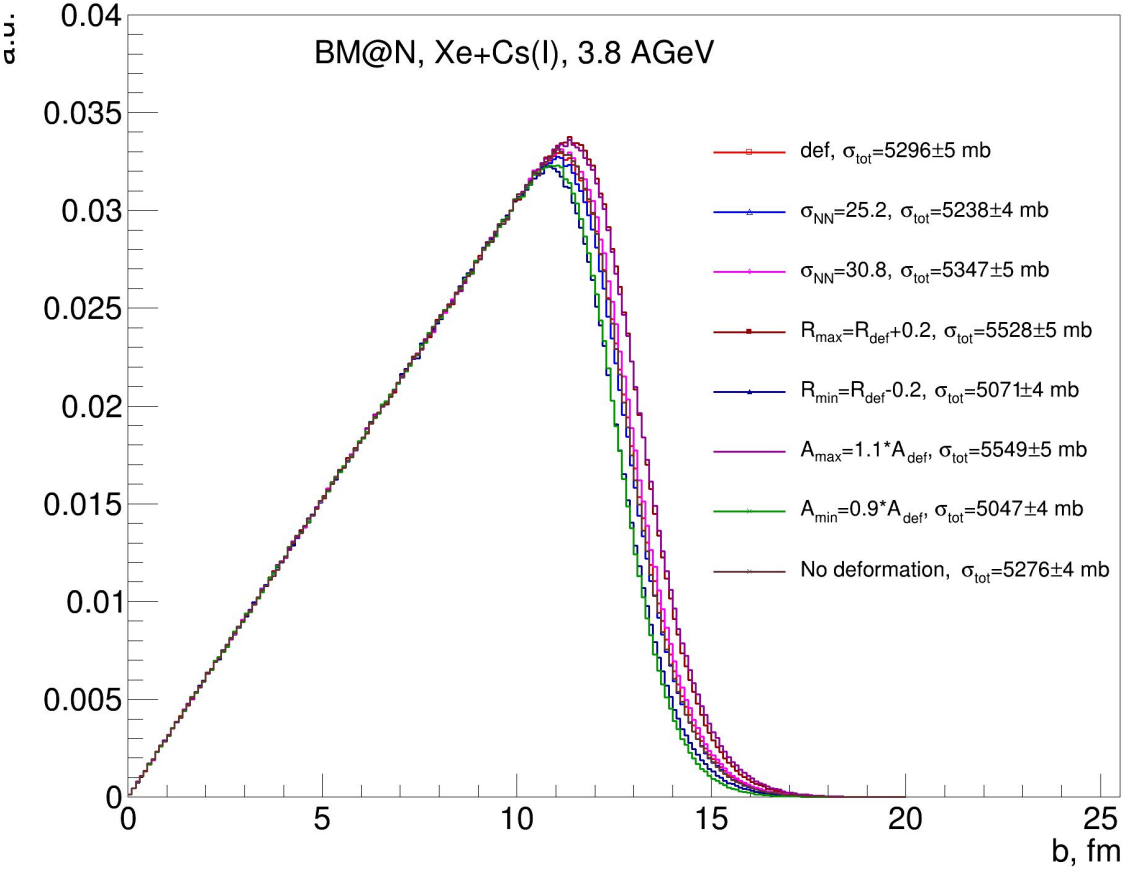
MC-Glauber

Разные оценки радиуса ядра

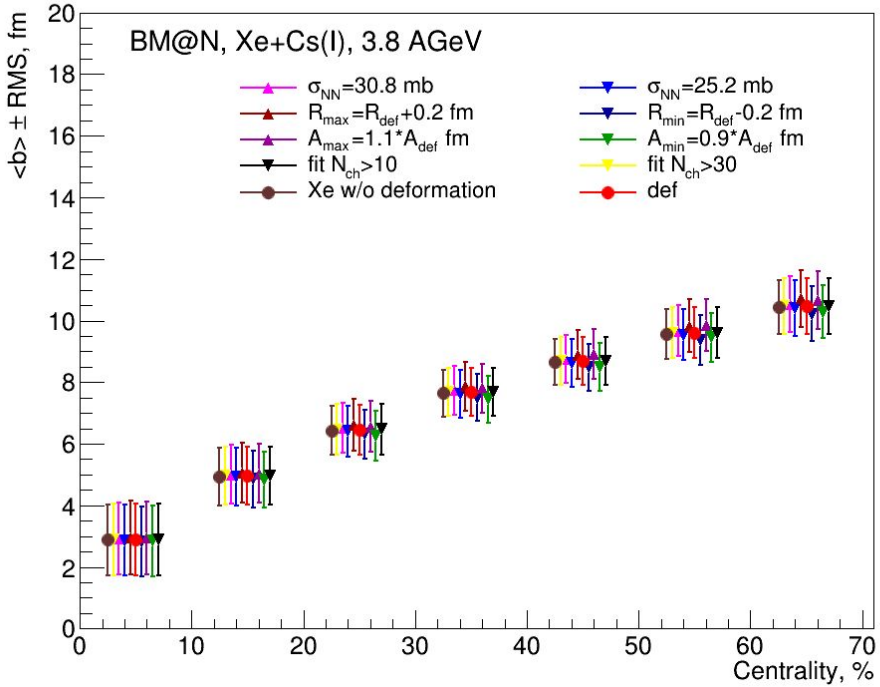
Ядро		Формула для R	R, fm	Эксп. RMS, фм	a, фм	Оценка R из RMS, фм
Xe^{124}	Standard scaling	$r_0 A^{1/3}$, r_0~1.2-1.3	5.98 - 6.48			
	UrQMD (mean field)	$[3A/(4\pi p_0)]^{1/3}$ p_0 = 0.15 - 0.2 fm	5.69 - 5.29			
	Woods-Saxon 3PF (MC-GI)	Подгонка / из RMS	5.431	4.7661	~0.6	5.44
Cs	Standard scaling	$r_0 A^{1/3}$, r_0~1.2-1.3	6.13 - 6.64			
	UrQMD (mean field)	$[3A/(4\pi p_0)]^{1/3}$ p_0 = 0.15 - 0.2 fm	5.95 - 5.41			
	Woods-Saxon 3PF (MC-GI)	Подгонка / из RMS	6.125	4.8041	~0.52	5.68
Cs(I)		½ Cs + ½ I	6.07			

