Analysis status

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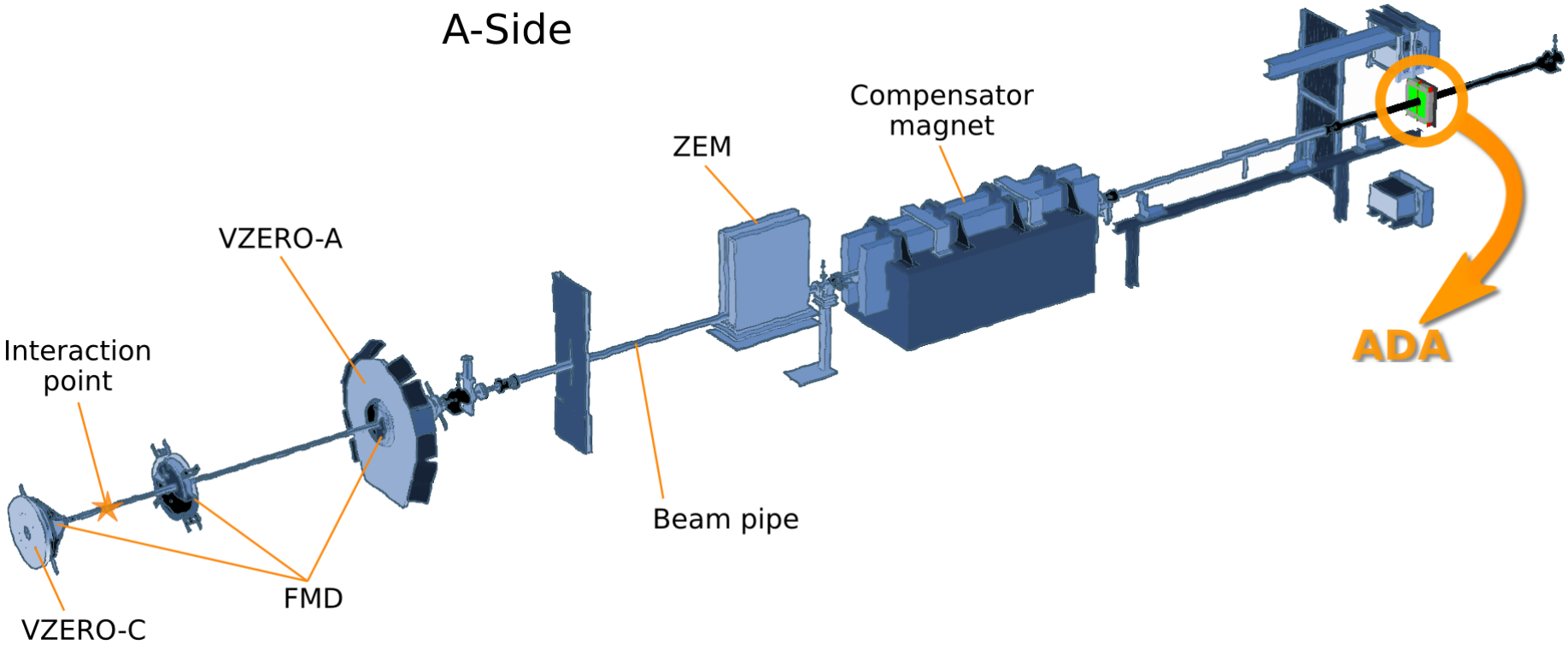
PUCP


A-Side
Compensator magnet
ZEM
VZERO-A
Interaction point
ADA
Beam pipe
FMD
VZERO-C

Data selection for 13 TeV analysis

Data set for 13 TeV analysis

- AD runs with increased HV to reach maximum efficiency
- HV settings to test sensitivity to changes.
- very low μ value to minimize pile up.
- Number of colliding bunches: 20, Empty-A: 37 Empty-B: 36
- Field polarity: ++
- JIRA ticket for MC: ALIROOT-7432 “MC for diffractive xsection runs”

Runs for cross sections at 13 TeV

Period	MC production	run	μ-value	MIP	events		
					DATA$^{(*)}$	Pythia	Phojet
LHC17j	LHC17h7{a,b}	274593	0.0014	8	0.42 M	4.4 M	5.2 M
		274594	0.0017	10	0.36 M	4.0 M	4.4 M
		274595	0.0038	8	0.73 M	8.1 M	8.3 M
		274596	0.0597	2	2.93 M		

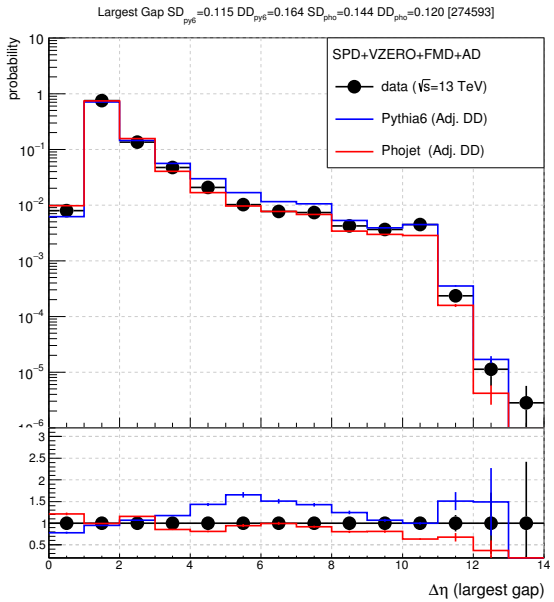
a=Pythia (Perugia-2011), b=Phojet

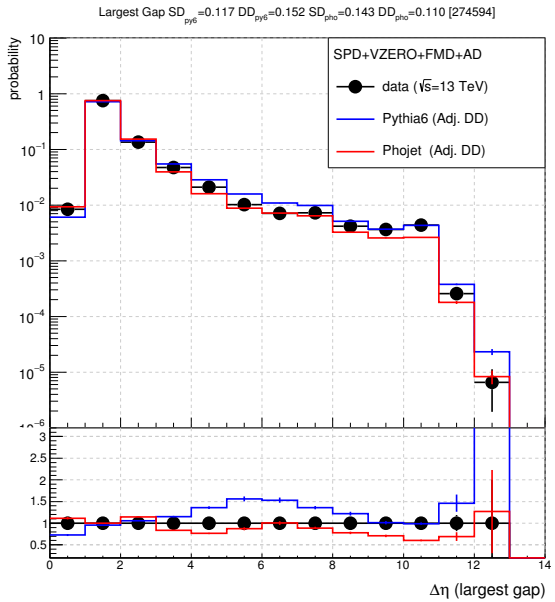
$^{(*)}$ number of CINT11 triggers (`CINT11 = SPD || VZERO || AD`)

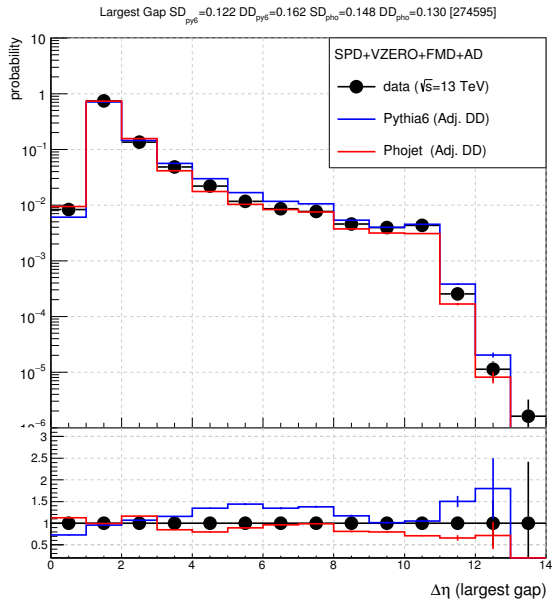
Sources of systematics

- Small run-by-run variations.
- Theoretical uncertainty in Diffractive model.

Small run-by-run variation







- Small run-by-run variations.
- This is part of our systematics (unless we can understand and correct this).

Runs for cross sections at 13 TeV

Period	MC production	run	μ-value	MIP	events		
					DATA$^{(*)}$	Pythia	Phojet
LHC17j	LHC17h7{a,b}	274593	0.0014	8	0.42 M	4.4 M	5.2 M
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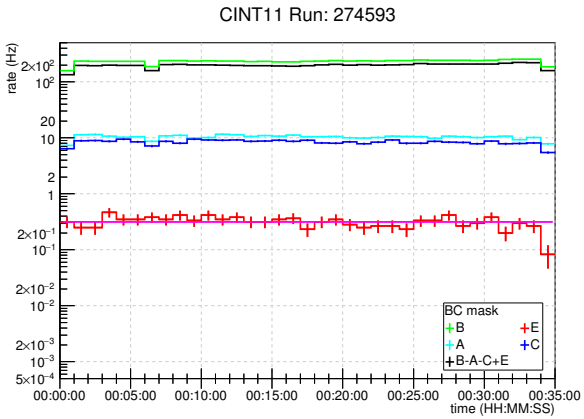
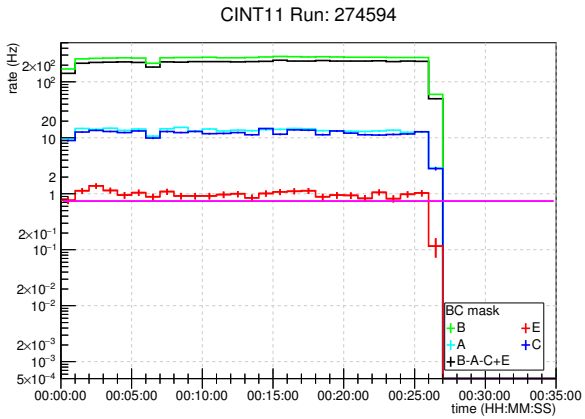
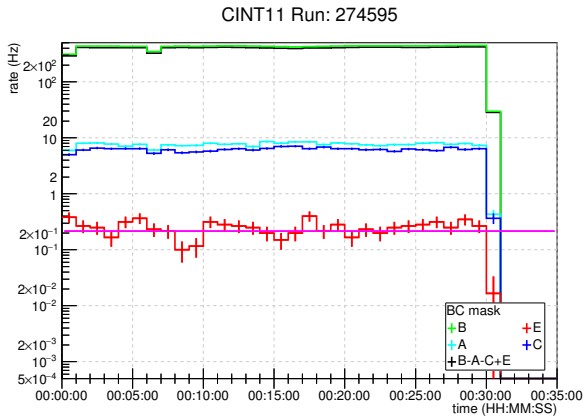
Evaluating noise run-by-run

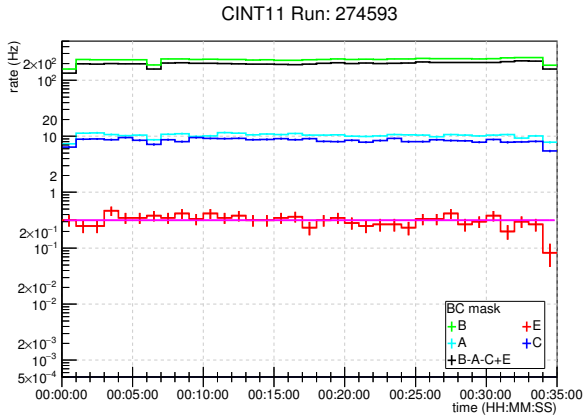


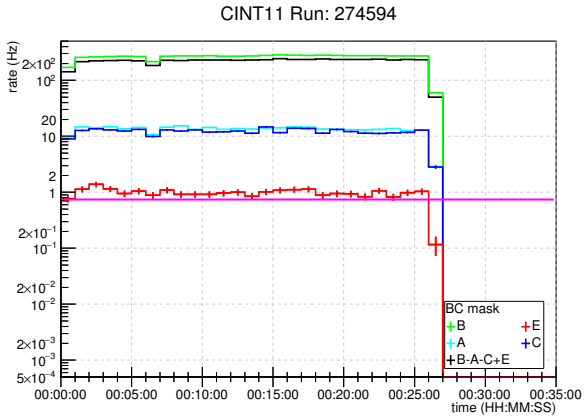


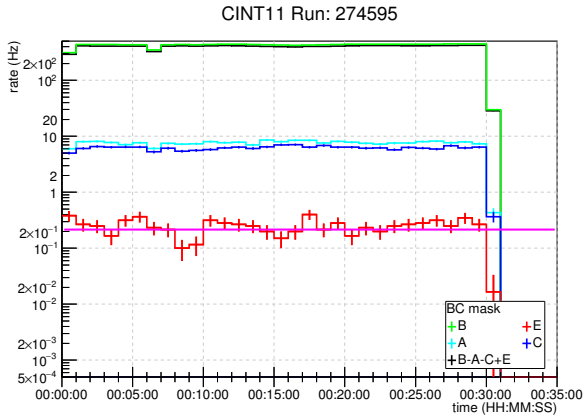


- 60 seconds average of trigger rate (Hz).
- Online Trigger: CINT11 (SPD or VZERO or AD)
- The red histogram show the Empty-Empty bunch crossings.

Evaluating noise run-by-run

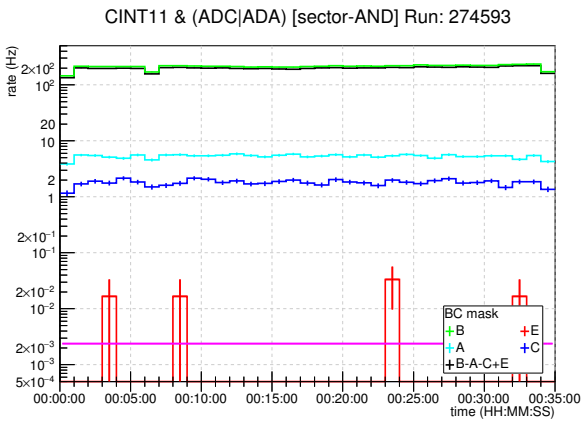


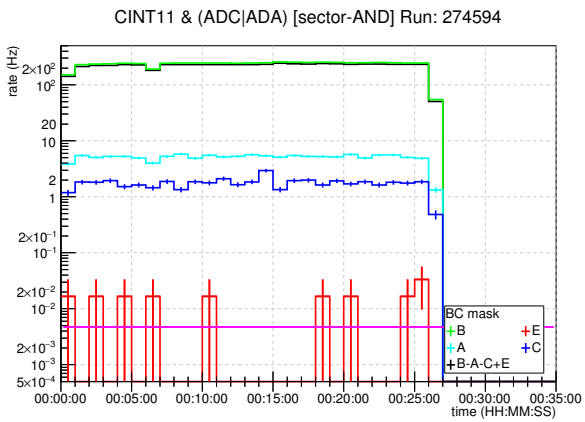


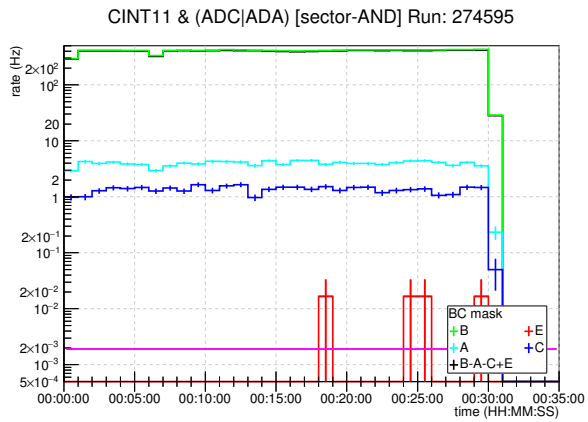


- Online Trigger: CINT11 (SPD or VZERO or AD)
- Empty-Empty rate increase in run 274593 where AD high voltage was higher (MIP=10 adc).
- Electronic noise in AD?

Evaluating noise due to AD (I)

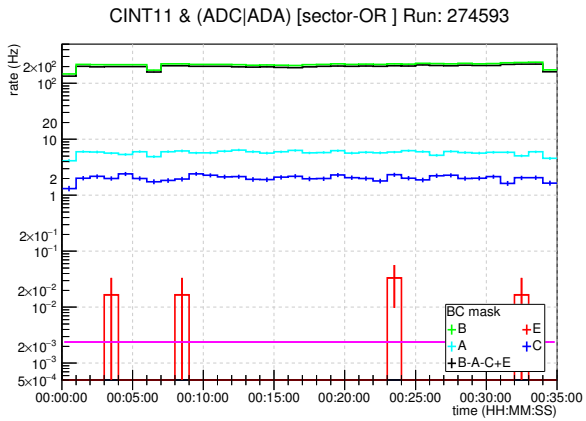


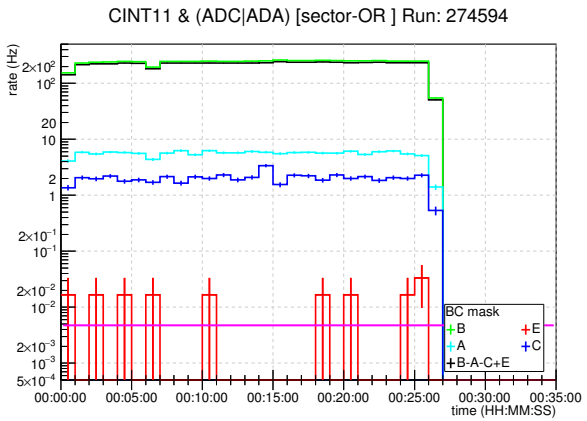


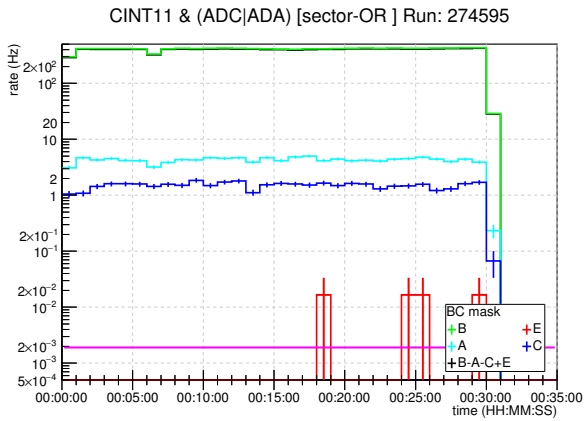


- Noise in CINT11 due to ADA+ADC (coincidence between corresponding pads)
- Empty-Empty rate due to AD is very low.
- Maybe module coincidence in AD is cleaning noise?

Evaluating noise Evaluating noise due to AD (II)

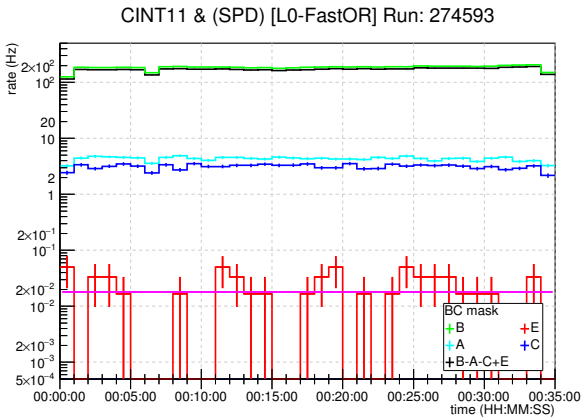


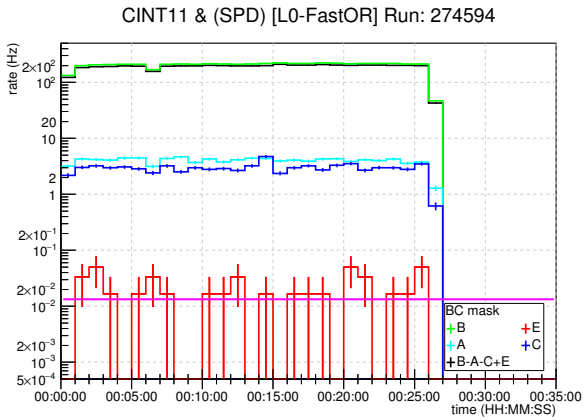


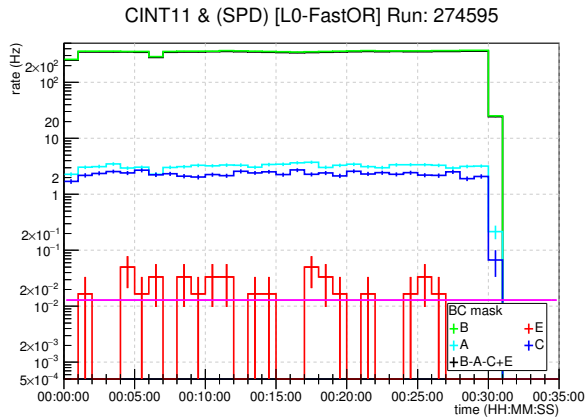


- Noise in CINT11 due to ADA+ADC (NO coincidence between corresponding pads)
- Empty-Empty rate due to AD is still very low.
- Noise is not due to AD.

Evaluating noise Evaluating noise due to SPD (I)

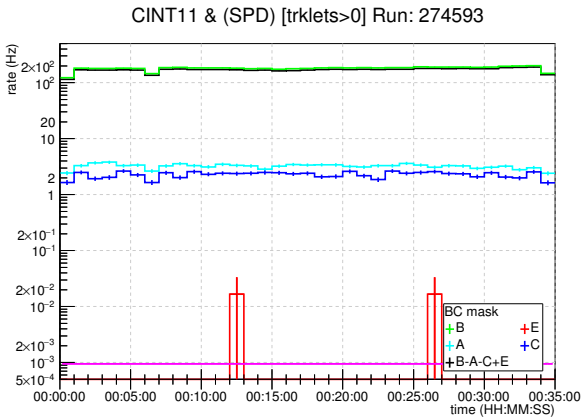


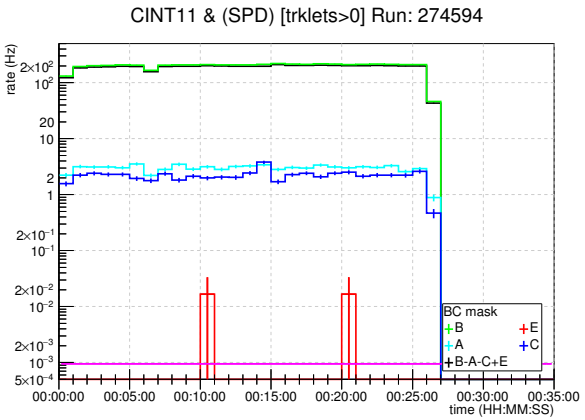


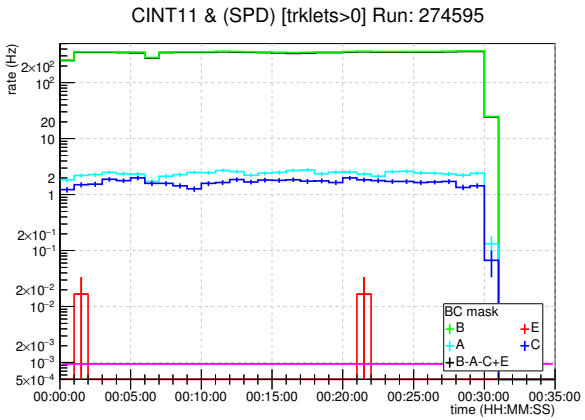


- Noise in CINT11 due to SPD (fast OR)
- High rateof Empty-Empty events.

Evaluating noise Evaluating noise due to SPD (II)







- Noise in CINT11 due to SPD (at least one tracklet)
- This cleans the noise in SPD.

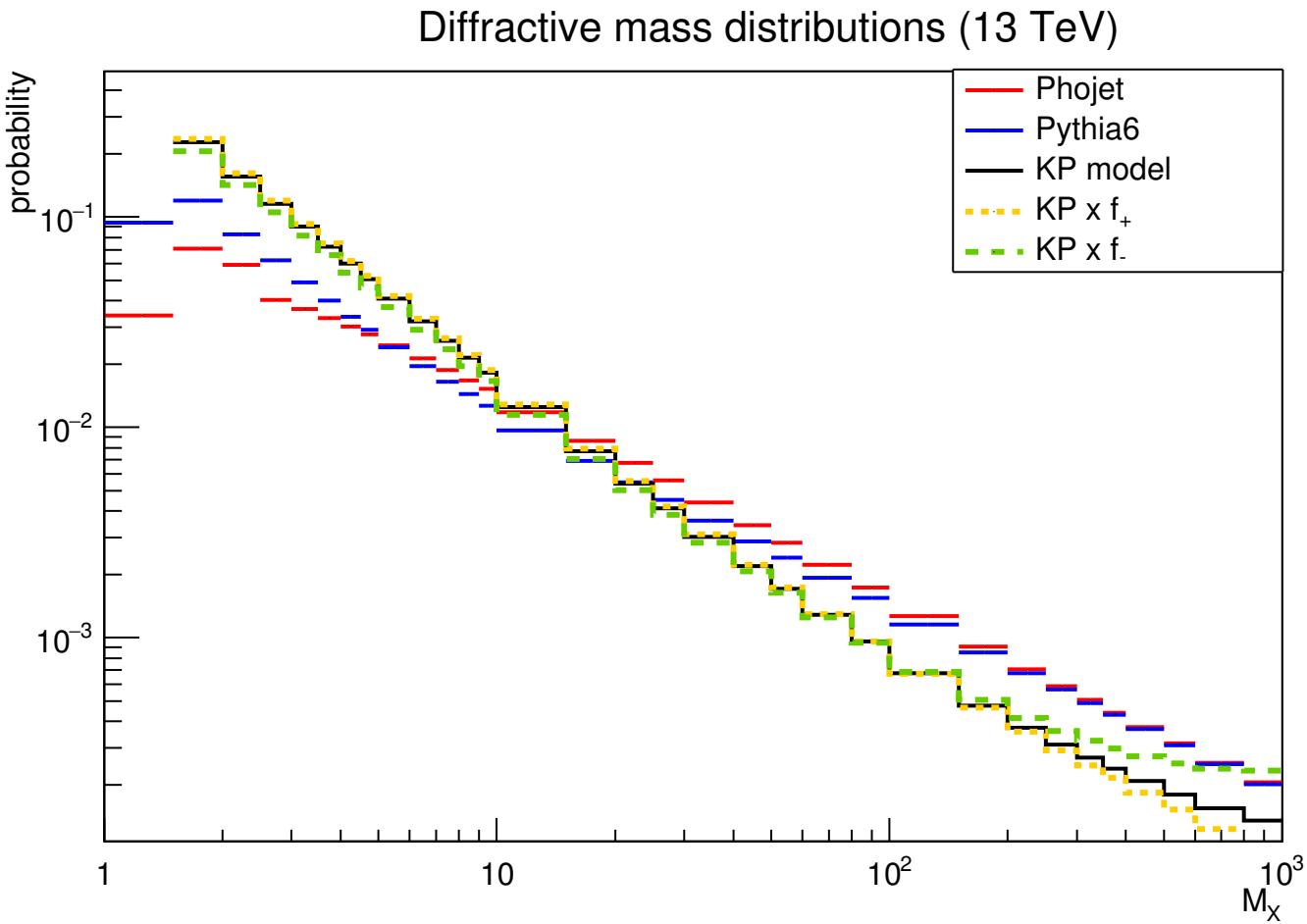
Estimation of systematic uncertainty

- In the previous ALICE paper our uncertainty in the knowledge of the diffractive mass distribution was estimated as follows:
- the curve from Kaydalov-Poghosyan model is multiplied by a linear function f_+ (f_-) whose value is 1.5 (0.5) at the lower diffractive mass threshold (m_{low}) and 1.0 at the high mass diffractive cut m_{high}
- The resulting distributions are normalized and the SD events are re-weighted accordingly.
- This changes the efficiencies, which in turns affects all the other calculations like the SD fraction.

$$f_-(m) = \begin{cases} f_-(m_{\text{low}}) & = \mathbf{0.5} \\ f_-(m_{\text{high}}) & = 1.0 \end{cases} \qquad f_+(m) = \begin{cases} f_+(m_{\text{low}}) & = \mathbf{1.5} \\ f_+(m_{\text{high}}) & = 1.0 \end{cases}$$

$m_{\text{low}} \approx 1.08$ is the lower diffractive mass threshold ($m_\pi + m_{\text{p}}$).

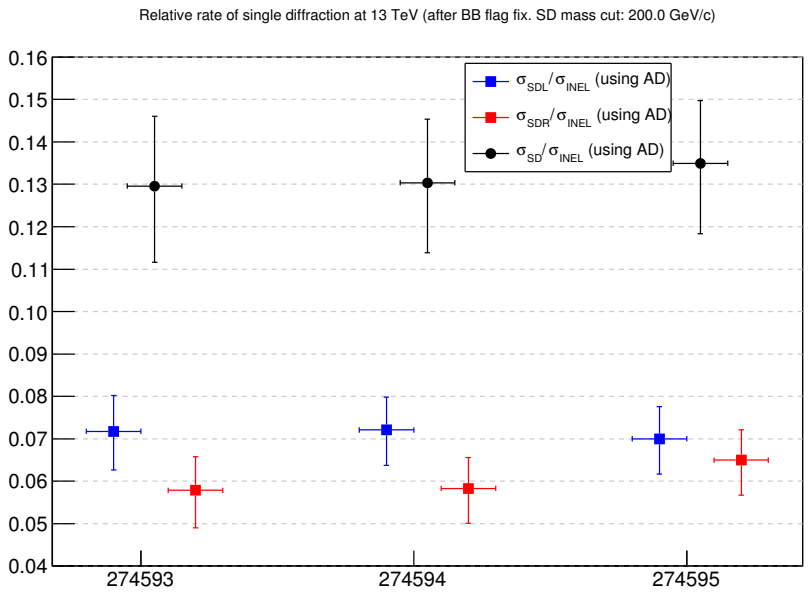
Estimation of systematic uncertainty



$$f_-(m) = \begin{cases} f_-(m_{\text{low}}) & = \mathbf{0.5} \\ f_-(m_{\text{high}}) & = 1.0 \end{cases} \qquad f_+(m) = \begin{cases} f_+(m_{\text{low}}) & = \mathbf{1.5} \\ f_+(m_{\text{high}}) & = 1.0 \end{cases}$$

SD before/after BB flag correction

- The black markers show the $\sigma_{\mathrm{SD}}/\sigma_{\mathrm{INEL}}$
- The error bars show the systematic uncertainty due to diffractive model.



Appendix

Data selection for 13 TeV analysis

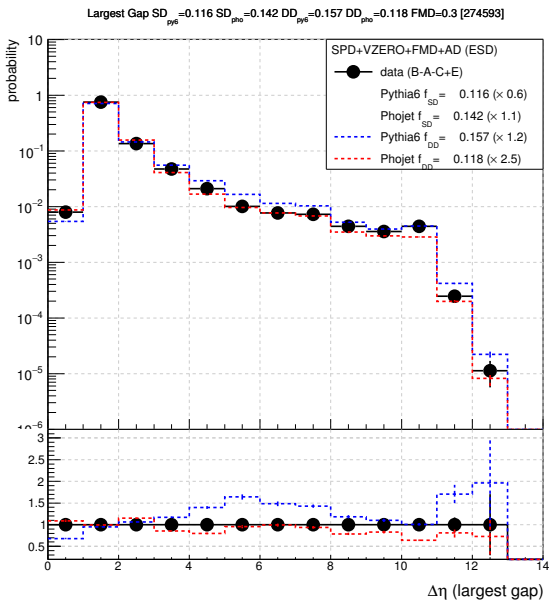
- Online Trigger: CINT11 (activity in SPD or VZERO or AD)
- vertex cut: $|V_z| < 10.0$ cm.
- Data is corrected using empty-A, empty-C, and empty-empty bunches.
- MC vertex distributions are re-weighted to follow the data
- FMD channels with very high rate (outliers) are masked in data and MC.

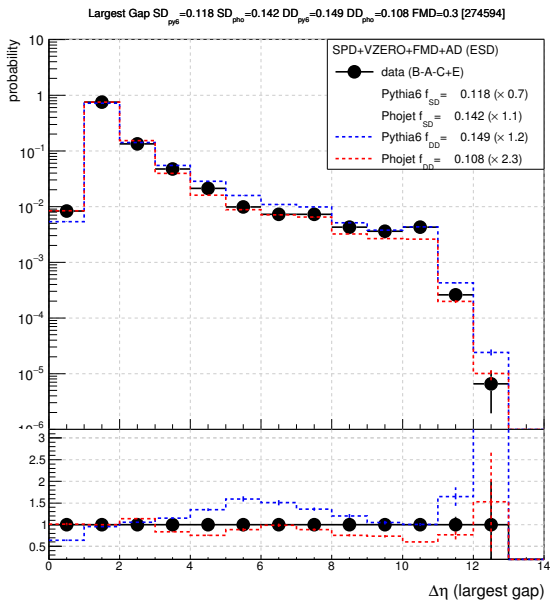
Content:

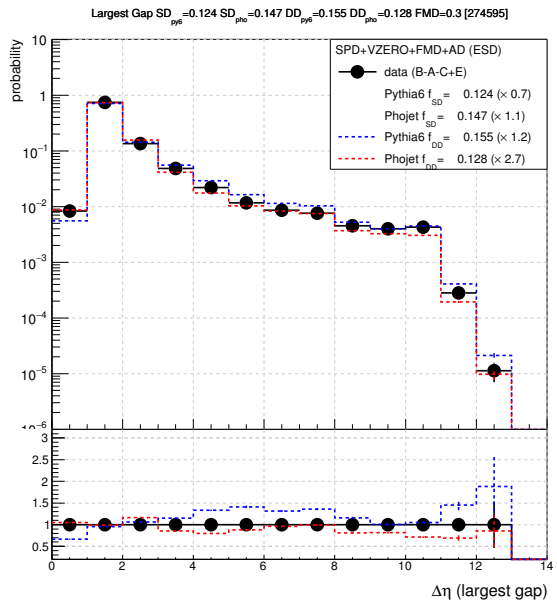
- Effect on DD and SD fraction estimation.
  - AD charge equalization undone.
  - BB flag correction.
  - AD charge threshold.
- Slides from previous week.
  - BB flag efficiencies, Charge and Time.
  - Correction used.
  - Charge distributions
  - Effect of BB flag corrections on several AD trigger rates per diffractive class (SDL, SDR, DD, ND).
  - Effect on DD and SD fraction estimation.

