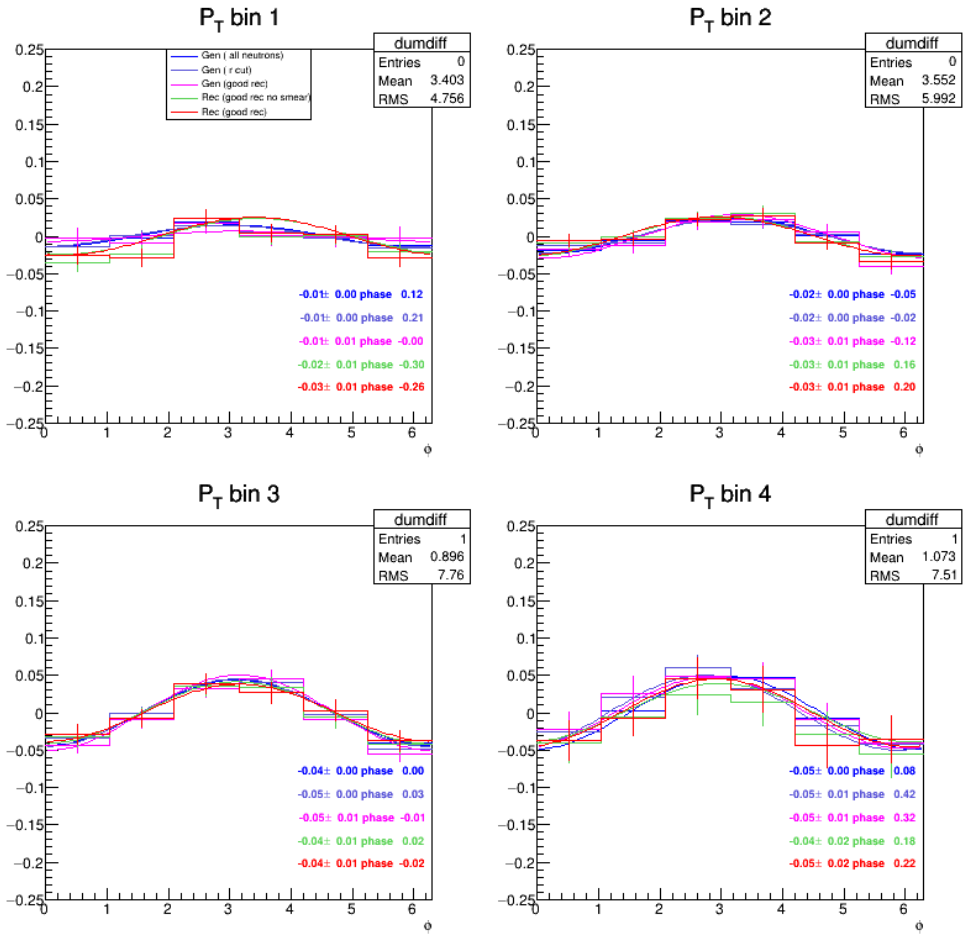
Asymmetry based on quadratic function

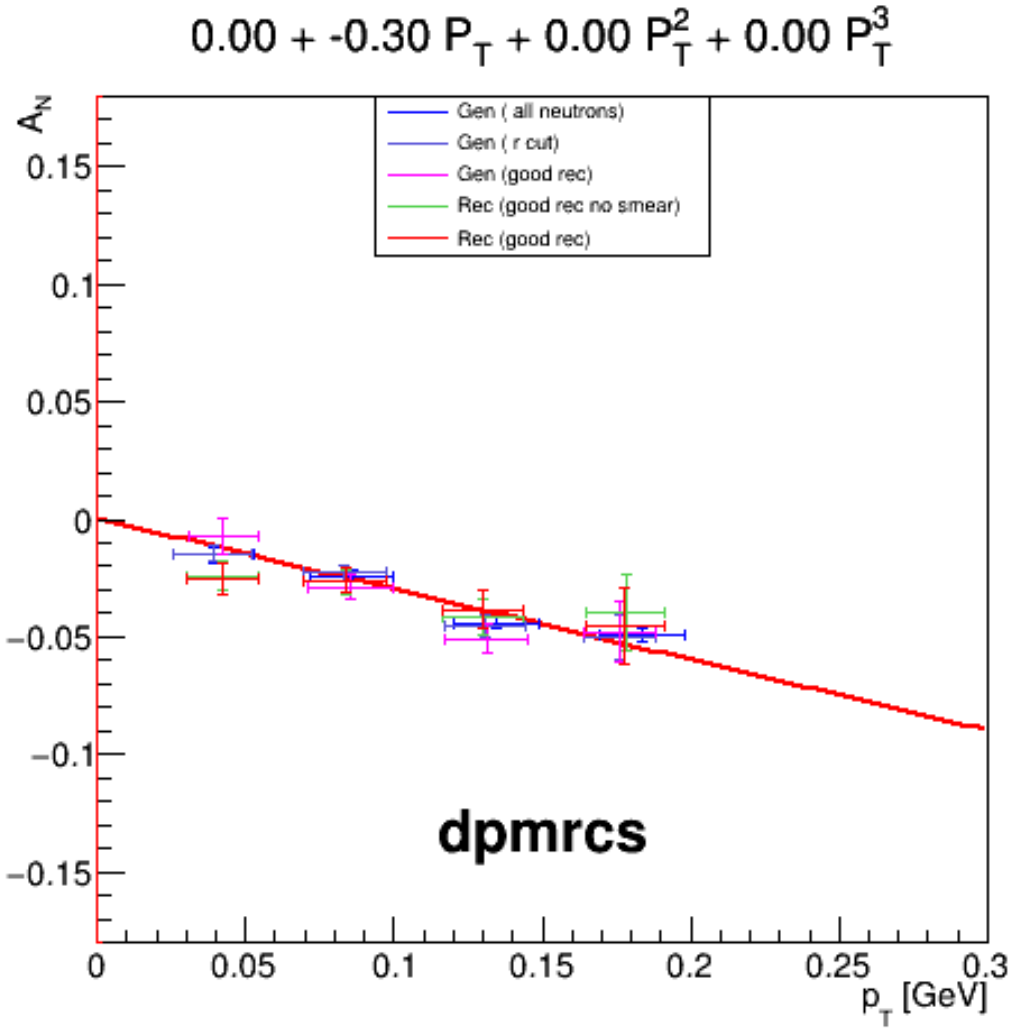




