Run 15 Diffractive EM-jet A_N Part 2

Xilin Liang

Dec. 6, 2023

Outline:

- RP cut study and event selection for the single diffractive event
- Background study for accidental coincidence (multiple collision event)
- Systematic uncertainty
- A_N results
- Plans for the next step and paper proposal discussion

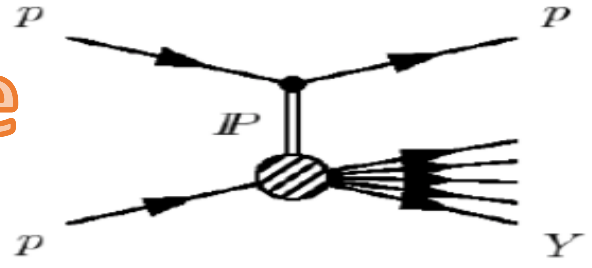
General Information for the data set

- Data set: run 15 pp transverse $\sqrt{s} = 200$ GeV ,fms stream
  - (production_pp200trans_2015)
- Production type: MuDst ; Production tag: P15ik
- Trigger for FMS : FMS small board sum, FMS large board sum and FMS-JP.
- EM-jet reconstruction: Anti-k_T algorithm with R=0.7
  - EM-jet: the jet reconstructed using only photons (FMS point).
  - Minimum p_T threshold based on trigger threshold

Diffractive process

Case 1: (Single diffractive event)
only 1 proton track on east side RP. No west side RP track requirement.
Require: small and large BBC east cut

This slide

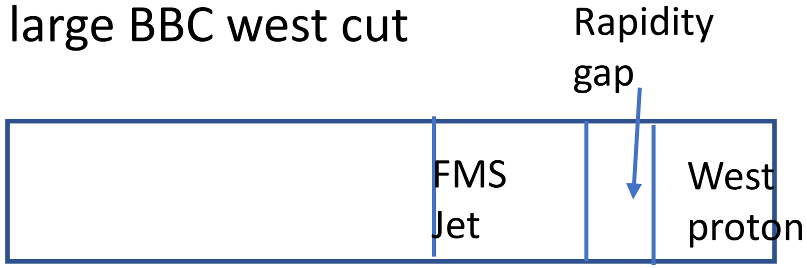


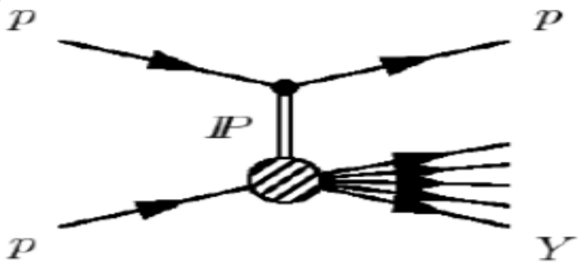
East RP track

FMS jets

Case 2: (semi-exclusive process)
only 1 proton track on west side RP. No requirement on east RP track
Require: small and large BBC west cut

Last week





West RP track

FMS jets

Outline for studying the RP cuts and BBC cuts

- Here are the idea and steps for considering the cuts for RP and BBC:

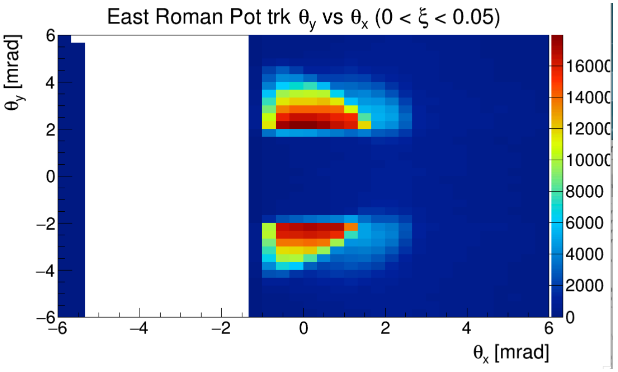
1. Since we reach to the agreement that the low BBC threshold should be applied, we first apply a rough cut on small BBC east < 150 . Goal: explore a rough RP P_X , P_Y cuts for different ξ range.
2. Apply the rough RP P_X , P_Y cuts from step 1, study the small/large BBC east ADC distribution and consider further cuts for small/large BBC cuts.
3. Apply the further cuts for east small/large BBC cuts, study the further RP P_X , P_Y cuts, and θ_X , θ_Y cuts for different ξ range.

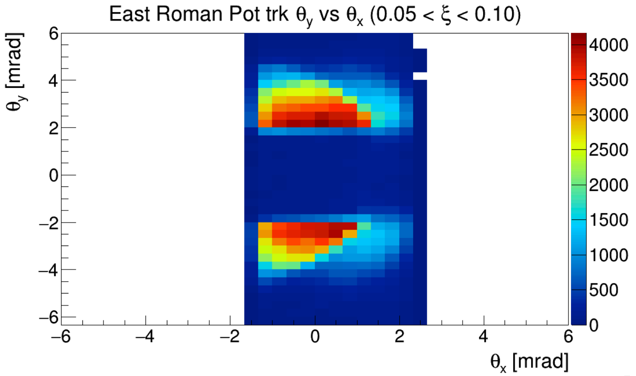
$$\xi = \frac{P_{beam} - P_{RP}}{P_{beam}}$$

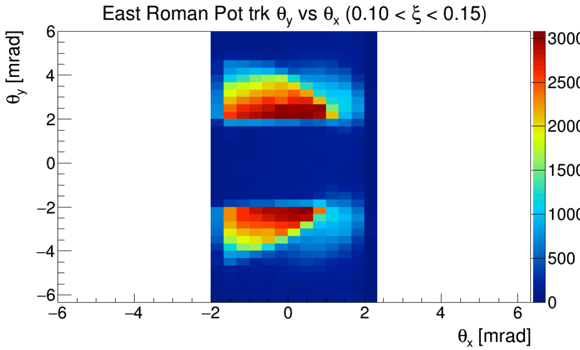
East RP track θ_Y vs θ_X with different ξ ranges

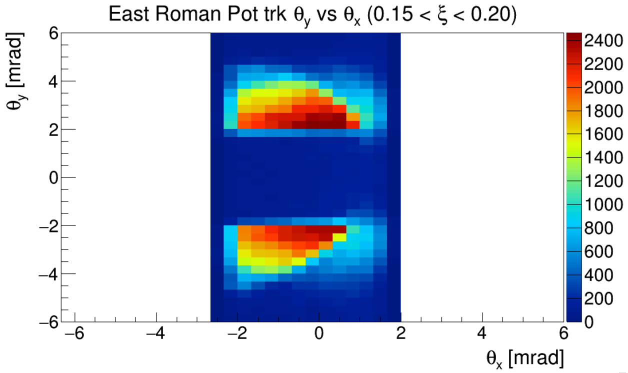
- Cuts applied at this stage: RP track hit at least 7 SSD planes , small BBC east < 150

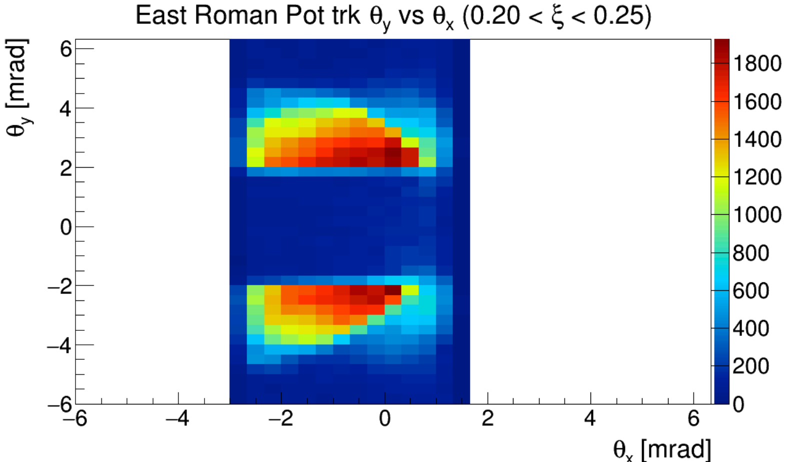
$$(\xi = \frac{P_{beam} - P_{RP}}{P_{beam}})$$