DD adjustment before BB flag correction

- AD charge equalization undone.
- before BB flag efficiency correction.
- MIP width not adjusted.

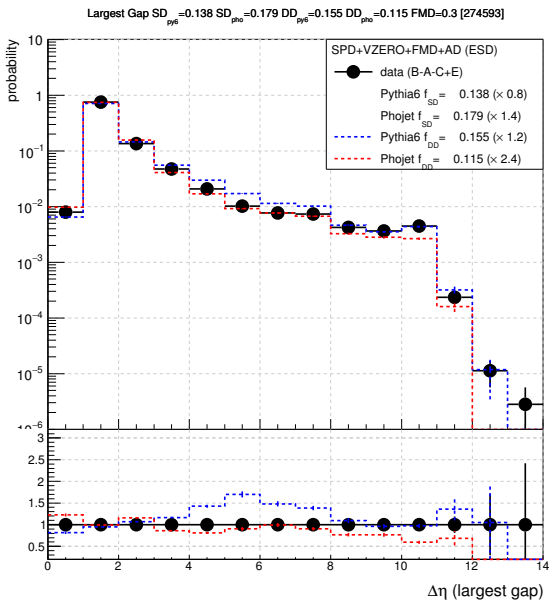


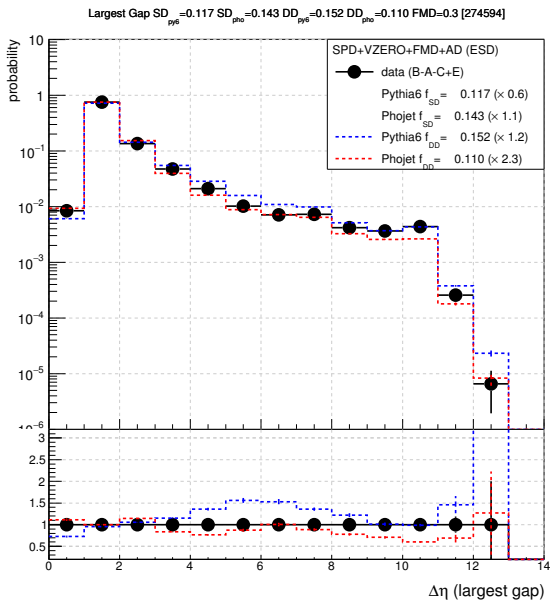


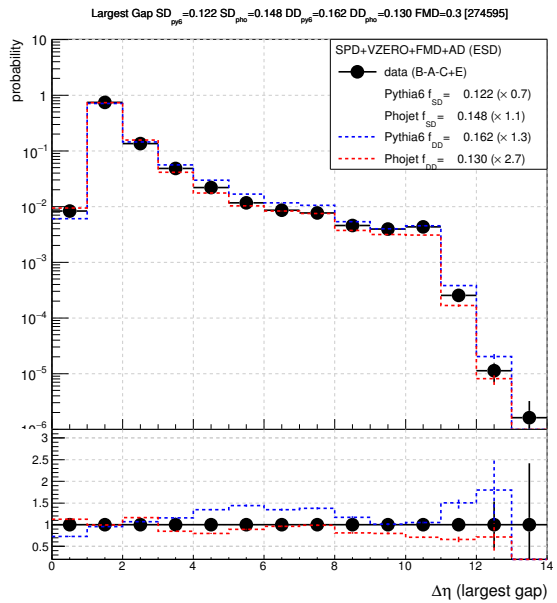


DD adjustment after BB flag correction

- AD charge equalization undone.
- after BB flag efficiency correction.
- MIP width not adjusted.

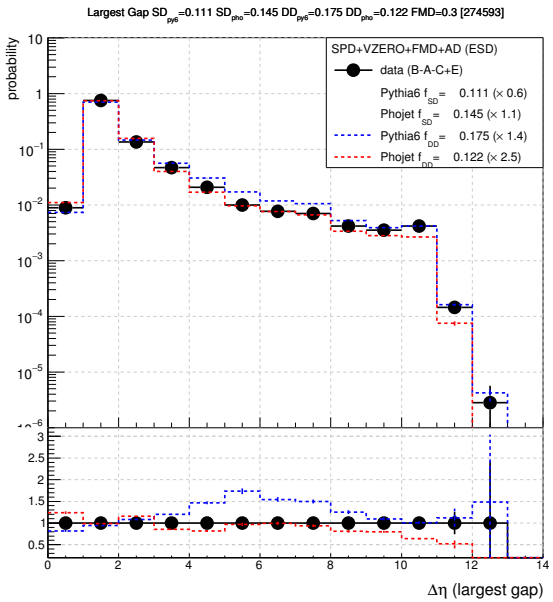


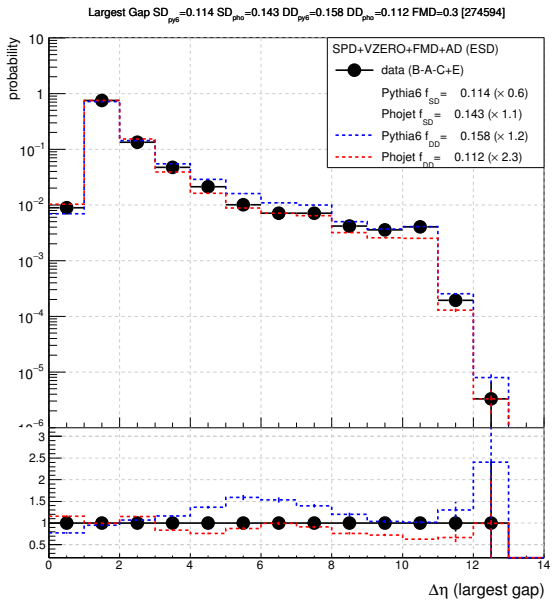


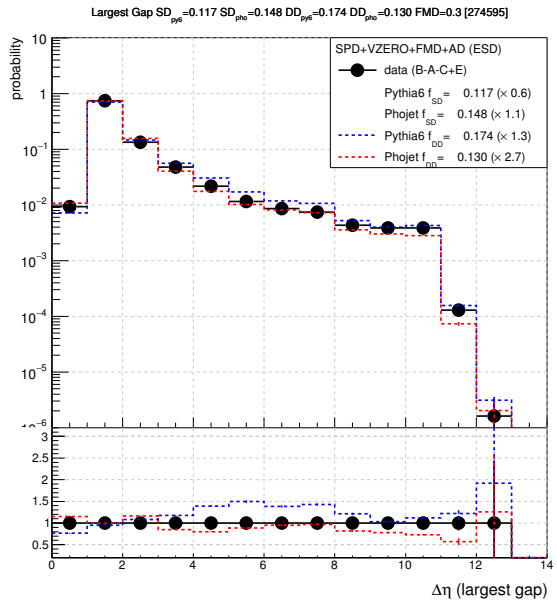


DD adjustment after BB flag correction

- AD charge equalization undone.
- after BB flag efficiency correction.
- MIP width not adjusted. AD charge threshold = 10 adc

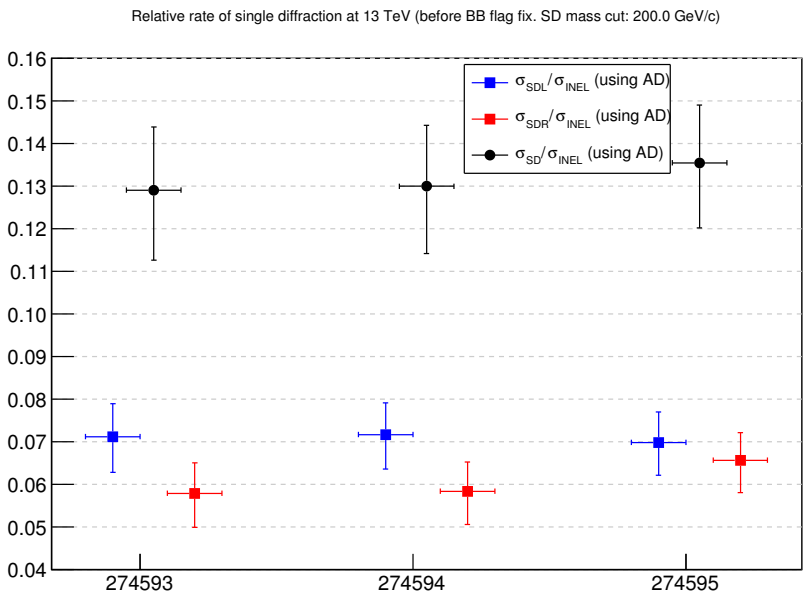






SD before/after BB flag correction

- AD charge equalization undone.
- before BB flag efficiency correction.
- MIP width not adjusted.



- The correction for BB flag efficiency has a small effect in DD and SD fractions.

SD before/after BB flag correction

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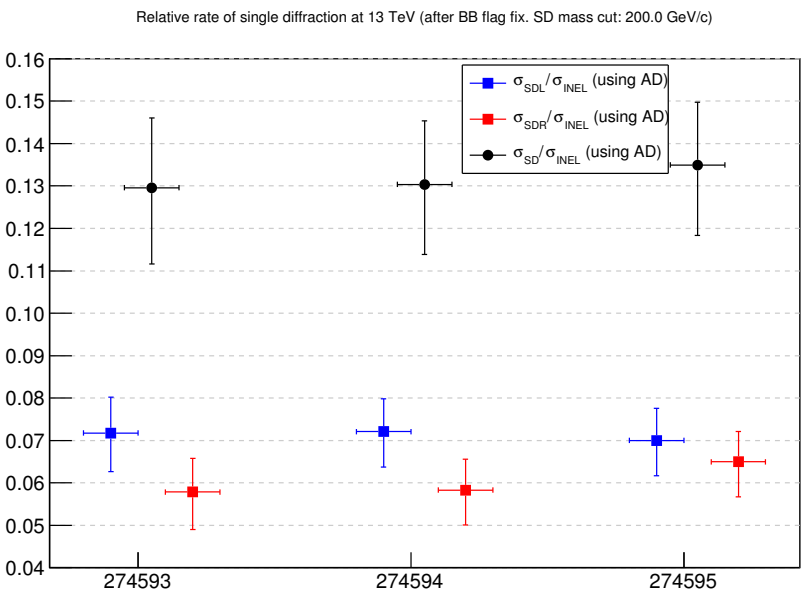

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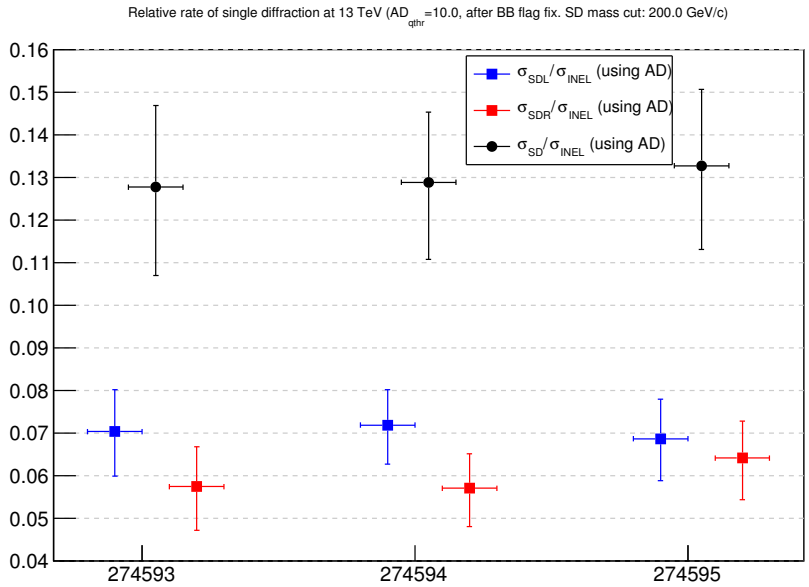
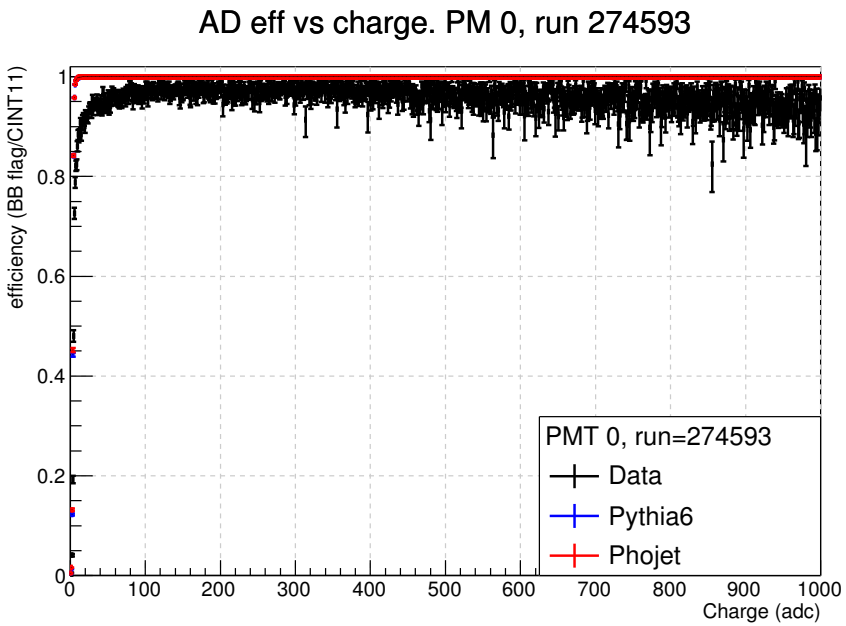
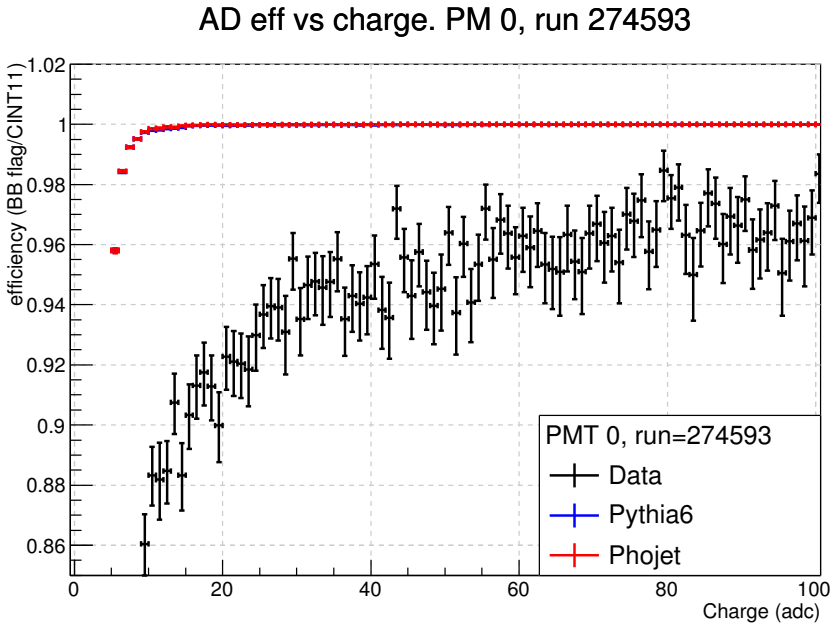


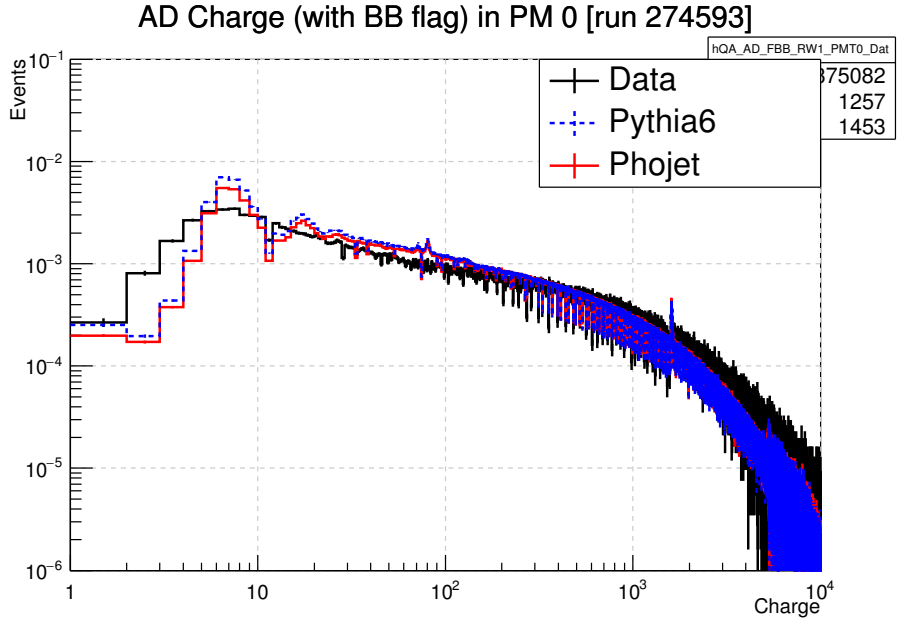
- The correction for BB flag efficiency has a small effect in DD and SD fractions.

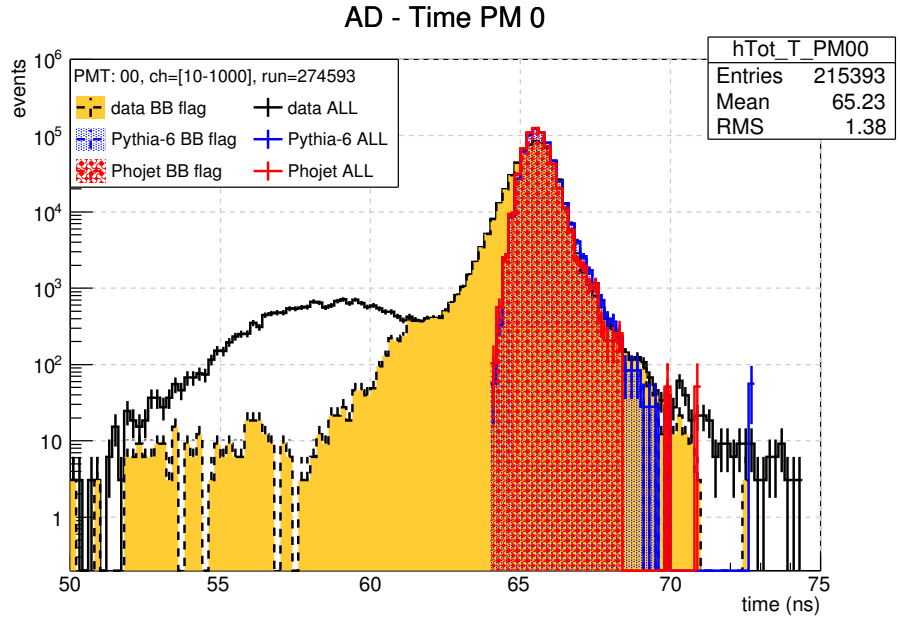
Previous slides

AD BB flag Eff, charge, Time (Data vs MC)

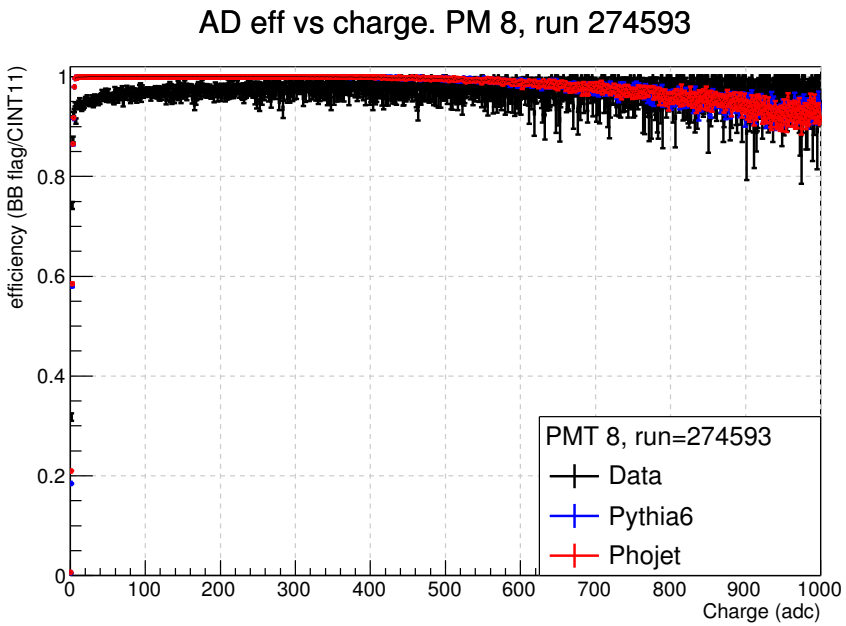


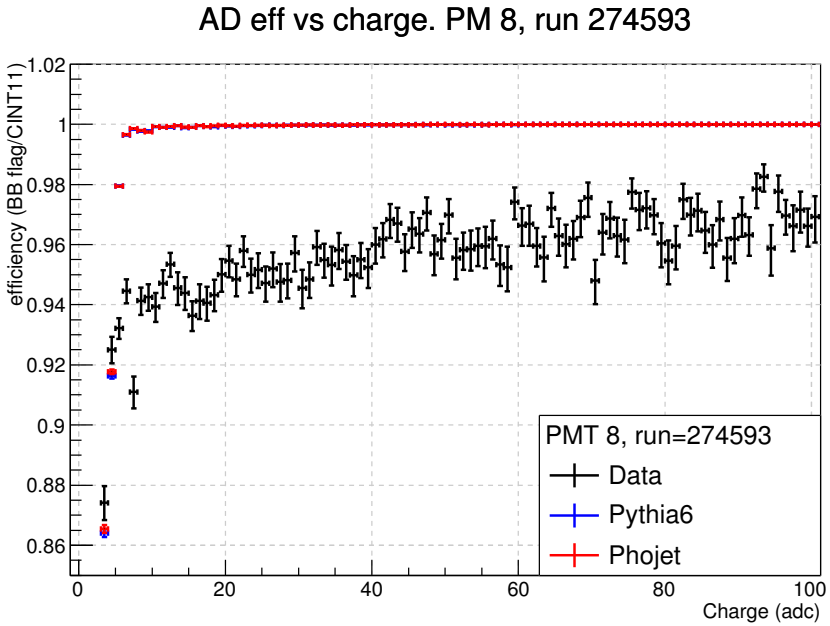


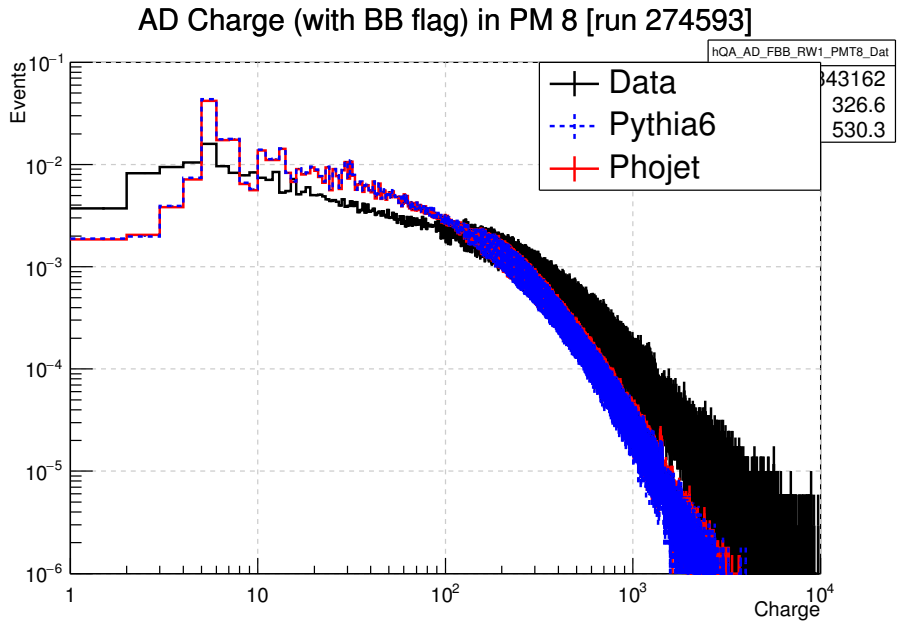


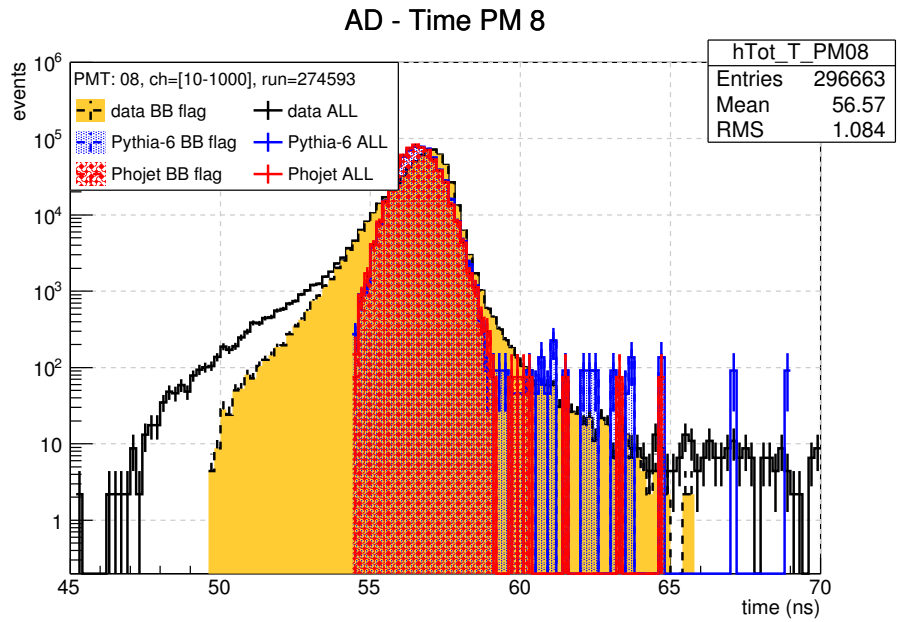


AD BB flag Eff, charge, Time (Data vs MC)



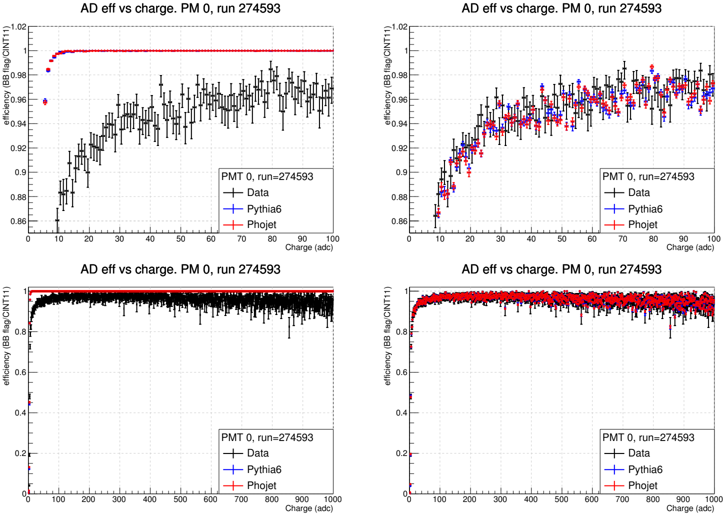






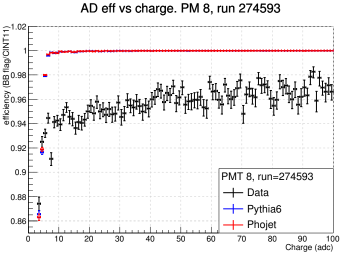
Correcting for BB flag efficiency. C-Side

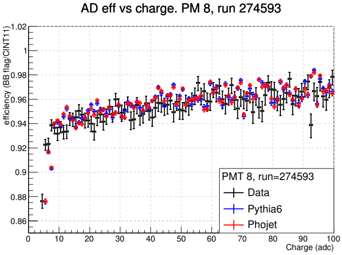
- Left: Uncorrected MC's.
- Right: MC after correction.

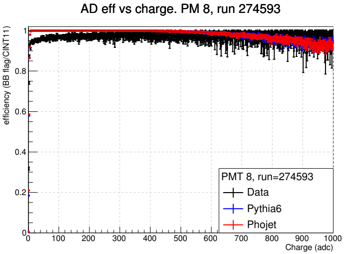


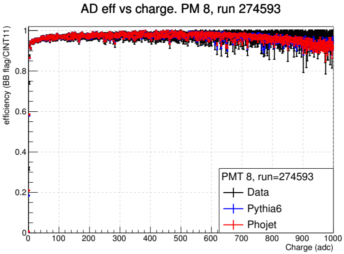
Correcting for BB flag efficiency. A-Side

- Left: Uncorrected MC's.
- Right: MC after correction.

