Diffractive EM Jet A_N at FMS with run 15 data correction and systematic uncertainty

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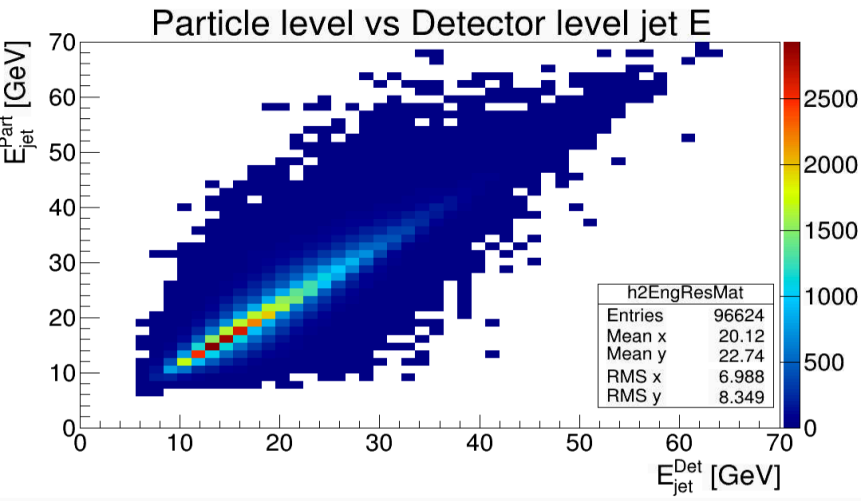
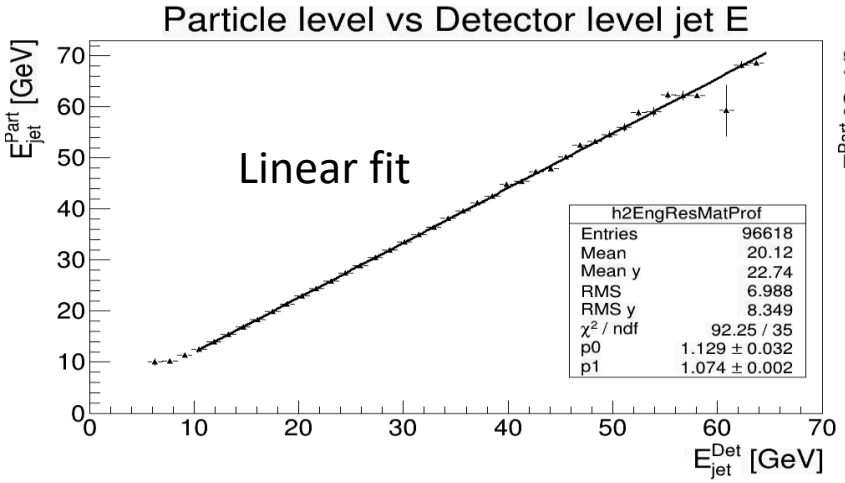
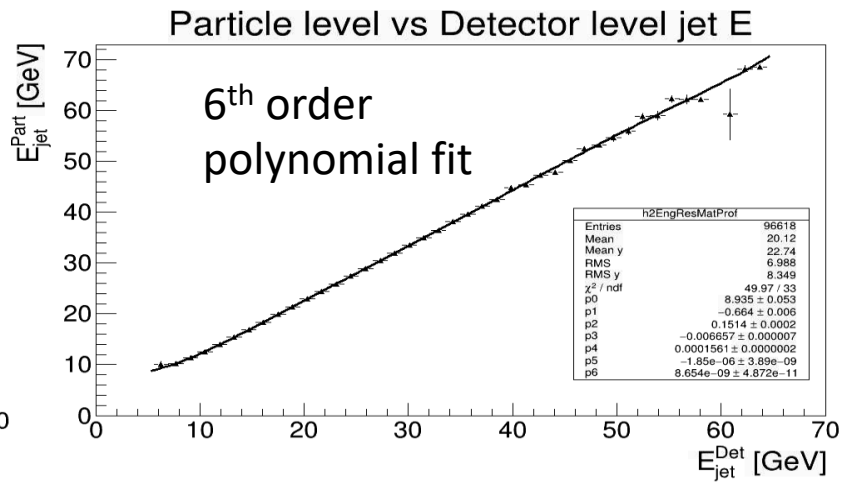
Apply energy correction from simulation