A Quick Scan of Created Asymmetries – Dpmjet Monte Carlo Sample

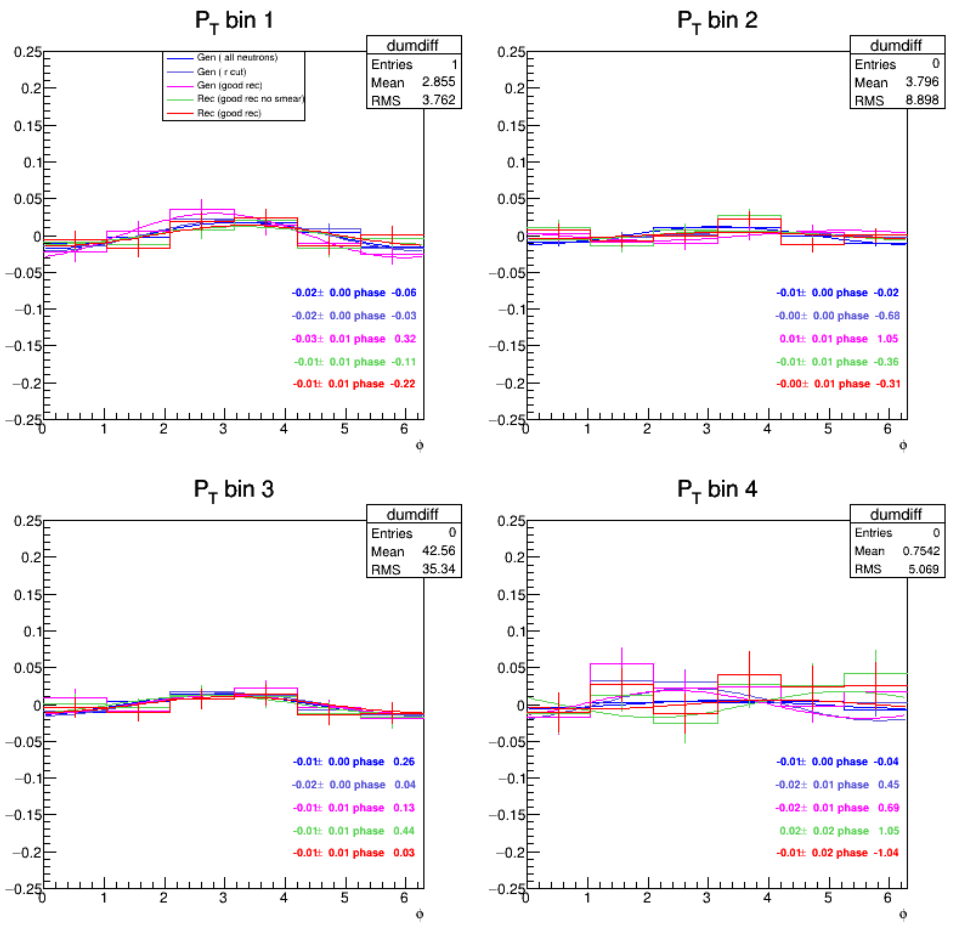
Asymmetry based on linear function