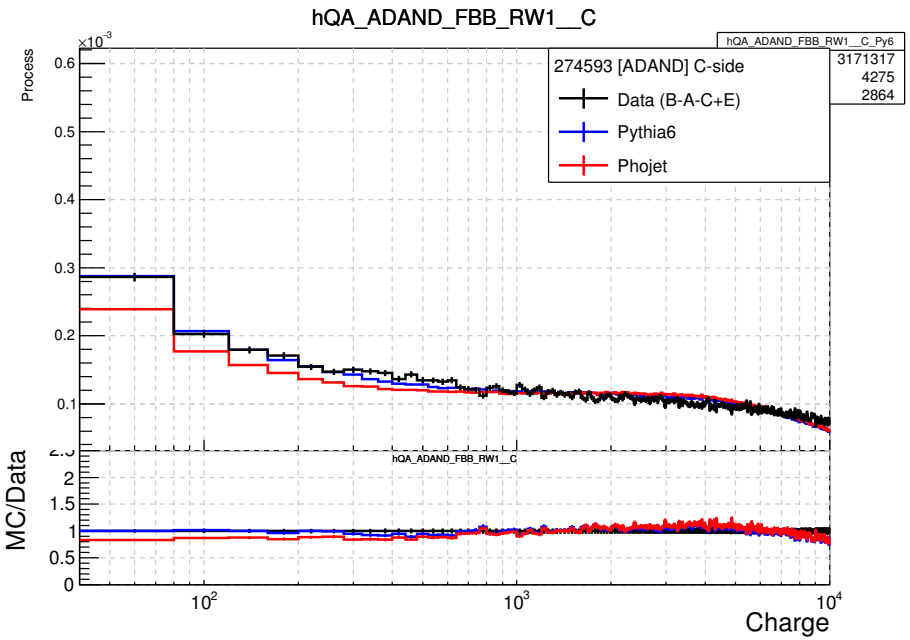


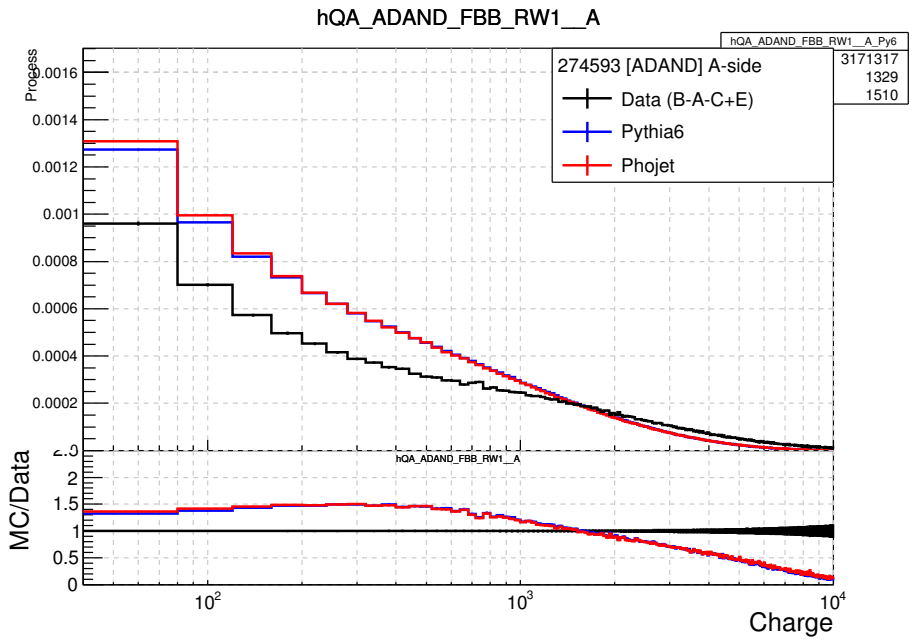


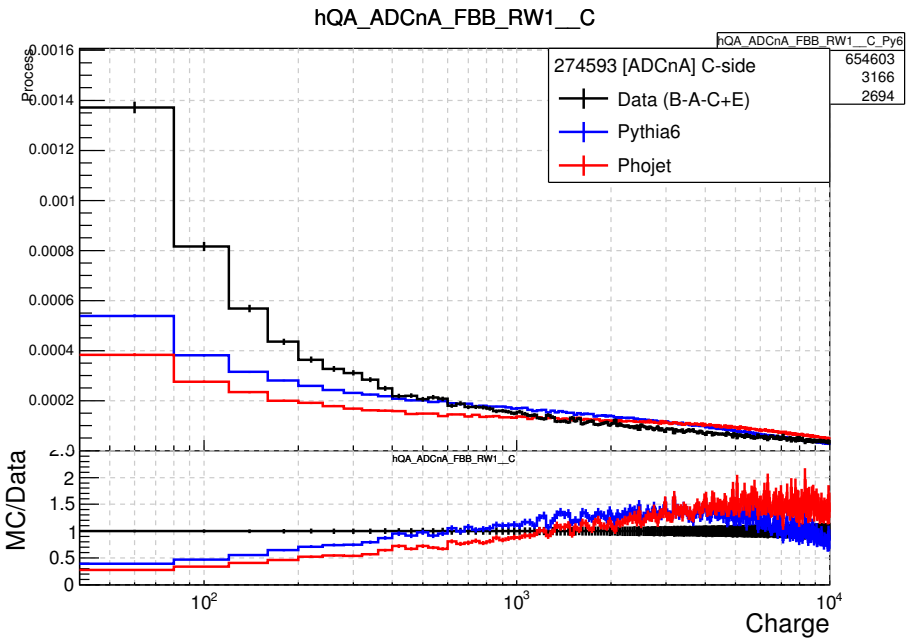


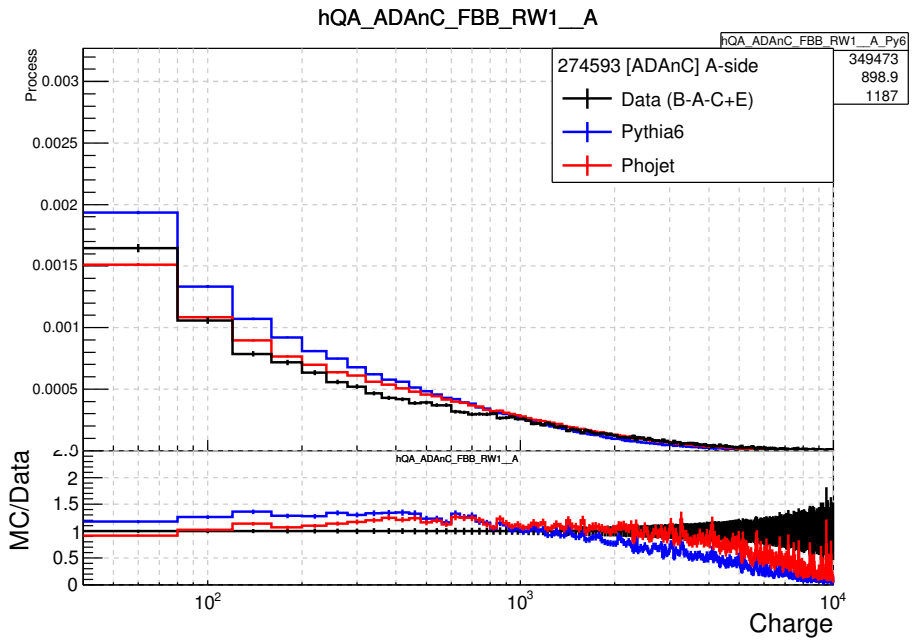


AD Charge per side (before BB flag correction)

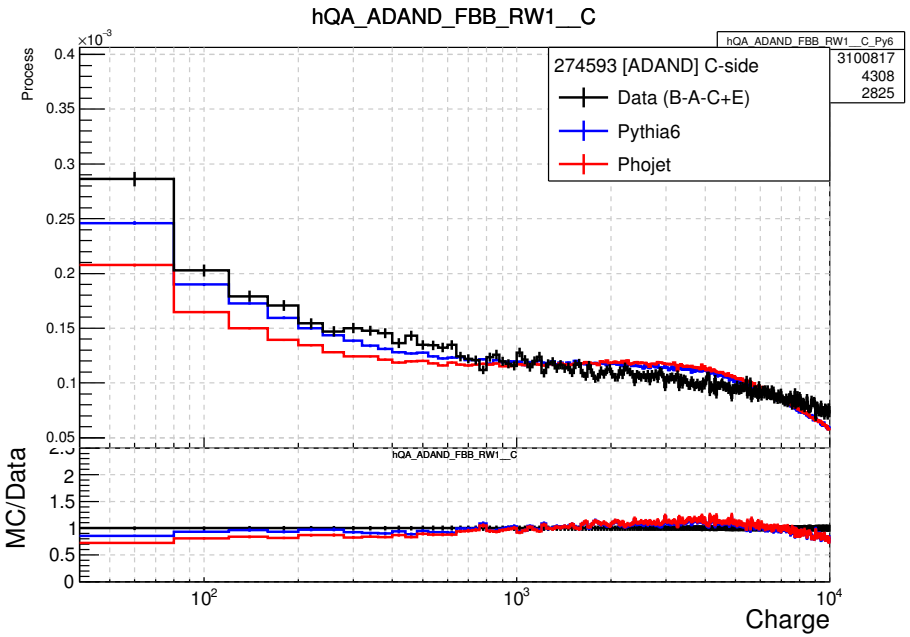


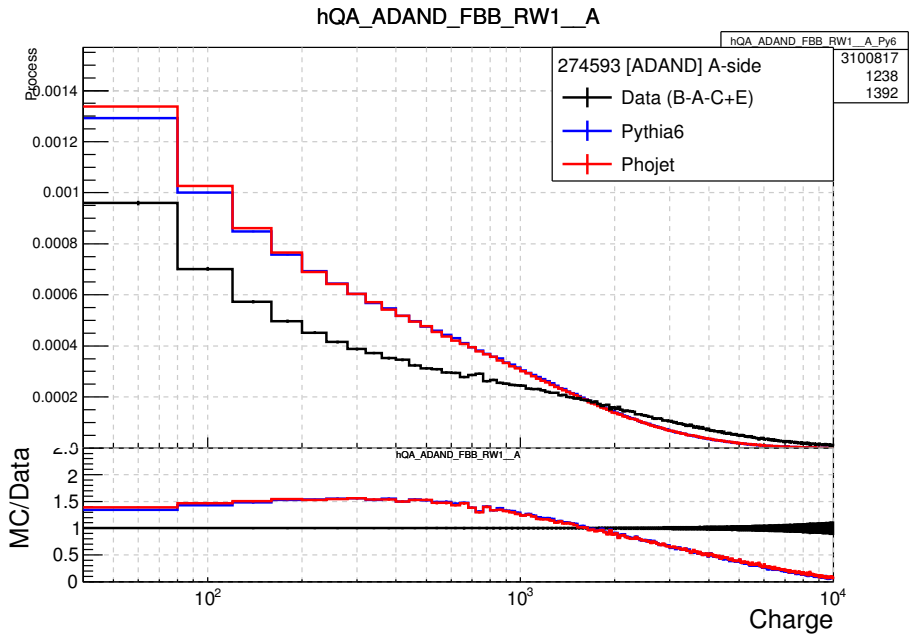


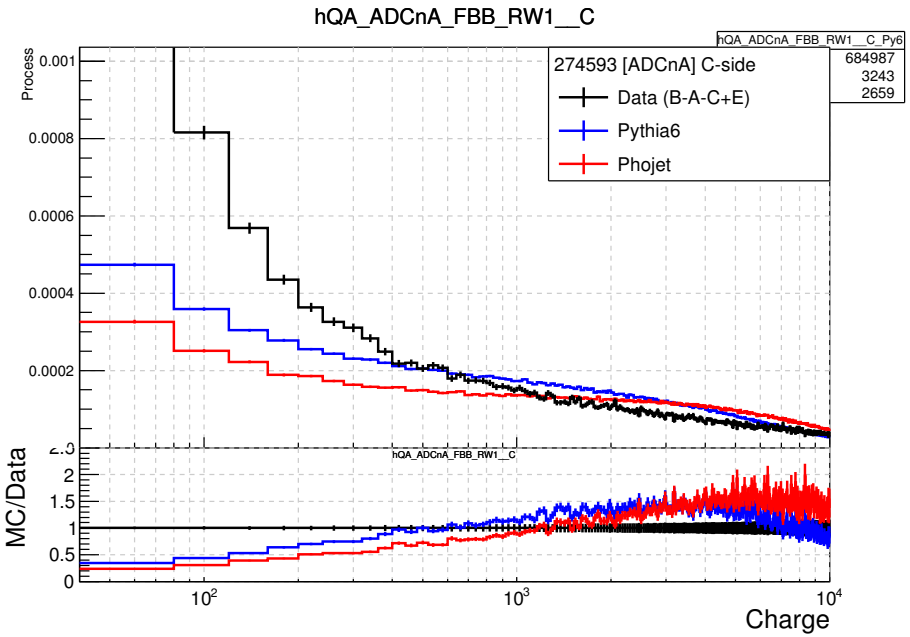


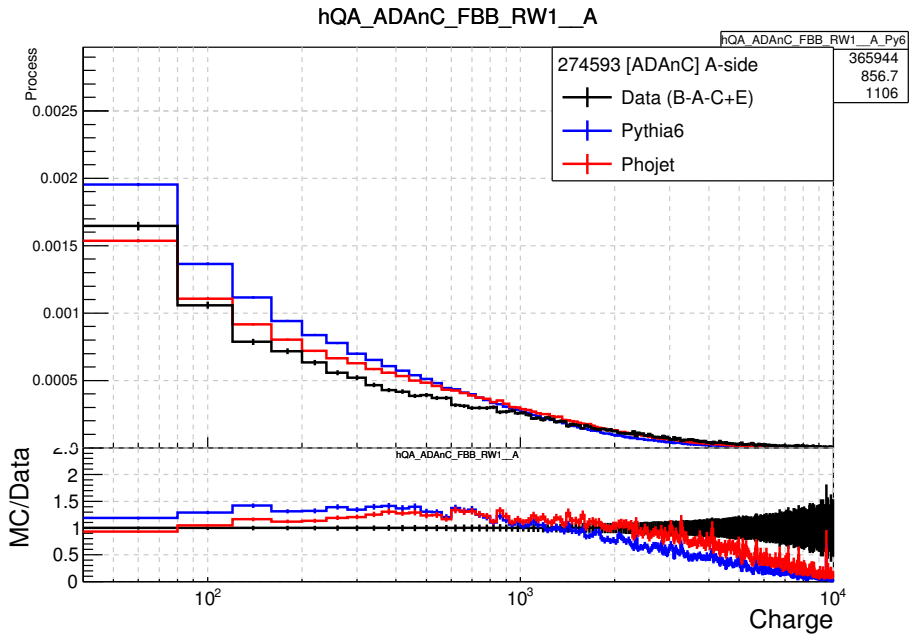


AD Charge per side (after BB flag correction)



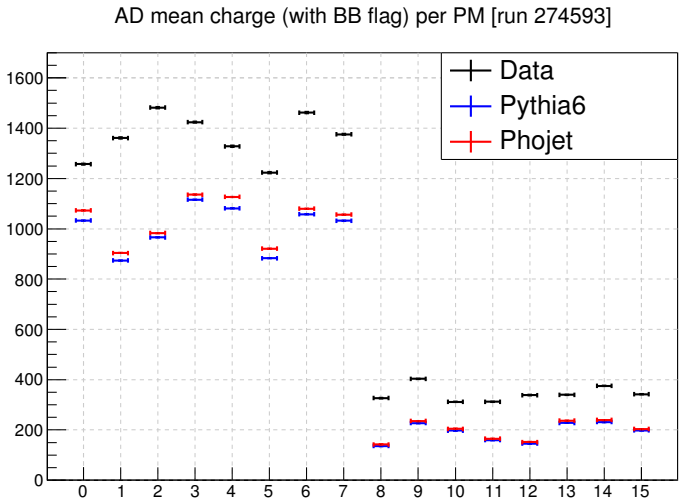




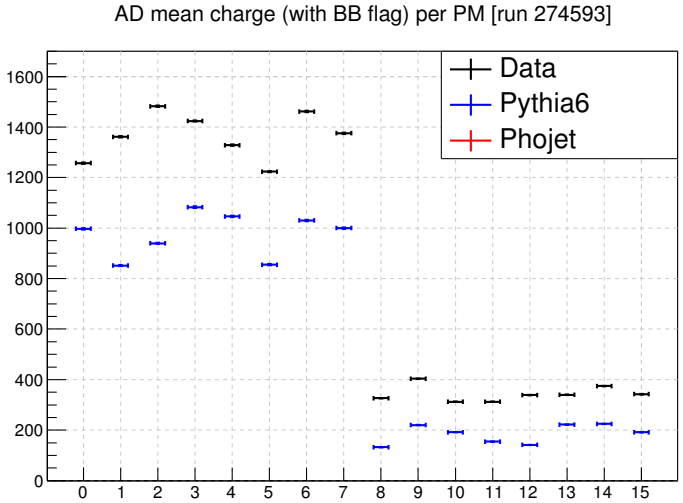


Mean charge

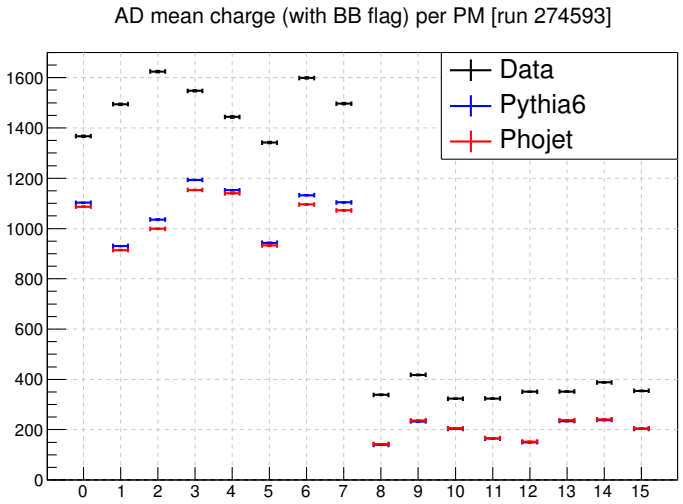
before MIP width adjustment



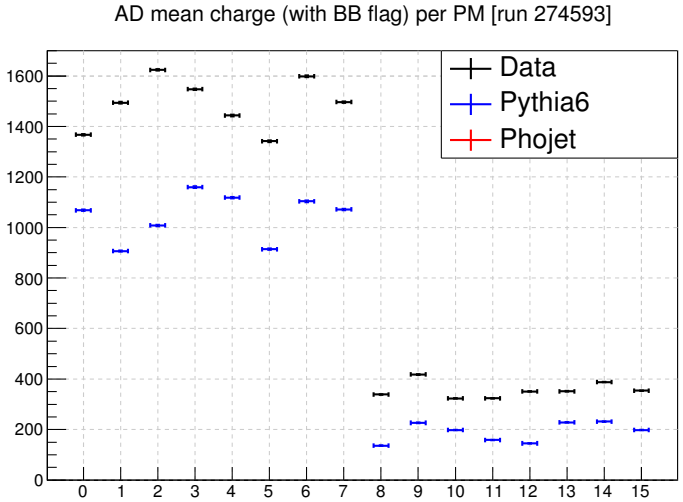
MIP adjusted



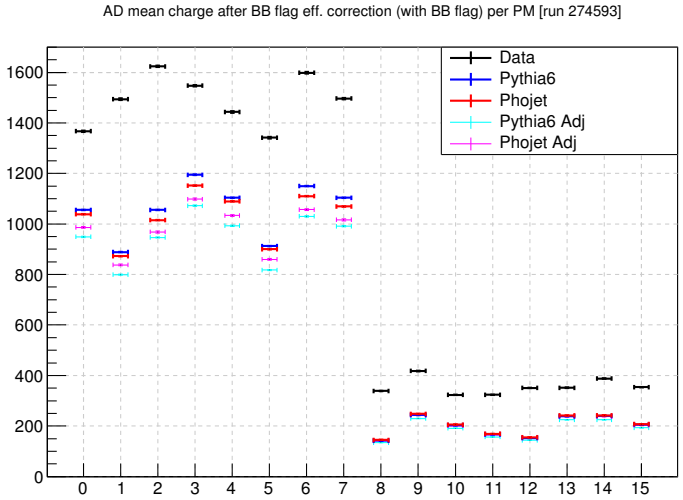
(ADAND) before MIP width adjustment



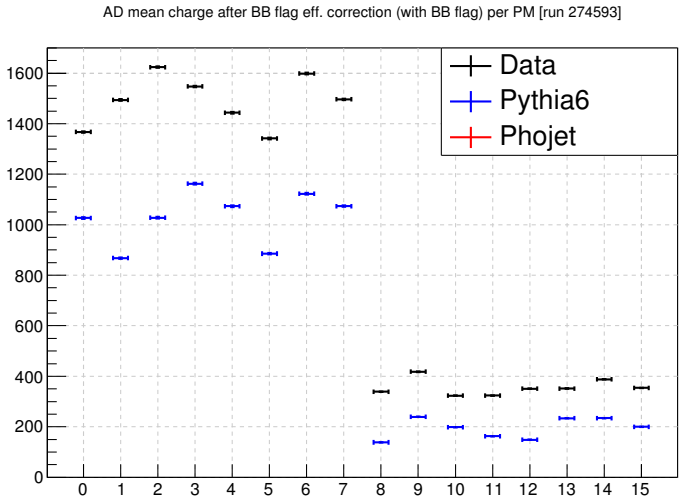
(ADAND) MIP width adjusted



(ADAND) before MIP width adjustment but with BB flag correction

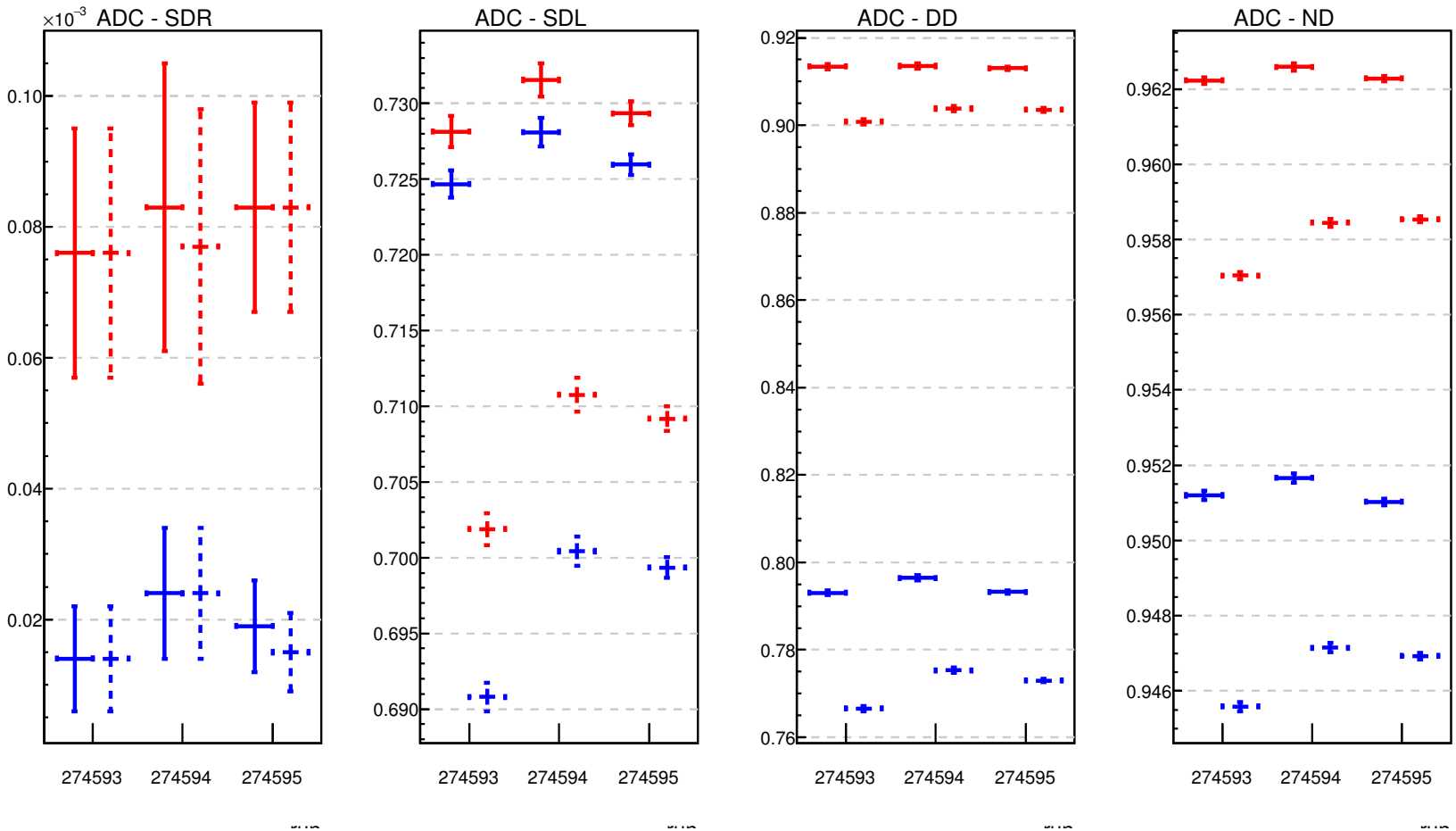


(ADAND) MIP width adjusted and BB flag corrected



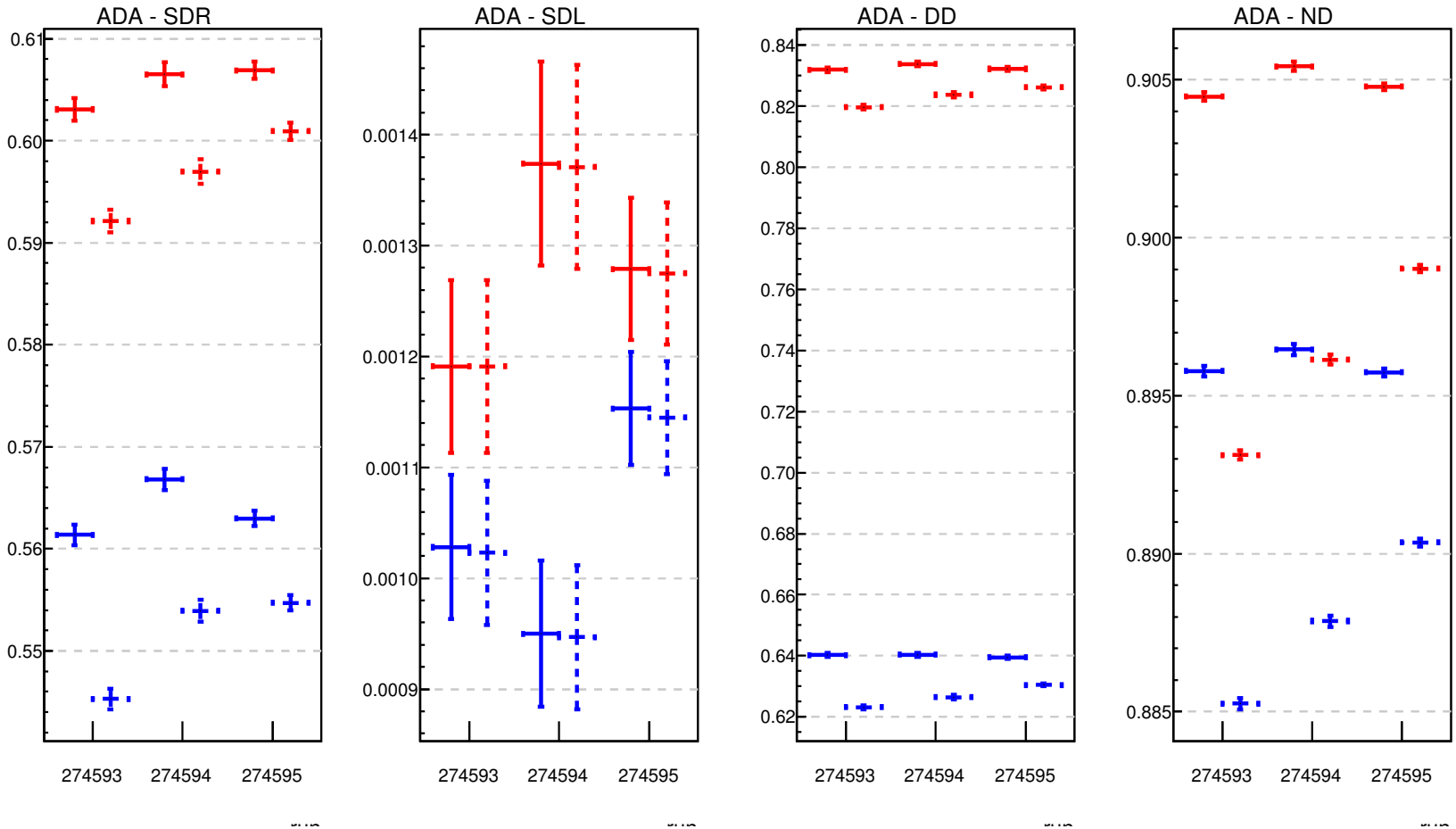
MC event ratios Before-After BB flag correction

- Pythia and Phojet.
- Dashed lines → MC corrected for BB flag efficiency.



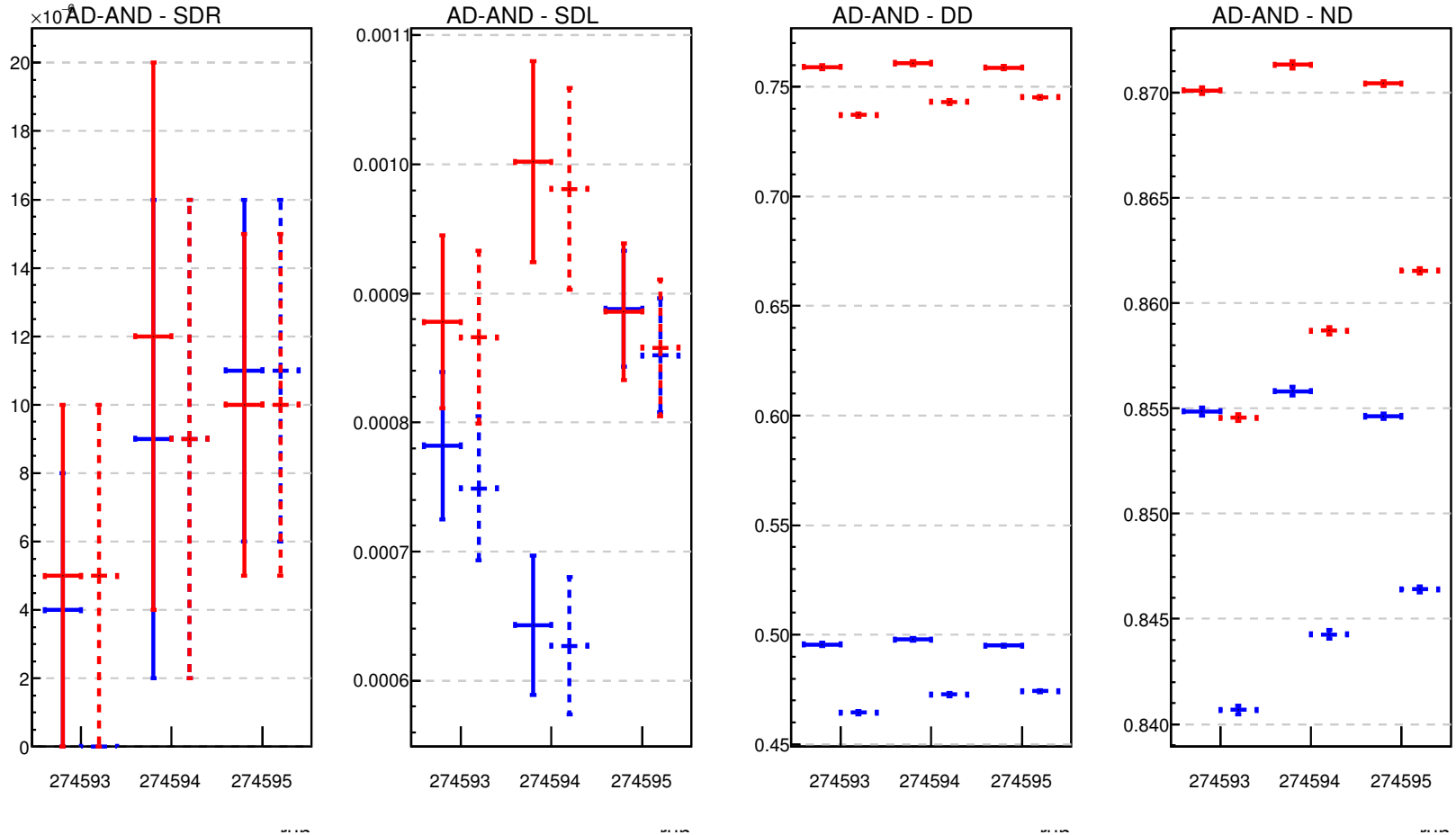
MC event ratios Before-After BB flag correction

- Pythia and Phojet.
- Dashed lines → MC corrected for BB flag efficiency.



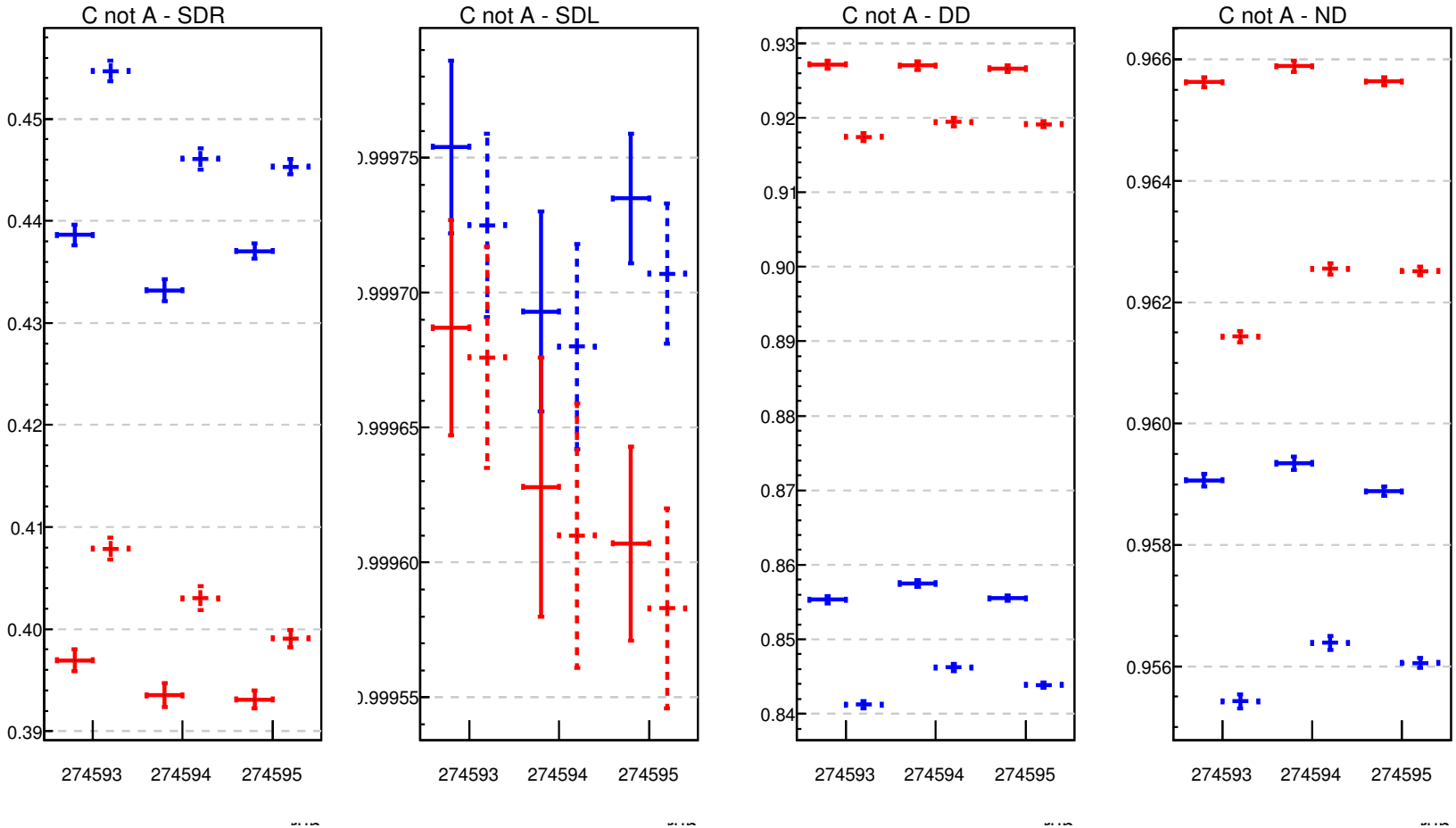
MC event ratios Before-After BB flag correction

- Pythia and Phojet.
- Dashed lines → MC corrected for BB flag efficiency.