- Detector level to particle level EM jet energy correlation from simulation.
  - Use 6th order polynomial to fit range [5,65] GeV, but apply [5, 10] GeV into correction.
  - Use linear fit for range [10, 65] GeV, but apply [10, 65] GeV into correction

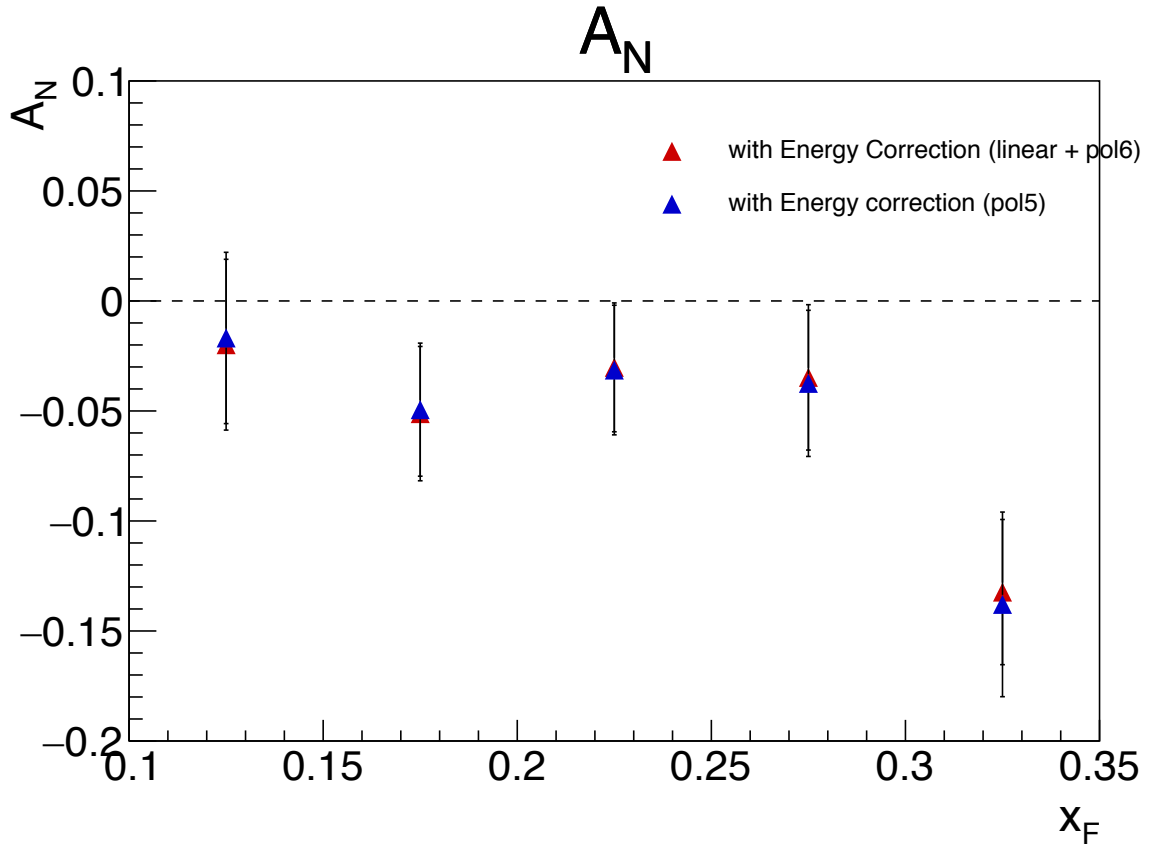






Energy correction uncertainty study

- Change energy correction function to 5th order polynomial for systematic uncertainty study for this time.