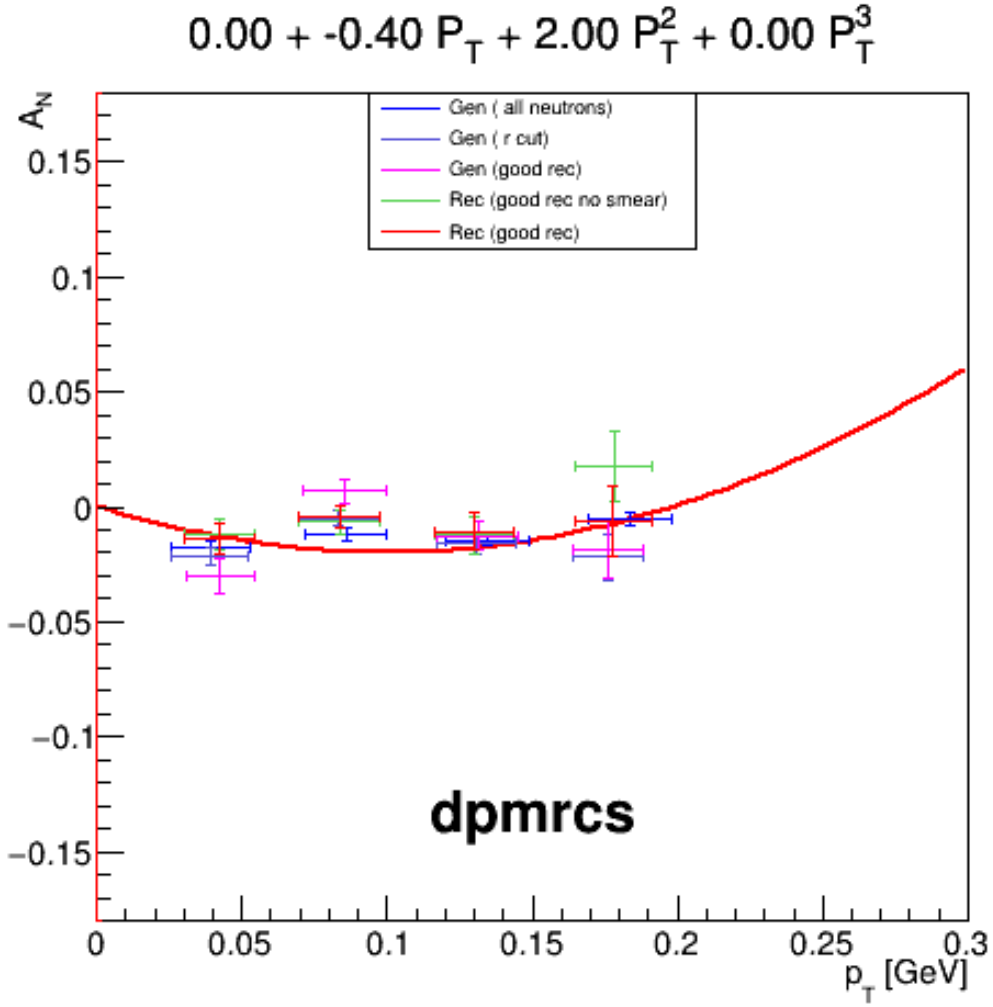




A Quick Scan of Created Asymmetries – Dpmjet Monte Carlo Sample

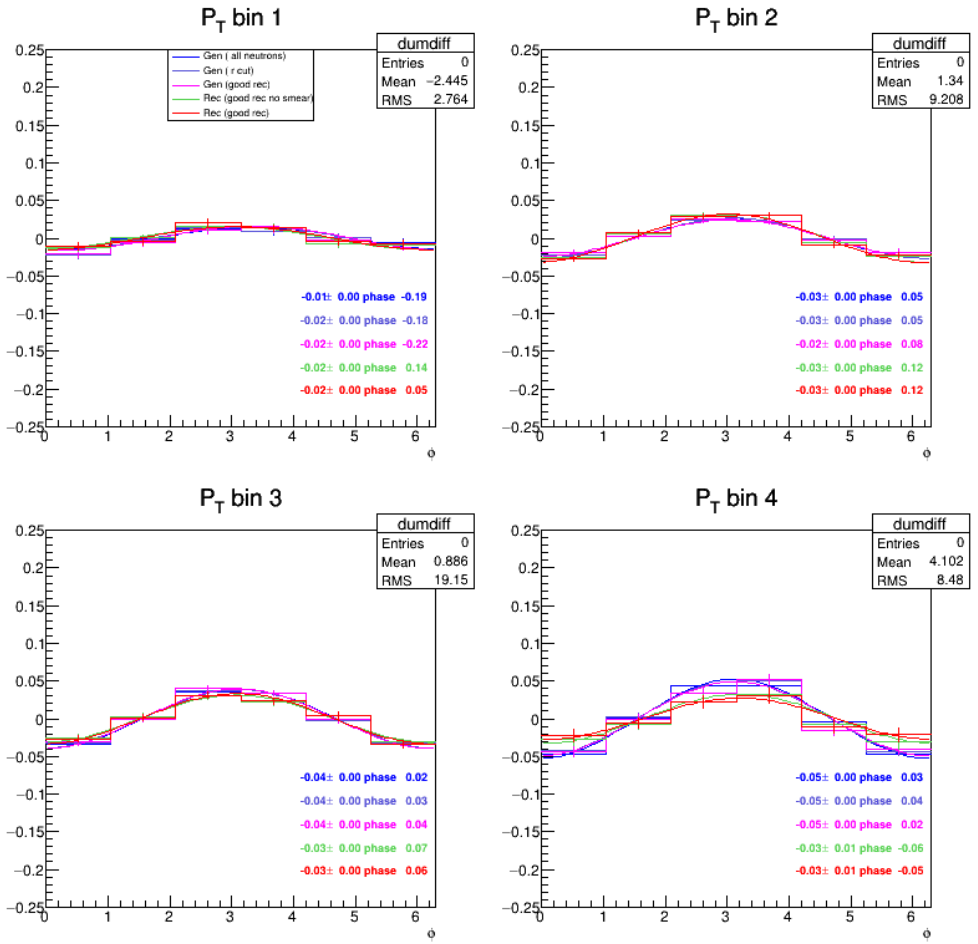