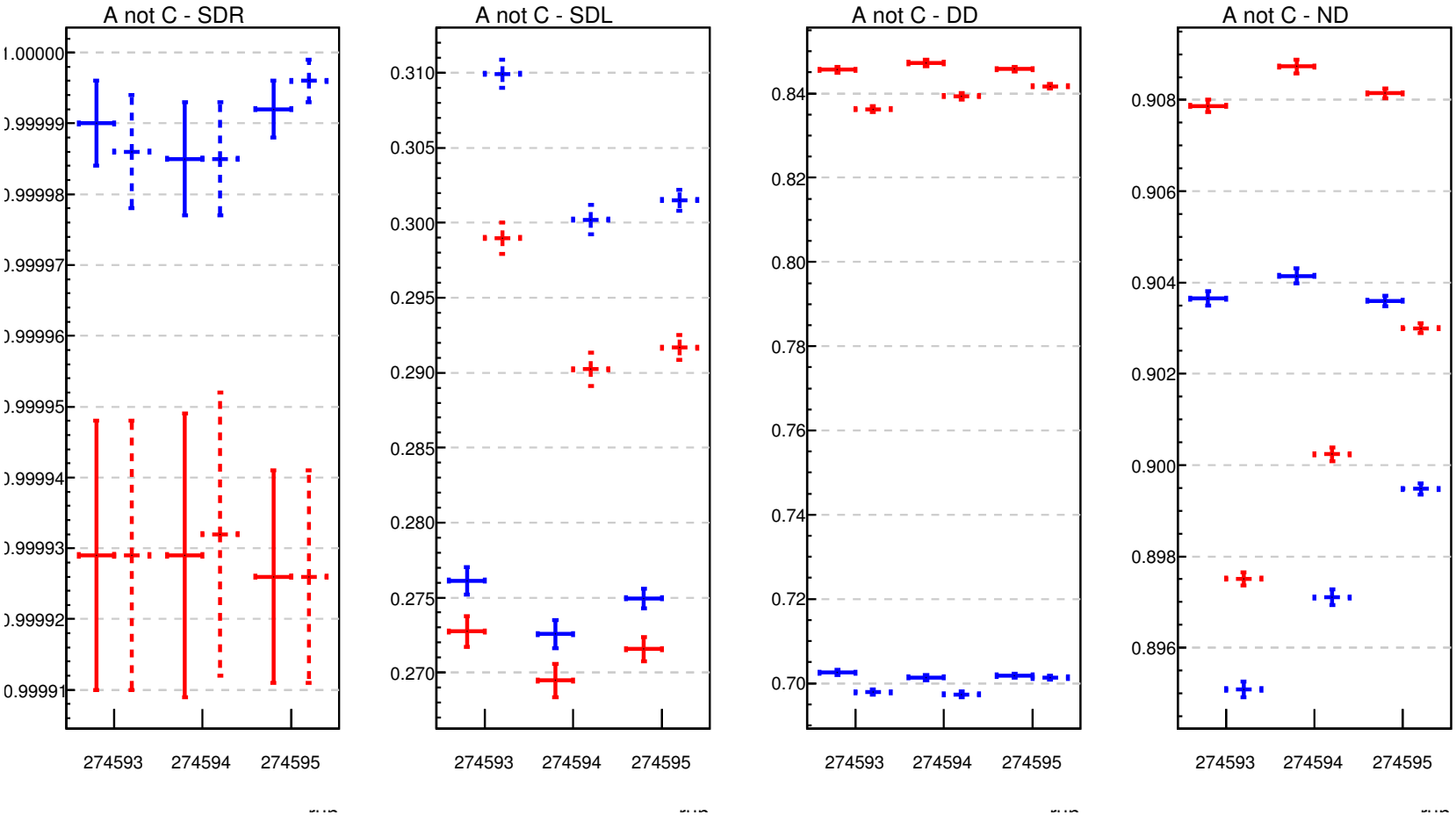
MC event ratios Before-After BB flag correction

- Pythia and Phojet.
- Dashed lines → MC corrected for BB flag efficiency.



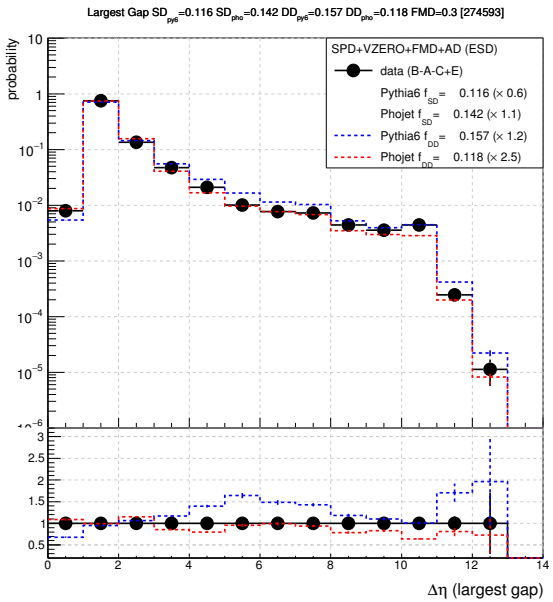
MC event ratios Before-After BB flag correction

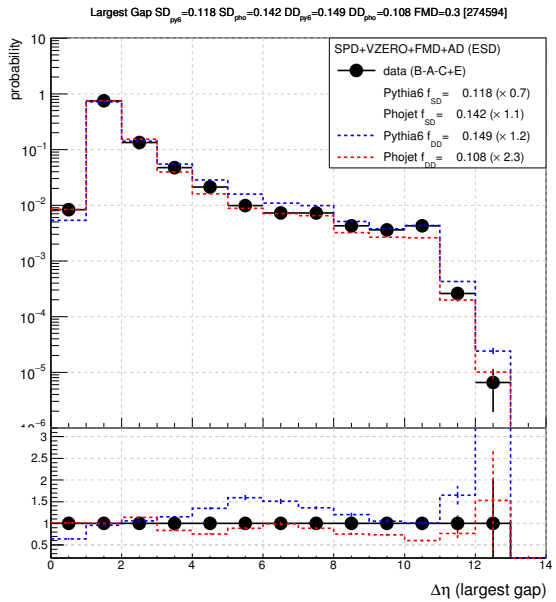
- Pythia and Phojet.
- Dashed lines → MC corrected for BB flag efficiency.

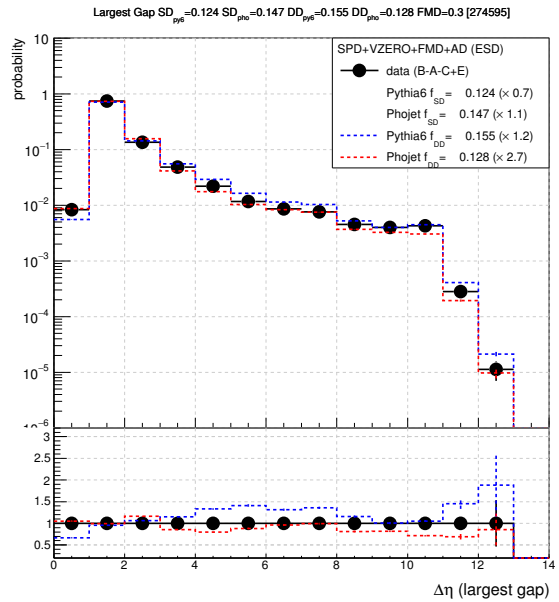


DD adjustment before BB flag correction

- before BB flag efficiency correction.
- MIP width not adjusted.

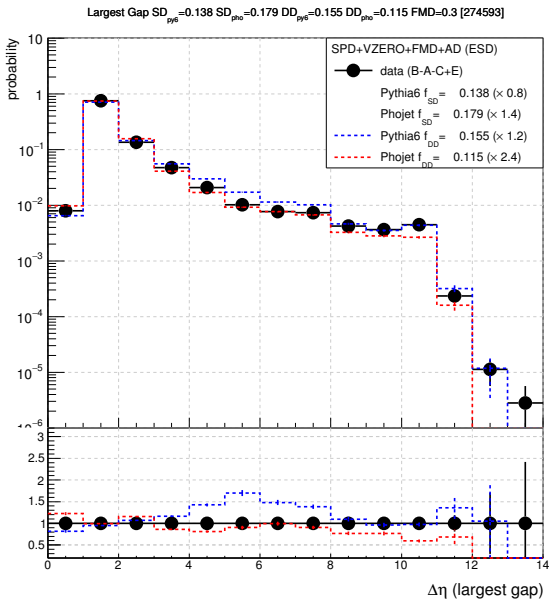


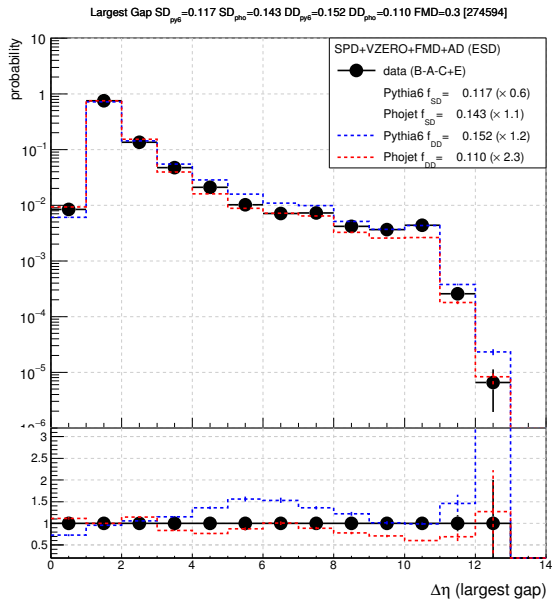


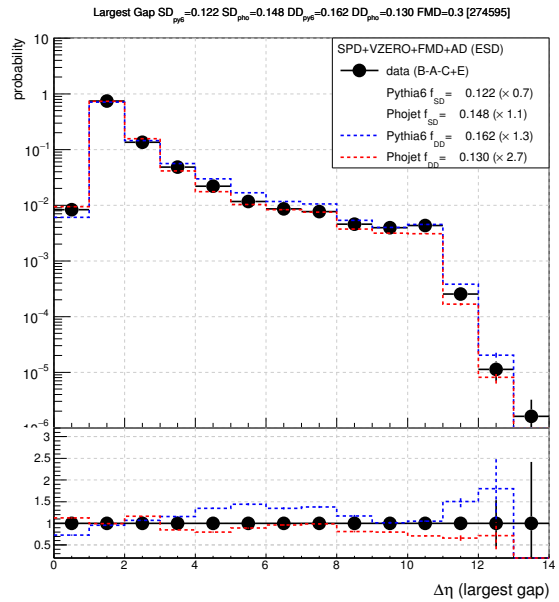


DD adjustment after BB flag correction

- after BB flag efficiency correction.
- MIP width not adjusted.

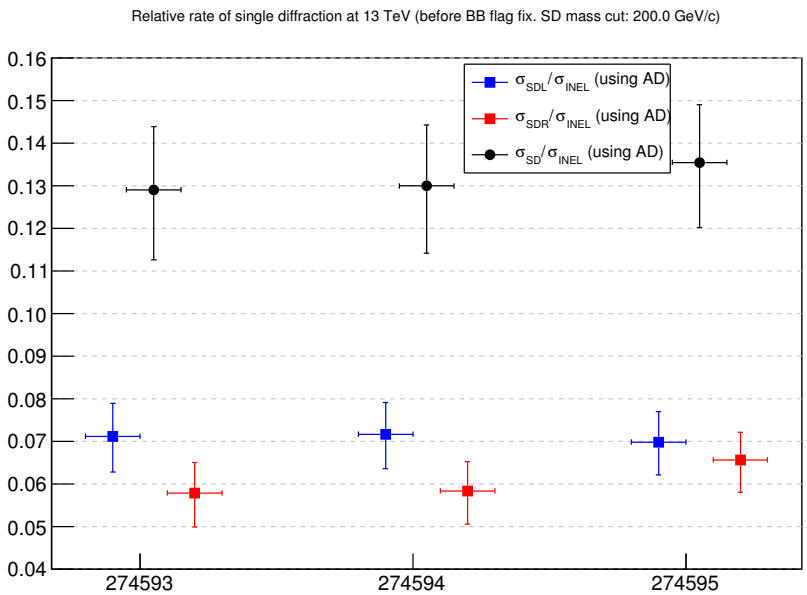






SD before/after BB flag correction

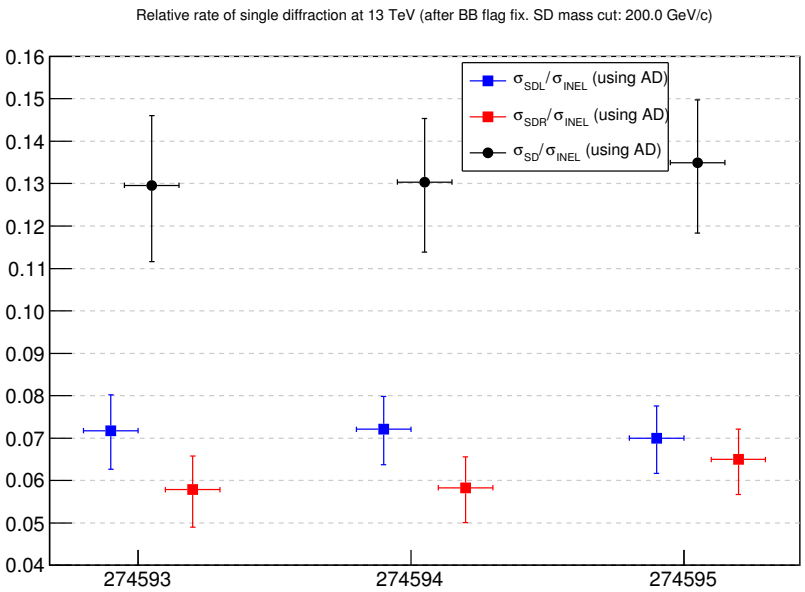
- before BB flag efficiency correction.
- MIP width not adjusted.



- The correction for BB flag efficiency has a small effect in DD and SD fractions.

SD before/after BB flag correction

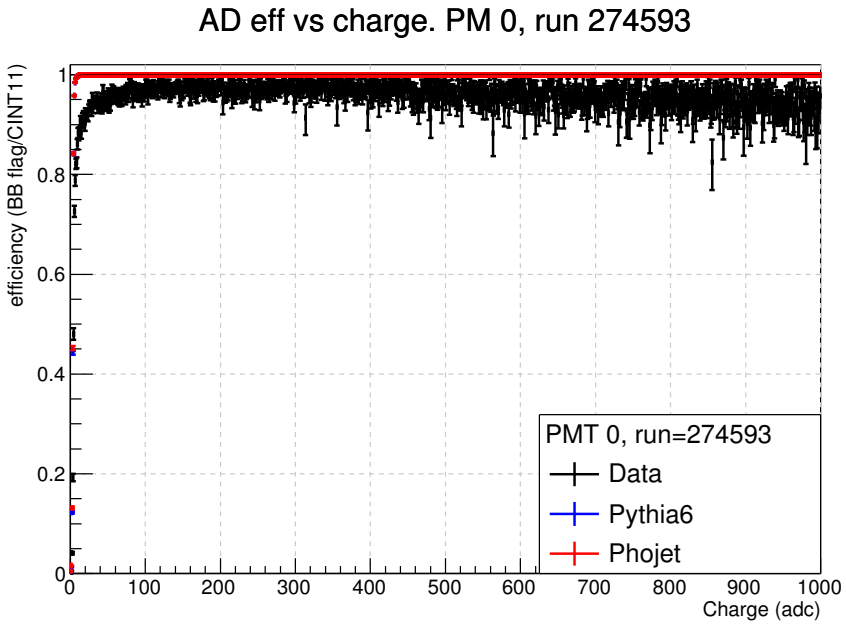
- after BB flag efficiency correction.
- MIP width not adjusted.

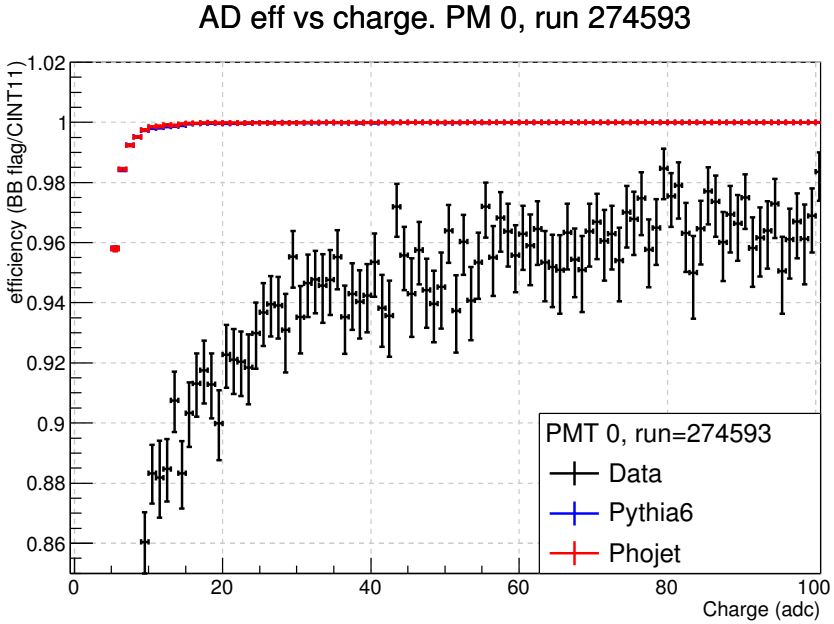


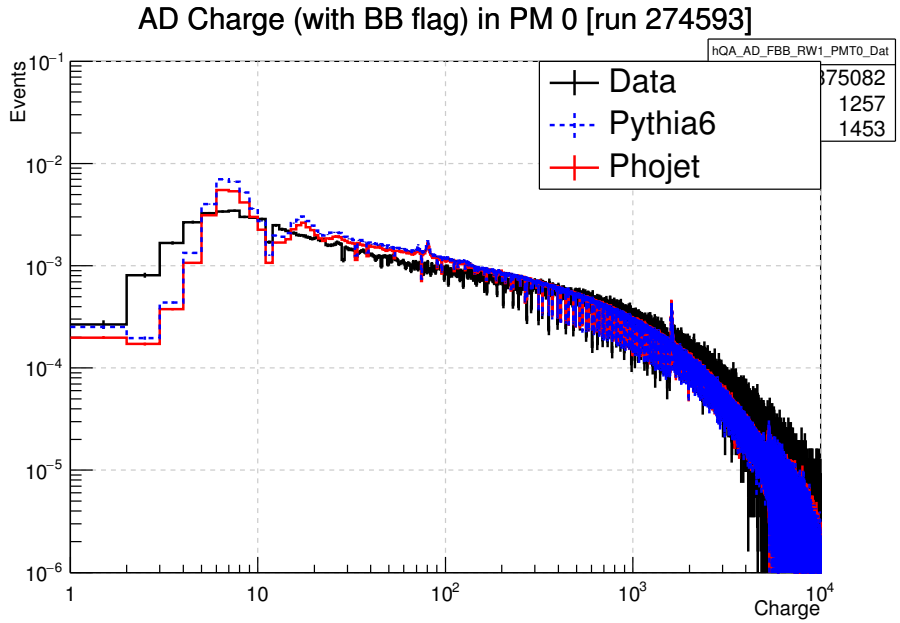
- The correction for BB flag efficiency has a small effect in DD and SD fractions.

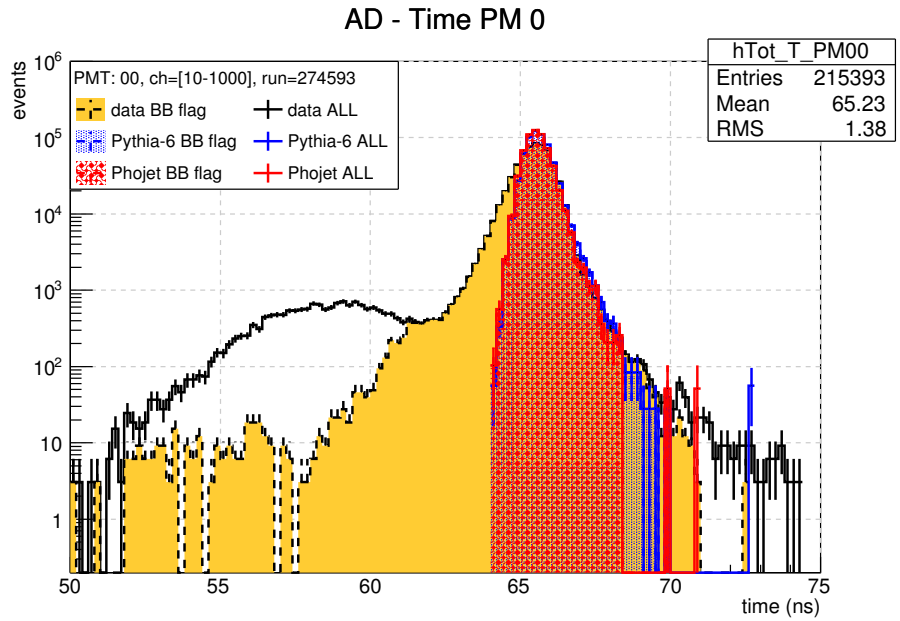
Appendix

AD BB flag Eff, charge, Time (Data vs MC)

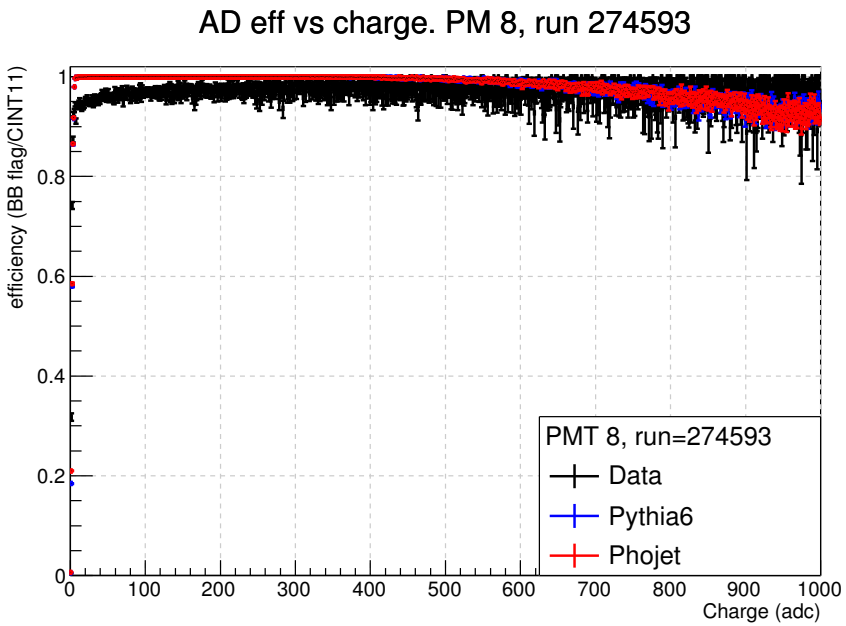


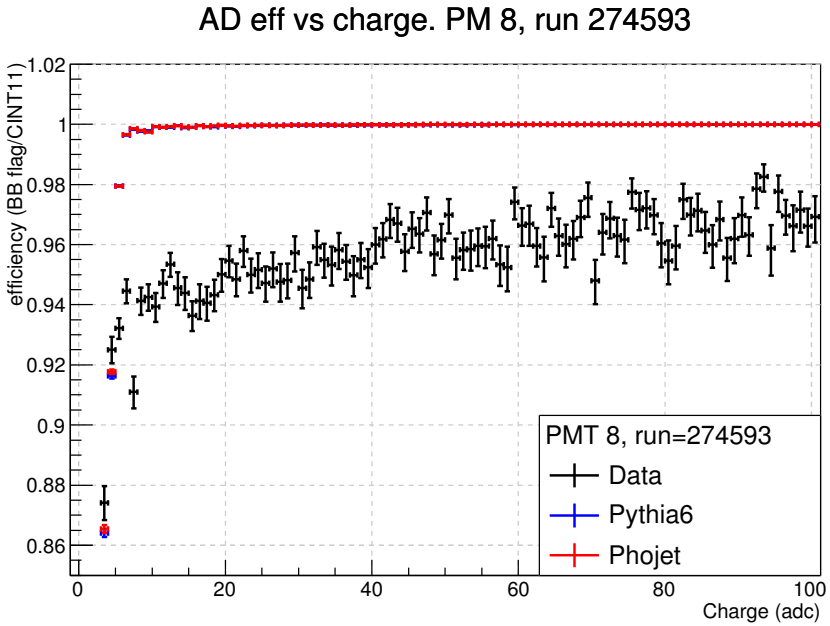


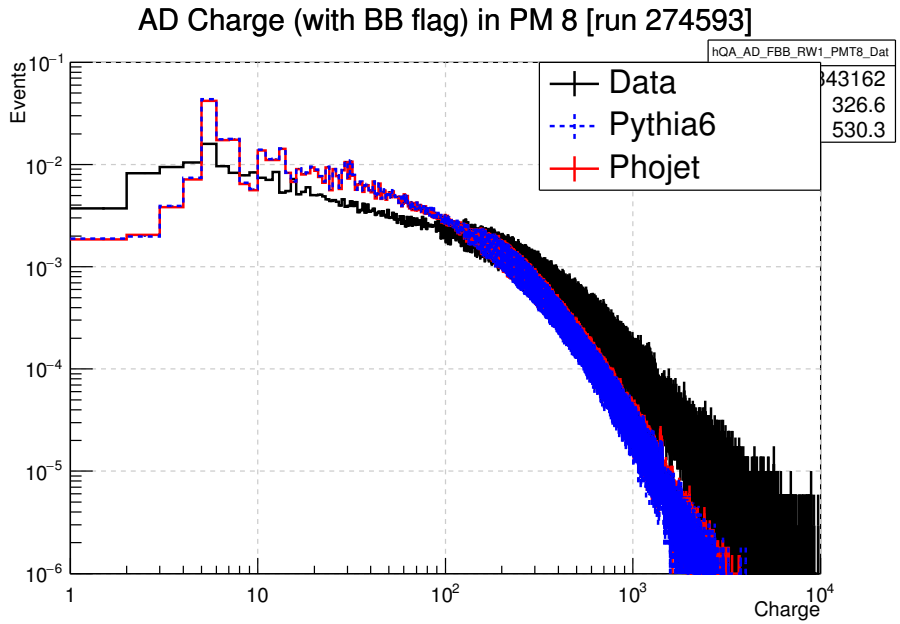


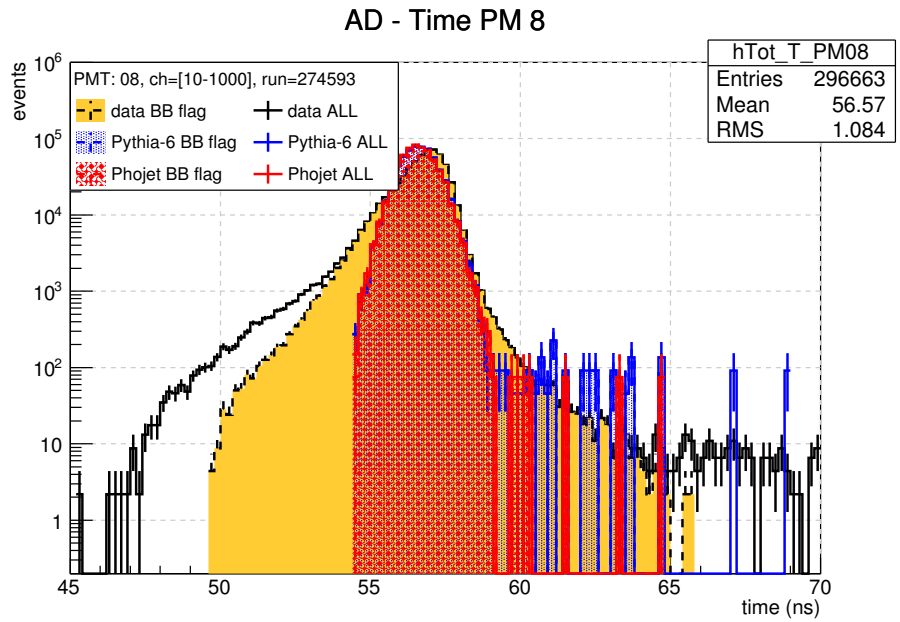


AD BB flag Eff, charge, Time (Data vs MC)









Event classes (1-Arm-L, 1-Arm-R, 2-Arm)

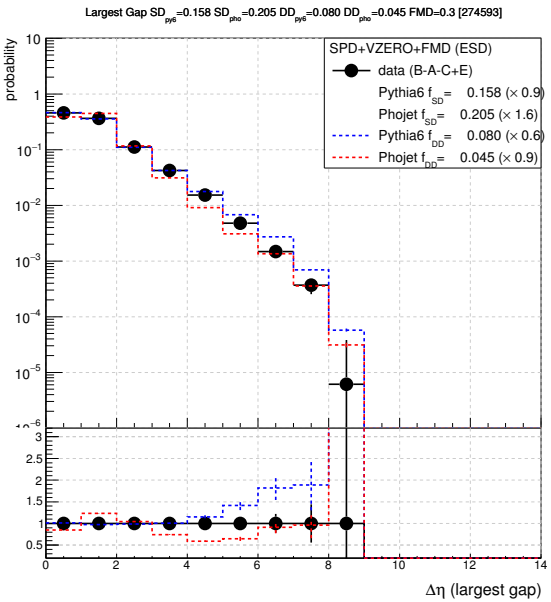
- We classified the event in three mutualy exclusive categories.
- We use the same 1-Arm-L(R), 2-Arm definitions as in the previous ALICE paper (https://arxiv.org/abs/1208.4968)
- However in this analysis we set the high mass cut for single diffraction at **200** GeV/c^2

- 1-Arm-L → selects SD-L events
- 1-Arm-R → selects SD-R events
- 2-Arm → selects double diffractive and non-diffractive events

Adjustment of DD fraction (no AD)

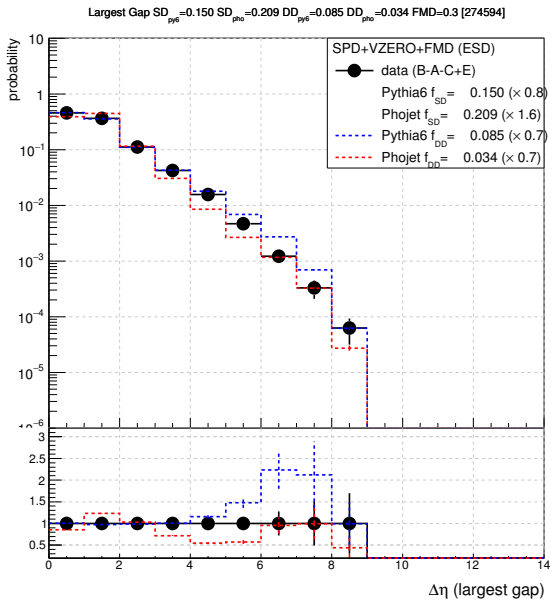
- largest gap ($\Delta\eta$) in 2-arm events
- The content of double diffraction (DD) in MC is adjusted so that Pythia (Phojet) bracket the data from above (below)
- Detectors used: SPD+FMD+VZERO
- **SD mass cut: 200** GeV/c^2

run 274593



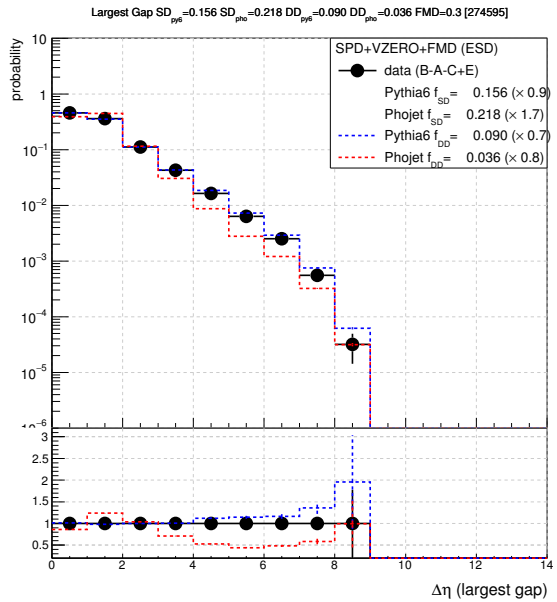
- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.080
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.040

run 274594



- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.085
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.040

run 274595

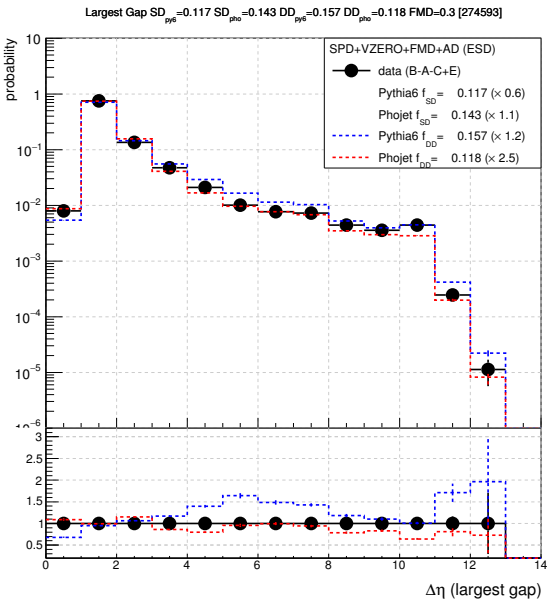


- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.090
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.040