EM jet energy uncertainty

- $\sigma_E = C \oplus R \oplus E$
  - C: Calibration uncertainty (2.5%)[1]
  - R: Radiation damage and non-linear response uncertainty (0.5%)[1]
  - E: Energy resolution and correction uncertainty (separate by different x_F bins)

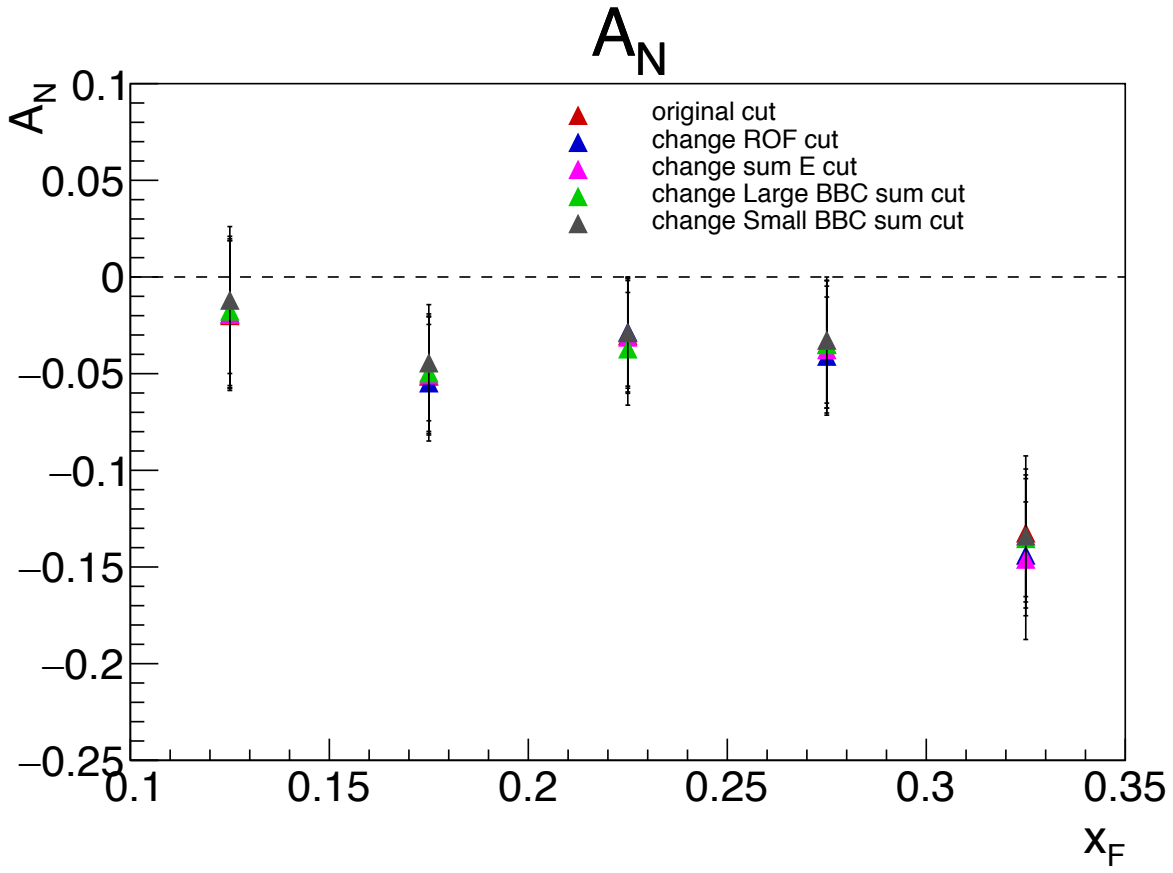
x_F range	After Energy correction average x_F range	EM jet Energy uncertainty (%)	x_F uncertainty
0.1 - 0.15	0.128	15.64%	0.020
0.15 - 0.2	0.176	4.34%	0.008
0.2 - 0.25	0.225	4.78%	0.011
0.25 - 0.3	0.275	8.25%	0.023
0.3 – 0.45	0.320	4.93%	0.016