Asymmetry based on quadratic function

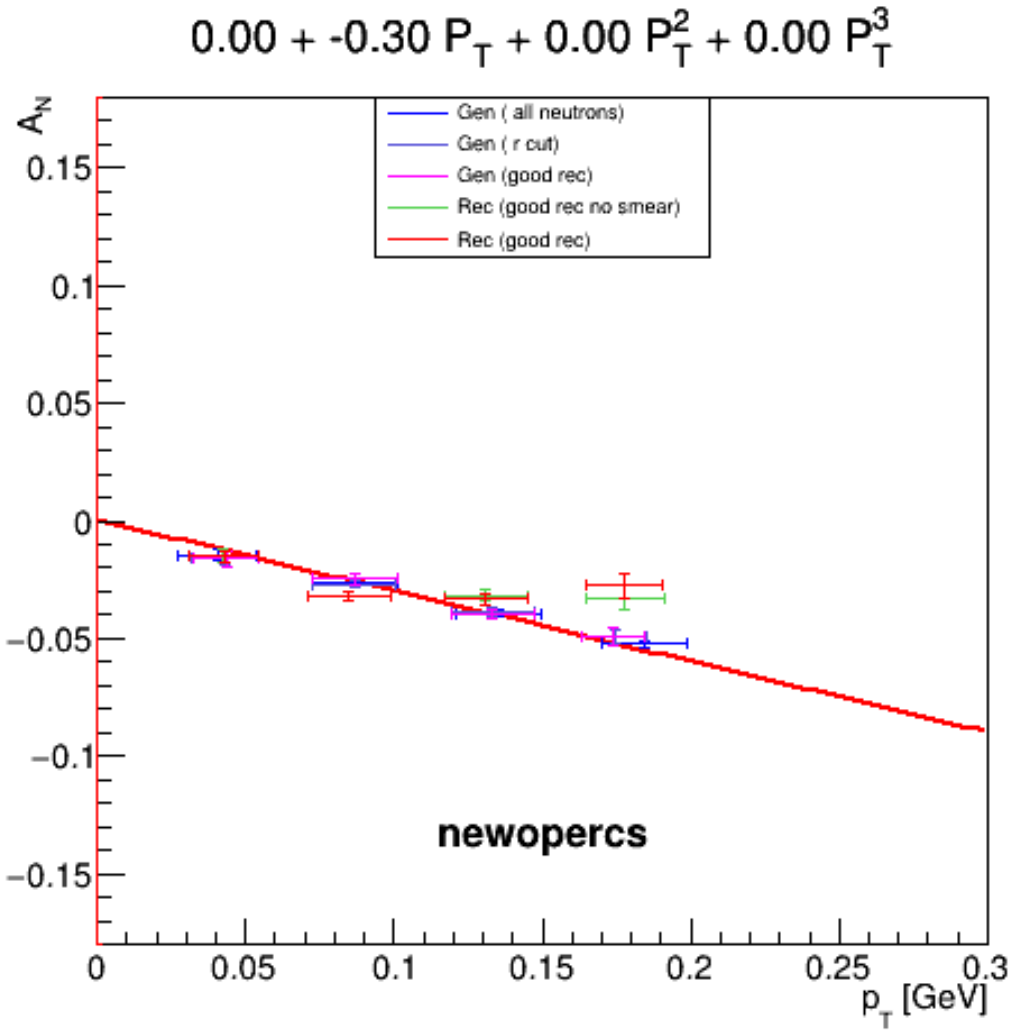




A Quick Scan of Created Asymmetries – One Pion Exchange (OPE) MC

Asymmetry based on linear function





A Quick Scan of Created Asymmetries – One Pion Exchange (OPE) MC

Asymmetry based on quadratic function