Adjustment of DD fraction (with AD)

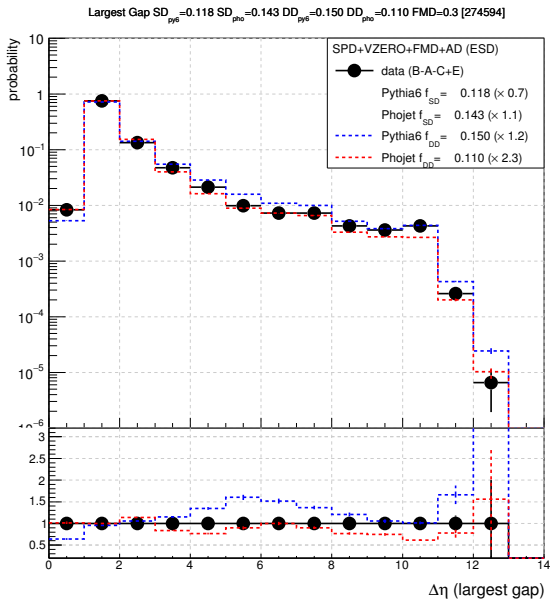
- largest gap ($\Delta\eta$) in 2-arm events
- The content of double diffraction (DD) in MC is adjusted so that Pythia (Phojet) brachet the data from above (below)
- Detectors used: SPD+FMD+VZERO+AD
- **SD mass cut: 200** GeV/c^2

run 274593



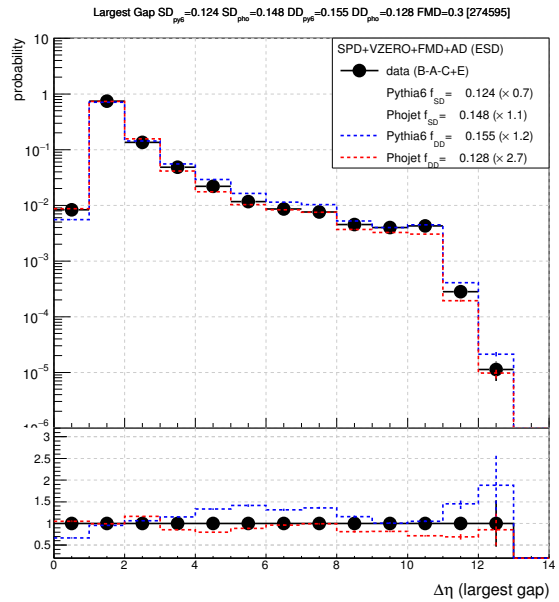
- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.155
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.120

run 274594



- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.150
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.110

run 274595

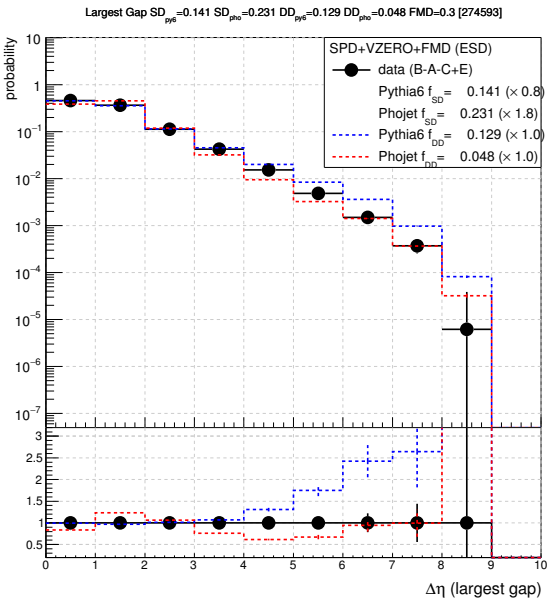


- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.155
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.125

Adjustment of DD fraction (no AD)

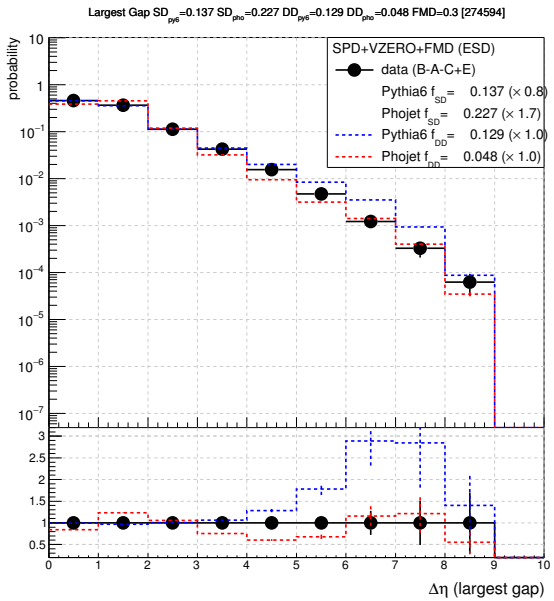
- largest gap ($\Delta\eta$) in 2-arm events
- The content of double diffraction (DD) in MC is adjusted so that Pythia (Phojet) bracket the data from above (below)
- Detectors used: SPD+FMD+VZERO
- SD mass cut: 1000 GeV/c^2

run 274593



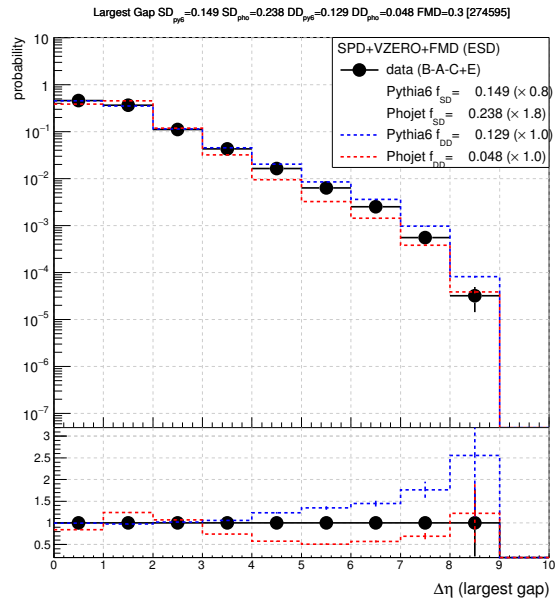
- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.129
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.048

run 274594



- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.129
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.048

run 274595

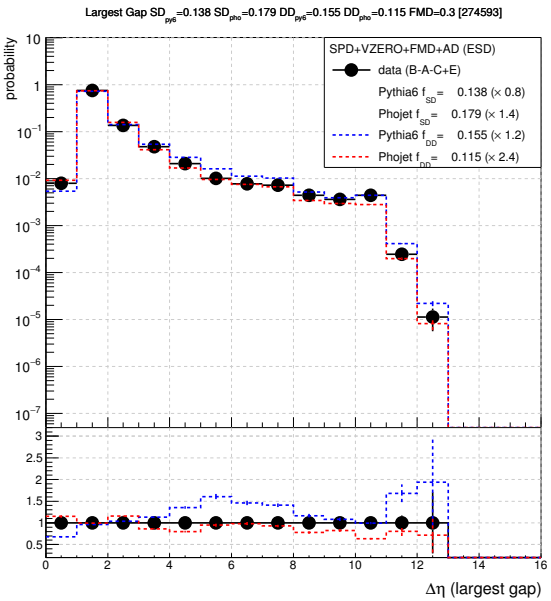


- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.129
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.048

Adjustment of DD fraction (with AD)

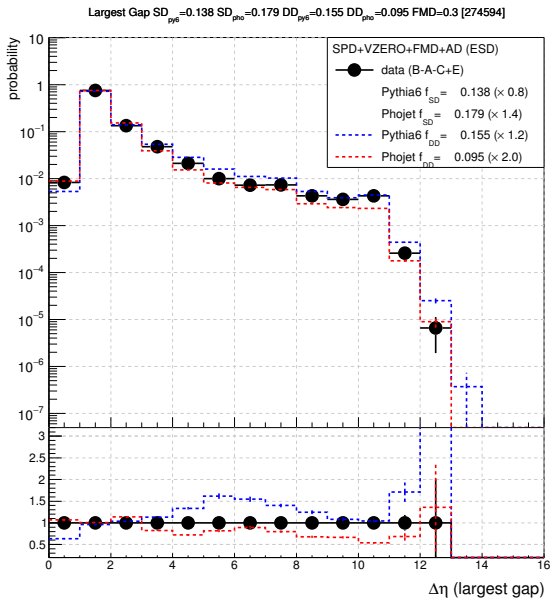
- largest gap ($\Delta\eta$) in 2-arm events
- The content of double diffraction (DD) in MC is adjusted so that Pythia (Phojet) brachet the data from above (below)
- Detectors used: SPD+FMD+VZERO+AD
- SD mass cut: 1000 GeV/c^2

run 274593



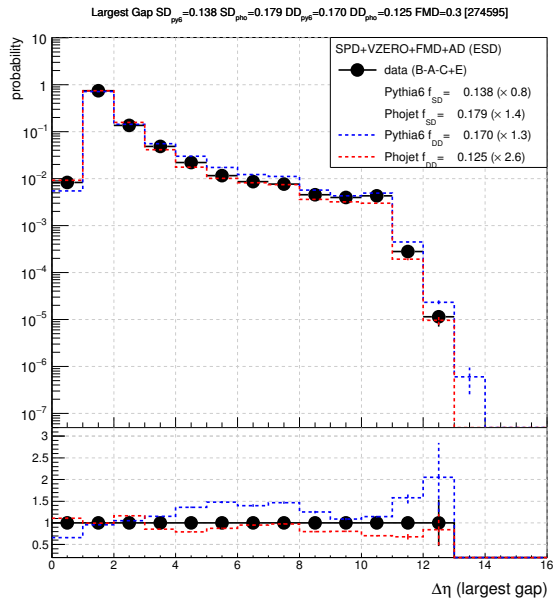
- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.155
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.115

run 274594



- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.155
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.095

run 274595

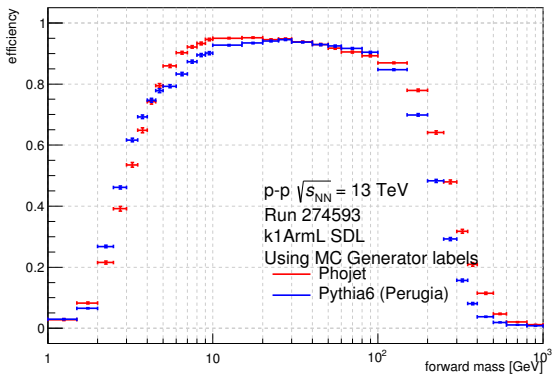


- $\mathrm{Pythia}_{\mathrm{DD}}$ = 0.170
- $\mathrm{Phojet}_{\mathrm{DD}}$ = 0.115

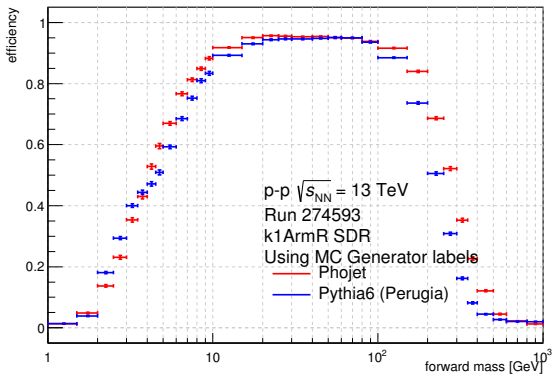
- Run: 274593 (AD MIP → 8 adc)
- Run: 274594 (AD MIP → 10 adc)
- Run: 274595 (AD MIP → 8 adc)
- 1-arm-L(top) and 1-arm-R(bottom) Efficiency vs diffracted mass

274593

1-Arm-L

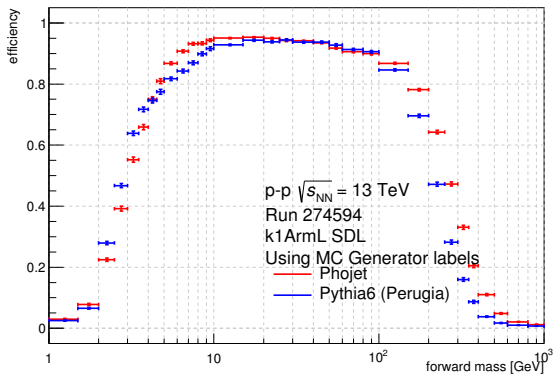


1-Arm-R

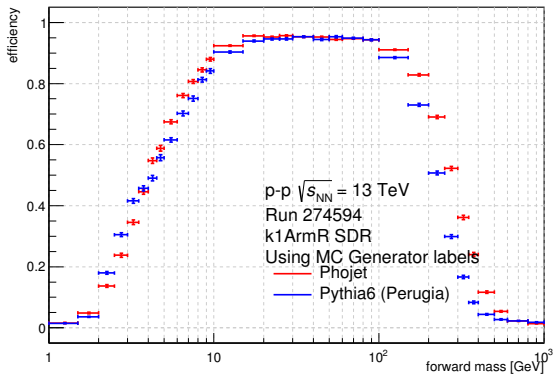


274594

1-Arm-L

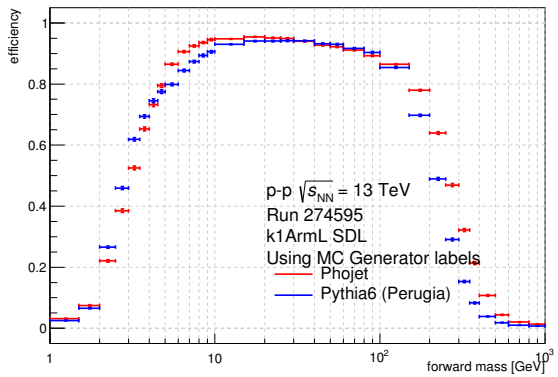


1-Arm-R

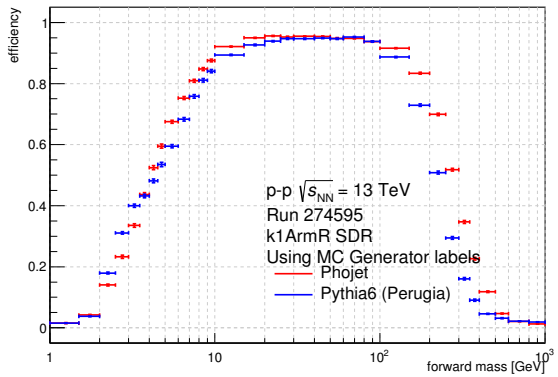


274595

1-Arm-L



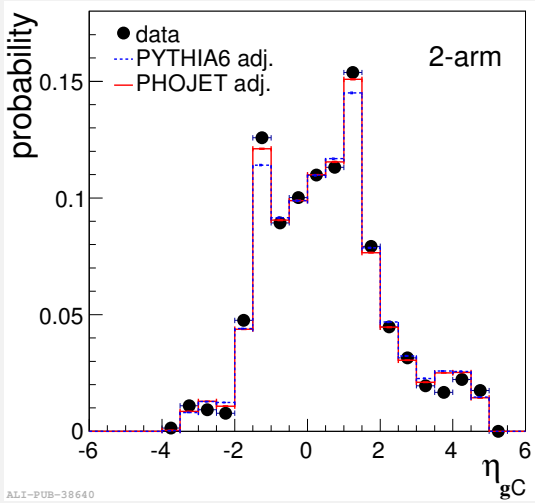
1-Arm-R



Center of largest gap in 2-arm events

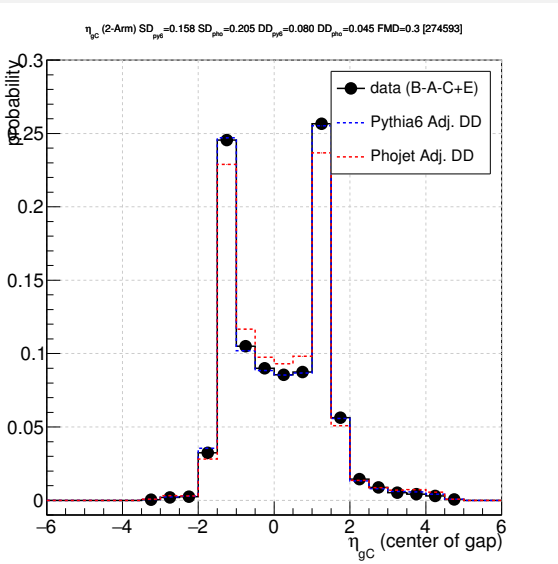
- Detectors used: SPD+FMD+VZERO

From ALICE paper



This analysis at 13 TeV

274593



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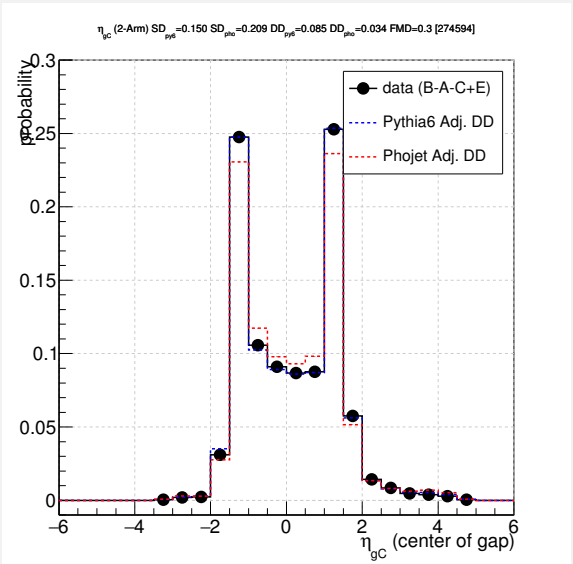

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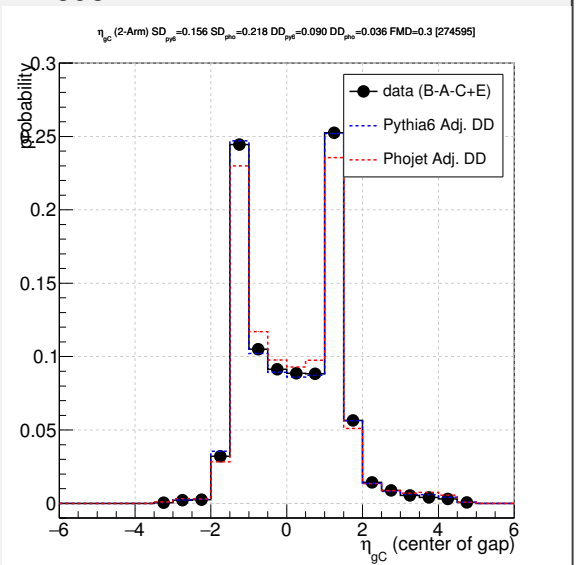
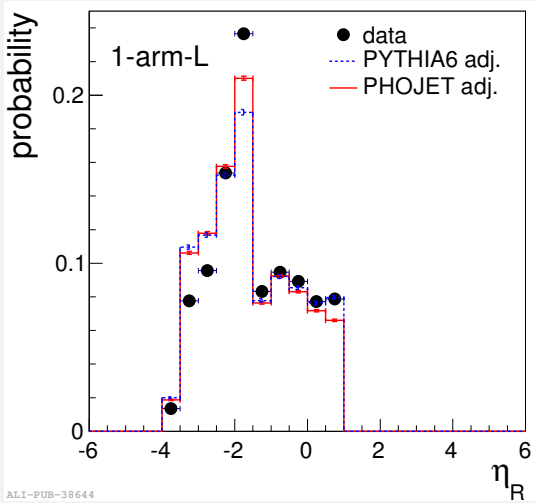


right most track in 1-arm-L events

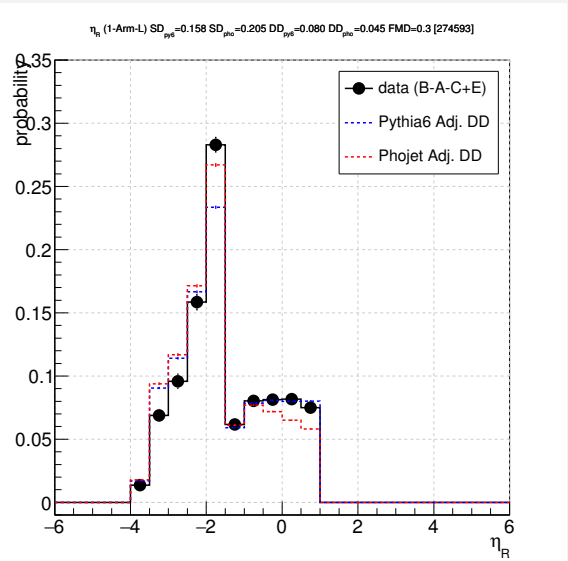
- Detectors used: SPD+FMD+VZERO

From ALICE paper



This analysis at 13 TeV

274593



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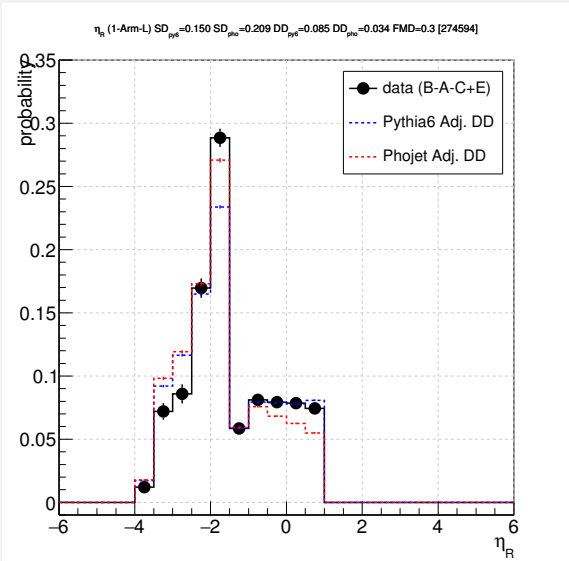

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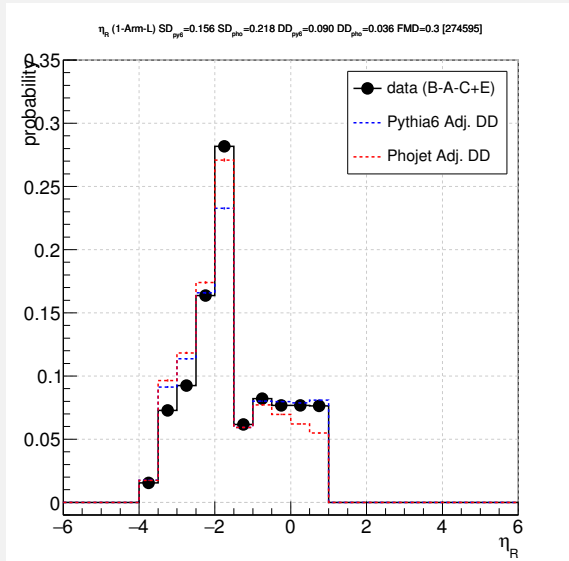
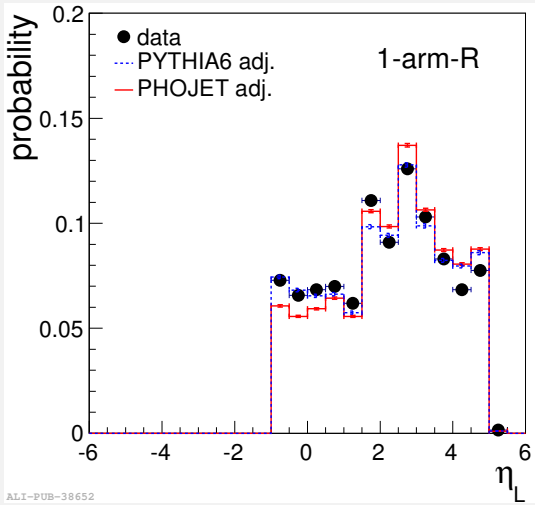


left most track in 1-arm-R events

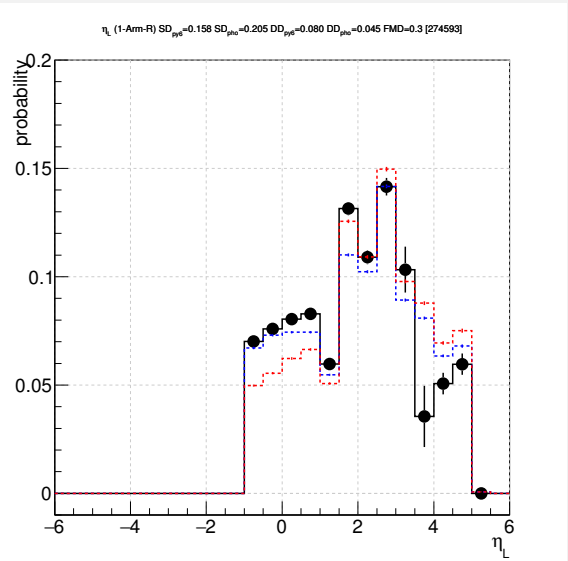
- Detectors used: SPD+FMD+VZERO

From ALICE paper



This analysis at 13 TeV

274593



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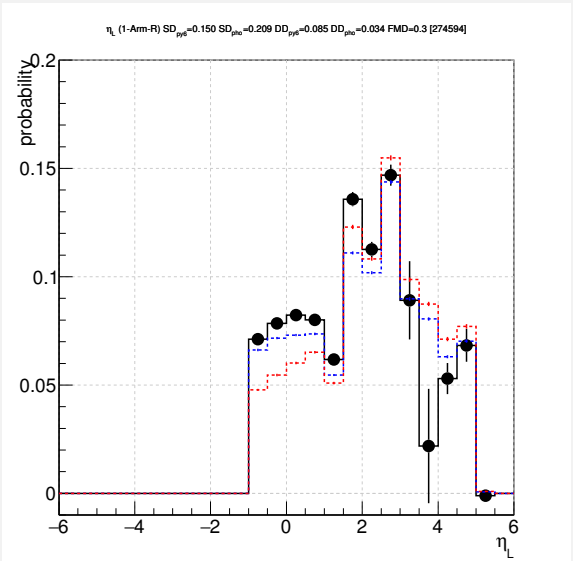

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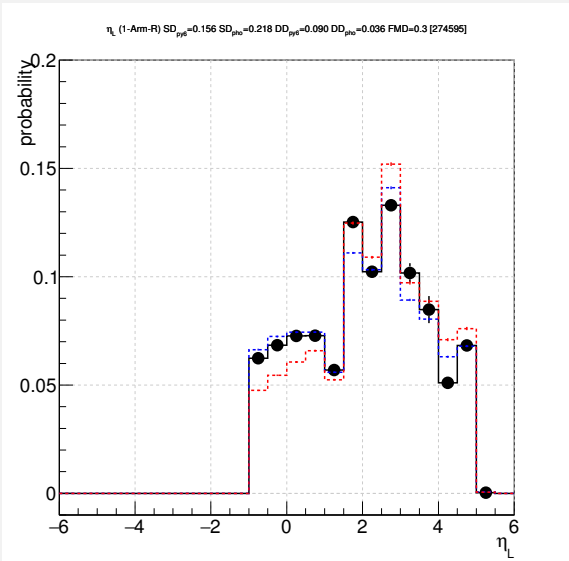
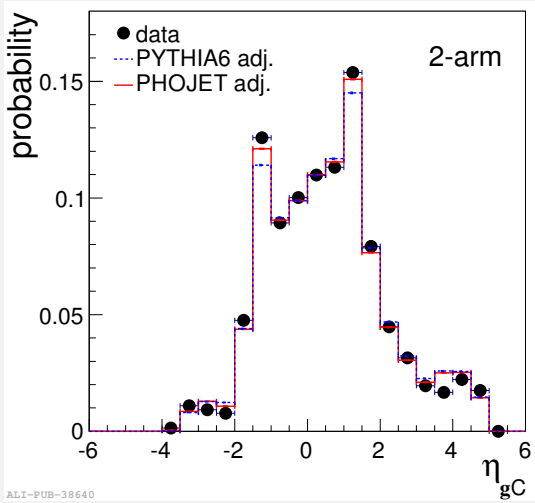


Center of largest gap in 2-arm events

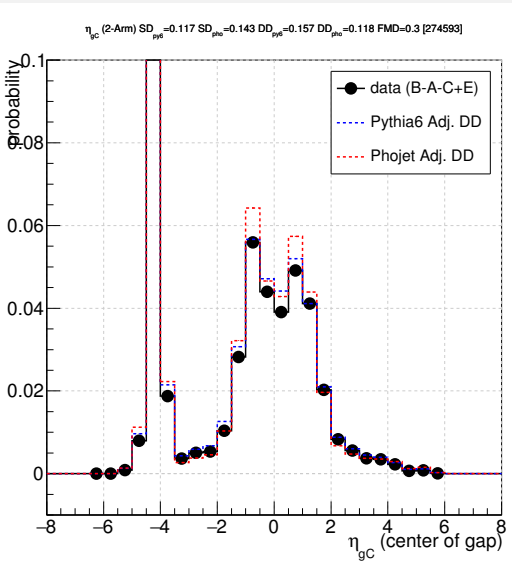
- Detectors used: SPD+FMD+VZERO+AD

From ALICE paper



This analysis at 13 TeV

274593



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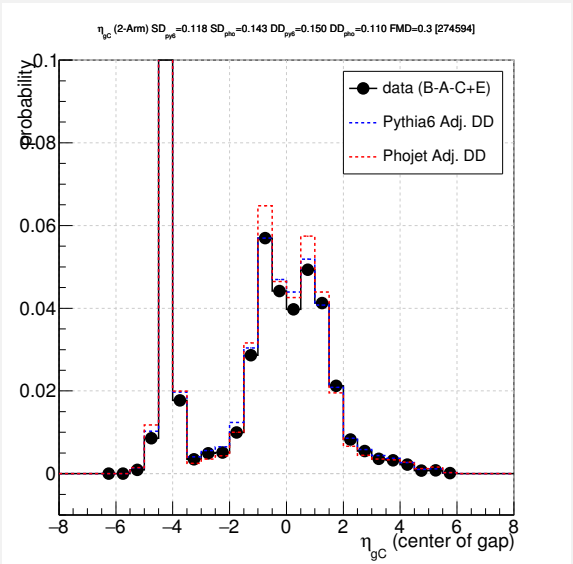