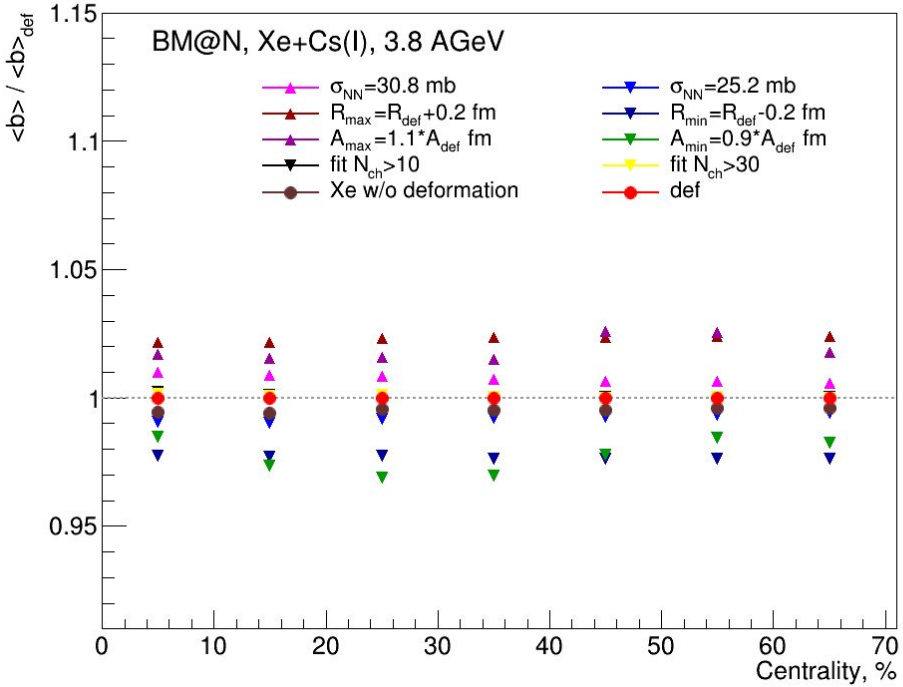
MC-Glauber

σ_{tot} =5290.7 ± 4.5 (stat) ± 184.3 (syst) mb

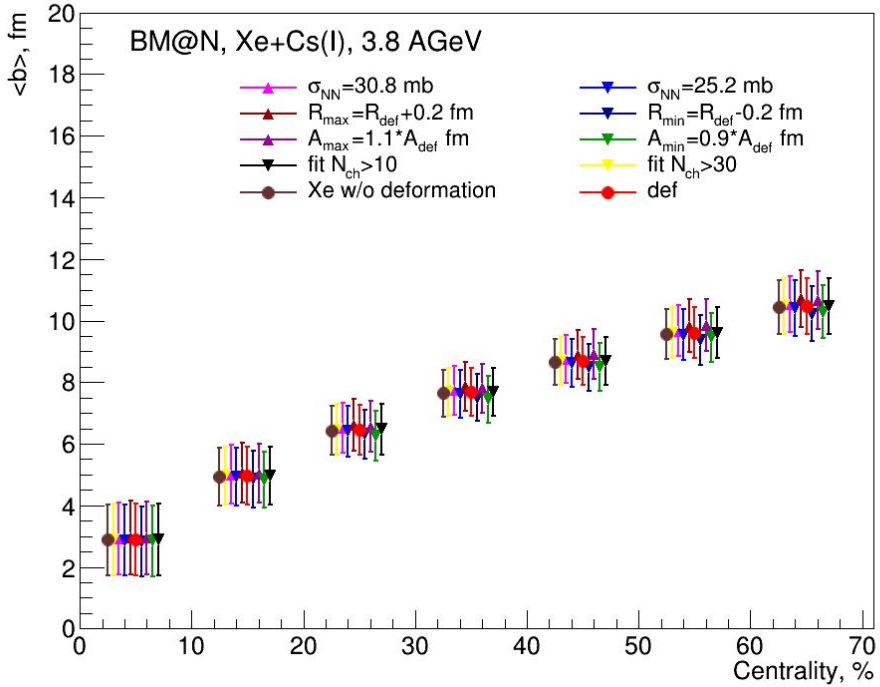


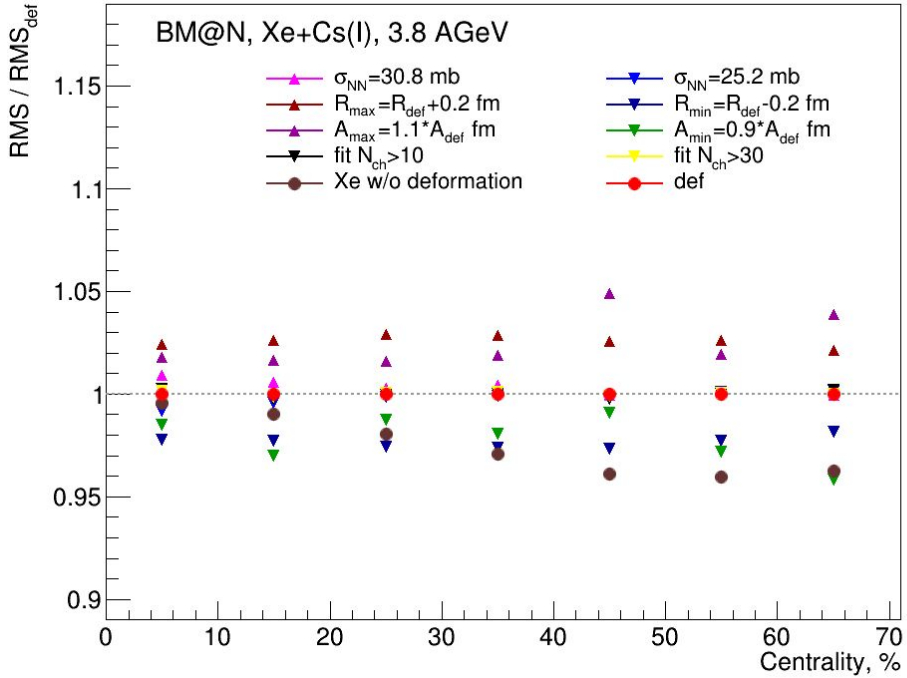
MC-Glauber


BM@N, Xe+Cs(I), 3.8 AGeV
σNN=30.8 mb
Rmax=Rdef+0.2 fm
Amax=1.1*Adef fm
fit Nch>10
Xe w/o deformation
σNN=25.2 mb
Rmin=Rdef-0.2 fm
Amin=0.9*Adef fm
fit Nch>30
def
<b> ± RMS, fm
Centrality, %