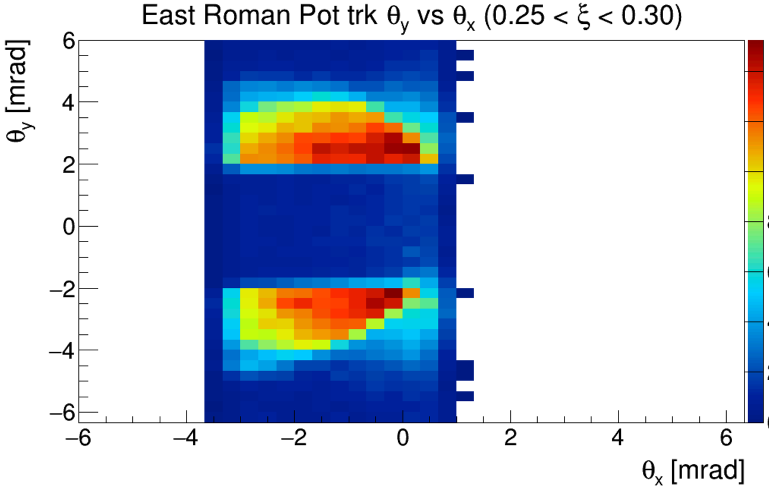


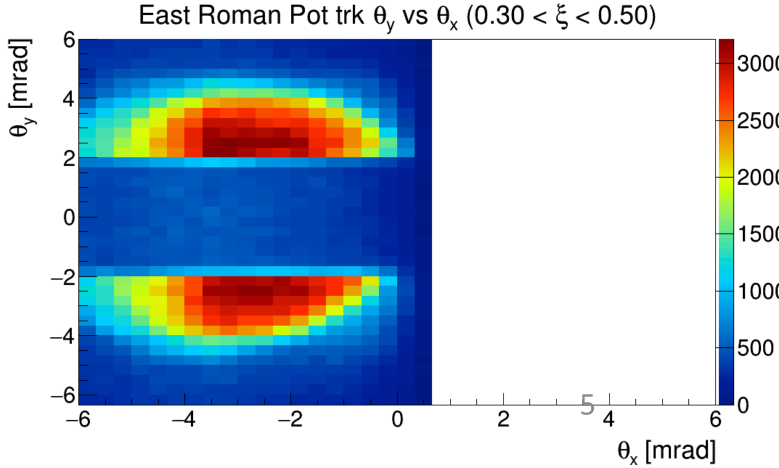










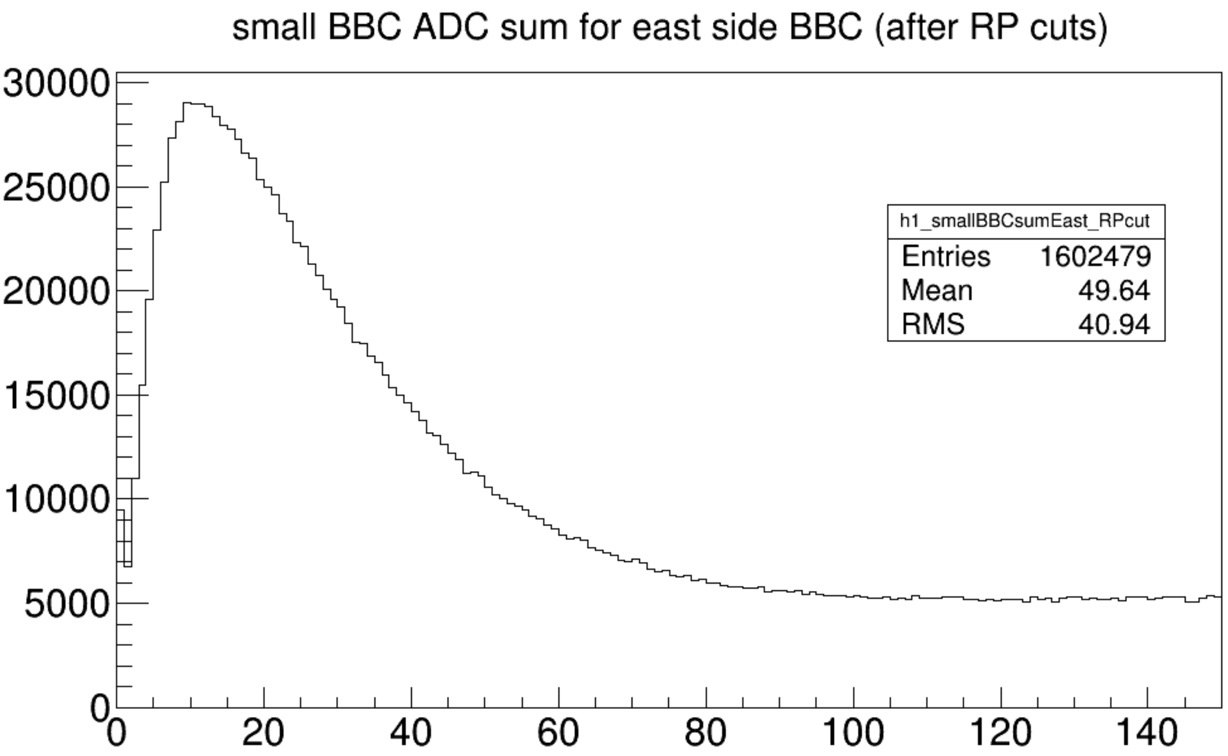


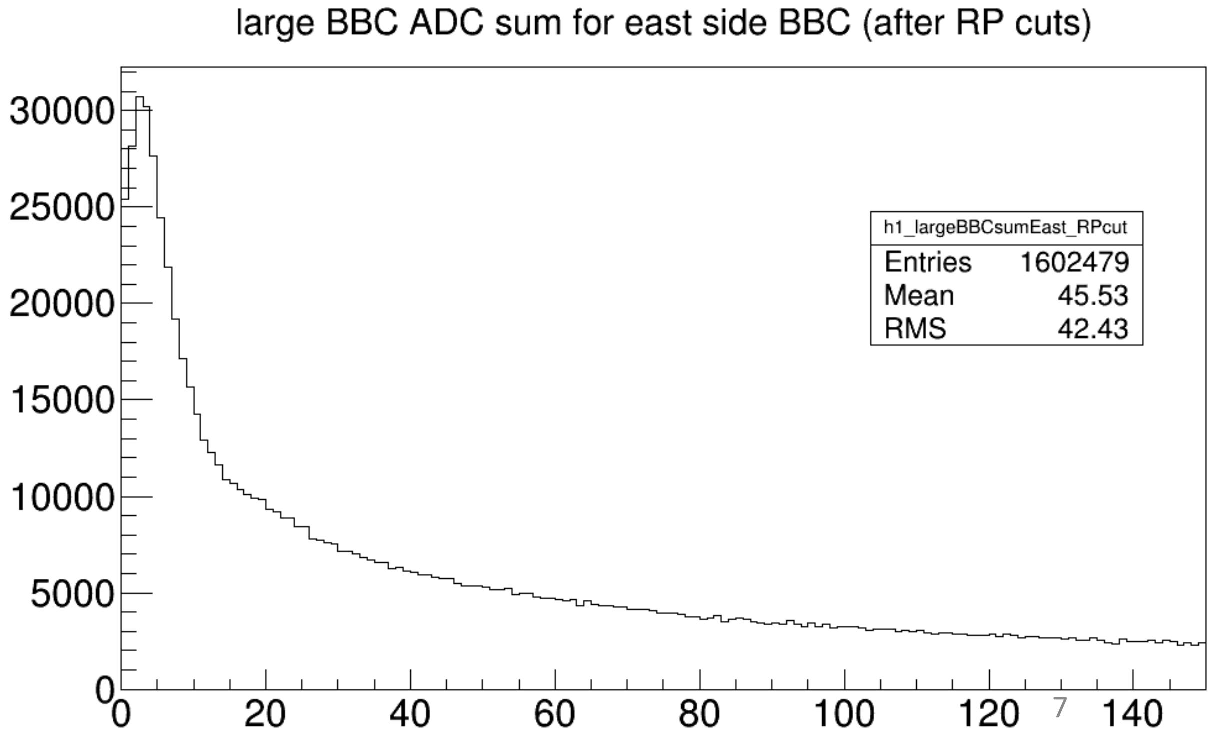
Rough cut on the **east** RP track θ_X and θ_Y

- Goal: explore the BBC cuts.
- We can consider the east RP θ_Y cut: $2 < |\theta_Y| < 4\ mrad$
- The east RP θ_X cut can be applied with ξ dependent
- $0.0 < \xi < 0.05$: $-1. < \theta_X < 1.5$ mrad
- $0.05 < \xi < 0.10$: $-1.25 < \theta_X < 1.25$ mrad
- $0.10 < \xi < 0.15$: $-1.5 < \theta_X < 1.25$ mrad
- $0.15 < \xi < 0.2$: $-2.0 < \theta_X < 0.75$ mrad
- $0.2 < \xi < 0.25$: $-2.5 < \theta_X < 0.75$ mrad
- $0.25 < \xi < 0.3$: $-3 < \theta_X < 0.5$ mrad
- $0.3 < \xi < 0.5$: $-5 < \theta_X < -0.25$ mrad
- Note: these are the rough cuts for east RP track θ_X and θ_Y

East small and large BBC ADC sum after the rough east RP track θ_X and θ_Y cuts

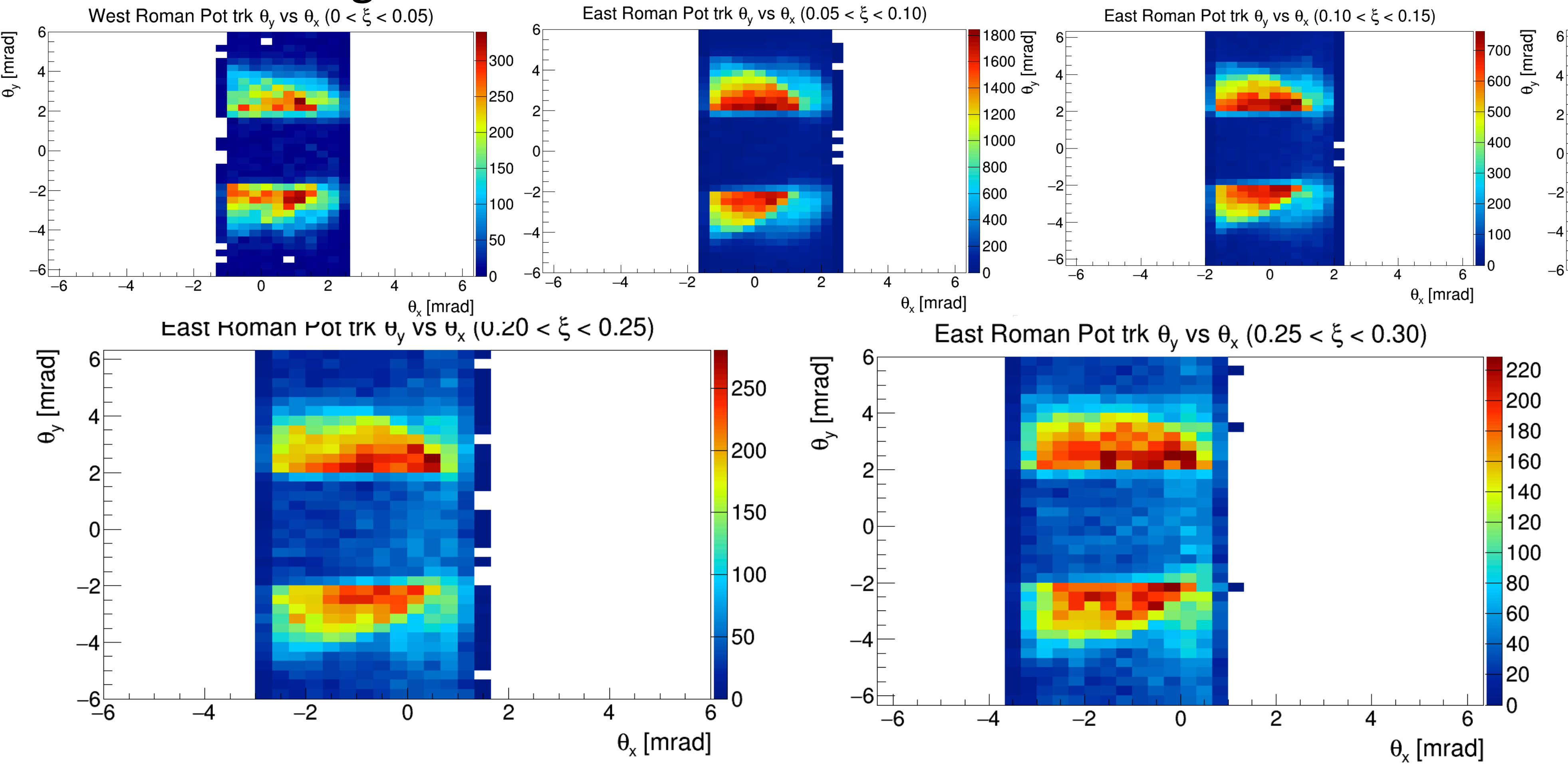
- Temporally apply the rough east RP track θ_X and θ_Y cuts to study the east small and large BBC ADC sum.
- We can consider small BBC east ADC sum < 90 and large BBC east < 80





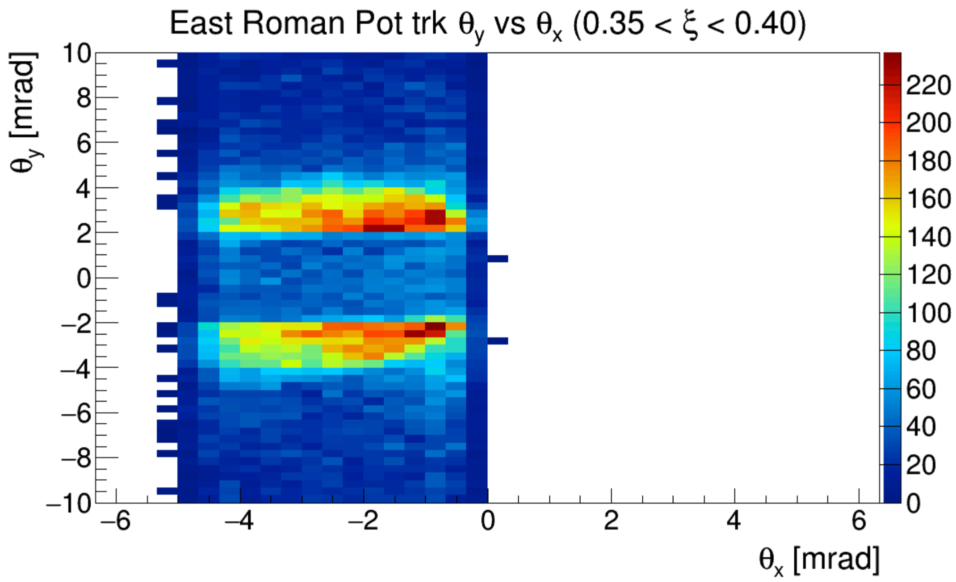
East RP track θ_Y vs θ_X with different ξ ranges