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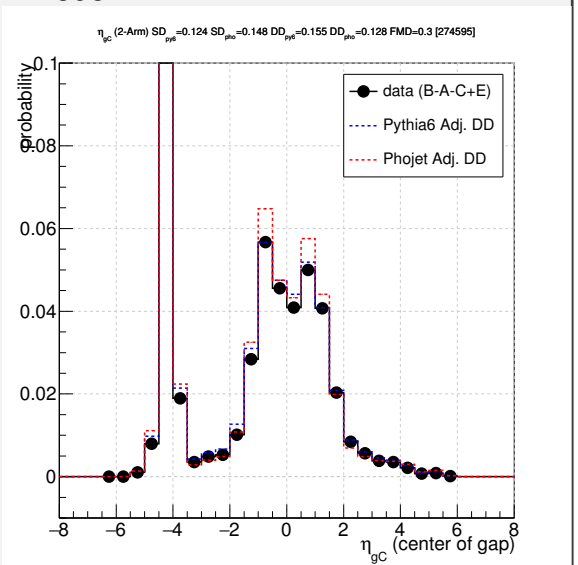
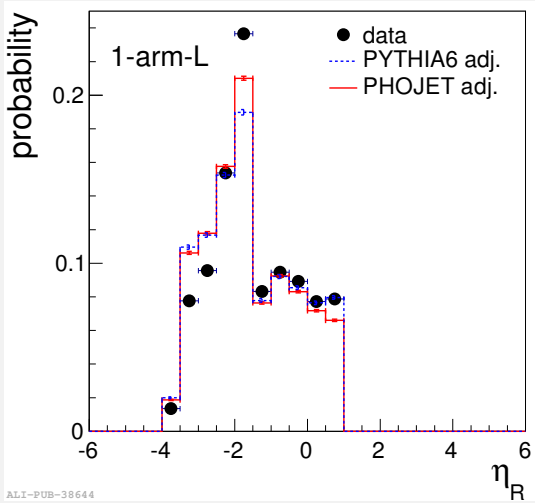


right most track in 1-arm-L events

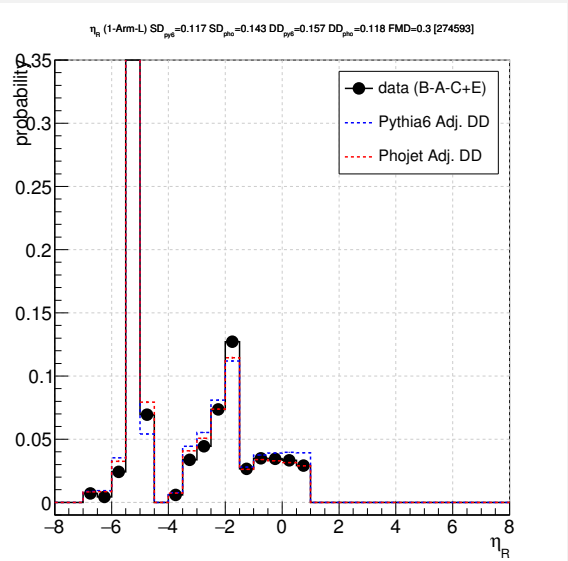
- Detectors used: SPD+FMD+VZERO+AD

From ALICE paper



This analysis at 13 TeV

274593



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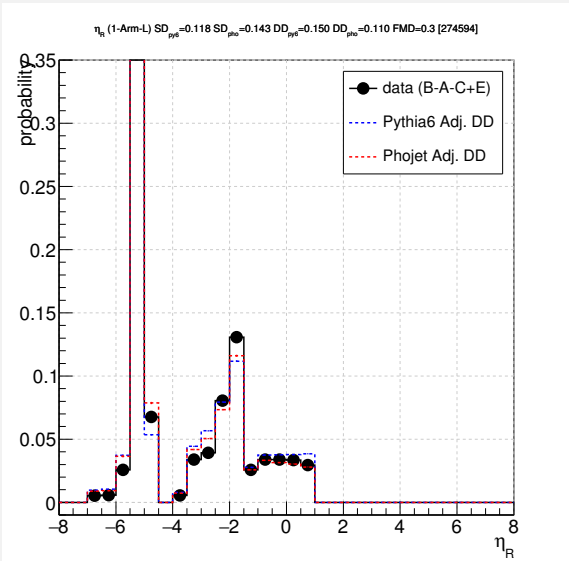

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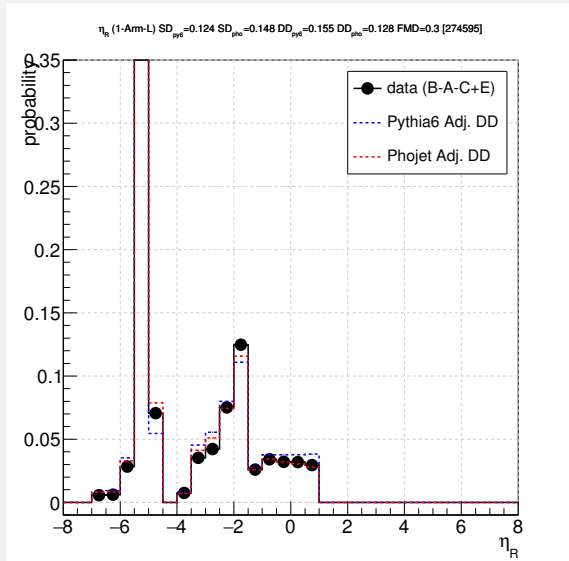
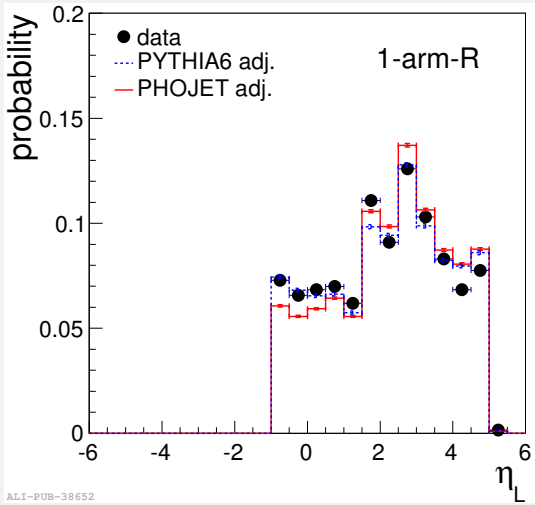


left most track in 1-arm-R events

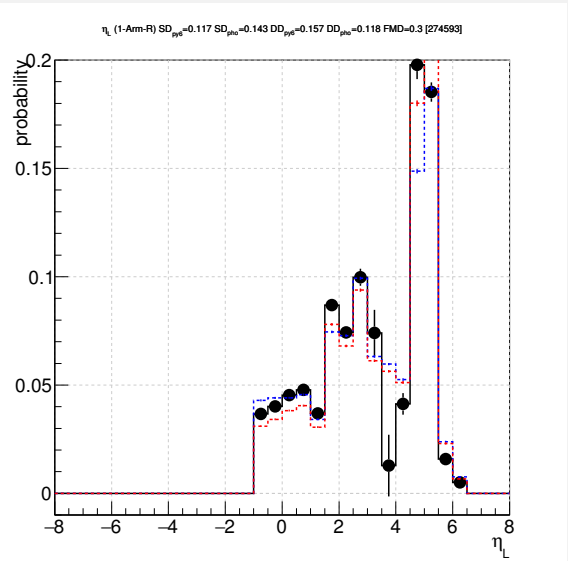
- Detectors used: SPD+FMD+VZERO+AD

From ALICE paper



This analysis at 13 TeV

274593



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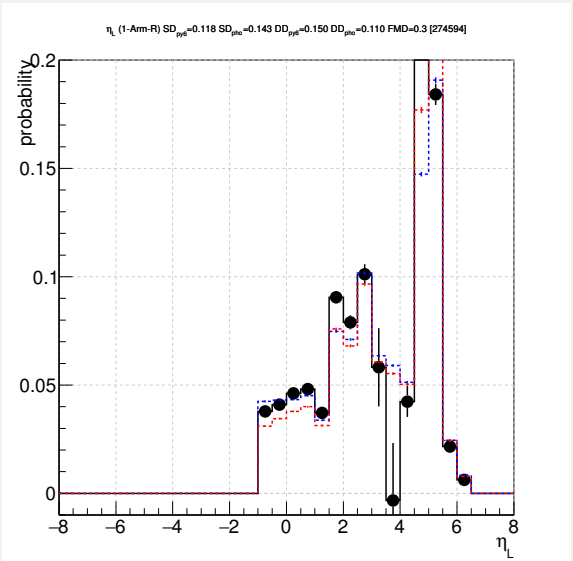

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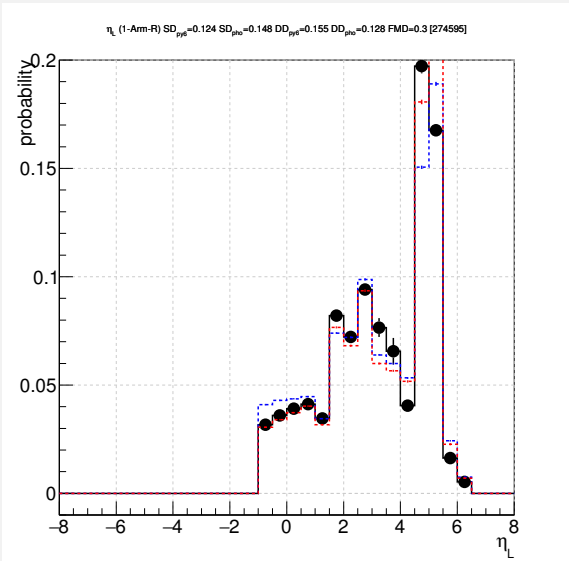


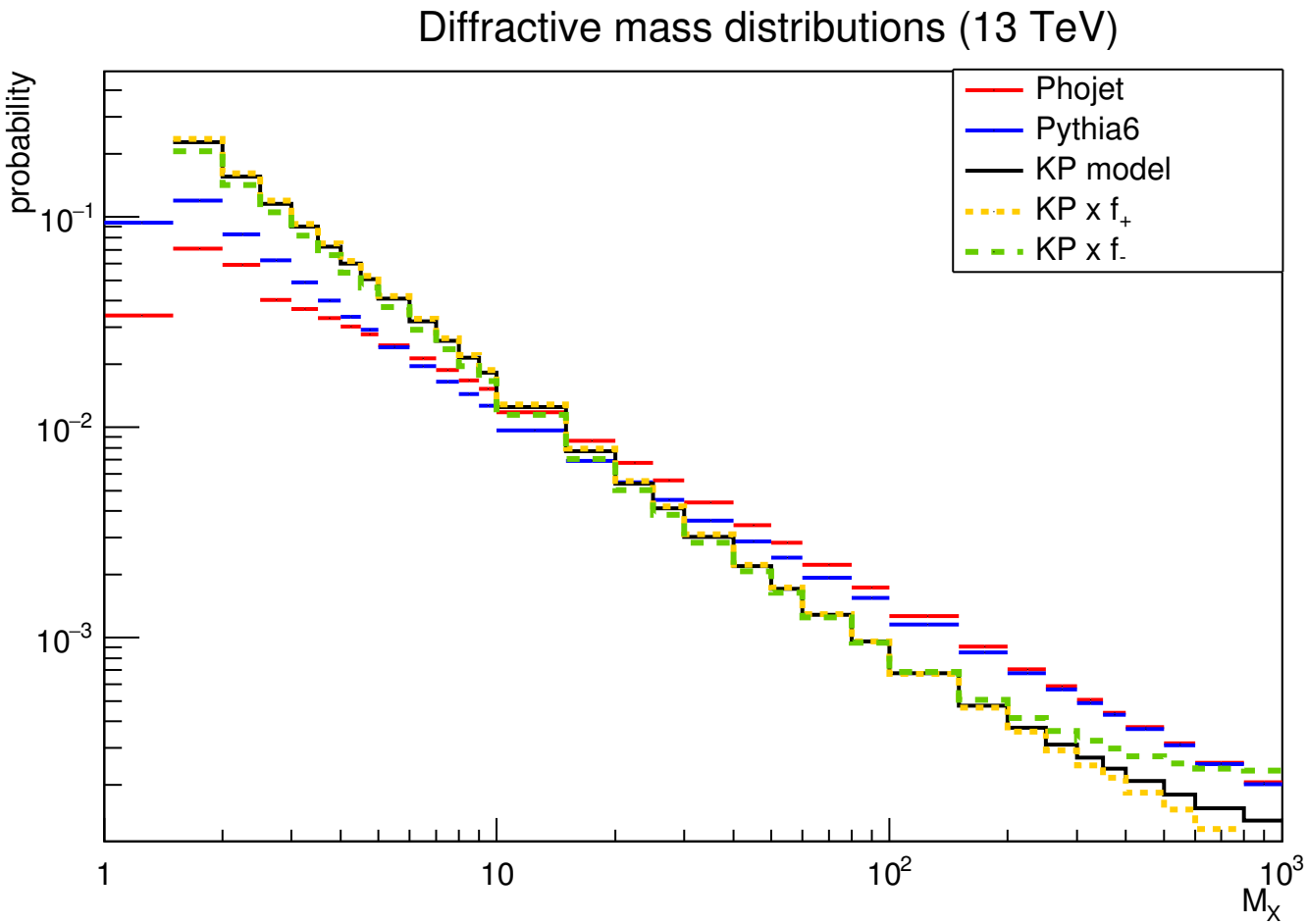
Estimation of systematic uncertainty

- To estimate our uncertainty in the knowledge of the diffractive mass distribution the curve from Kaydalov-Poghosyan model is multiplied by a linear function f_+ (f_-) whose value is 1.5 (0.5) at the lower diffractive mass threshold (m_{low}) and 1.0 at the high mass diffractive cut m_{high}
- The resulting distributions are normalized and the SD events are re-weighted accordingly.
- This changes the efficiencies, which in turns affects all the other calculations like the SD fraction.

$$f_-(m) = \begin{cases} f_-(m_{\text{low}}) & = \mathbf{0.5} \\ f_-(m_{\text{high}}) & = 1.0 \end{cases} \qquad f_+(m) = \begin{cases} f_+(m_{\text{low}}) & = \mathbf{1.5} \\ f_+(m_{\text{high}}) & = 1.0 \end{cases}$$

$m_{\text{low}} \approx 1.08$ is the lower diffractive mass threshold ($m_\pi + m_{\text{p}}$).

Estimation of systematic uncertainty



$$f_-(m) = \begin{cases} f_-(m_{\text{low}}) & = \mathbf{0.5} \\ f_-(m_{\text{high}}) & = 1.0 \end{cases} \qquad f_+(m) = \begin{cases} f_+(m_{\text{low}}) & = \mathbf{1.5} \\ f_+(m_{\text{high}}) & = 1.0 \end{cases}$$

Selection Efficiencies at 13 TeV (no AD)

- Detectors used: SPD+FMD+VZERO
- Errors show systematic uncertainty evaluated using ±50% variation of Kaydalov-Poghosyan model.

Selection efficiencies at 13 TeV

run	Process	1-arm-L	1-arm-R	2-arm
274593	SD L-side	$0.2141^{+0.0086}_{-0.0038}$	$0.0022^{+0.0030}_{-0.0016}$	$0.1345^{+0.0631}_{-0.0188}$
	SD R-side	$0.0007^{+0.0009}_{-0.0004}$	$0.2858^{+0.0117}_{-0.0037}$	$0.1262^{+0.0699}_{-0.0234}$
	NSD	$0.0167^{+0.0047}_{-0.0053}$	$0.0266^{+0.0083}_{-0.0093}$	$0.9425^{+0.0208}_{-0.0529}$
274594	SD L-side	$0.2174^{+0.0082}_{-0.0032}$	$0.0021^{+0.0028}_{-0.0015}$	$0.1347^{+0.0637}_{-0.0187}$
	SD R-side	$0.0007^{+0.0008}_{-0.0004}$	$0.2912^{+0.0111}_{-0.0017}$	$0.1275^{+0.0707}_{-0.0234}$
	NSD	$0.0168^{+0.0047}_{-0.0053}$	$0.0266^{+0.0082}_{-0.0092}$	$0.9430^{+0.0205}_{-0.0514}$
274595	SD L-side	$0.2142^{+0.0090}_{-0.0037}$	$0.0022^{+0.0031}_{-0.0016}$	$0.1346^{+0.0641}_{-0.0189}$
	SD R-side	$0.0007^{+0.0008}_{-0.0004}$	$0.2867^{+0.0108}_{-0.0026}$	$0.1271^{+0.0693}_{-0.0229}$
	NSD	$0.0171^{+0.0048}_{-0.0056}$	$0.0272^{+0.0083}_{-0.0095}$	$0.9413^{+0.0210}_{-0.0512}$
7 TeV	SD L-side	$0.243^{+0.117}_{-0.029}$	$0.0007^{+0.0010}_{-0.0006}$	$0.041^{+0.032}_{-0.017}$
(Previous Paper)	SD R-side	$0.0002^{+0.0003}_{-0.0002}$	$0.333^{+0.121}_{-0.027}$	$0.038^{+0.034}_{-0.019}$
	NSD	0.013 ± 0.003	0.022 ± 0.006	0.952 ± 0.014

the diffractive mass cut was set 1000.0

Selection Efficiencies at 13 TeV (with AD)

- Detectors used: SPD+FMD+VZERO+AD
- Errors show systematic uncertainty evaluated using ±50% variation of Kaydalov-Poghosyan model.

Selection efficiencies at 13 TeV

run	Process	1-arm-L	1-arm-R	2-arm
274593	SD L-side	$0.5584^{+0.0234}_{-0.0318}$	$0.0007^{+0.0001}_{-0.0001}$	$0.1393^{+0.0652}_{-0.0197}$
	SD R-side	$0.0003^{+0.0002}_{-0.0001}$	$0.4926^{+0.0281}_{-0.0260}$	$0.1256^{+0.0694}_{-0.0228}$
	NSD	$0.0198^{+0.0045}_{-0.0054}$	$0.0159^{+0.0028}_{-0.0035}$	$0.9601^{+0.0097}_{-0.0438}$
274594	SD L-side	$0.5636^{+0.0238}_{-0.0316}$	$0.0007^{+0.0001}_{-0.0001}$	$0.1394^{+0.0659}_{-0.0198}$
	SD R-side	$0.0002^{+0.0002}_{-0.0001}$	$0.4973^{+0.0265}_{-0.0248}$	$0.1267^{+0.0701}_{-0.0229}$
	NSD	$0.0191^{+0.0052}_{-0.0060}$	$0.0152^{+0.0032}_{-0.0039}$	$0.9619^{+0.0109}_{-0.0436}$
274595	SD L-side	$0.5582^{+0.0259}_{-0.0315}$	$0.0007^{+0.0000}_{-0.0001}$	$0.1395^{+0.0666}_{-0.0202}$
	SD R-side	$0.0003^{+0.0002}_{-0.0001}$	$0.4951^{+0.0279}_{-0.0258}$	$0.1264^{+0.0687}_{-0.0222}$
	NSD	$0.0217^{+0.0052}_{-0.0063}$	$0.0173^{+0.0033}_{-0.0042}$	$0.9563^{+0.0112}_{-0.0435}$
7 TeV	SD L-side	$0.243^{+0.117}_{-0.029}$	$0.0007^{+0.0010}_{-0.0006}$	$0.041^{+0.032}_{-0.017}$
(Previous Paper)	SD R-side	$0.0002^{+0.0003}_{-0.0002}$	$0.333^{+0.121}_{-0.027}$	$0.038^{+0.034}_{-0.019}$
	NSD	0.013 ± 0.003	0.022 ± 0.006	0.952 ± 0.014

Estimation of $\sigma_{\mathrm{SD}}/\sigma_{\mathrm{INEL}}$

- From data we have the ratios 1-arm-L/2-arm, 1-arm-R/2-arm as constrains.
- Furthermore, from the distribution of largest gaps in 2-arm events we adjusted the fraction of DD.
- From MC we got the efficiencies of the SD and NSD events to be detected as 1-arm-L(R) and 2-arm classes.

Very preliminary estimate of $\sigma_{SD}/\sigma_{INEL}$ (no AD)

Ratios 1-arm-L(R) to 2-arm (SPD+FMD+VZERO)

run	ratio definition	ratio (meassured)	side	$\sigma_{SD}/\sigma_{INEL}$ per side	$\sigma_{SD}/\sigma_{INEL}$ total
274593	1-arm-L/2-arm	0.0439 ± 0.0004	L-side	$0.097^{+0.021}_{-0.020}$	$0.186^{+0.050}_{-0.046}$
	1-arm-R/2-arm	0.0600 ± 0.0004	R-side	$0.089^{+0.028}_{-0.026}$	
274594	1-arm-L/2-arm	0.0441 ± 0.0004	L-side	$0.096^{+0.022}_{-0.020}$	$0.182^{+0.050}_{-0.047}$
	1-arm-R/2-arm	0.0591 ± 0.0005	R-side	$0.086^{+0.029}_{-0.026}$	
274595	1-arm-L/2-arm	0.0430 ± 0.0003	L-side	$0.099^{+0.021}_{-0.026}$	$0.205^{+0.047}_{-0.057}$
	1-arm-R/2-arm	0.0654 ± 0.0003	R-side	$0.106^{+0.026}_{-0.031}$	
paper 7TeV	1-arm-L/2-arm	0.0458 ± 0.00001	L-side	$0.10^{+0.02}_{-0.04}$	$0.20^{+0.04}_{-0.07}$
	1-arm-R/2-arm	0.0680 ± 0.00001	R-side	$0.10^{+0.02}_{-0.03}$	

- Errors show the variation due to±50% KP model.
- `if (`$M_X > 1000$`) then SD` $\rightarrow$ `ND`

Very preliminary estimate of $\sigma_{SD}/\sigma_{INEL}$ (with AD)

Ratios 1-arm-L(R) to 2-arm (SPD+FMD+VZERO+AD)					
run	ratio definition	ratio (meassured)	side	$\sigma_{SD}/\sigma_{INEL}$ per side	total
274593	1-arm-L/2-arm	0.0787 ± 0.0005	L-side	$0.085^{+0.013}_{-0.009}$	$0.154^{+0.022}_{-0.016}$
	1-arm-R/2-arm	0.0572 ± 0.0004	R-side	$0.070^{+0.010}_{-0.007}$	
274594	1-arm-L/2-arm	0.0786 ± 0.0005	L-side	$0.085^{+0.014}_{-0.010}$	$0.155^{+0.024}_{-0.018}$
	1-arm-R/2-arm	0.0569 ± 0.0004	R-side	$0.070^{+0.011}_{-0.008}$	
274595	1-arm-L/2-arm	0.0781 ± 0.0004	L-side	$0.086^{+0.009}_{-0.015}$	$0.168^{+0.016}_{-0.027}$
	1-arm-R/2-arm	0.0639 ± 0.0003	R-side	$0.082^{+0.007}_{-0.013}$	

- Errors show the corrected variation due to$\pm$50% KP model.
- `if (`$M_X > 1000$`) then SD` $\rightarrow$ `ND`

Very preliminary estimate of $\sigma_{\mathrm{SD}}/\sigma_{\mathrm{INEL}}$ (No AD)

Ratios 1-arm-L(R) to 2-arm (SPD+FMD+VZERO)						
run	ratio definition	ratio meassured(*)	ratio adjusted MC(**)	side	$\sigma_{\mathrm{SD}}/\sigma_{\mathrm{INEL}}$ per side	total
274593	1-arm-L/2-arm	0.0439 ± 0.0004	(0.0428 ± 0.0006)	L-side	$0.095^{+0.018}_{-0.022}$	$0.184^{+0.037}_{-0.043}$
	1-arm-R/2-arm	0.0600 ± 0.0004	(0.0614 ± 0.0007)	R-side	$0.089^{+0.019}_{-0.021}$	
274594	1-arm-L/2-arm	0.0441 ± 0.0004	(0.0426 ± 0.0006)	L-side	$0.093^{+0.019}_{-0.022}$	$0.178^{+0.039}_{-0.044}$
	1-arm-R/2-arm	0.0591 ± 0.0005	(0.0611 ± 0.0008)	R-side	$0.085^{+0.020}_{-0.022}$	
274595	1-arm-L/2-arm	0.0430 ± 0.0003	(0.0443 ± 0.0006)	L-side	$0.090^{+0.020}_{-0.023}$	$0.186^{+0.041}_{-0.047}$
	1-arm-R/2-arm	0.0654 ± 0.0003	(0.0635 ± 0.0008)	R-side	$0.096^{+0.021}_{-0.023}$	

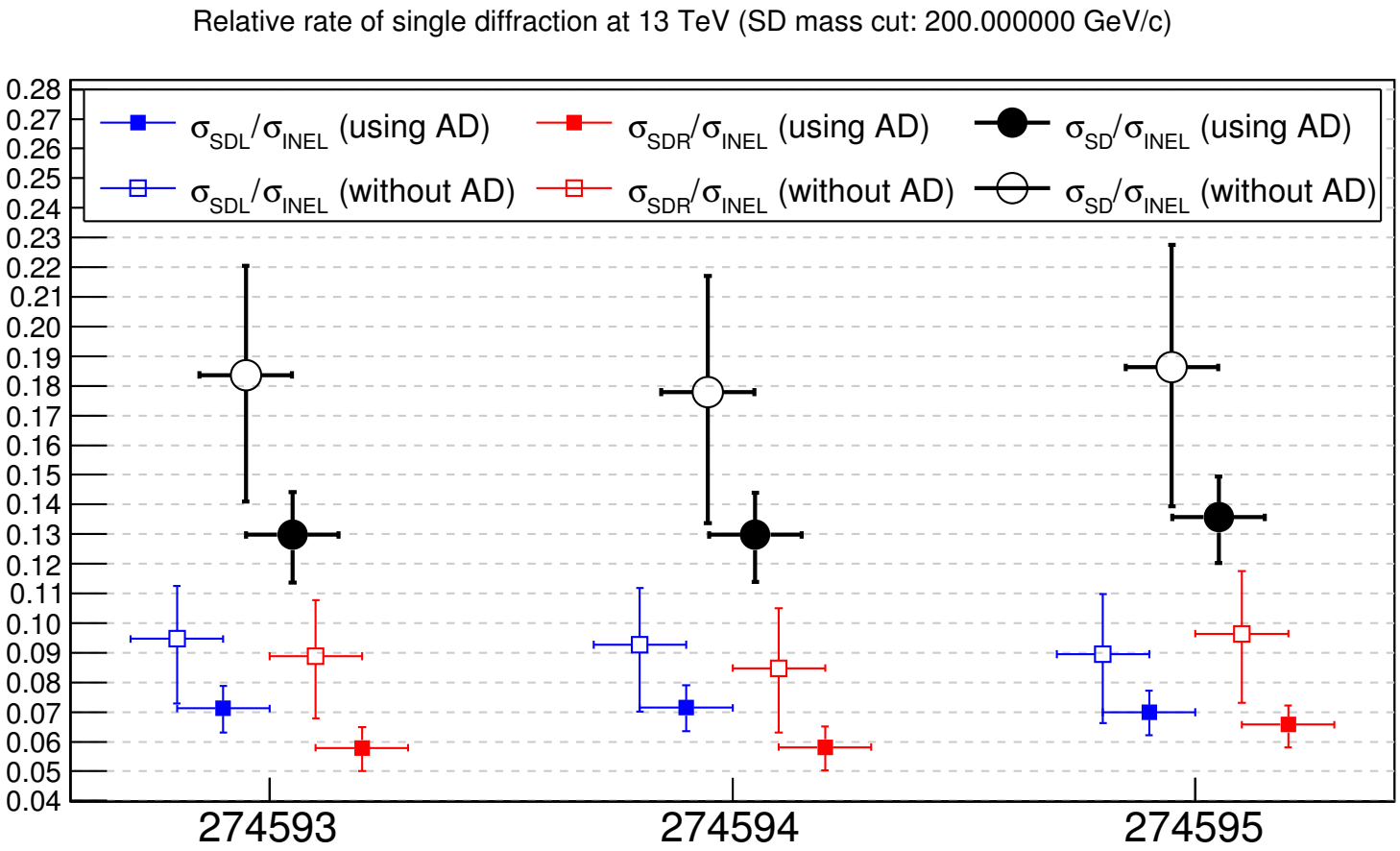
- (*) Data: Estatistical errors.
- (**) MC: Errors show the difference between Pythia and Phojet.
- All other errors due to ±50% variation of KP model.
- `if` ($M_{\mathrm{X}} > 200\ \mathrm{GeV}/c^2$) `then SD` $\rightarrow$ `ND`

Very preliminary estimate of $\sigma_{SD}/\sigma_{INEL}$ (with AD)

Ratios 1-arm-L(R) to 2-arm (SPD+FMD+VZERO+AD)						
run	ratio definition	ratio meassured(*)	ratio adjusted MC(**)	side	$\sigma_{SD}/\sigma_{INEL}$ per side	total
274593	1-arm-L/2-arm	0.0787 ± 0.0005	(0.0725 ± 0.0006)	L-side	$0.071^{+0.008}_{-0.008}$	$0.129^{+0.014}_{-0.016}$
	1-arm-R/2-arm	0.0572 ± 0.0004	(0.0624 ± 0.0005)	R-side	$0.058^{+0.007}_{-0.008}$	
274594	1-arm-L/2-arm	0.0786 ± 0.0005	(0.0724 ± 0.0006)	L-side	$0.071^{+0.007}_{-0.008}$	$0.130^{+0.014}_{-0.016}$
	1-arm-R/2-arm	0.0569 ± 0.0004	(0.0622 ± 0.0005)	R-side	$0.058^{+0.007}_{-0.008}$	
274595	1-arm-L/2-arm	0.0781 ± 0.0004	(0.0761 ± 0.0006)	L-side	$0.070^{+0.007}_{-0.008}$	$0.136^{+0.014}_{-0.016}$
	1-arm-R/2-arm	0.0639 ± 0.0003	(0.0656 ± 0.0005)	R-side	$0.066^{+0.007}_{-0.008}$	

- $(^{*})$ Data: Estatistical errors.
- $(^{**})$ MC: Errors show the difference between Pythia and Phojet.
- All other errors due to ±50% variation of KP model.
- `if` $(M_X > 200\ \mathrm{GeV}/c^2)$ `then SD` $\rightarrow$ `ND`

Very preliminary estimate of $\sigma_{\mathrm{SD}}/\sigma_{\mathrm{INEL}}$



Very preliminary estimate of $\sigma_{SD}/\sigma_{INEL}$

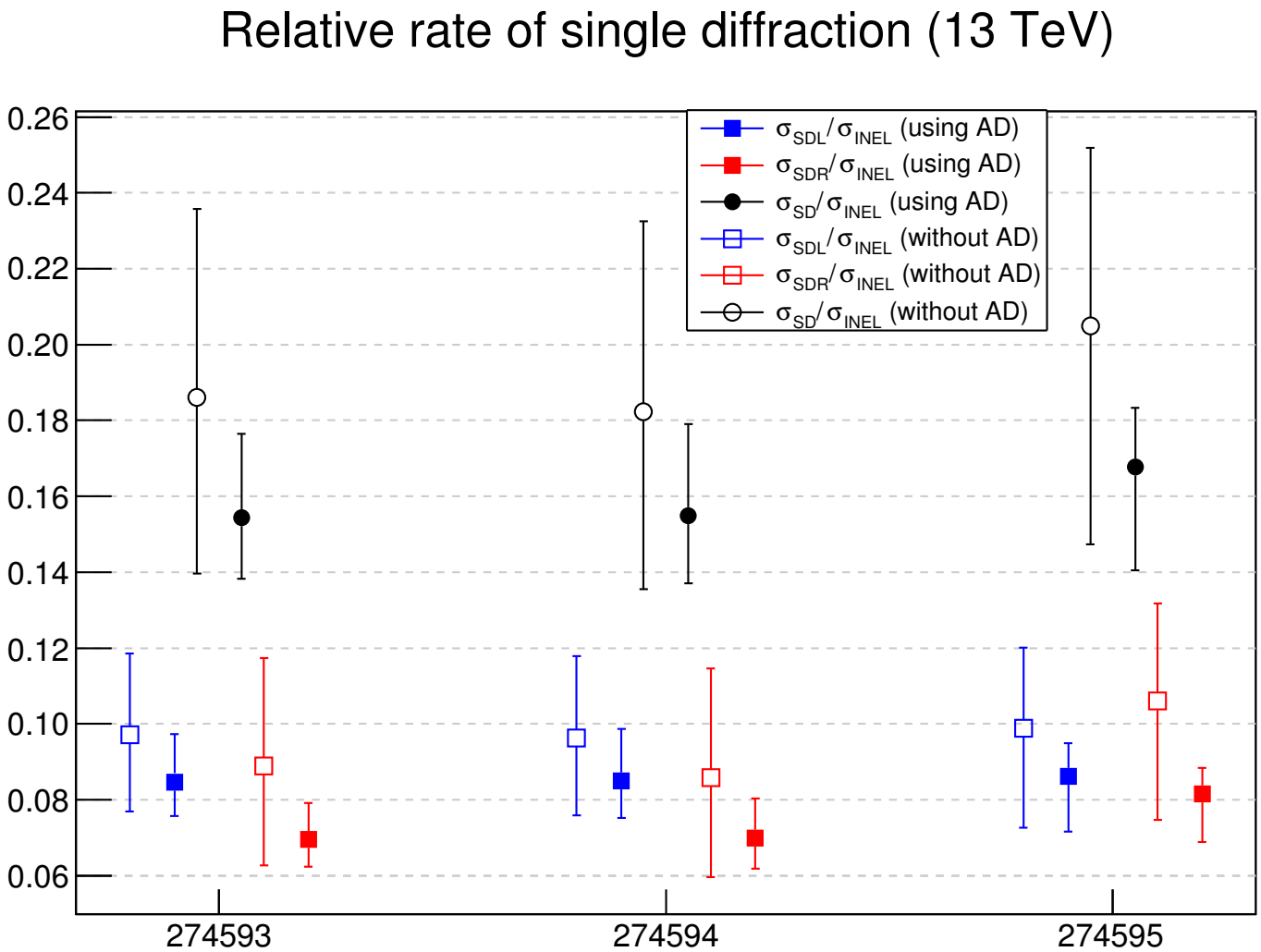


Table 3: V0-AND and MB-OR trigger efficiencies

run	V0-AND (%) MC	MB-OR (*) (%) MC	V0-AND/MB-OR measured	V0-AND/MB-OR simulated
274593	$76.09^{+2.62}_{-2.07}$	$86.81^{+3.34}_{-2.68}$	0.8837 ± 0.0005	$0.877^{+0.003}_{-0.004}$
274594	$76.81^{+2.73}_{-2.26}$	$87.31^{+3.38}_{-2.81}$	0.8866 ± 0.0006	$0.880^{+0.003}_{-0.003}$
274595	$75.59^{+2.75}_{-2.25}$	$86.57^{+3.55}_{-2.94}$	0.8767 ± 0.0004	$0.873^{+0.004}_{-0.004}$
paper 7TeV	$74.2^{+5.0}_{-2.0}$	$85.2^{+6.2}_{-3.0}$	0.8727 ± 0.0001	0.871 ± 0.007