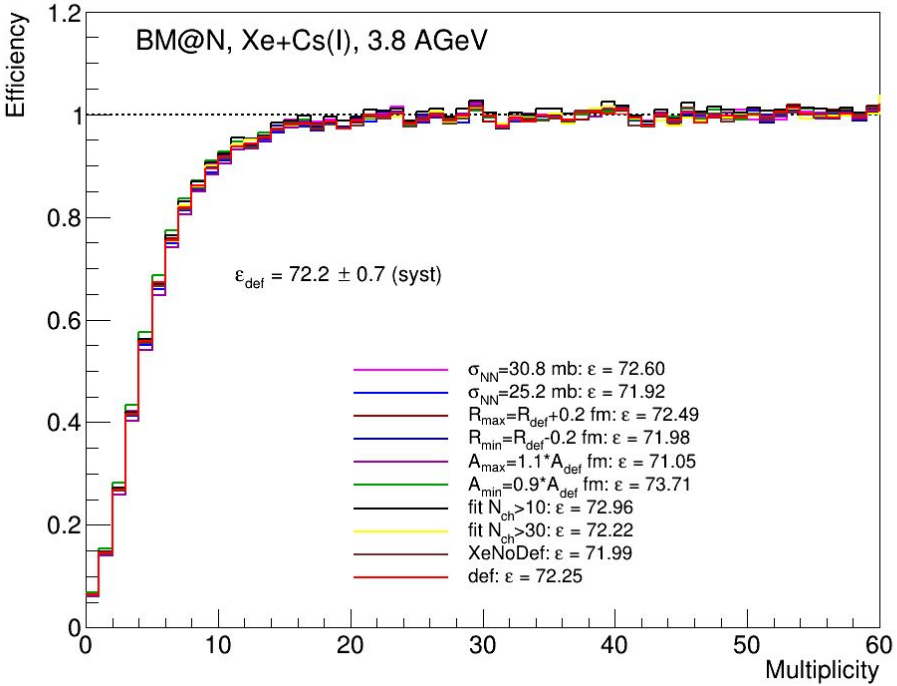

BM@N, Xe+Cs(I), 3.8 AGeV
σNN=30.8 mb
Rmax=Rdef+0.2 fm
Amax=1.1*Adef fm
fit Nch>10
Xe w/o deformation
σNN=25.2 mb
Rmin=Rdef-0.2 fm
Amin=0.9*Adef fm
fit Nch>30
def
<b> / <b>def
Centrality, %

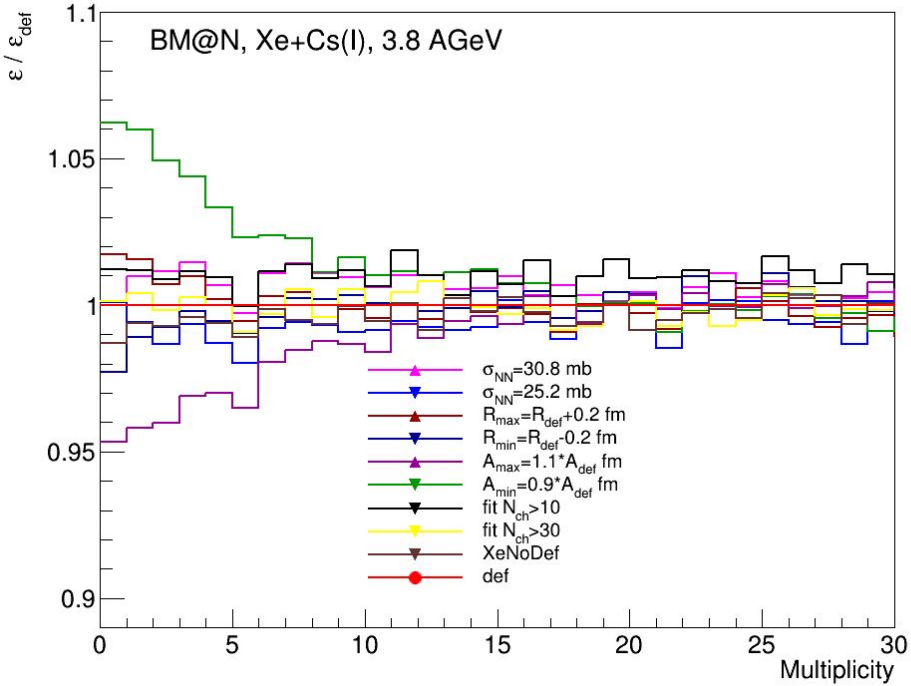
MC-Glauber


BM@N, Xe+Cs(I), 3.8 AGeV
σNN=30.8 mb
Rmax=Rdef+0.2 fm
Amax=1.1*Adef fm
fit Nch>10
Xe w/o deformation
σNN=25.2 mb
Rmin=Rdef-0.2 fm
Amin=0.9*Adef fm
fit Nch>30
def
<b>, fm
Centrality, %


BM@N, Xe+Cs(I), 3.8 AGeV
σNN=30.8 mb
Rmax=Rdef+0.2 fm
Amax=1.1*Adef fm
fit Nch>10
Xe w/o deformation
σNN=25.2 mb
Rmin=Rdef-0.2 fm
Amin=0.9*Adef fm
fit Nch>30
def
RMS / RMSdef
Centrality, %

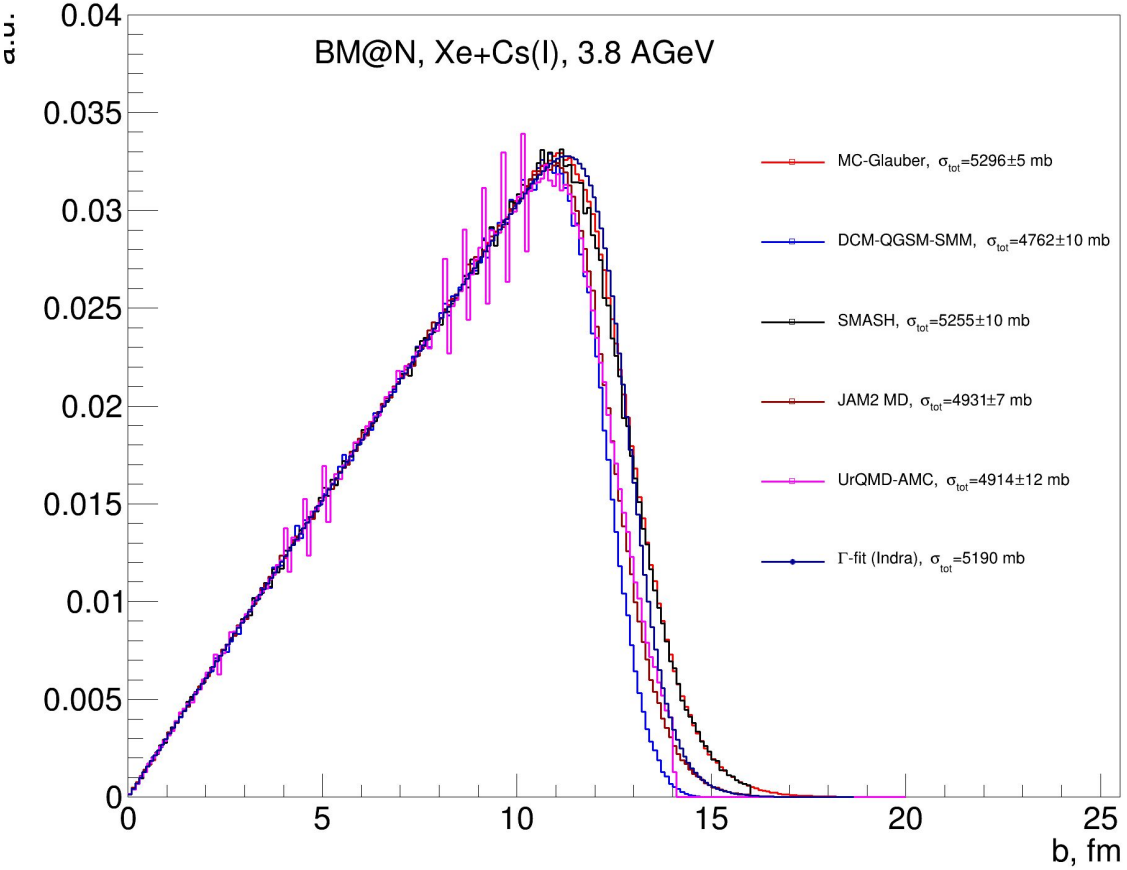
MC-Glauber


BM@N, Xe+Cs(I), 3.8 AGeV
Efficiency
Multiplicity
ε_{def} = 72.2 ± 0.7 (syst)
σ_{NN}=30.8 mb: ε = 72.60
σ_{NN}=25.2 mb: ε = 71.92
$R_{max}=R_{def}$+0.2 fm: ε = 72.49
$R_{min}=R_{def}$-0.2 fm: ε = 71.98
$A_{max}=1.1*A_{def}$ fm: ε = 71.05
$A_{min}=0.9*A_{def}$ fm: ε = 73.71
fit N_{ch}>10: ε = 72.96
fit N_{ch}>30: ε = 72.22
XeNoDef: ε = 71.99
def: ε = 72.25