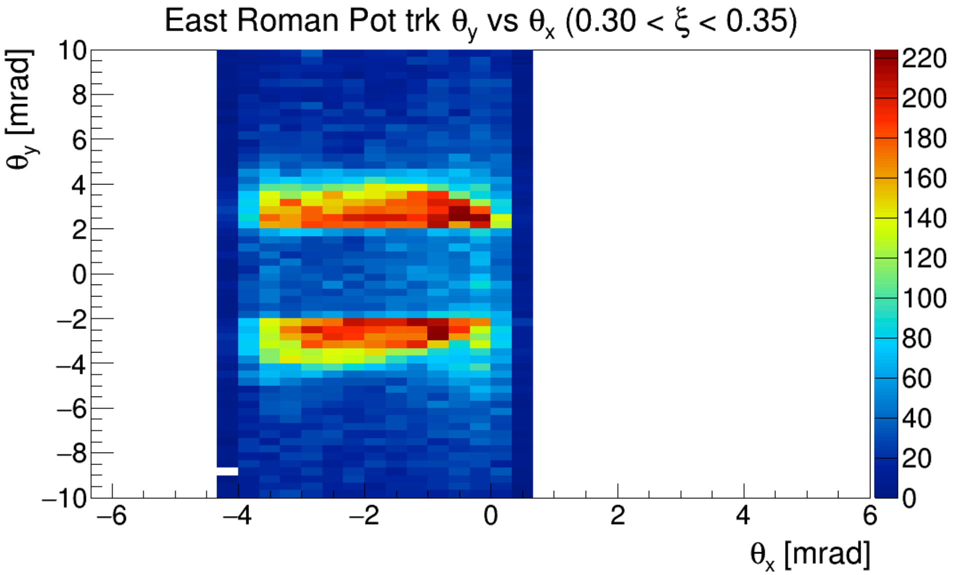
- Cross check after the small/large BBC east cuts
- Cuts applied at this stage: RP track hit at least 7 SSD planes , small BBC east ADC sum < 90 and large BBC east < 80

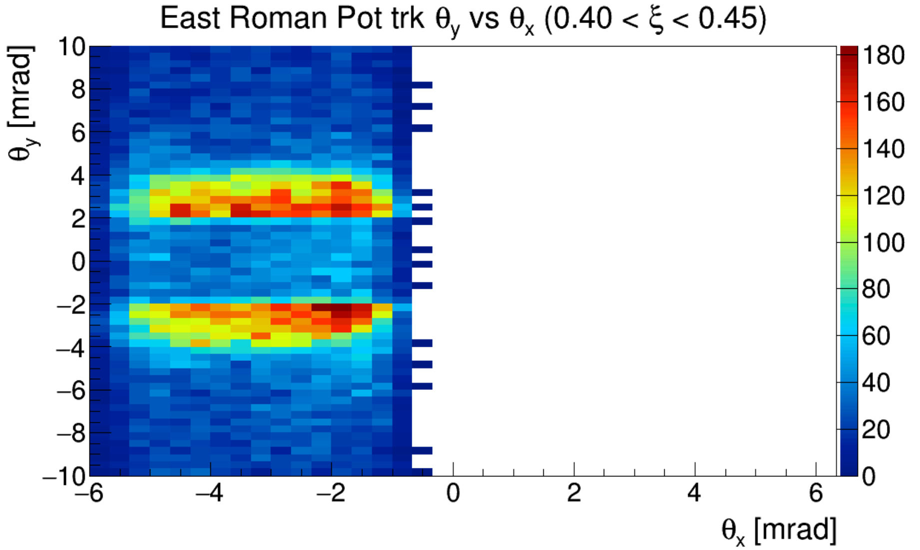


East RP track θ_Y vs θ_X with different ξ ranges

- Cross check after the small/large BBC east cuts
- Cuts applied at this stage: RP track hit at least 7 SSD planes , small BBC east ADC sum < 90 and large BBC east < 80





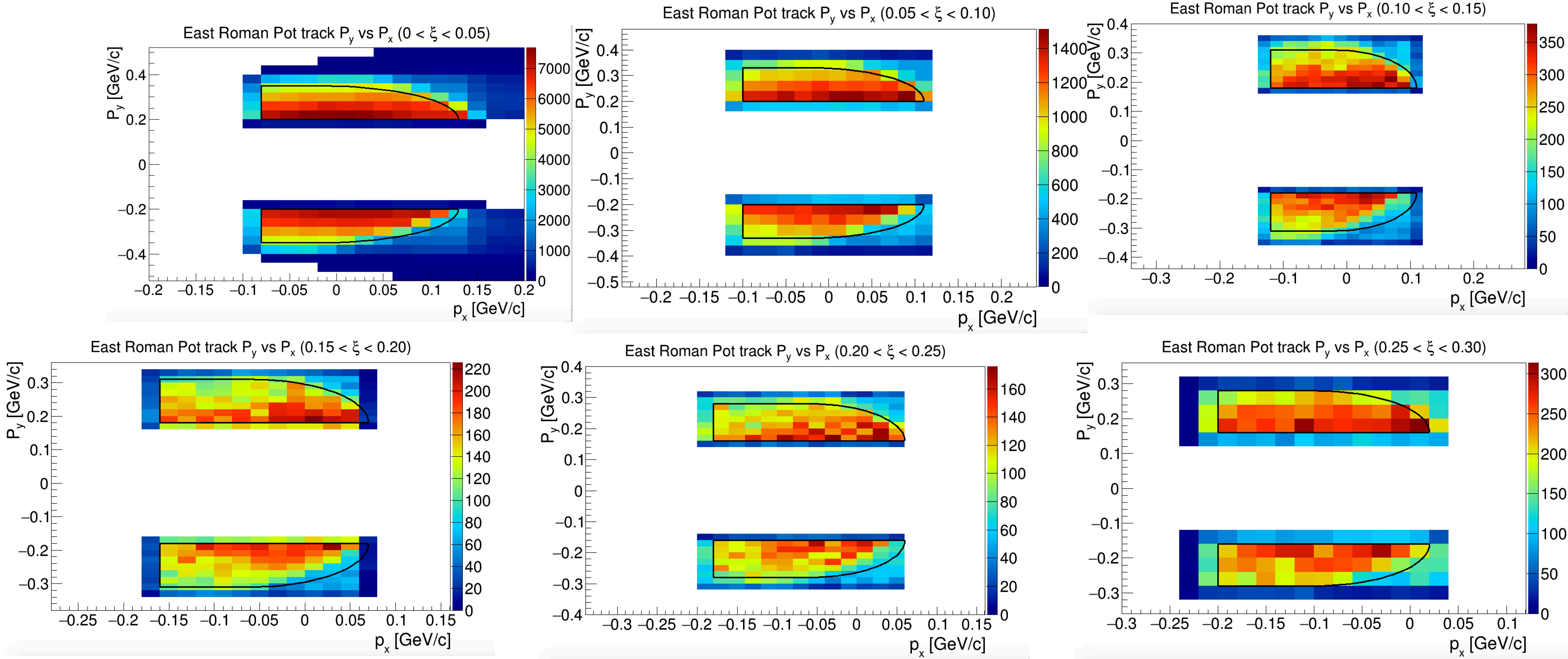


Final cut on the **east** RP track θ_X and θ_Y

- We can consider the east RP θ_Y cut: $2 < |\theta_Y| < 4\,mrad$
- The east RP θ_X cut can be applied with ξ dependent
- $0.0 < \xi < 0.05$: $-1. < \theta_X < 1.5$ mrad
- $0.05 < \xi < 0.10$: $-1.25 < \theta_X < 1.25$ mrad
- $0.10 < \xi < 0.15$: $-1.5 < \theta_X < 1.25$ mrad
- $0.15 < \xi < 0.2$: $-2.0 < \theta_X < 0.75$ mrad
- $0.2 < \xi < 0.25$: $-2.5 < \theta_X < 0.75$ mrad
- $0.25 < \xi < 0.3$: $-3 < \theta_X < 0.5$ mrad
- $0.3 < \xi < 0.35$: $-3.5 < \theta_X < 0.25$ mrad
- $0.35 < \xi < 0.4$: $-4.5 < \theta_X < -0.25$ mrad
- $0.3 < \xi < 0.5$: $-5 < \theta_X < -0.5$ mrad

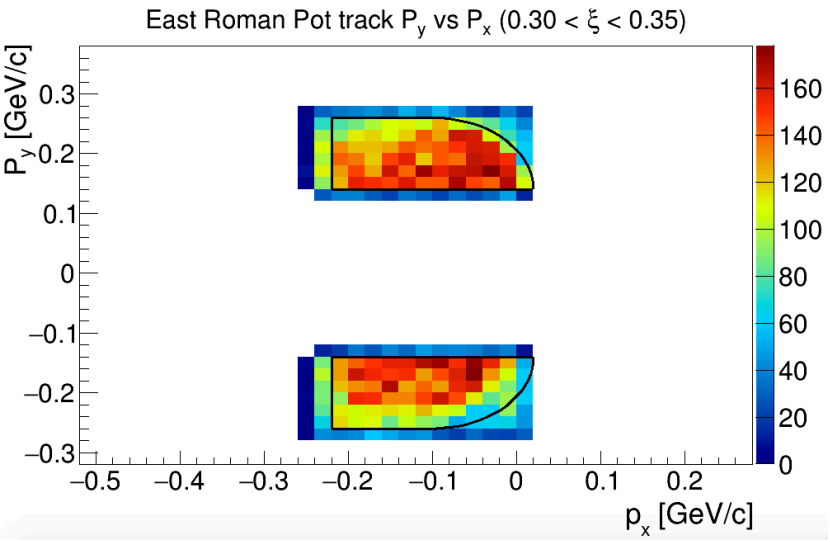
East RP track P_Y vs P_X

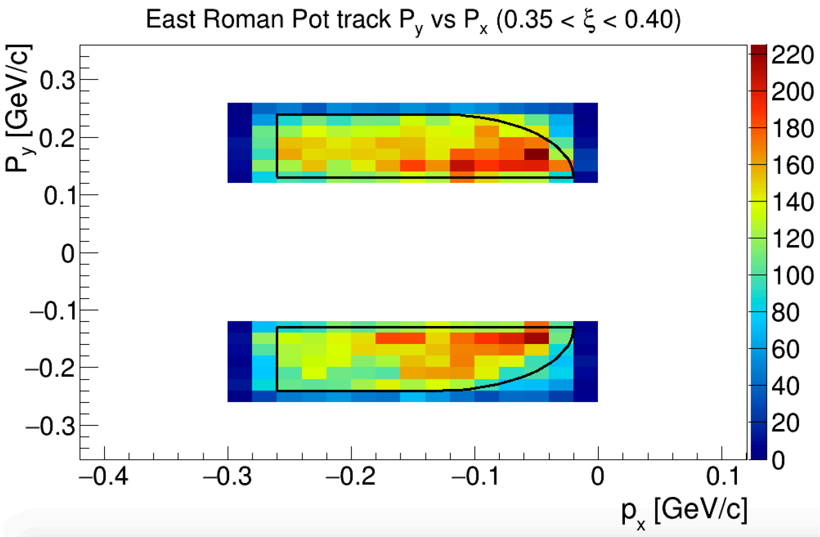
- Applying the BBC east small/large ADC sum cuts and RP θ_X and θ_Y cuts, we check the east RP track P_Y vs P_X distribution.
- Shape of each half: rectangle + quarter circle (black curve)

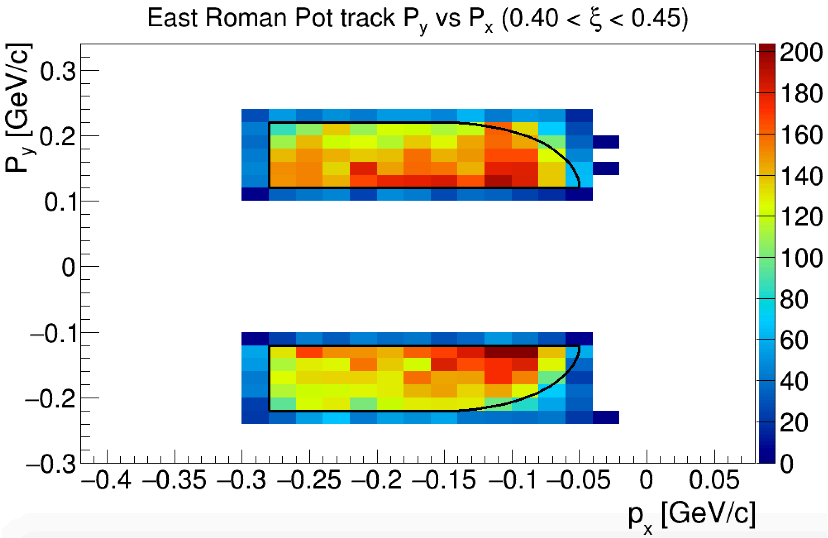


East RP track P_Y vs P_X

- Applying the BBC east small/large ADC sum cuts and RP θ_X and θ_Y cuts, we check the east RP track P_Y vs P_X distribution.
- Shape of each half: rectangle + quarter circle (black curve)