- `MB-OR = SPD || VZERO`
- Errors are statistical
- `if` ($M_X > 200$ GeV/c^2) `then SD` $\rightarrow$ `ND`

Table 3: AD-AND and MB-OR trigger efficiencies

run	AD-AND (%) MC	MB-OR (**) (%) MC	AD-AND/MB-OR measured	AD-AND/MB-OR simulated
274593	$71.12^{+1.47}_{-1.20}$	$95.67^{+0.65}_{-0.44}$	0.7673 ± 0.0007	$0.743^{+0.013}_{-0.013}$
274594	$71.33^{+1.42}_{-1.15}$	$95.73^{+0.65}_{-0.45}$	0.7664 ± 0.0007	$0.745^{+0.013}_{-0.013}$
274595	$70.54^{+1.52}_{-1.24}$	$95.49^{+0.65}_{-0.43}$	0.7586 ± 0.0005	$0.739^{+0.013}_{-0.013}$

- `MB-OR = SPD || VZERO || AD`
- Errors show the uncertainty estimated from ±50% variation of KP model
- `if` ($M_X > 200\ \mathrm{GeV}/c^2$) `then SD` $\rightarrow$ `ND`

Table 3: V0-AND and MB-OR trigger efficiencies

run	V0-AND (%) MC	MB-OR (*) (%) MC	V0-AND/MB-OR measured	V0-AND/MB-OR simulated
274593	$77.51^{+1.45}_{-2.12}$	$88.03^{+2.60}_{-2.09}$	0.8837 ± 0.0005	$0.881^{+0.005}_{-0.009}$
274594	$78.14^{+1.59}_{-2.23}$	$88.36^{+2.63}_{-2.12}$	0.8866 ± 0.0006	$0.884^{+0.004}_{-0.008}$
274595	$75.90^{+2.38}_{-1.25}$	$86.93^{+3.29}_{-1.83}$	0.8767 ± 0.0004	$0.873^{+0.004}_{-0.005}$
paper 7TeV	$74.2^{+5.0}_{-2.0}$	$85.2^{+6.2}_{-3.0}$	0.8727 ± 0.0001	0.871 ± 0.007

- `MB-OR = SPD || VZERO`
- Errors show the uncertainty estimated from $\pm 50\%$ variation of KP model
- `if` ($M_X > 1000$ GeV$/c^2$) `then SD` $\rightarrow$ `ND`

Table 3: AD-AND and MB-OR trigger efficiencies

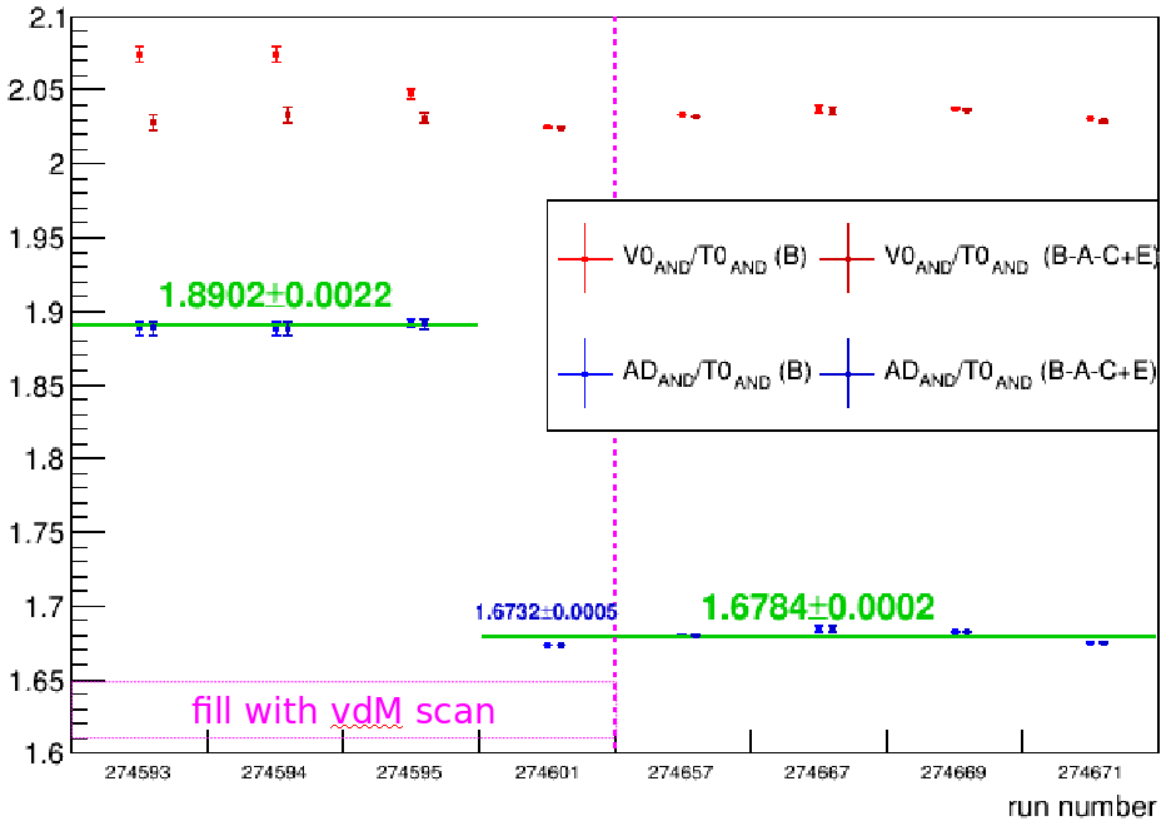
run	AD-AND (%) MC	MB-OR (**) (%) MC	AD-AND/MB-OR measured	AD-AND/MB-OR simulated
274593	$71.64^{+0.89}_{-1.61}$	$95.00^{+0.95}_{-0.10}$	0.7673 ± 0.0007	$0.754^{+0.010}_{-0.024}$
274594	$71.82^{+0.84}_{-1.57}$	$95.05^{+1.00}_{-0.15}$	0.7664 ± 0.0007	$0.756^{+0.010}_{-0.024}$
274595	$70.14^{+1.34}_{-0.93}$	$94.59^{+1.27}_{-0.14}$	0.7586 ± 0.0005	$0.742^{+0.011}_{-0.019}$

- `MB-OR = SPD || VZERO || AD`
- Errors show the uncertainty estimated from ±50% variation of KP model
- `if` ($M_X > 1000\ \mathrm{GeV}/c^2$) `then SD` $\rightarrow$ `ND`

Estimating σ_{INEL}

Preliminary estimation

- Using V0/T0 and AD/T0 ratios
-

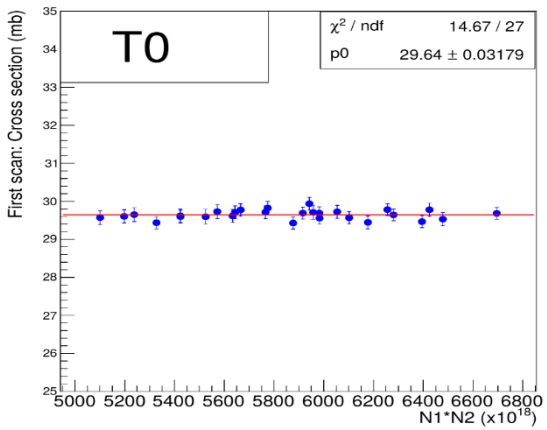


- Subtraction of bkgd has an effect on V0, negligible on AD
- For the vdM scan and from run 274601 on nominal HV were set in AD

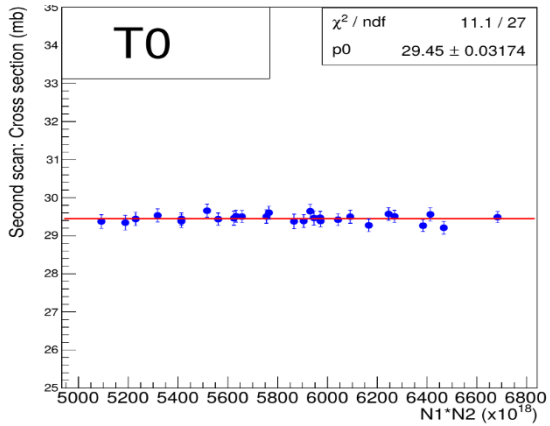
T0 visible cross section (2016 vdM scan)

https://indico.cern.ch/event/698863/contributions/2873043/attachments/1590153/2516127/Fill4937_analysis_update_26Jan18.pdf

scan 1



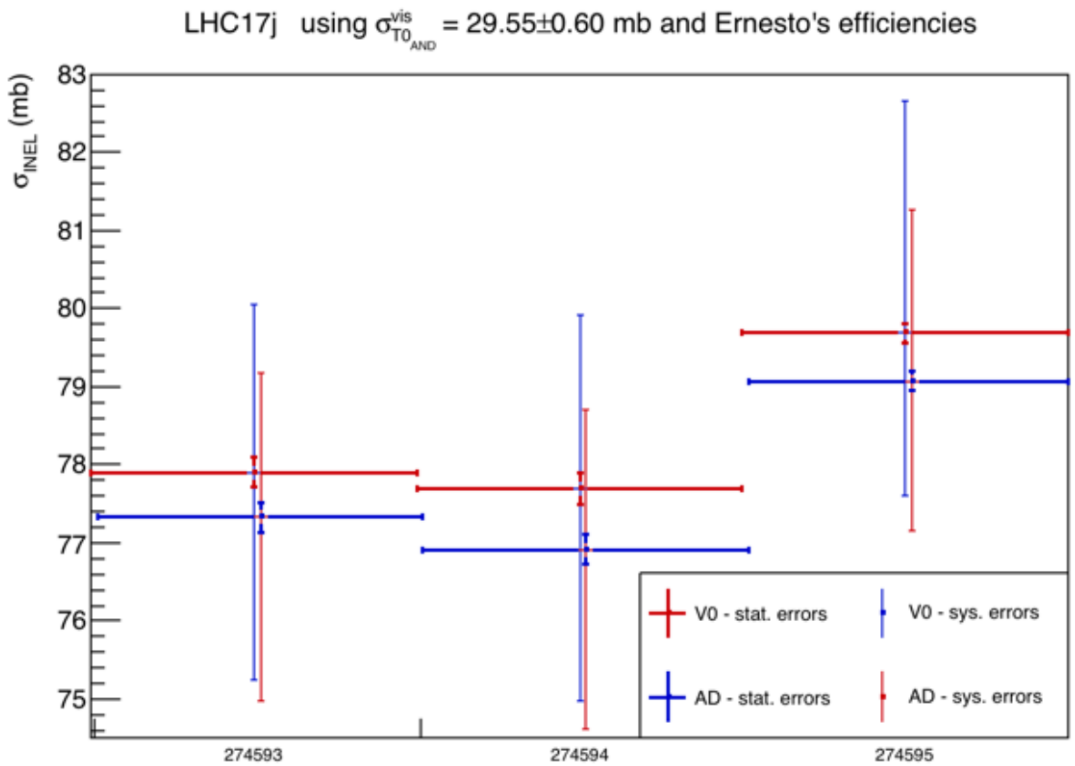
scan 2



- For now we use $\sigma(0TVX)^{vis,2016} = (29.55 \pm 0.6)$ mb; assigned sys. error is 2%.
- Note that this visible cross section is for the **2016 vdM scan**
  → we assume that T0 efficiency is same in 2017

very preliminary estimation

Not to be quoted



- Run-by-run fluctuations are covered by sys. errors
- INEL cross sections normalized using V0 and AD are consistent within sys. errors
- Total sys. errors (T0 visible σ, efficiencies from tuned MC) ≈ 2.6-3.0%

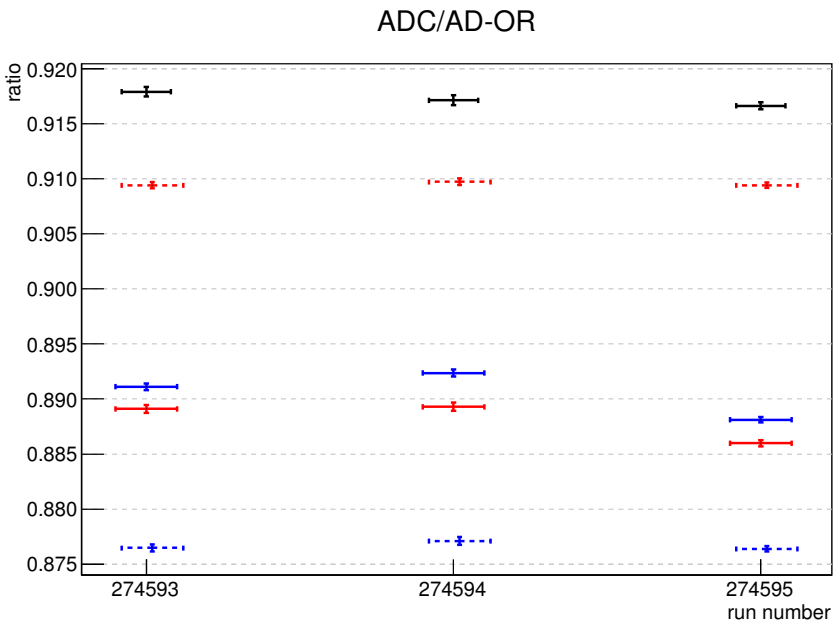
Issues left to complete the work

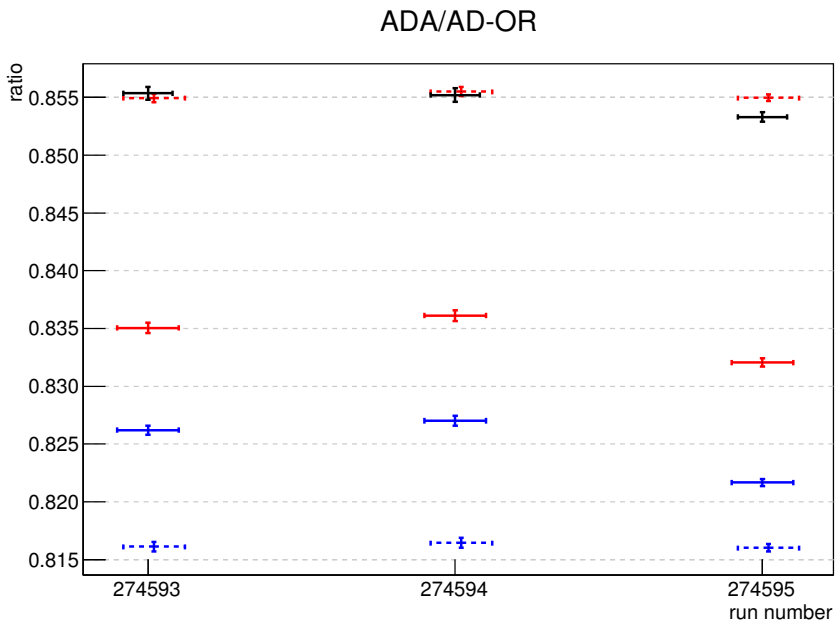
- Definition of SD and DD
- Re-analysis of 0.9, 5, 7, 8 and 13 TeV data with coherent definition
- Estimate of the systematic errors
  - sensitivity to changes of detector settings
  - include additional generator.
  - detector and beam line simulation, model
  - sensitivity to the low mass region, where bound states are produced with low multiplicity
- We need the results of the VdM scans.

Back-Up slides

comparison of ratios, Data vs tuned MC

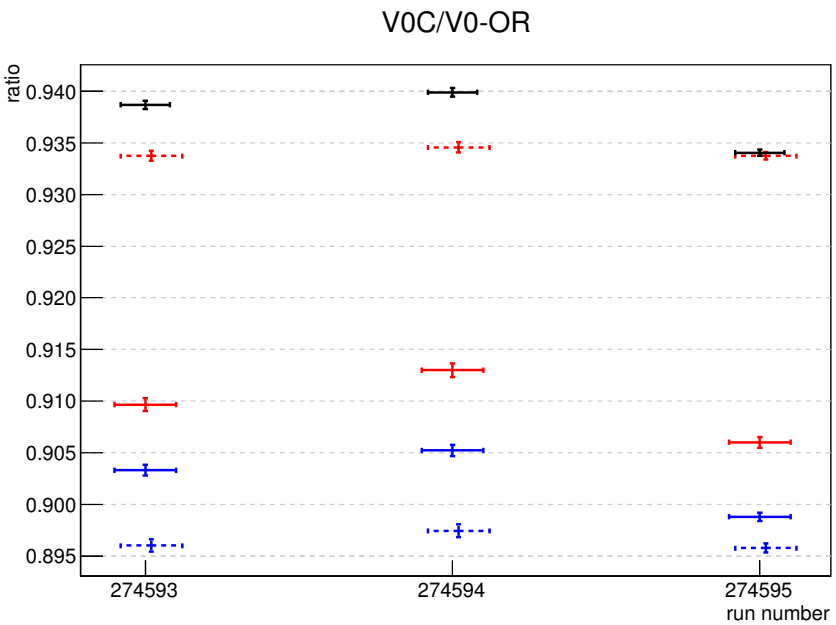
- Diffractive model: Kaidalov Poghosyan
- Solid lines: Adjusted fractions.
- Dashed lines: Default fractions.
- Data, Pythia6, Phojet

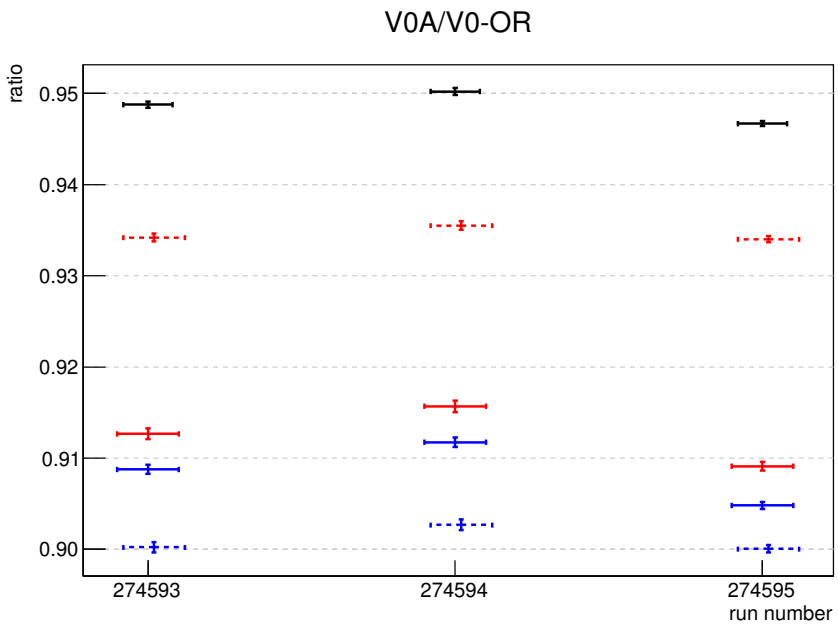




comparison of ratios, Data vs tuned MC

- Diffractive model: Kaidalov Poghosyan
- Solid lines: Adjusted fractions.
- Dashed lines: Default fractions.
- Data, Pythia6, Phojet





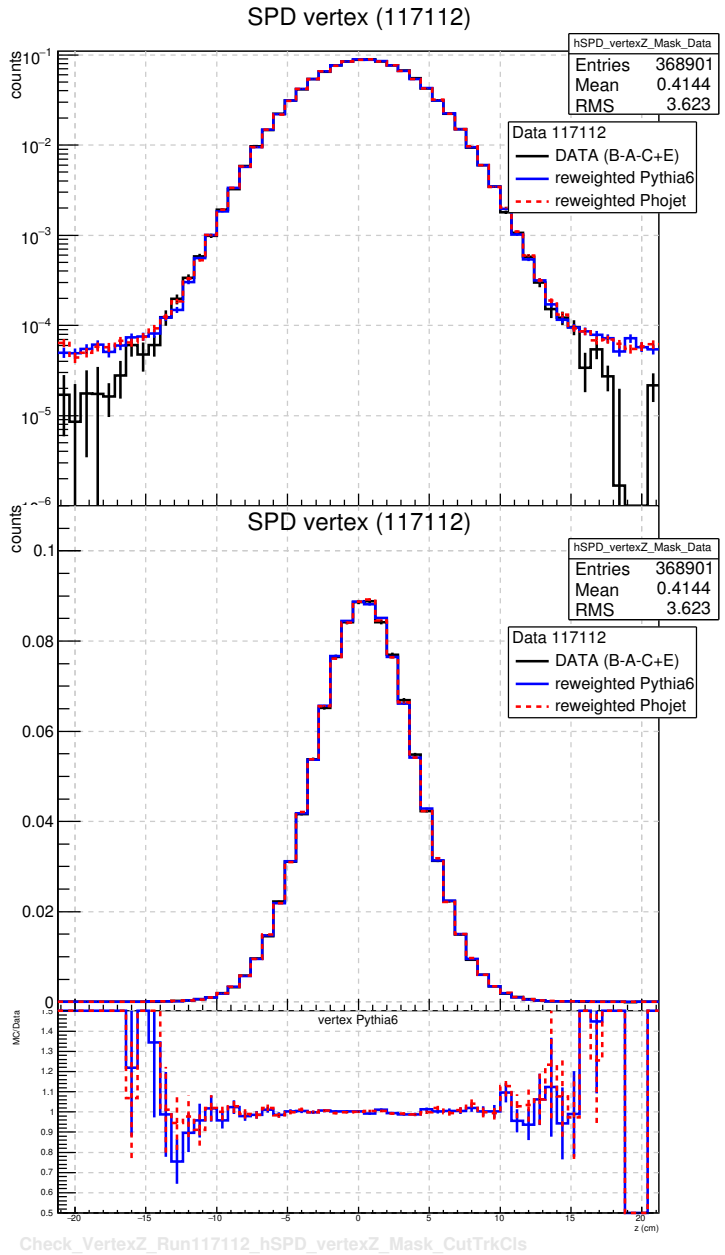
- ALIROOT-5051 (Reconstruction)
- ALIROOT-5064 (Simulation)
- “Simulation of runs for measurement of cross-sections and charged multiplicities”

MC for 7TeV cross sections

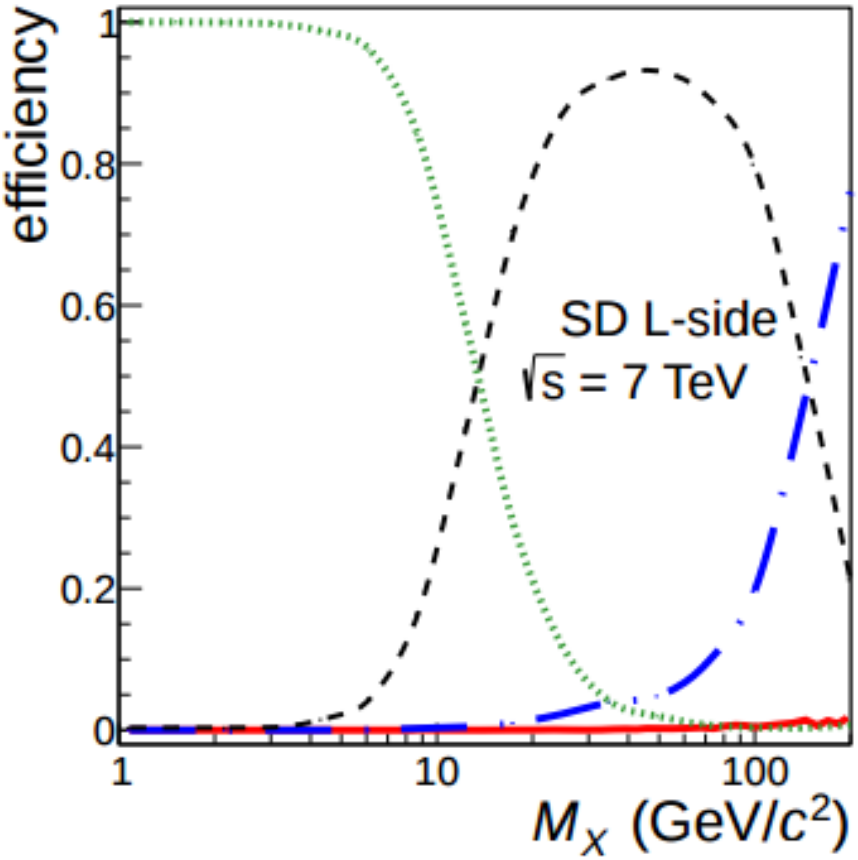
Period	MC production	run	μ-value	B-B	B-A	B-C	field	events
LHC10b	LHC11h2{a,b}	117112	0.013	2	1	1	−−	2.79 M
LHC10c	LHC11h3{a,b}	119161	0.090	1	1	1	−−	3.07 M
		120505	0.055	3	3	3	−−	4.43 M
		120671	0.037	3	3	3	−−	0.75 M
LHC10d	LHC11h4{a,b}	126407	0.044	8	5	5	++	5.18 M

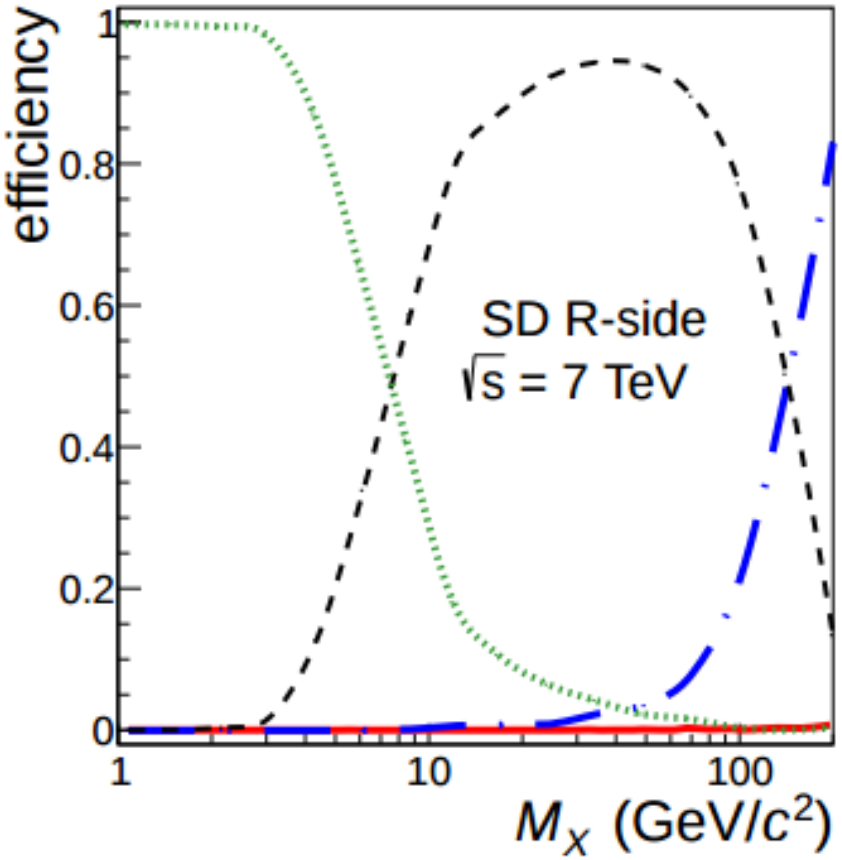
a=tuned Pythia, b=tuned Phojet

- Vertex distribution check
- MB-OR (SPD+V0)
- 7 TeV

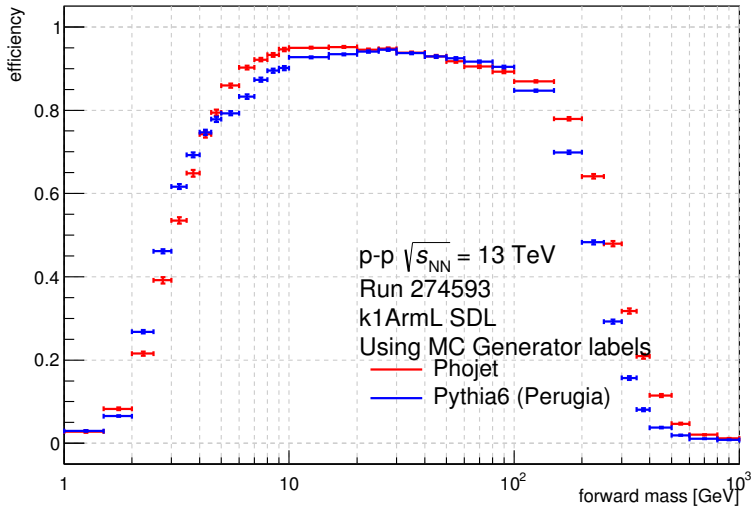


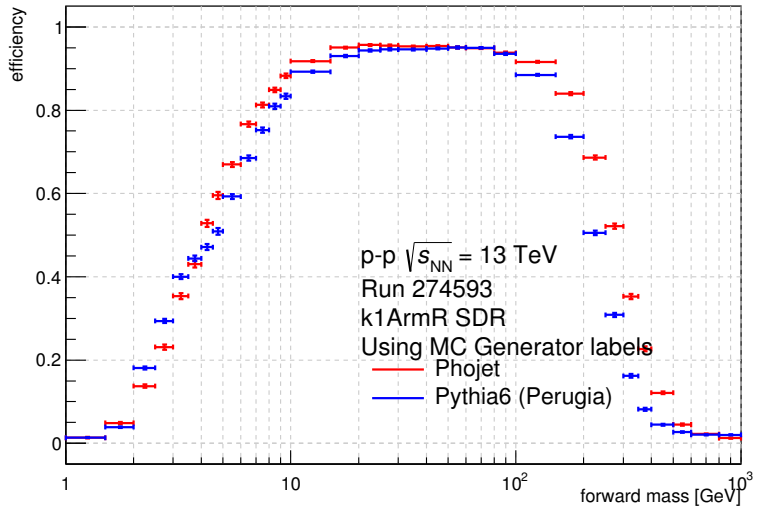
- **1Arm** Efficiency vs diffracted mass (from ALICE paper)
- SPD+FMD+V0
- 7 TeV

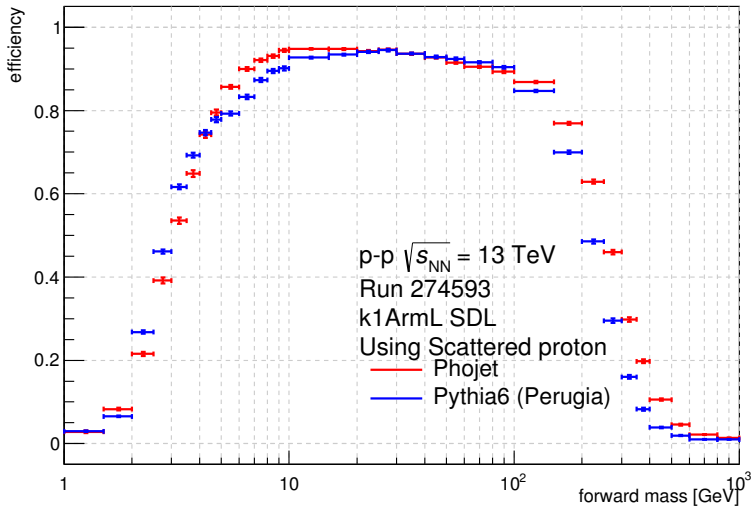


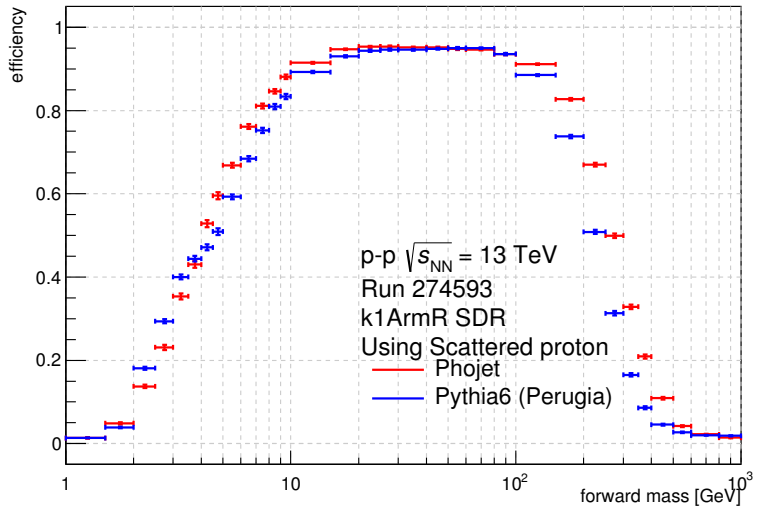


- Run: 274593. AD MIP → 8 adc.
- **top:** AD Efficiency vs diffracted mass (Using generator MC labels)
- **bottom:** AD Efficiency vs diffracted mass (Using the most forward proton)