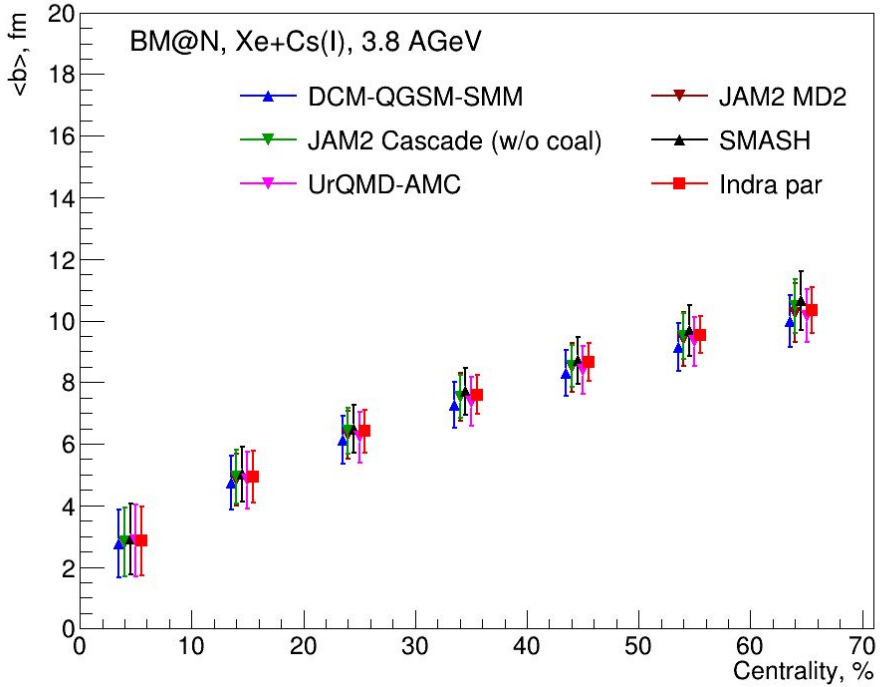

BM@N, Xe+Cs(I), 3.8 AGeV
ε / ε_{def}
Multiplicity
σ_{NN}=30.8 mb
σ_{NN}=25.2 mb
$R_{max}=R_{def}$+0.2 fm
$R_{min}=R_{def}$-0.2 fm
$A_{max}=1.1*A_{def}$ fm
$A_{min}=0.9*A_{def}$ fm
fit N_{ch}>10
fit N_{ch}>30
XeNoDef
def