List of **east** RP track P_X and P_Y cuts

- $0.0 < \xi < 0.05$: $(P_X + 0.02)^2 + (|P_Y| - 0.2)^2 < 0.15^2$ or $-0.08 < P_X < -0.02$, and $0.2 < |P_Y| < 0.35$
- $0.05 < \xi < 0.1$: $(P_X + 0.02)^2 + (|P_Y| - 0.2)^2 < 0.13^2$ or $-0.10 < P_X < -0.02$, and $0.2 < |P_Y| < 0.33$
- $0.1 < \xi < 0.15$: $(P_X + 0.02)^2 + (|P_Y| - 0.18)^2 < 0.13^2$ or $-0.12 < P_X < -0.02$, and $0.18 < |P_Y| < 0.31$
- $0.15 < \xi < 0.2$: $(P_X + 0.06)^2 + (|P_Y| - 0.18)^2 < 0.13^2$ or $-0.16 < P_X < -0.05$, and $0.18 < |P_Y| < 0.31$
- $0.2 < \xi < 0.25$: $(P_X + 0.06)^2 + (|P_Y| - 0.16)^2 < 0.12^2$ or $-0.18 < P_X < -0.06$, and $0.16 < |P_Y| < 0.28$
- $0.25 < \xi < 0.3$: $(P_X + 0.10)^2 + (|P_Y| - 0.16)^2 < 0.12^2$ or $-0.20 < P_X < -0.10$, and $0.16 < |P_Y| < 0.28$
- $0.3 < \xi < 0.35$: $(P_X + 0.10)^2 + (|P_Y| - 0.14)^2 < 0.12^2$ or $-0.22 < P_X < -0.10$, and $0.14 < |P_Y| < 0.26$
- $0.35 < \xi < 0.4$: $(P_X + 0.13)^2 + (|P_Y| - 0.13)^2 < 0.11^2$ or $-0.26 < P_X < -0.13$, and $0.13 < |P_Y| < 0.24$
- $0.4 < \xi < 0.45$: $(P_X + 0.15)^2 + (|P_Y| - 0.12)^2 < 0.1^2$ or $-0.28 < P_X < -0.15$, and $0.12 < |P_Y| < 0.22$

Event selection and corrections

- **FMS**
  - 9 Triggers, veto on FMS-LED
  - Only 1 EM-jet per event is allowed
  - bit shift, bad / dead / hot channel masking (include fill by fill hot channel masking)
  - Jet reconstruction: StJetMaker2015 , Anti-kT, R<0.7 , FMS point energy > 2 GeV, $p_T > 1$ GeV/c, trigger p_T threshold cut, FMS point as input.
- **Only allow acceptable beam polarization (up/down).**
- **Vertex** (Determine vertex z priority according to TPC , VPD, BBC.)
  - Vertex $|z| < 80\ cm$
- **Roman Pot and Single Diffractive process:**
- Acceptable cases:

  1. Only 1 east RP track , no requirement on west RP

  - RP track must be good track:

  a) Each track hits > 6 planes

  b) East RP ξ dependent θ_X , θ_Y , P_X and P_Y cuts
- East Large BBC ADC sum < 80 and East Small BBC ADC sum < 90

Corrections:
EM-jet energy correction and Underlying Event correction

Background study: zerobias stream

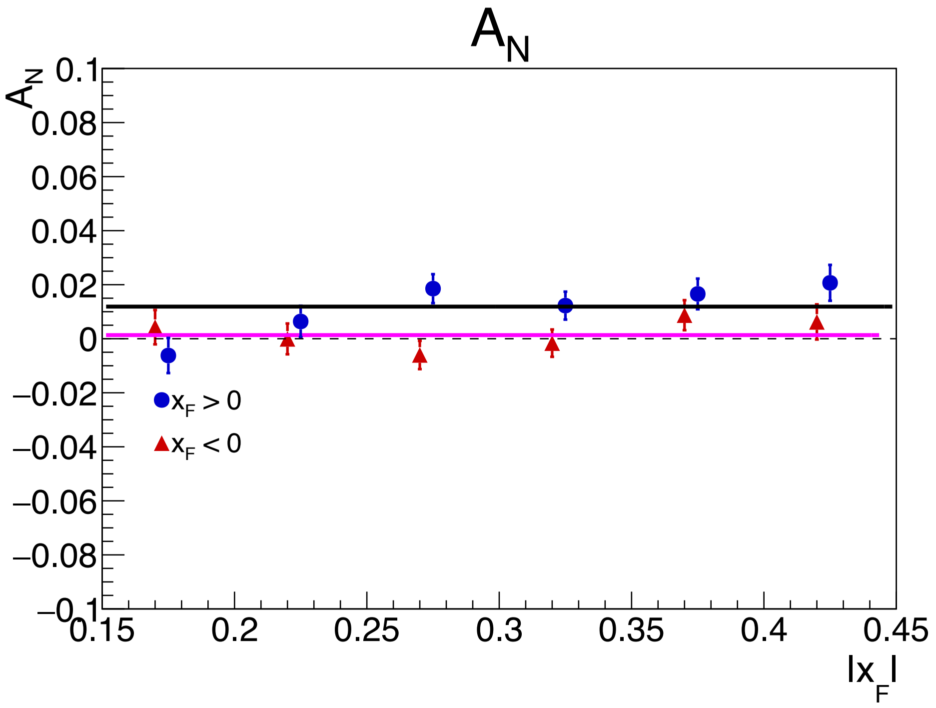
- Motivation: study the fraction of east RP coincident rate as accidental coincidence (multiple collision event).
- Data production and stream : **production_pp200trans_2015 , st_zerobias_adc**
- Production tag: P16id
- The BBC east cuts are same as FMS data
- Event distribution:
  - Total N events: 724,485
  - 3538 events (0.49%) contain 1 east good RP track (no BBC east cuts)
  - **1478 events (0.20%) contain 1 east good RP track (with BBC east cuts)**
  - 89 events (0.012%) contain 1 east good RP track and 1 west good RP track.
- Therefore, about 0.2% of the events are the accidental coincidences, and should be the same rate for every process.

Background study: FMS EM-jet and east BBC veto (RG)

- The process with FMS EM-jets and east BBC veto are one potential source of the background.
  - The east BBC covers a unit of 3 for pseudorapidity gap. We call it RG event set.
  - They are a subset of inclusive process.
  - The random coincidence of the single diffractive events in the RG is 0.2%
- Event selections:
  - The same FMS EM-jets cuts
  - The same east BBC cuts.

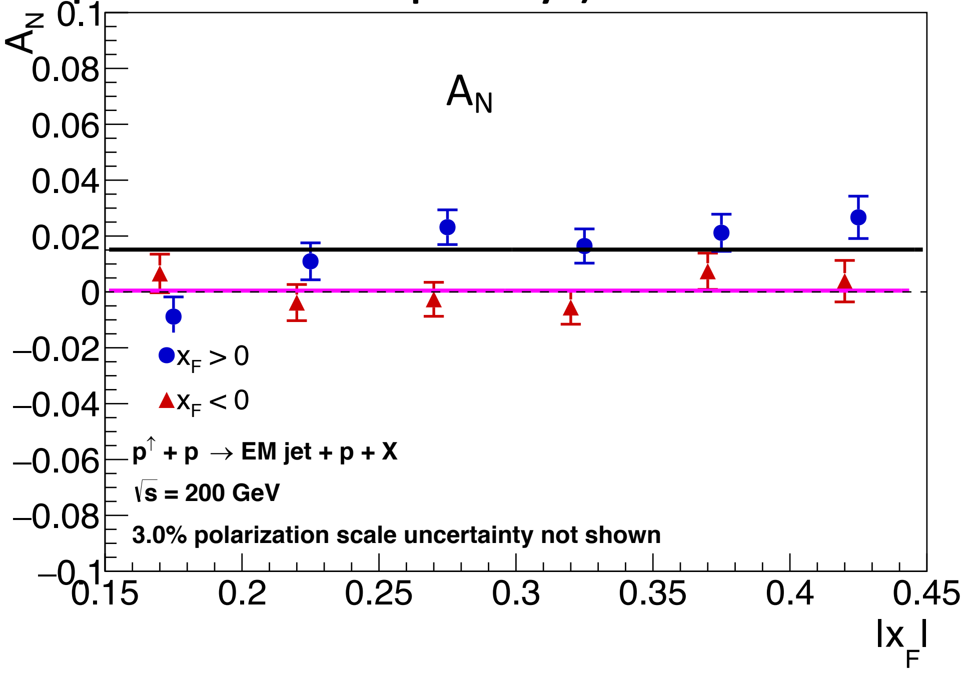
East Large BBC ADC sum < 80 and East Small BBC ADC sum < 90

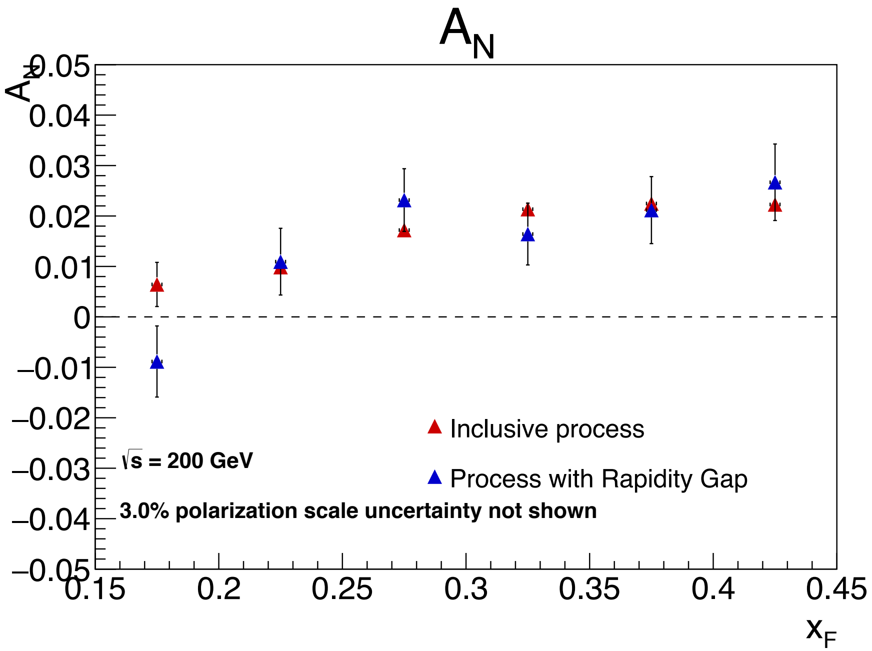
The results are the A_N of RG events with all photon multiplicity EM-jets.



Background study: FMS EM-jet and east BBC veto (RG)

- RG events with 1 or 2 photon multiplicity EM-jets.
- Event selections:
  - The same FMS EM-jets cuts
  - The same east BBC cuts   East Large BBC ADC sum < 80 and East Small BBC ADC sum < 90
- Comparison (right plot) between inclusive process and RG events for A_N (1 or 2 photon multiplicity)





Background study: Estimate the Accidental coincidence

- **A**ccidental **C**oincidence (AC) (multiple collision event) are coming from the situation that the FMS EM-jets and the east RP tracks are not correlated, i.e. the FMS EM-jets and the east RP tracks are coming from multiple collisions.
- The random coincidence of the single diffractive events in the RG events is 0.2%
- Background fraction:

$$frac_{bkg} = \frac{n_{AC}}{n_{mea}} = \frac{n_{AC}}{n_{RG}} \times \frac{n_{RG}}{n_{mea}}$$

Need to be measured

n_{AC} number of accidental events in the analysis
n_{mea} is the number of events counted after the event selection for the analysis (FMS EM-jet + East RP + East BBC veto)

Calculate the background fraction

- We use the process with FMS EM-jets and east BBC (RG).
  - All photon multiplicity , 1 or 2 photon multiplicity
- Event selections:
  - The same FMS EM-jets cuts
  - The same east BBC cuts.