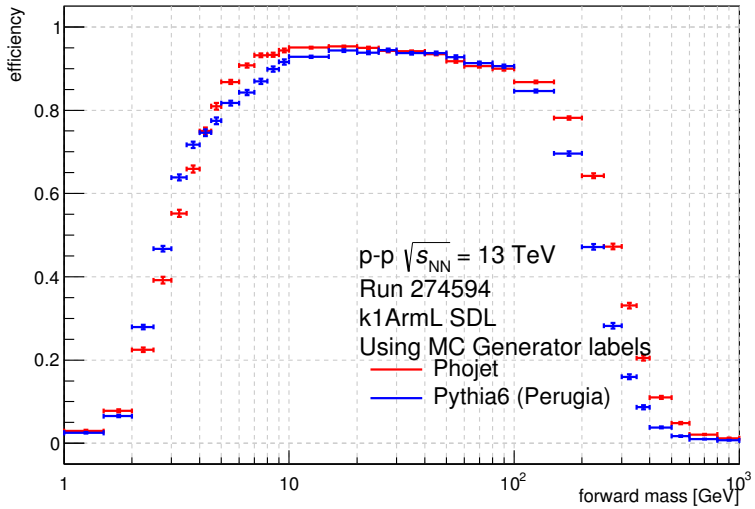


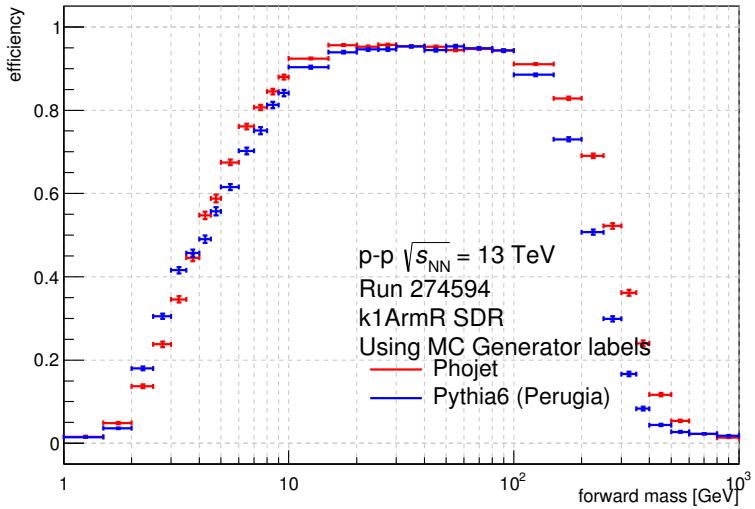


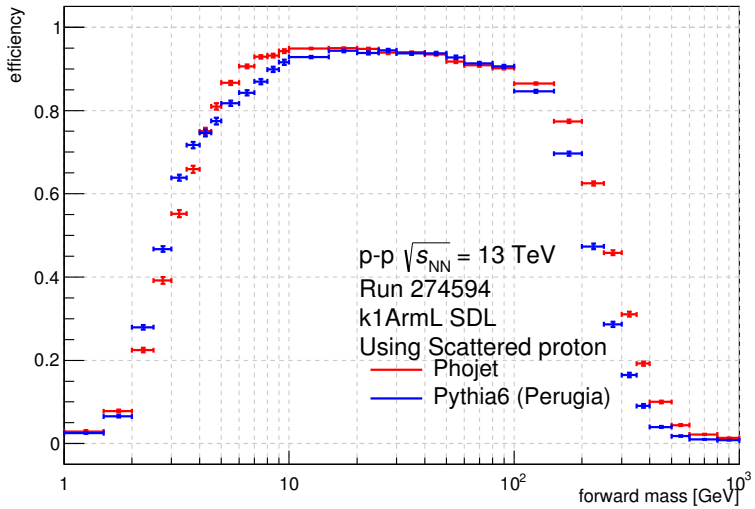


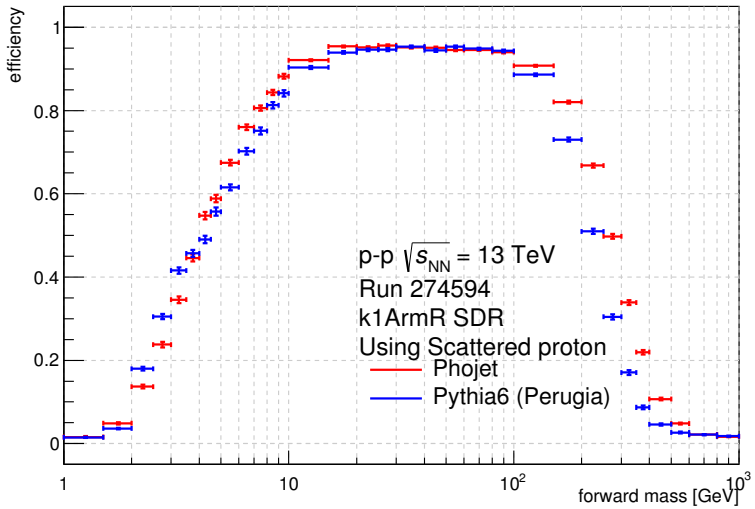


- Run: 274594. AD MIP → 10 adc.
- **top:** AD Efficiency vs diffracted mass (Using generator MC labels)
- **bottom:** AD Efficiency vs diffracted mass (Using the most forward proton)

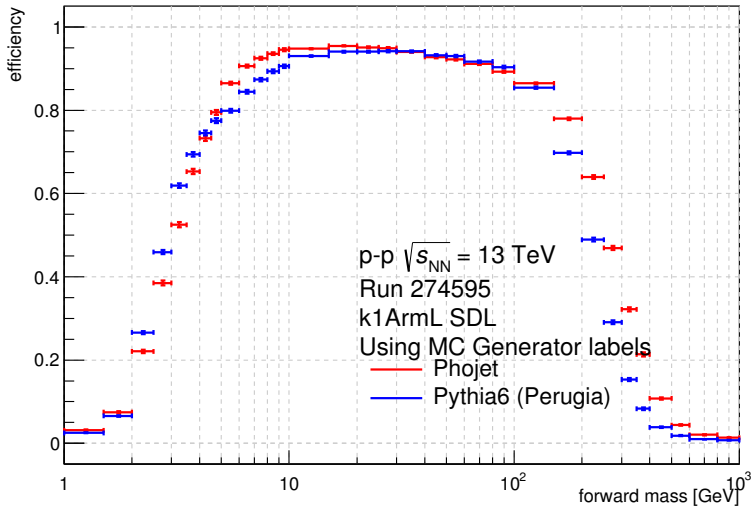


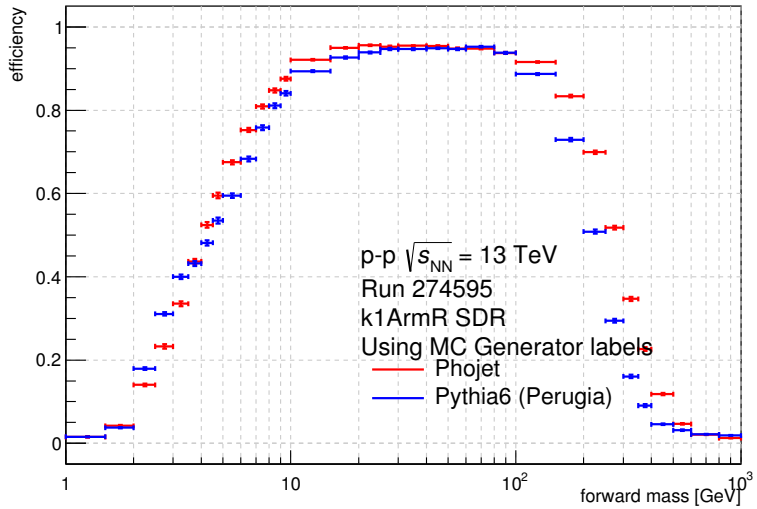


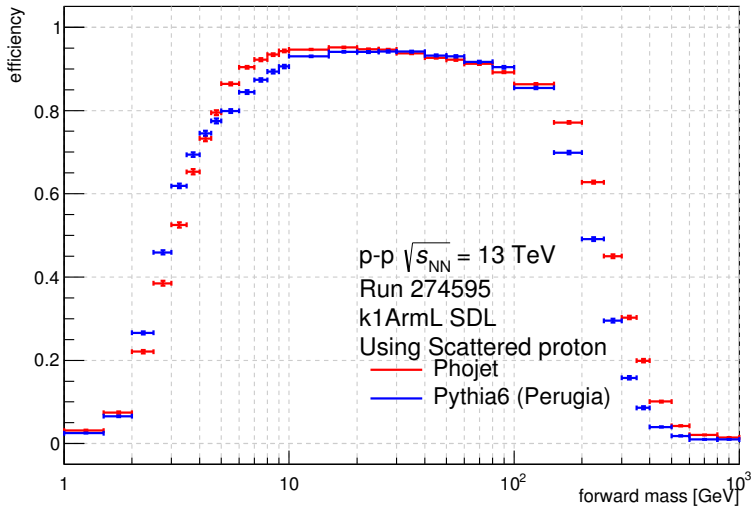


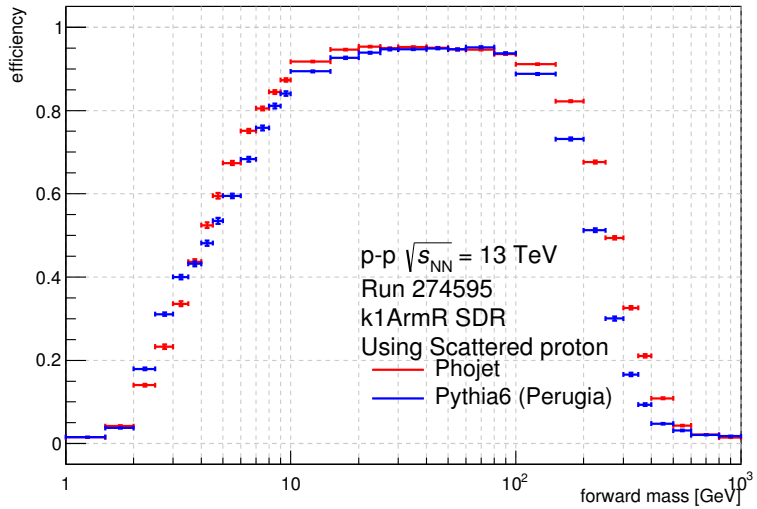


- Run: 274595. AD MIP → 8 adc.
- **top:** AD Efficiency vs diffracted mass (Using generator MC labels)
- **bottom:** AD Efficiency vs diffracted mass (Using the most forward proton)









Event classes (single-tracks events)

- $\eta_R \rightarrow$ particle with the highest (rightmost) pseudorapidity
- $\eta_L \rightarrow$ particle with the lowest (leftmost) pseudorapidity.

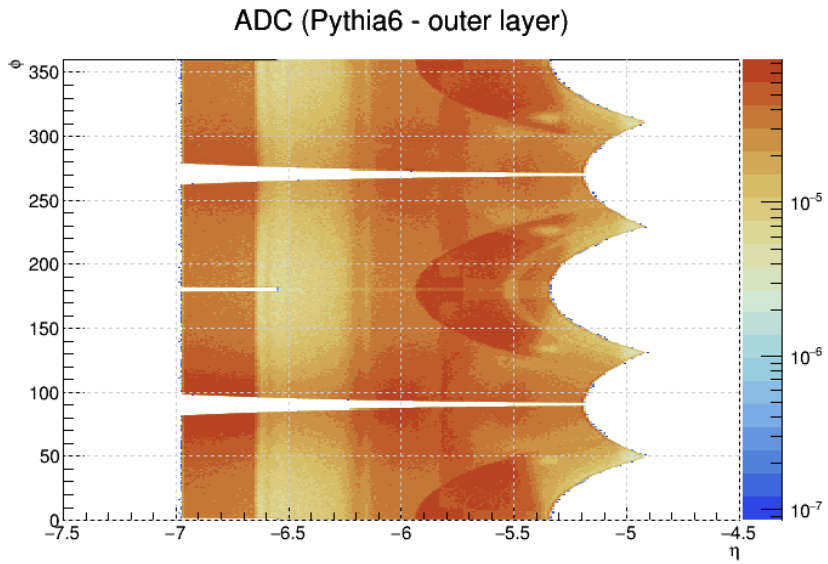
An event is single-track if and only if all the pseudo-tracks are in the pseudo-rapidity range $\eta_R - \eta_L < 0.5$ and the azimuthal angle ϕ of all of them is within 45 degrees. If this condition is not fulfilled the event is said to be multi-track. This of course means that any event having only one pseudo-track is also single-track. Then for single-track events we define the center of pseudorapidity distribution (η_C) as:

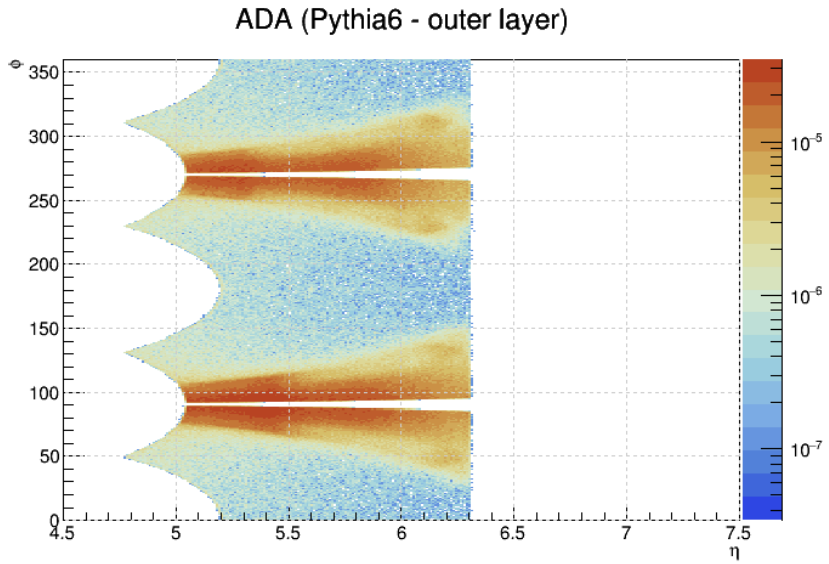
$$\eta_C = \frac{1}{2}(\eta_R + \eta_L)$$

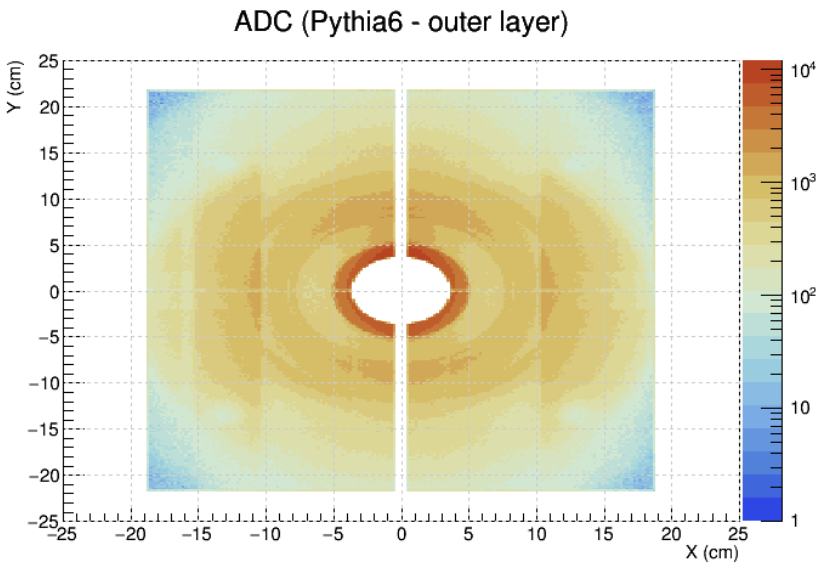
Then with this information we classify the events as:

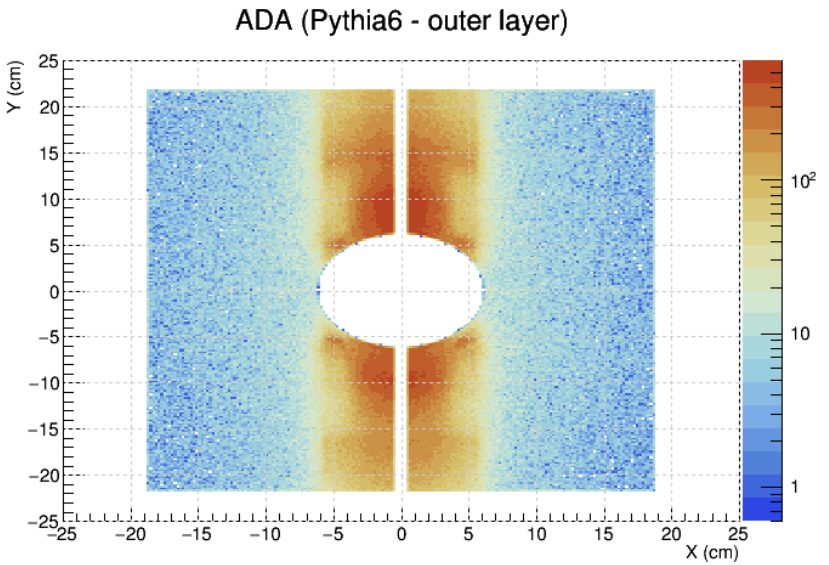
- 1-arm-L, if $\eta_C < 0$
- 1-arm-R, if $\eta_C > 0$

Pythia6, 13 TeV

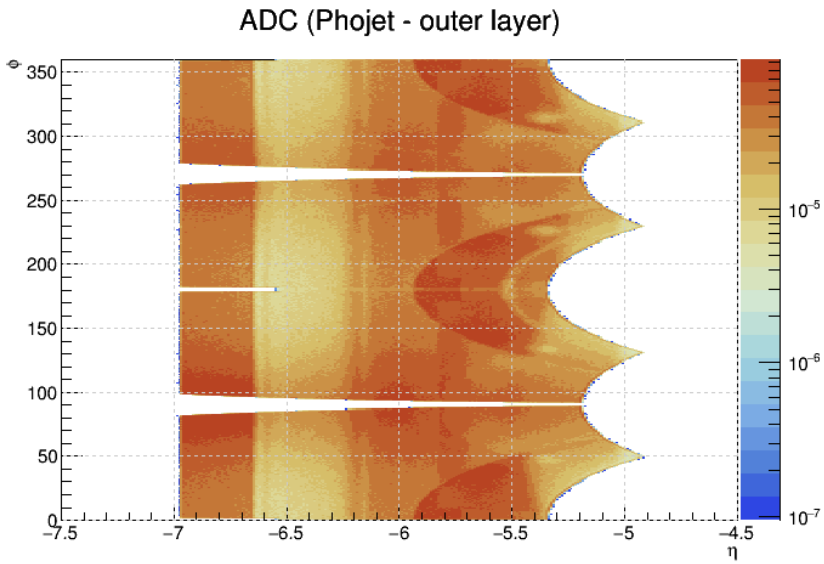


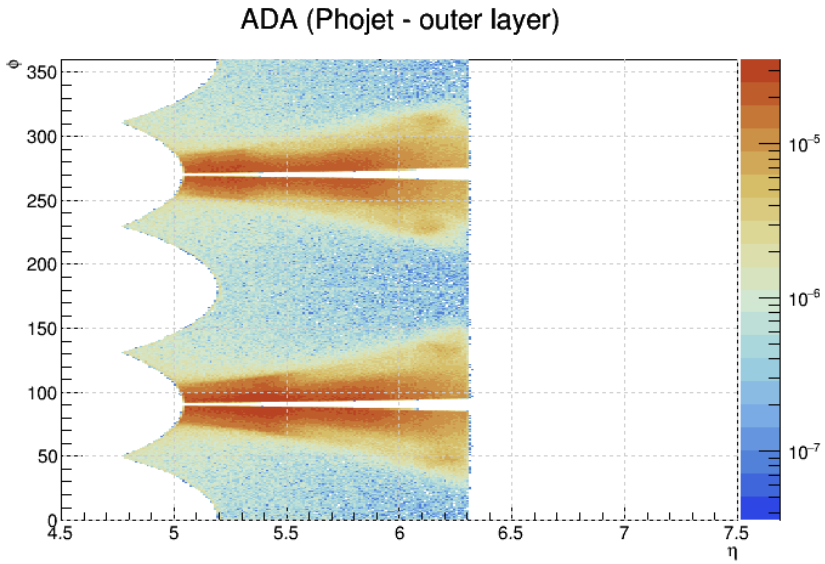


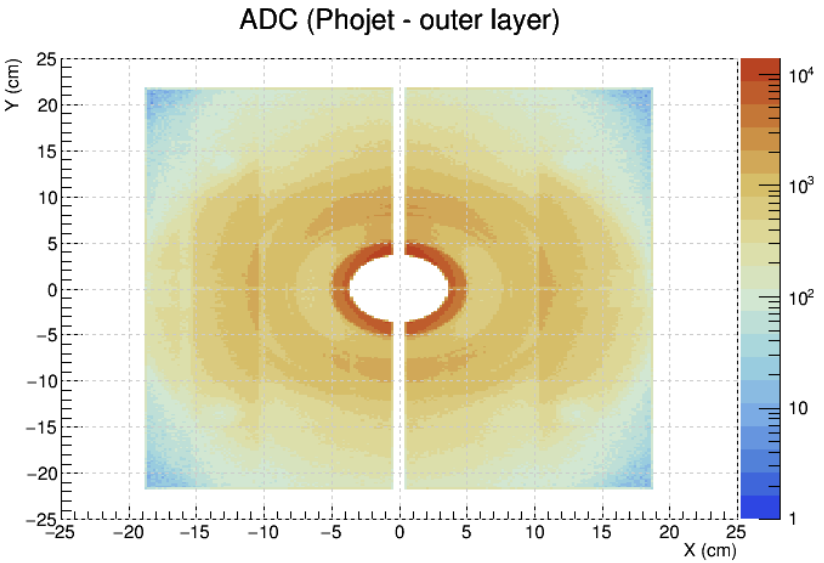


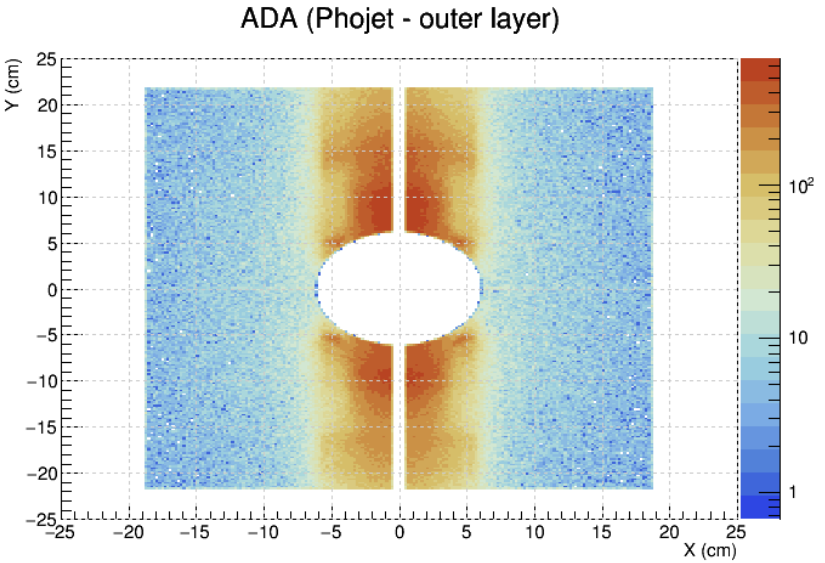


Phojet, 13 TeV

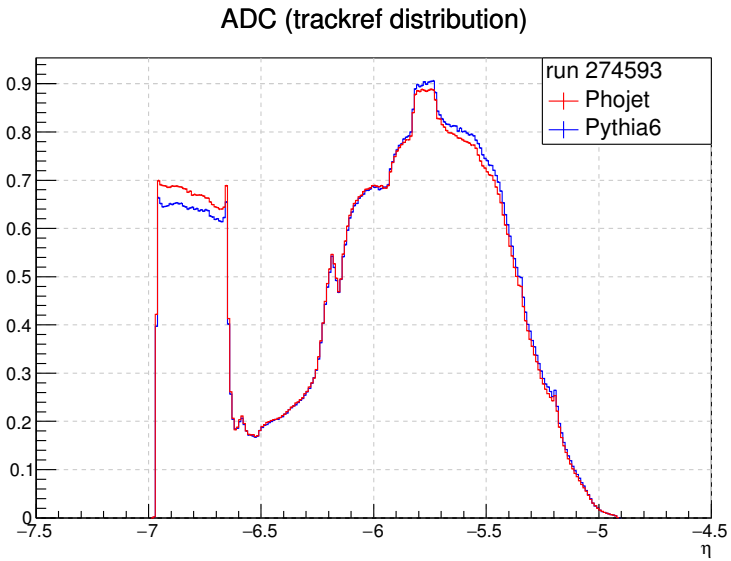


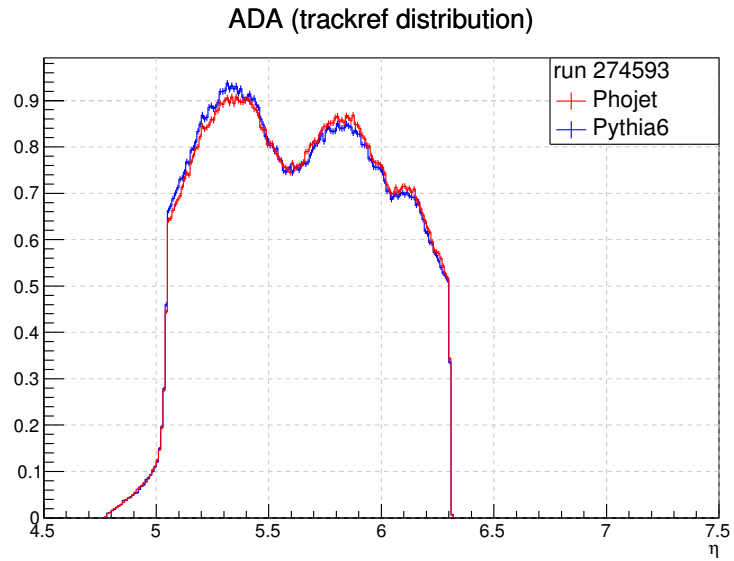


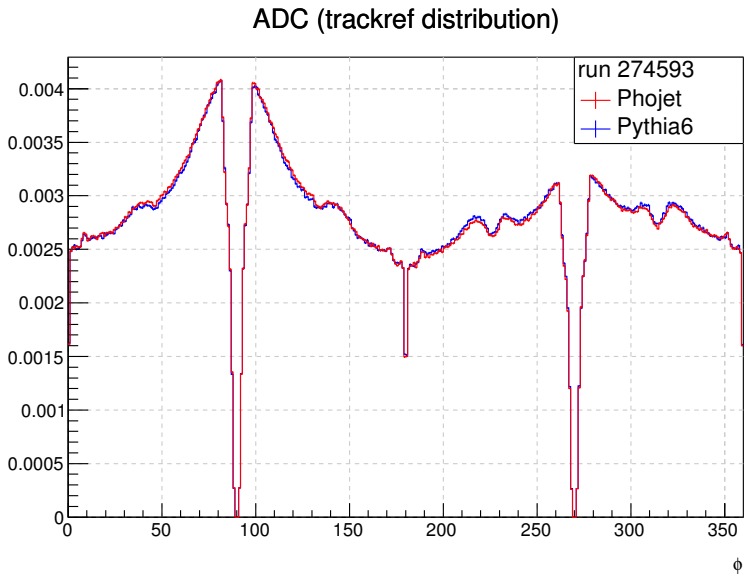


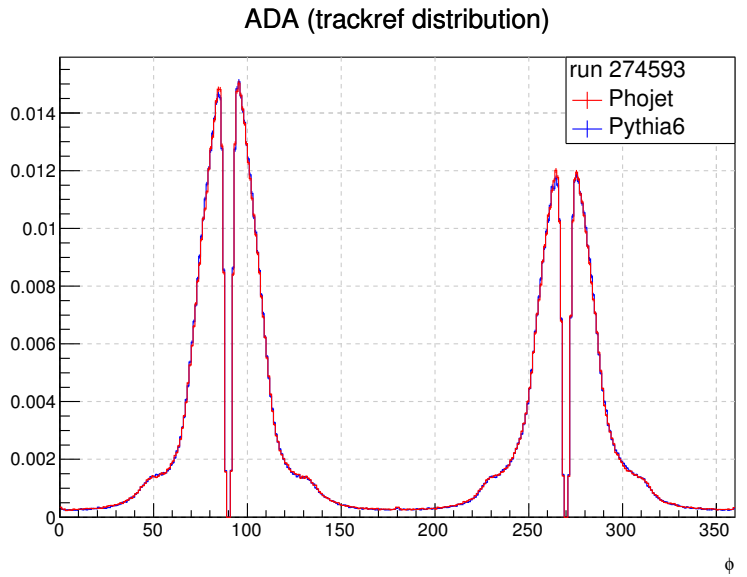


- Charged Track distributions from AD.
- normalized to integral unity
- MC truth



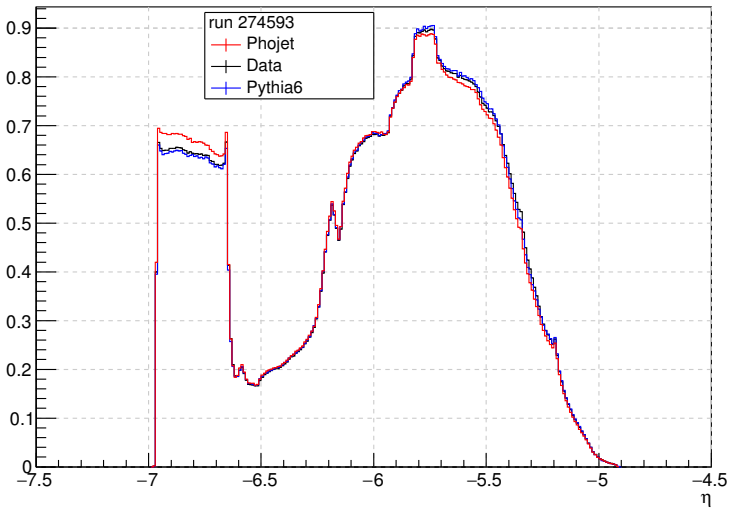




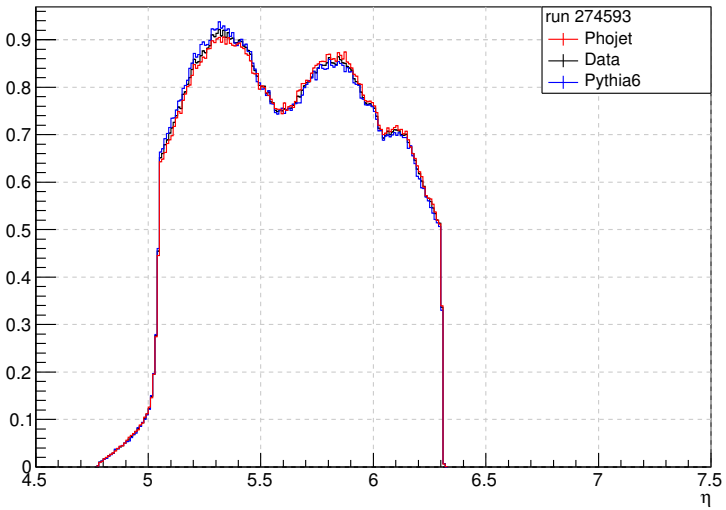


- Charged Track distributions from AD.
- normalized to integral unity
- Check for Data.

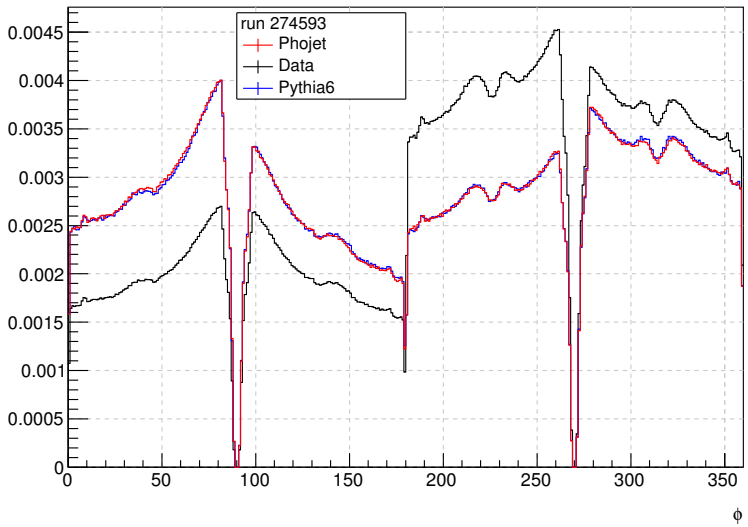
ADC (used track distribution)



ADA (used track distribution)



ADC (used track distribution)



ADA (used track distribution)