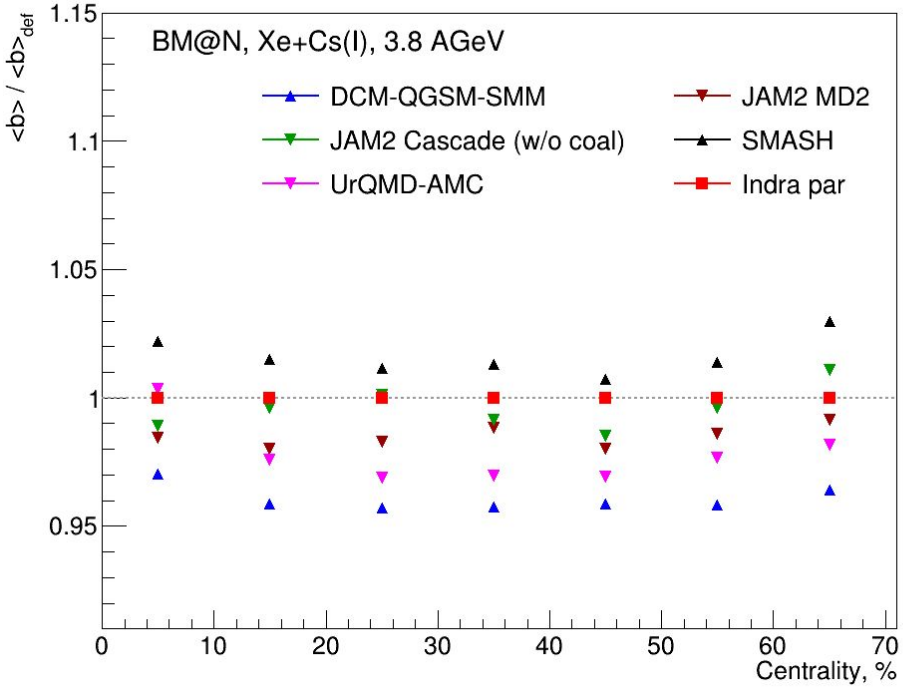
Gamma-fit

σ_{tot} = 4966 ± 207 (syst) mb

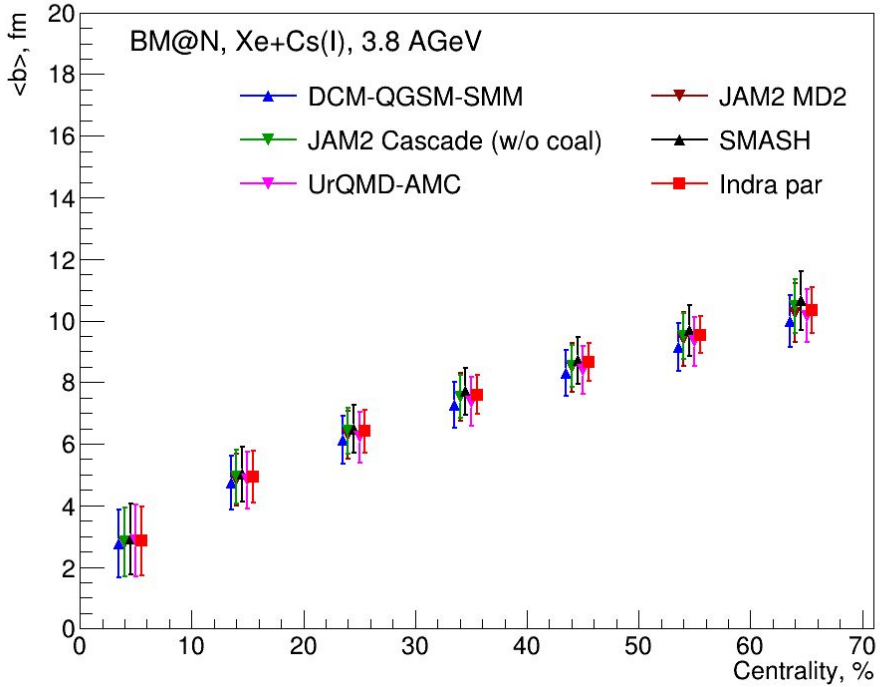


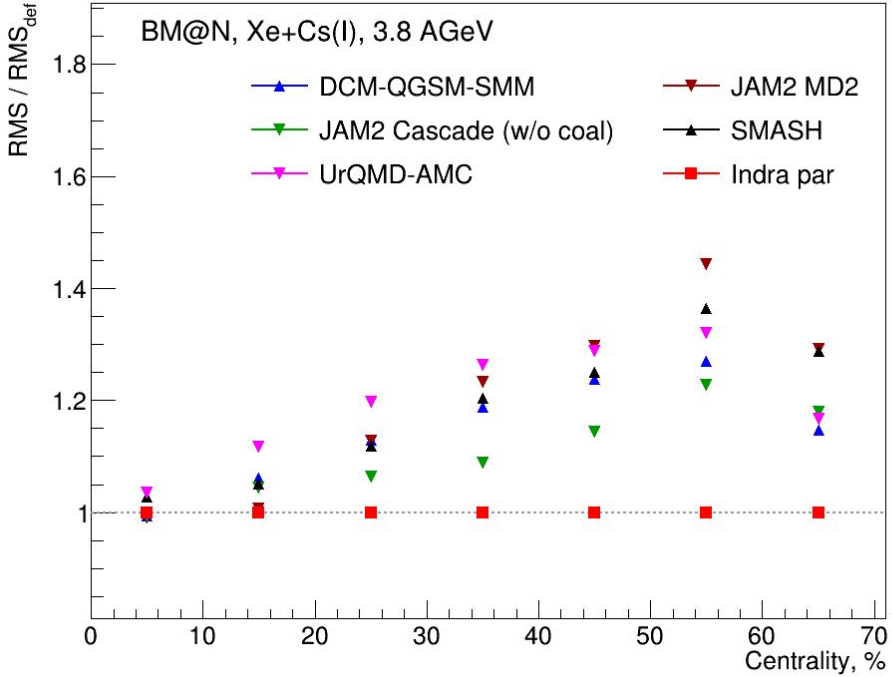
Gamma-fit


BM@N, Xe+Cs(I), 3.8 AGeV
DCM-QGSM-SMM
JAM2 Cascade (w/o coal)
UrQMD-AMC
JAM2 MD2
SMASH
Indra par
<b>, fm
Centrality, %

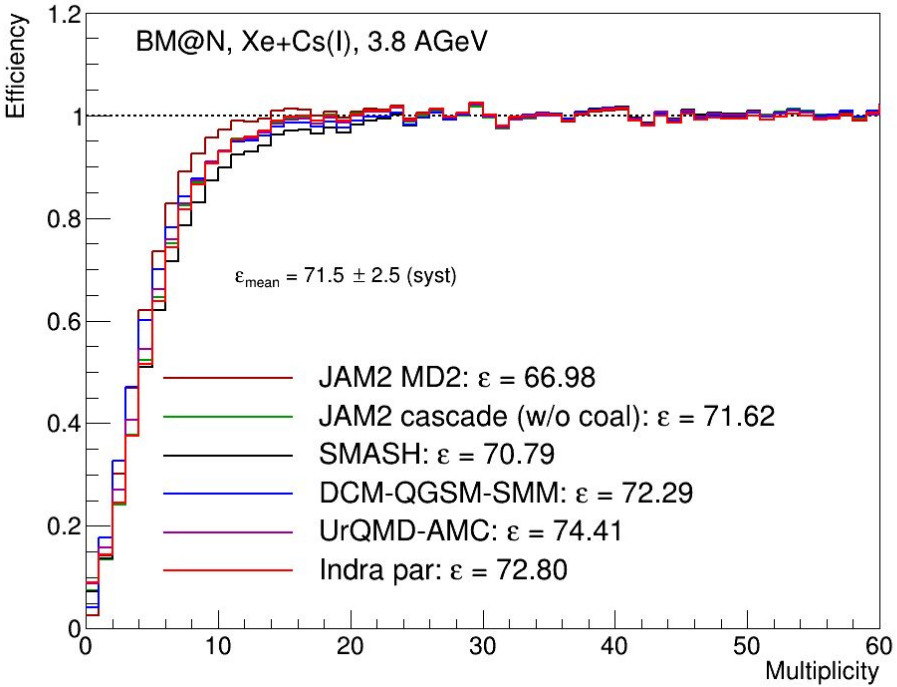

BM@N, Xe+Cs(I), 3.8 AGeV
DCM-QGSM-SMM
JAM2 Cascade (w/o coal)
UrQMD-AMC
JAM2 MD2
SMASH
Indra par
<b> / <b>def
Centrality, %

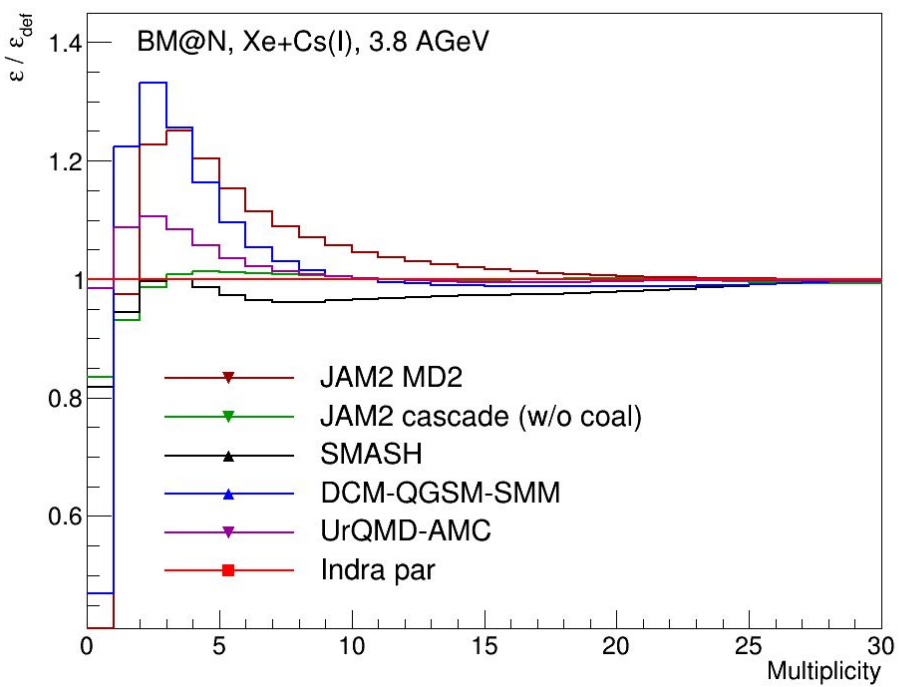
Gamma-fit


BM@N, Xe+Cs(I), 3.8 AGeV
DCM-QGSM-SMM
JAM2 Cascade (w/o coal)
UrQMD-AMC
JAM2 MD2
SMASH
Indra par
<b>, fm
Centrality, %