East Large BBC ADC sum < 80 and East Small BBC ADC sum < 90

0.2%

$$frac_{bkg} = \frac{n_{AC}}{n_{mea}} = \frac{n_{AC}}{n_{RG}} \times \frac{n_{RG}}{n_{mea}}$$

- Calculate the yields for events with EM-jet in different x_F bins.

X_F	$frac_{bkg}$ for all photon multiplicity	$frac_{bkg}$ for 1 , 2 photon multiplicity
0.1 – 0.2	1.5%	1.5%
0.2 – 0.25	1.5%	1.5%
0.25 – 0.3	1.5%	1.6%
0.3 – 0.35	1.6%	1.6%
0.35 – 0.4	1.6%	1.6%
0.4 – 0.45	1.7%	1.7%

Signal A_N and its error propagation

- $A_N(sig) = \frac{A_N(mea) - frac(bkg) * A_N(bkg)}{frac(sig)} = \frac{A_N(mea) - frac(bkg) * A_N(bkg)}{1 - frac(bkg)}$
- $\sigma^2 = \left(\frac{\partial A_N(sig)}{\partial A_N(mea)}\right)^2 \sigma A_N^2(mea) + \left(\frac{\partial A_N(sig)}{\partial frac(bkg)}\right)^2 \sigma frac^2(bkg) + \left(\frac{\partial A_N(sig)}{\partial A_N(bkg)}\right)^2 \sigma A_N^2(bkg)$
- $= \left(\frac{1}{1 - frac(bkg)}\right)^2 \sigma A_N^2(mea) + \left(\frac{A_N(sig)}{1 - frac(bkg)}\right)^2 \sigma frac^2(bkg) + \left(\frac{frac(bkg)}{1 - frac(bkg)}\right)^2 \sigma A_N^2(bkg)$
- $= \left(\frac{1}{frac(sig)}\right)^2 \sigma A_N^2(mea) + \left(\frac{A_N(sig)}{frac(sig)}\right)^2 \sigma frac^2(bkg) + \left(\frac{frac(bkg)}{frac(sig)}\right)^2 \sigma A_N^2(bkg)$

Uncertainty from background

- $A_N(sig) = \frac{A_N(mea) - frac(bkg) * A_N(bkg)}{frac(sig)} = \frac{A_N(mea) - frac(bkg) * A_N(bkg)}{1 - frac(bkg)}$
- Since the fraction of background is small, it will have little effect on the A_N, but we will assign the different for statistical uncertainty w/wo correction as systematic. Assign them to systematic uncertainty.
  - $\sigma_{bkg} = \sqrt{\sigma_{cor}^2 - \sigma_{uncor}^2}$
- $\sigma^2 = \left(\frac{1}{frac(sig)}\right)^2 \sigma A_N^2(mea) + \left(\frac{A_N(sig)}{frac(sig)}\right)^2 \sigma frac^2(bkg) + \left(\frac{frac(bkg)}{frac(sig)}\right)^2 \sigma A_N^2(bkg)$

Only need to consider!

$\sigma frac^2(bkg)$ is small, this term is neglectable

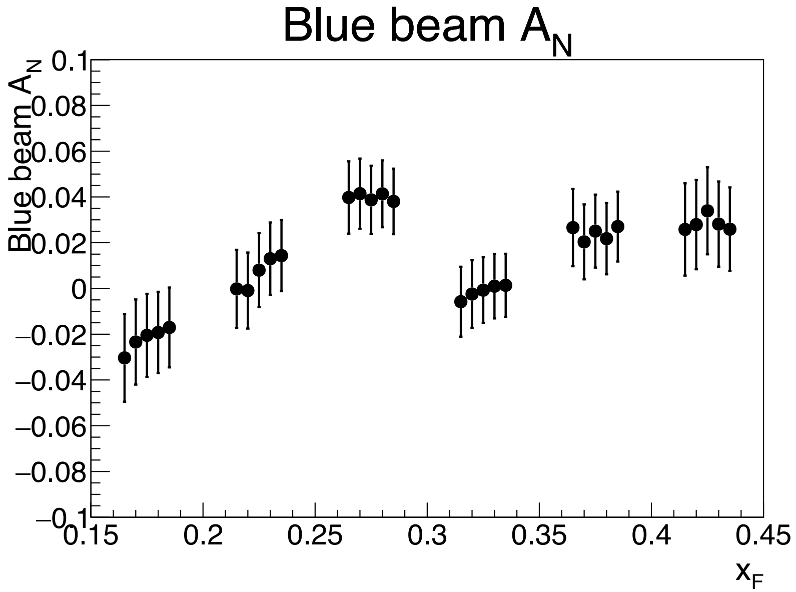
$\frac{frac(bkg)}{frac(sig)}$ is small, this term is neglectable

Systematic uncertainty

- We use Bayesian method for systematic uncertainty study. **(ref: arXiv:hep-ex/0207026)**
- First of all, for the cuts we choose, varying each individual cut value for calculating the asymmetry.
  - Small BBC east ADC sum cuts: choose < 70, < 80, <100, <110 for systematic uncertainty
  - Large BBC east ADC sum cuts: choose < 60, < 70, <90, <100 for systematic uncertainty
  - Ring of Fire (get rid of small-bs-3 trigger).
  - Background

Example: Small BBC east cuts

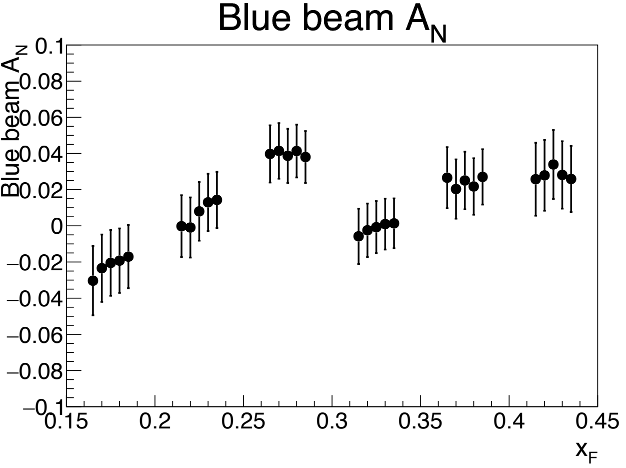
Each x_F set, from left to right: varying the cuts from original: -20, -10, 0, +10, +20



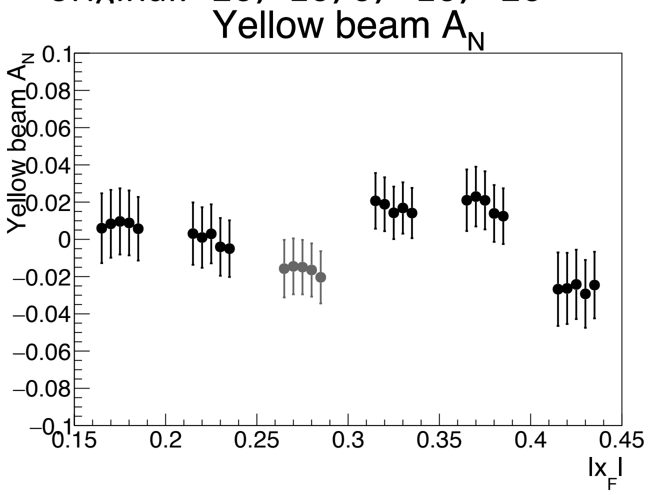
A_N results for varying the cuts (systematic)

All photon multiplicity

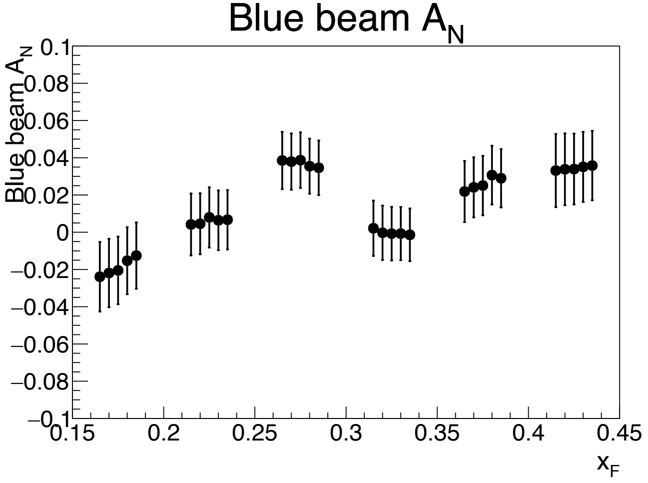
Small BBC east cuts



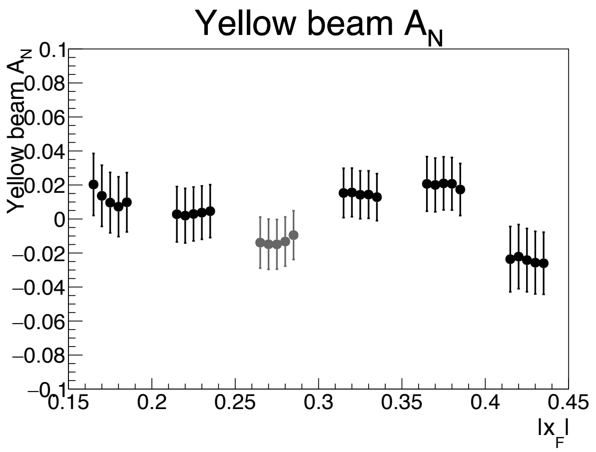
Each x_F set, from left to right: varying the cuts from original: -20, -10, 0, +10, +20



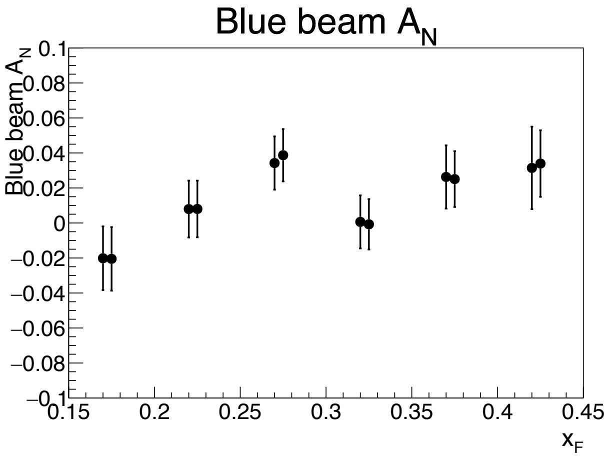
Large BBC east cuts



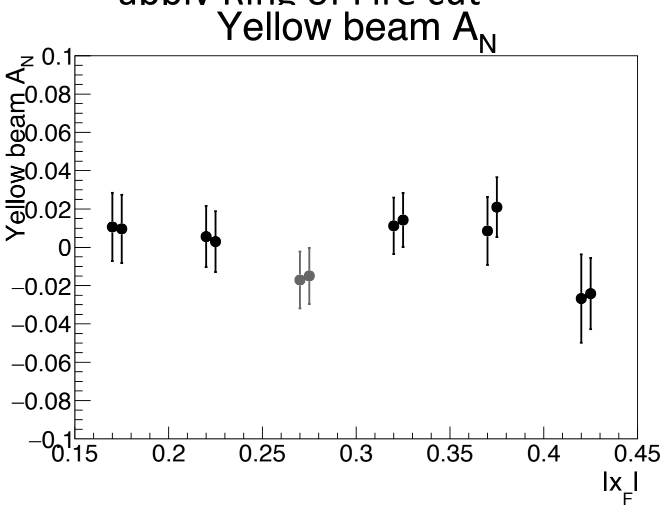
Each x_F set, from left to right: varying the cuts from original: -20, -10, 0, +10, +20



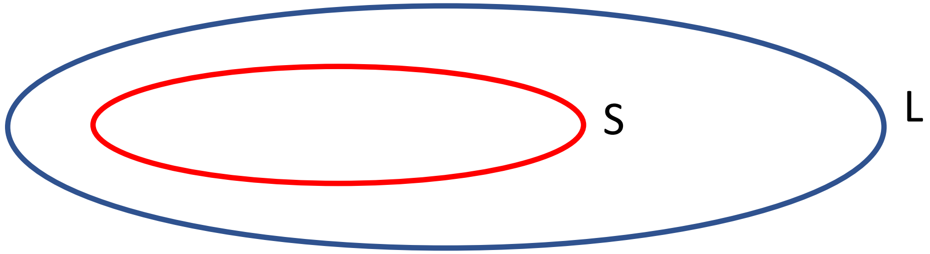
Ring of Fire cuts



Each x_F set, from left to right: Apply Ring of Fire cut, do not apply Ring of Fire cut



Idea for Barlow check



- Considering 2 correlated samples, larger one (sample “L”) and smaller one (sample “S”), we get the measured results for them with statistical uncertainty: $A_L \pm \sigma_L$ and $A_S \pm \sigma_S$.
  - Their correlated uncertainty: $\sigma_\delta^2 = \sigma_L^2 + \sigma_S^2 + 2\rho\sigma_L\sigma_S$, where ρ is correlation. For this case, $\rho = -1$. Therefore, $\sigma_\Delta^2 = \sigma_S^2 - \sigma_L^2$.
  - The discrepancy arise for this 2 data samples will be the σ_Δ .
  - Then, Barlow proposed a check on the measured difference between the 2 datasets ($|A_L - A_S|$), and try to compare with this discrepancy σ_Δ .
  - If the measured difference is less than 1 σ, the check pass and the correct thing is to do nothing -> Don’t need to add this into systematic.
- Ref: **arXiv:hep-ex/0207026**. The related part is in page 8 – 11.