[1] Z. Zhu , Measurement of Transverse Single Spin Asymmetry for pi0 at Forward Direction in 200 and 500 GeV Polarized Proton-Proton Collisions at RHIC-STAR

Systematic uncertainty for residual background

- Systematic uncertainties for residual background effect mainly come from the cut for selecting signal from background.
  - Energy sum cut: change the energy sum cut to check the uncertainty.
  - Small BBC ADC sum cut: change 100 to 105
  - Large BBC ADC sum cut: change 60 to 65
- Ring of fire
  - Trigger: fms-sm-bs3

x_F	E sum Cut original	E sum cut for systematic
0.1 - 0.15	E_{sum} < 108 GeV	E_{sum} < 112 GeV
0.15 - 0.2	E_{sum} < 108 GeV	E_{sum} < 112 GeV
0.2 - 0.25	E_{sum} < 110 GeV	E_{sum} < 114 GeV
0.25 - 0.3	E_{sum} < 110 GeV	E_{sum} < 114 GeV
0.3 – 0.45	E_{sum} < 115 GeV	E_{sum} < 120 GeV



Polarization uncertainty

- $\sigma(P_{set}) = P_{set} \cdot \frac{\sigma(scale)}{P} \oplus \sigma_{set}(fill\ to\ fill) \oplus P_{set} \cdot \frac{\sigma(profile)}{P}$
- $\frac{\sigma(scale)}{P} = 3\%$ [1]
- $\frac{\sigma(profile)}{P} = \frac{2.2\%}{\sqrt{M}} = 0.3\ \%$ [1]
- $\sigma^2{}_{set}(fill\ to\ fill) = (1 - \frac{M}{N}) \frac{\sum_{fill} {L_{fill}}^2 \sigma^2(P_{fill})}{(\sum_{fill} L_{fill})^2}$
  - $\sigma_{set}(fill\ to\ fill)$ = 0.3%
  - $\sigma(P_{fill}) = \sigma(P_0) \oplus \sigma(\frac{dP}{dt})(\frac{\sum_{run} t_{run} L_{run}}{L_{fill}} - t_0) \oplus \frac{\sigma(fill\ to\ fill)}{P} P_{fill}$ [2]

Close to 0

- so $\sigma(P_{set}) = 3.0\%$

[1] W. B. Schmidke, RHIC polarization for Runs 9-17

[2] Z. Chang Example calculation of fill-to-fill polarization uncertainties

Summary for systematic uncertainty

- Analyze separately by different x_F bins.
- Energy uncertainty is accounted into x-axis (x_F, not shown in the preliminary plot)
- Systematic uncertainty terms accounted to Y-axis (A_N, shown in the preliminary plot)
  - Energy sum cut
  - Small BBC ADC sum cut
  - Large BBC ADC sum cut
  - Ring of Fire
- Polarization uncertainty (3.0%).

Systematic uncertainty table

Uncertainty value = $\left| \frac{A_N(original) - A_N(systematic)}{A_N(original)} \right|$

Blue beam X_F	small BBC	large BBC	Ring of Fire	Energy sum cut	summary
0.125	0.117332	0.400258	0.0483722	0.0309222	0.421034
0.175	0.0336984	0.134208	0.0680646	0.0123518	0.154702
0.225	0.23084	0.0482274	0.0585945	0.0276688	0.244565
0.275	0.00501827	0.060795	0.178	0.0805313	0.204672
0.325	0.0220069	0.0117138	0.0865313	0.102659	0.136558

Yellow beam X_F	small BBC	large BBC	Ring of Fire	Energy sum cut	summary
0.125	0.219171	0.180549	0.426774	2.24948	2.30715
0.175	0.483761	0.74152	0.220412	0.142123	0.923394
0.225	0.271693	0.200808	0.153996	0.286028	0.468687
0.275	0.146116	0.542164	0.105183	0.337213	0.663376
0.325	0.0323442	0.581033	0.0589296	0.601611	0.839079

Preliminary request page

- Drupal page for preliminary request: https://drupal.star.bnl.gov/STAR/blog/liangxl/Run-15-diffractive-EM-jet-preliminary-request-0

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