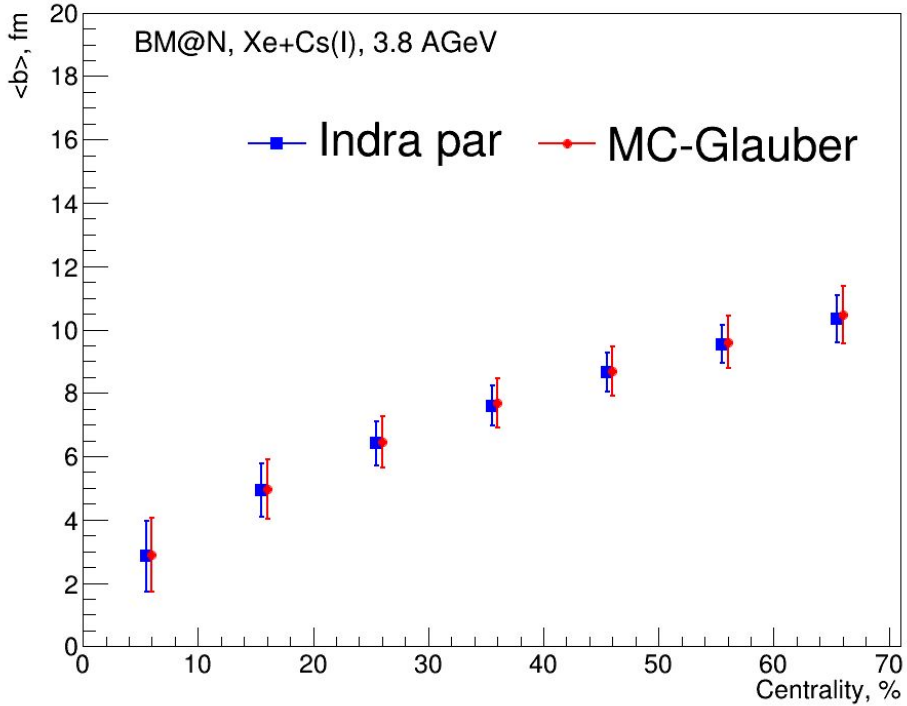

BM@N, Xe+Cs(I), 3.8 AGeV
DCM-QGSM-SMM
JAM2 Cascade (w/o coal)
UrQMD-AMC
JAM2 MD2
SMASH
Indra par
RMS / RMS_def
Centrality, %

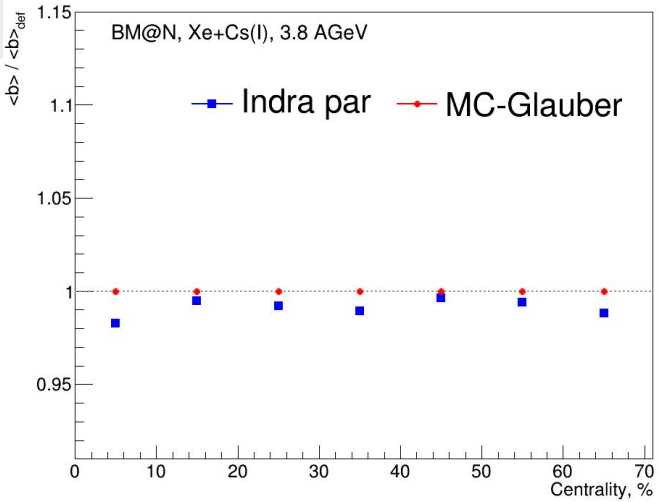
Gamma-fit

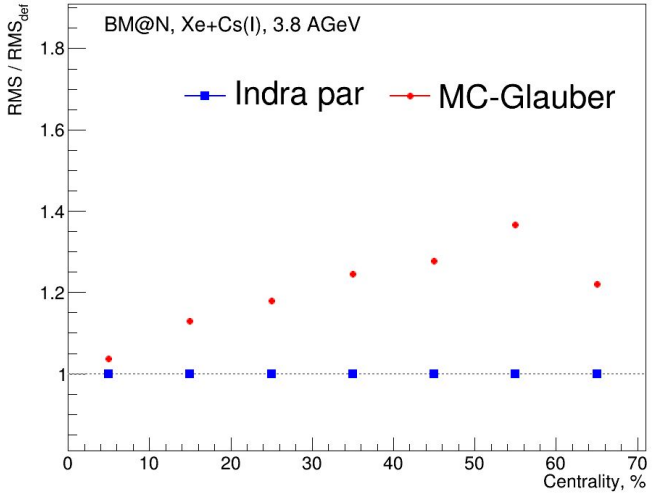

BM@N, Xe+Cs(I), 3.8 AGeV
Efficiency
Multiplicity
ε_{mean} = 71.5 ± 2.5 (syst)
JAM2 MD2: ε = 66.98
JAM2 cascade (w/o coal): ε = 71.62
SMASH: ε = 70.79
DCM-QGSM-SMM: ε = 72.29
UrQMD-AMC: ε = 74.41
Indra par: ε = 72.80

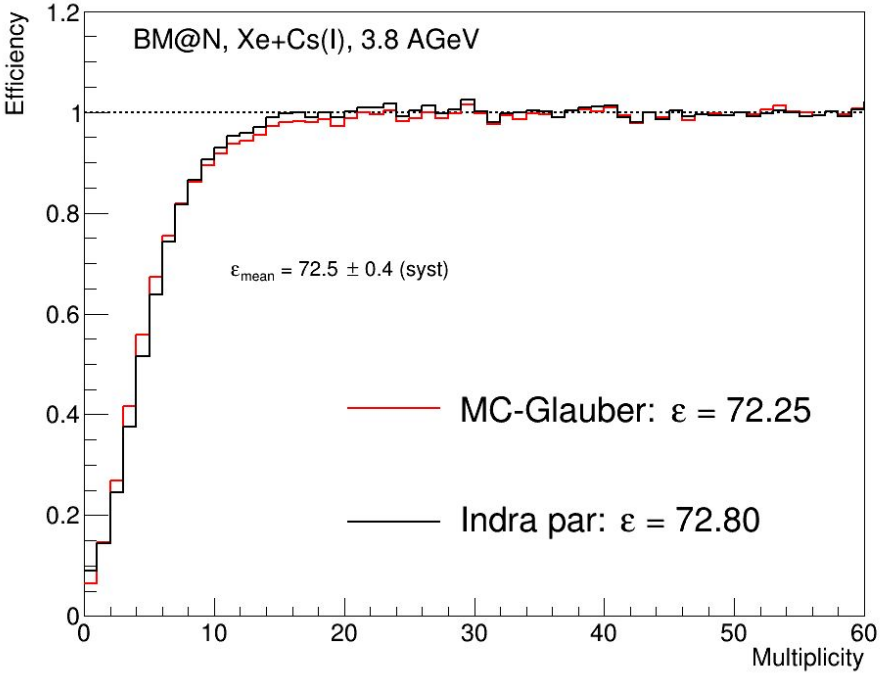

BM@N, Xe+Cs(I), 3.8 AGeV
ε / ε_def
Multiplicity
JAM2 MD2
JAM2 cascade (w/o coal)
SMASH
DCM-QGSM-SMM
UrQMD-AMC
Indra par