Calculating the systematic uncertainty (All photon multiplicity)

- Then, find out the maximum ($A_N(1) \pm \delta(1)$, with statistical uncertainty) , and the minimum ($A_N(2) \pm \delta(2)$, with statistical uncertainty) for the varying cuts as systematic uncertainty.
- If the $\frac{|A_N(1)-A_N(2)|}{\sqrt{|(\delta(1))^2-(\delta(2))^2|}} > 1$ (Barlow check), use the **standard deviation** of all the A_N from varying all the cuts for this systematic term (σ_i), otherwise, the systematic (σ_i), for this term will be assigned 0 (values under 0 term are the systematic results not using this criteria)
- The final systematic will be counted bin by bin (x_F bins) : $\sigma_{sys} = \sqrt{\sum_i (\sigma_i)^2}$

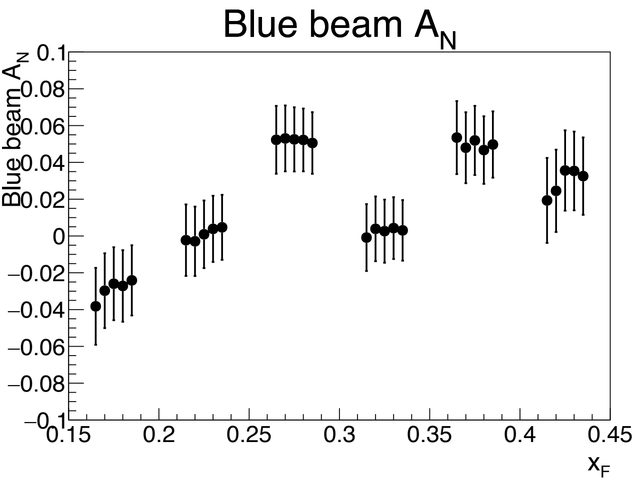
Blue beam x_F	Small BBC east	Large BBC east	Ring of Fire	Background	Summary
0.1 - 0.2	0.0046	0.0042	0 (0.00017)	0.0032	0.0070 (0.0070)
0.2 - 0.25	0.0064	0 (0.0014)	0 (0.000025)	0.0029	0.0070 (0.0071)
0.25 - 0.3	0 (0.0014)	0.0017	0.0022	0.0026	0.0039 (0.0041)
0.3 – 0.35	0.0026	0 (0.0012)	0 (0.00068)	0.0026	0.0037 (0.0039)
0.35 – 0.4	0.0027	0.0032	0 (0.00061)	0.0029	0.0051 (0.0051)
0.4 – 0.45	0.0030	0 (0.00096)	0 (0.0012)	0.0035	0.0046 (0.0048)

Yellow beam x_F	Small BBC east	Large BBC east	Ring of Fire	Background	Summary
0.1 - 0.2	0 (0.0016)	0.0046	0 (0.00050)	0.0032	0.0056 (0.0058)
0.2 - 0.25	0.0035	0 (0.00090)	0.0013	0.0028	0.0046 (0.0047)
0.25 - 0.3	0.0021	0.0020	0 (0.0011)	0.0026	0.0039 (0.0040)
0.3 – 0.35	0.0026	0 (0.00097)	0 (0.0015)	0.0025	0.0036 (0.0040)
0.35 – 0.4	0.0042	0.0013	0.0062	0.0028	0.0081
0.4 – 0.45	0.0018	0 (0.0014)	0 (0.0013)	0.0034	0.0039 (0.0043)

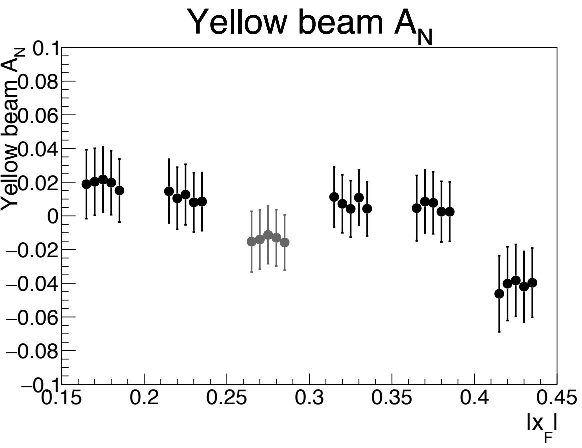
A_N results for varying the cuts (systematic)

1 or 2 photon multiplicity

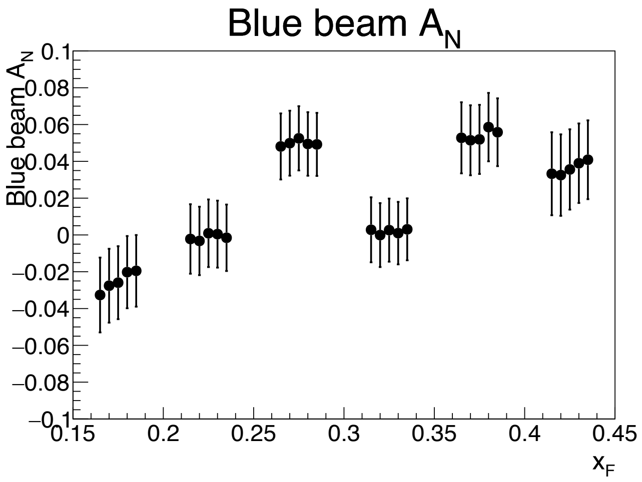
Small BBC east cuts



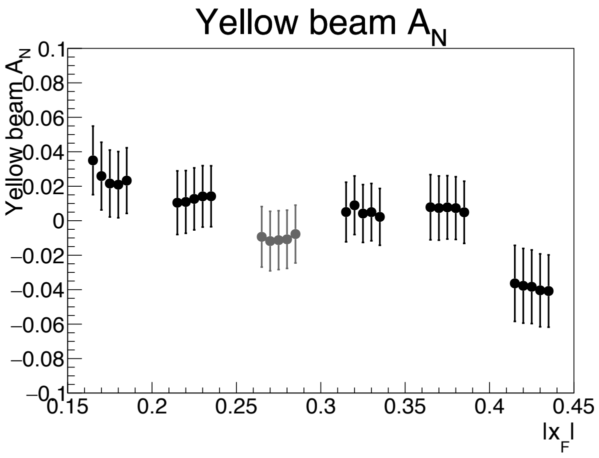
Each x_F set, from left to right: varying the cuts from original: -20, -10, 0, +10, +20



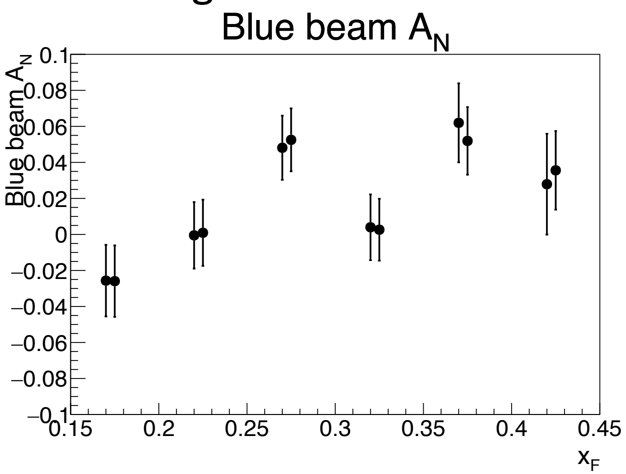
Large BBC east cuts



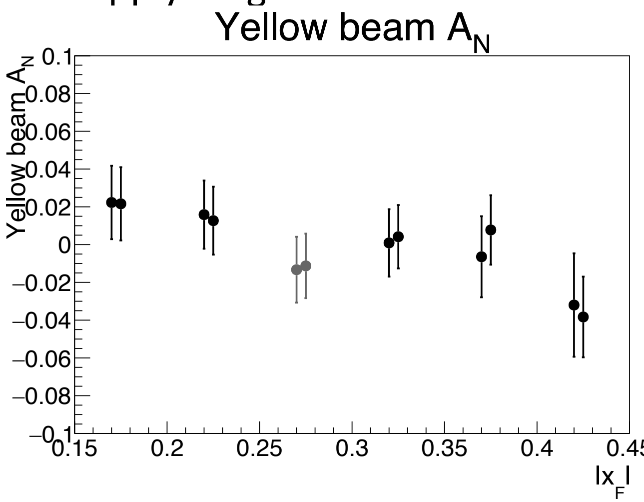
Each x_F set, from left to right: varying the cuts from original: -20, -10, 0, +10, +20



Ring of Fire cuts



Each x_F set, from left to right: Apply Ring of Fire cut, do not apply Ring of Fire cut



Calculating the systematic uncertainty (1 or 2 photon multiplicity)

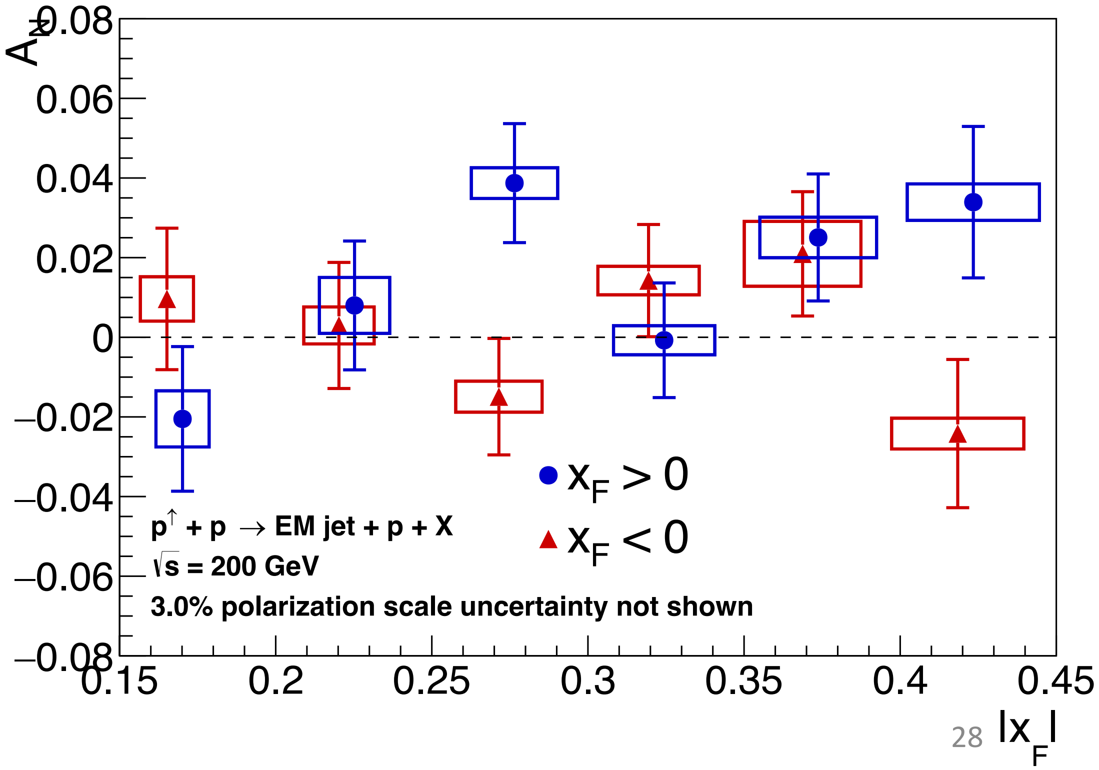
- Then, find out the maximum ($A_N(1) \pm \delta(1)$, with statistical uncertainty) , and the minimum ($A_N(2) \pm \delta(2)$, with statistical uncertainty) for the varying cuts as systematic uncertainty.
- If the $\frac{|A_N(1)-A_N(2)|}{\sqrt{|(\delta(1))^2-(\delta(2))^2|}} > 1$ (Barlow check), use the **standard deviation** of all the A_N from varying all the cuts for this systematic term (σ_i), otherwise, the systematic (σ_i), for this term will be assigned 0 (values under 0 term are the systematic results not using this criteria)
- The final systematic will be counted bin by bin (x_F bins) : $\sigma_{sys} = \sqrt{\sum_i (\sigma_i)^2}$

Blue beam x_F	Small BBC east	Large BBC east	Ring of Fire	Background	Summary
0.1 - 0.2	0.0040	0.0049	0 (0.00014)	0.0036	0.0078 (0.0078)
0.2 - 0.25	0.0031	0.0016	0 (0.00071)	0.0033	0.0048 (0.0048)
0.25 - 0.3	0 (0.00083)	0.0015	0.0022	0.0031	0.0041 (0.0041)
0.3 – 0.35	0 (0.0018)	0 (0.0012)	0 (0.00068)	0.0031	0.0031 (0.0038)
0.35 – 0.4	0 (0.0025)	0.0027	0 (0.0050)	0.0034	0.0043 (0.0071)
0.4 – 0.45	0.0065	0.0032	0 (0.0039)	0.0040	0.0083 (0.0091)

Yellow beam x_F	Small BBC east	Large BBC east	Ring of Fire	Background	Summary
0.1 - 0.2	0.0022	0.0051	0 (0.00035)	0.0035	0.0066 (0.0066)
0.2 - 0.25	0 (0.0025)	0 (0.0016)	0.0016	0.0032	0.0036 (0.0046)
0.25 - 0.3	0 (0.0016)	0 (0.0015)	0 (0.0010)	0.0031	0.0031 (0.0039)
0.3 – 0.35	0.0031	0.0022	0 (0.0016)	0.0030	0.0048 (0.0051)
0.35 – 0.4	0 (0.0025)	0 (0.0011)	0.0071	0.0033	0.0078 (0.0083)
0.4 – 0.45	0.0027	0 (0.0017)	0 (0.0032)	0.0039	0.0048 (0.0060)

A_N results for all photon multiplicity

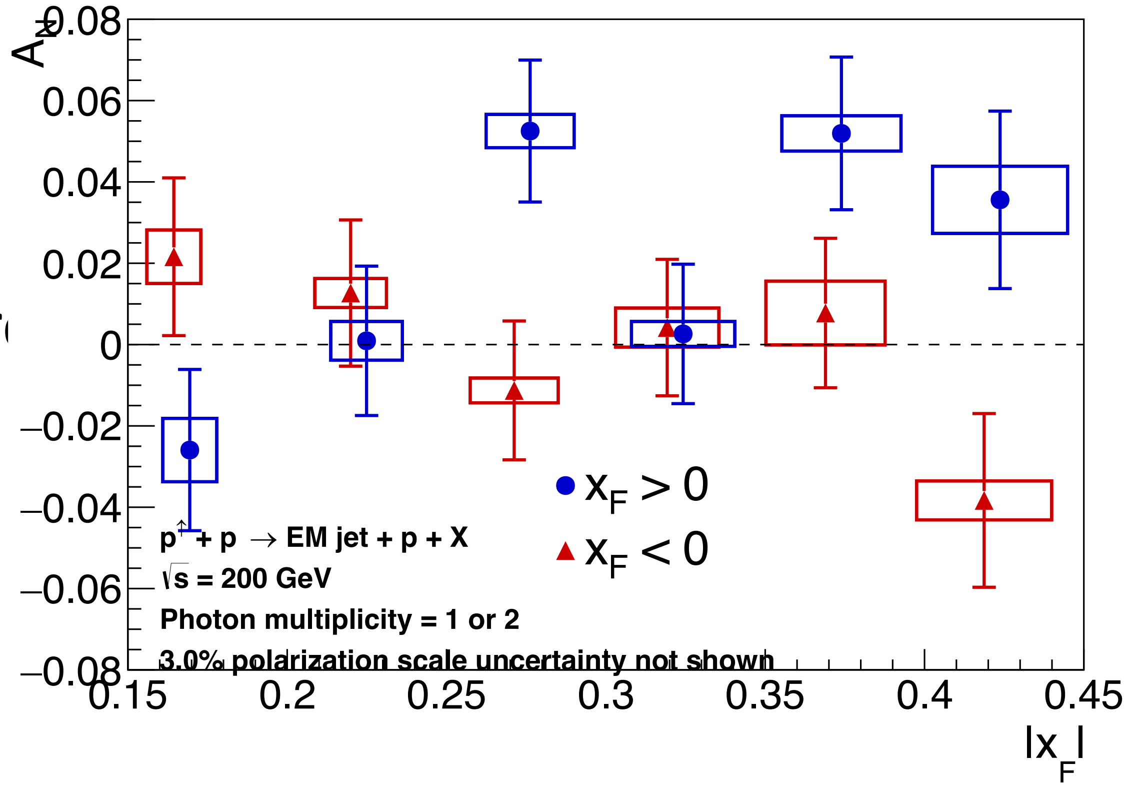
- 6 x_F bins are considered: [0.1, 0.2], [0.2,0.25], [0.25,0.3], [0.3,0.35] , [0.35,0.4], [0.4,0.45]
- All photon multiplicity
- Constant fit is applied to calculate the significance of non-zero
- Blue beam A_N is 2.1 σ to be non-zero.
  - Constant fit: 0.015 ± 0.0069
  - $\chi^2/n.d.f$: 1.65
- Yellow beam A_N is 0.28 σ to be non-zero.
  - Constant fit: 0.0019 ± 0.0068
  - $\chi^2/n.d.f$: 1.04



Note: Systematic uncertainty are considering the Barlow check criteria.

A_N results for 1 or 2 photon multiplicity

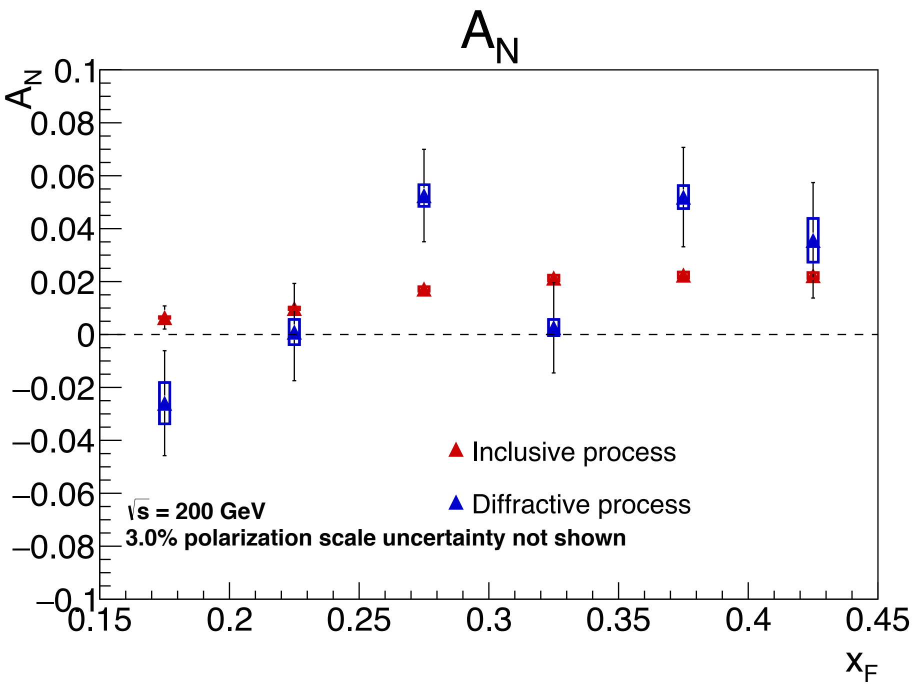
- 6 x_F bins are considered: [0.1, 0.2], [0.2,0.25], [0.25,0.3], [0.3,0.35] , [0.35,0.4], [0.4,0.45]
- 1 or 2 photon multiplicity
- Constant fit is applied to calculate the significance of non-zero
- Statistical uncertainty only
- Blue beam A_N is 2.6 σ to be non-zero.
  - Constant fit: 0.020 ± 0.0079
  - $\chi^2/n.d.f$: 2.55
- Yellow beam A_N is 0.038 σ to be non-zer
  - Constant fit: 0.00030 ± 0.0078
  - $\chi^2/n.d.f$: 1.06



Note: Systematic uncertainty are considering the Barlow check criteria.

Comparison between inclusive process and diffractive process

- We compare the results between inclusive process and diffractive process.
  - Both are with EM-jet 1 or 2 photon multiplicity
  - The diffractive process are tagging 1 east RP track.



Next step

1. Some cross check for the EM-jet p_T vs x_F distribution, and compare with inclusive results.
2. Discuss with RP group (Woldek, Leszek) to ask for further comments and suggestions. Also inform the LFS-UPC group for the results.
   - Reason: we use the RP detector, so it's better to gather suggestion from RP experts
3. Paper proposal (Discussion)
   - Currently, we still have 2 possible options for papers. Note: we plan to release the run15 inclusive and diffractive results together.
   - Option1: only 1 PRD paper for both analysis.
   - Option2: 1 PRD paper focusing on inclusive result; 1 PLB paper focusing on diffractive result

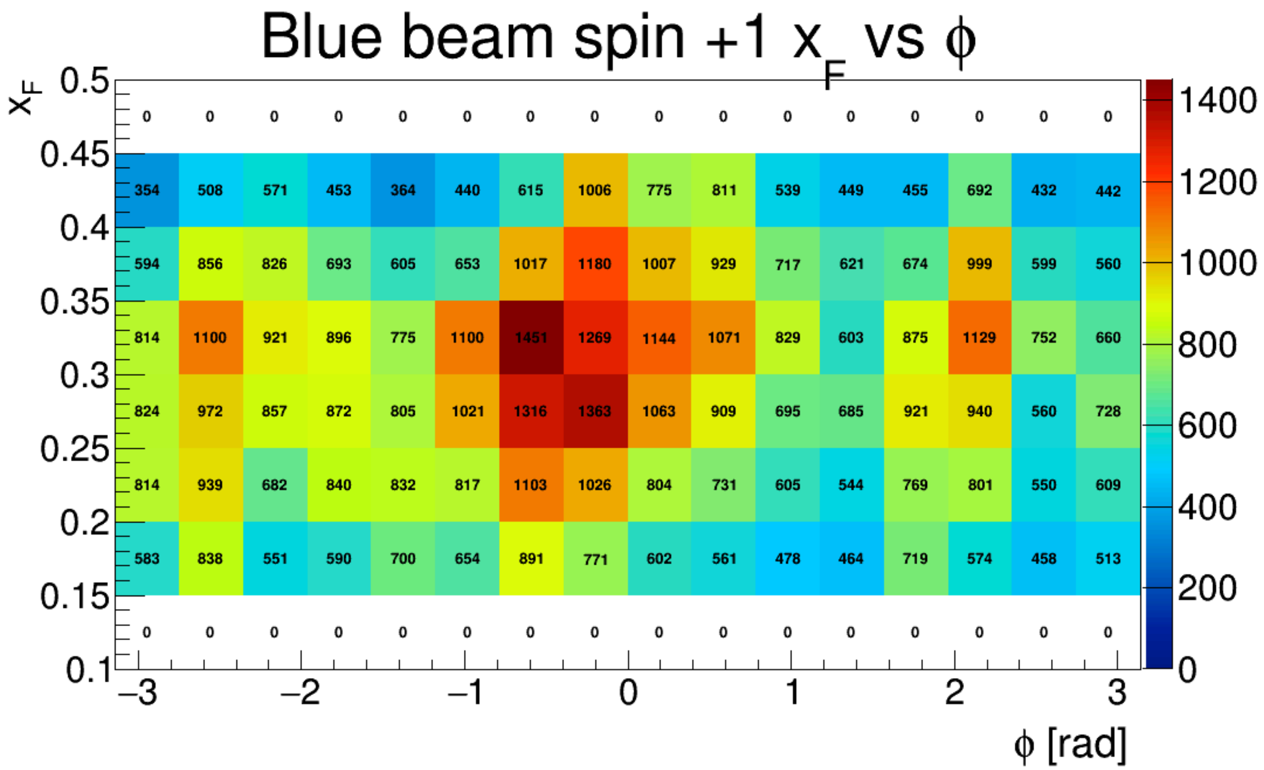
Conclusion

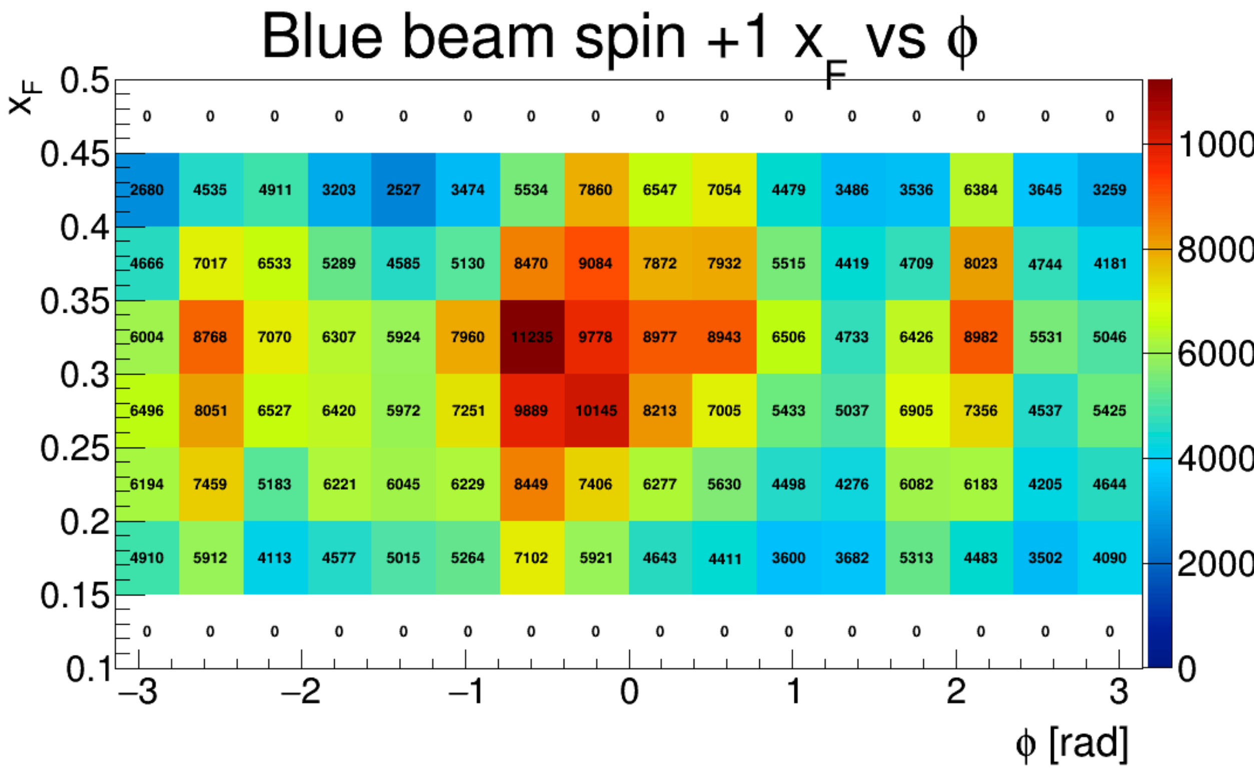
- Now we see the blue beam A_N are mostly positive. They are also different from what we see for the A_N for the case with only 1 west RP track (semi-exclusive process).
- Background study for AC events shows that their contribution is small. We assign them to systematic uncertainty.

Back up

Counting the events for different diffractive process

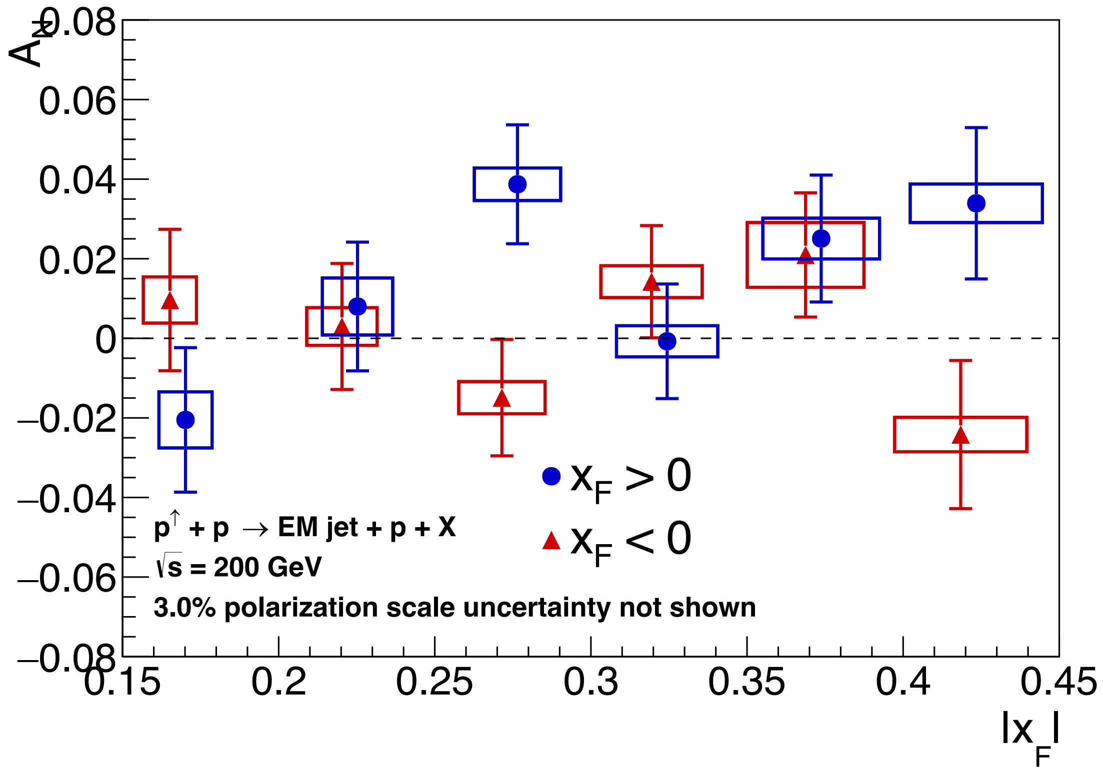
- We count the yields for different diffractive processes.
  - Left: single diffractive process with FMS EM-jet, east BBC veto, east RP cut
  - Right: Diffractive process with FMS EM-jet and east BBC veto only.





A_N results for all photon multiplicity

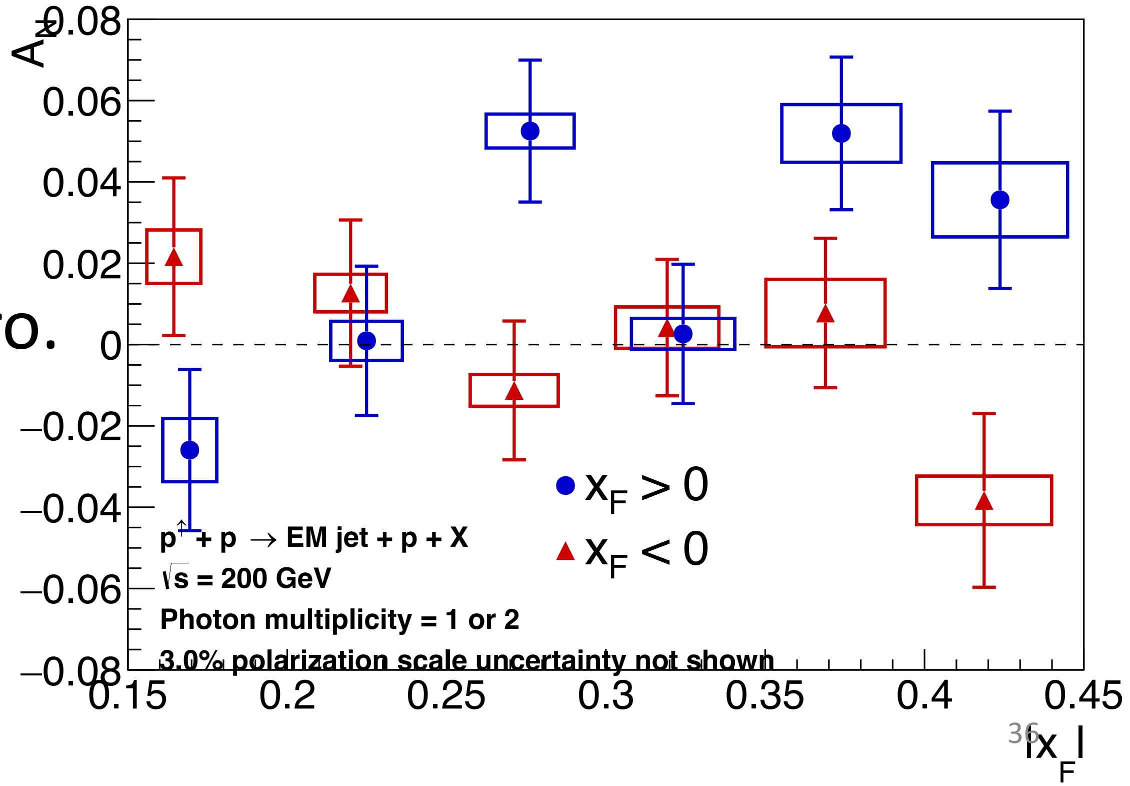
- 6 x_F bins are considered: [0.1, 0.2], [0.2,0.25], [0.25,0.3], [0.3,0.35] , [0.35,0.4], [0.4,0.45]
- All photon multiplicity
- Constant fit is applied to calculate the significance of non-zero
- Blue beam A_N is 2.1 σ to be non-zero.
  - Constant fit: 0.015 ± 0.0069
  - $\chi^2/n.d.f$: 1.65
- Yellow beam A_N is 0.28 σ to be non-zero.
  - Constant fit: 0.0019 ± 0.0068
  - $\chi^2/n.d.f$: 1.03



Note: Systematic uncertainty are not considering the $\frac{|A_N(1)-A_N(2)|}{\sqrt{|(\delta(1))^2-(\delta(2))^2|}} > 1$ criteria.

A_N results for 1 or 2 photon multiplicity

- 6 x_F bins are considered: [0.1, 0.2], [0.2,0.25], [0.25,0.3], [0.3,0.35] , [0.35,0.4], [0.4,0.45]
- 1 or 2 photon multiplicity
- Constant fit is applied to calculate the significance of non-zero
- Statistical uncertainty only
- Blue beam A_N is 2.5 σ to be non-zero.
  - Constant fit: 0.020 ± 0.0079
  - $\chi^2/n.d.f$: 2.58
- Yellow beam A_N is 0.049 σ to be non-zero.
  - Constant fit: 0.00037 ± 0.0078
  - $\chi^2/n.d.f$: 1.04



Note: Systematic uncertainty are not considering the $\frac{|A_N(1)-A_N(2)|}{\sqrt{|(\delta(1))^2-(\delta(2))^2|}} > 1$ criteria.