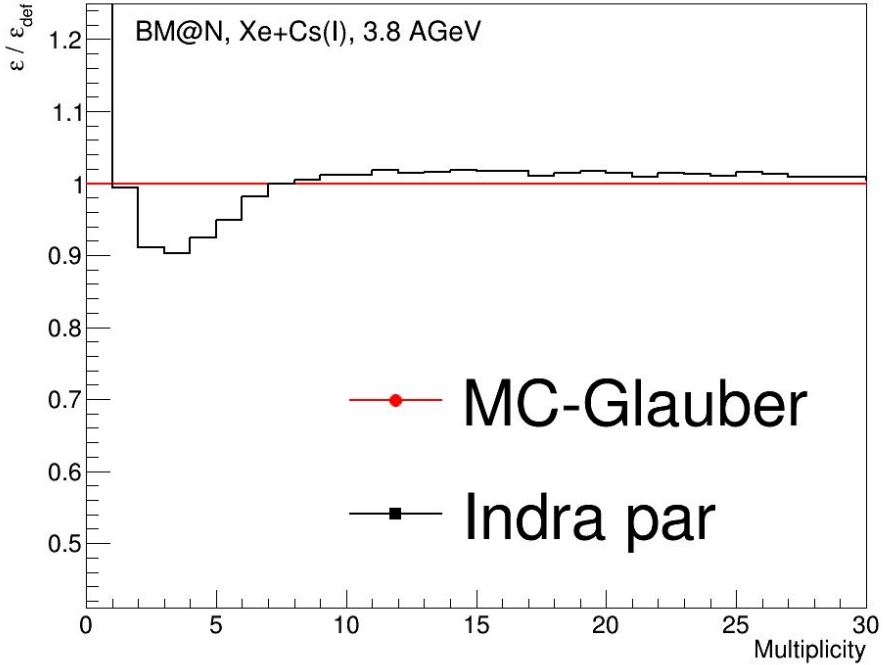
Models	proj (Xe)	targ (Cs)
DCM-QGSM-SMM	(Z=54) 131	(Z=55) 133
JAM2 MD2	(Z=54) 124	(Z=55) 133
smash	(Z=54) 124	(Z=54) 130
UrQMD	(Z=54) 124	(Z=55) 133


BM@N, Xe+Cs(I), 3.8 AGeV
Indra par
MC-Glauber
<b>, fm
Centrality, %


BM@N, Xe+Cs(I), 3.8 AGeV
Indra par
MC-Glauber
<b> / <b>def
Centrality, %


BM@N, Xe+Cs(I), 3.8 AGeV
Indra par
MC-Glauber
RMS / RMSdef
Centrality, %


BM@N, Xe+Cs(I), 3.8 AGeV
Efficiency
Multiplicity
ε_{mean} = 72.5 ± 0.4 (syst)
MC-Glauber: ε = 72.25
Indra par: ε = 72.80

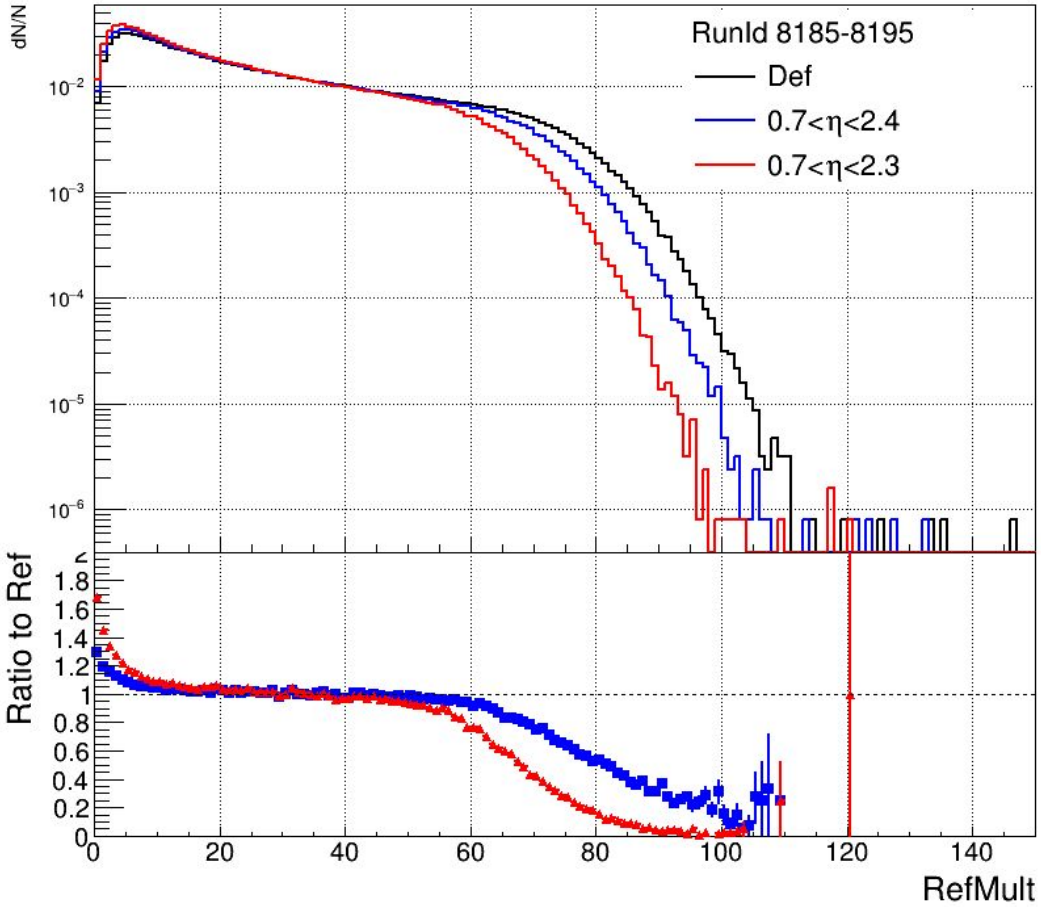

BM@N, Xe+Cs(I), 3.8 AGeV
ε / ε_def
Multiplicity
MC-Glauber
Indra par

RefMult cut

Dif RefMult

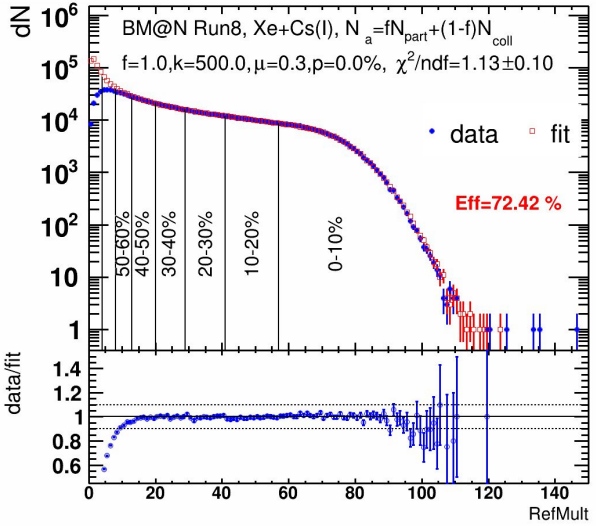
def RefMult:

- $0.05<p_T<2.0$
- $0.7<eta<2.5$
- $DCA_R<1.0$

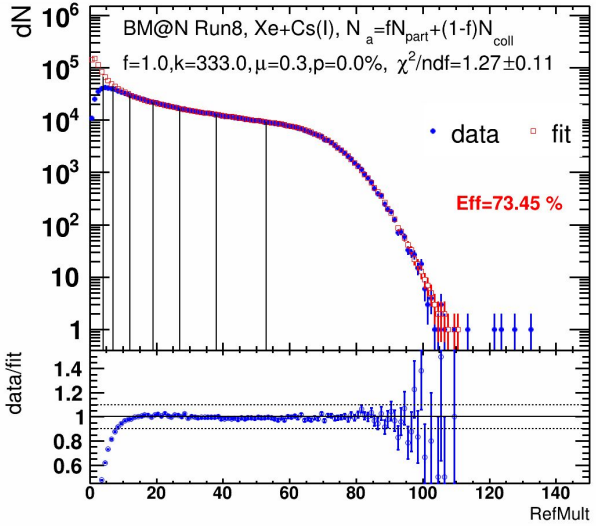


Fit of RefMult for different eta cuts

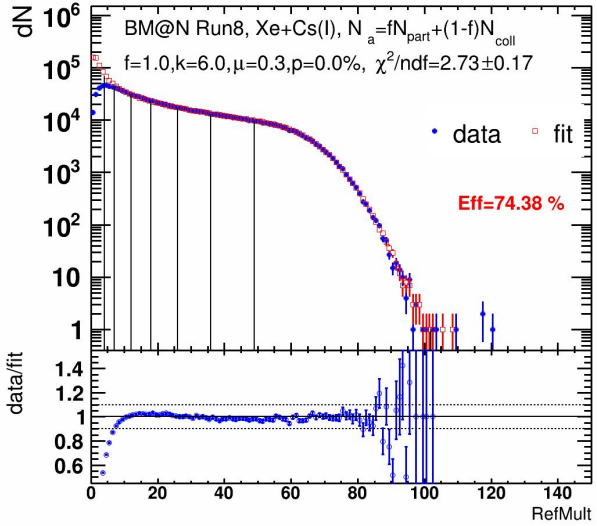
0.7<eta<2.5



0.7<eta<2.4

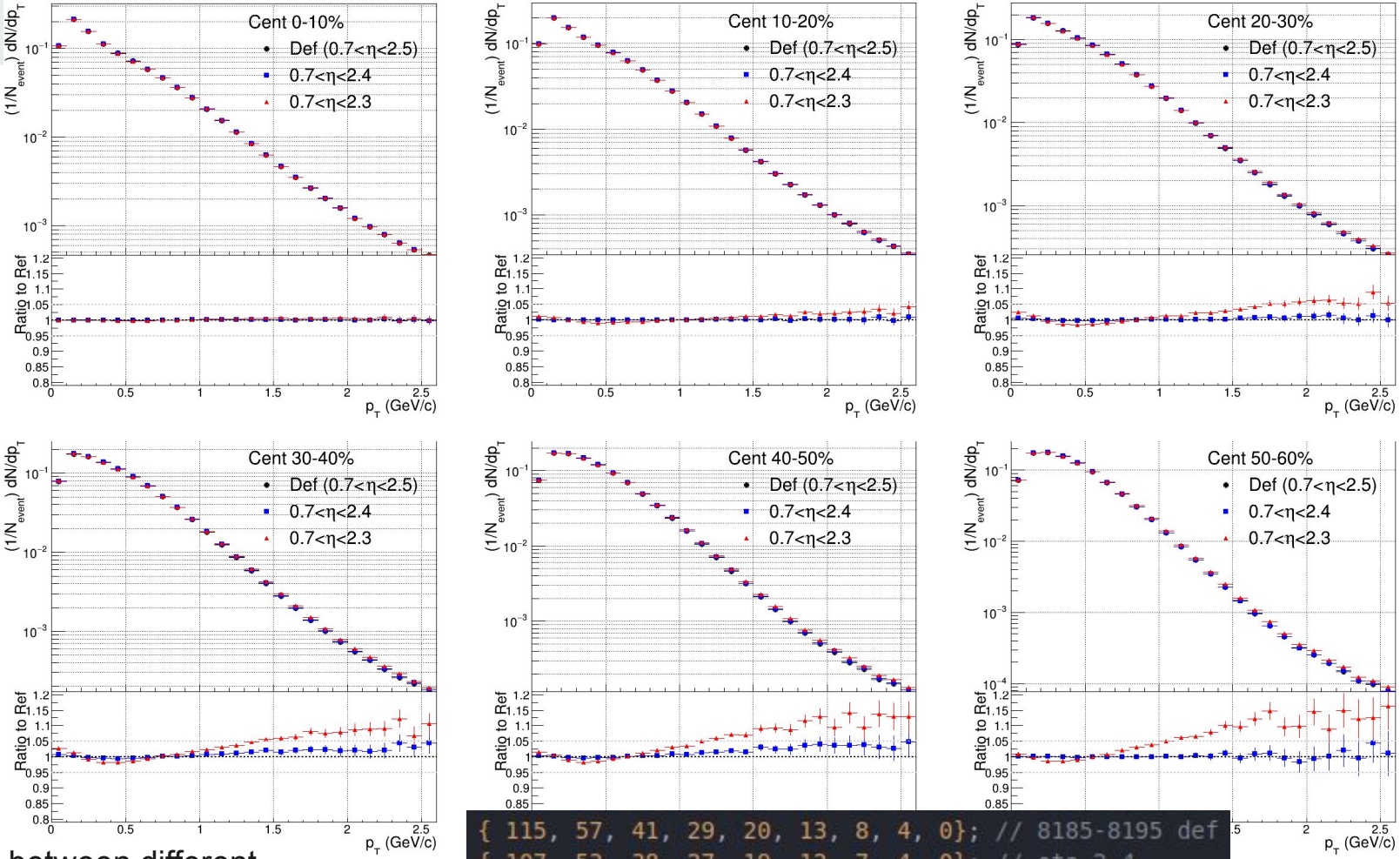


0.7<eta<2.3




```
{ 115, 57, 41, 29, 20, 13, 8, 4, 0}; // 8185-8195 def
{ 107, 53, 38, 27, 19, 12, 7, 4, 0}; // eta 2.4
{ 102, 49, 36, 26, 18, 12, 7, 4, 0}; // eta 2.3
```

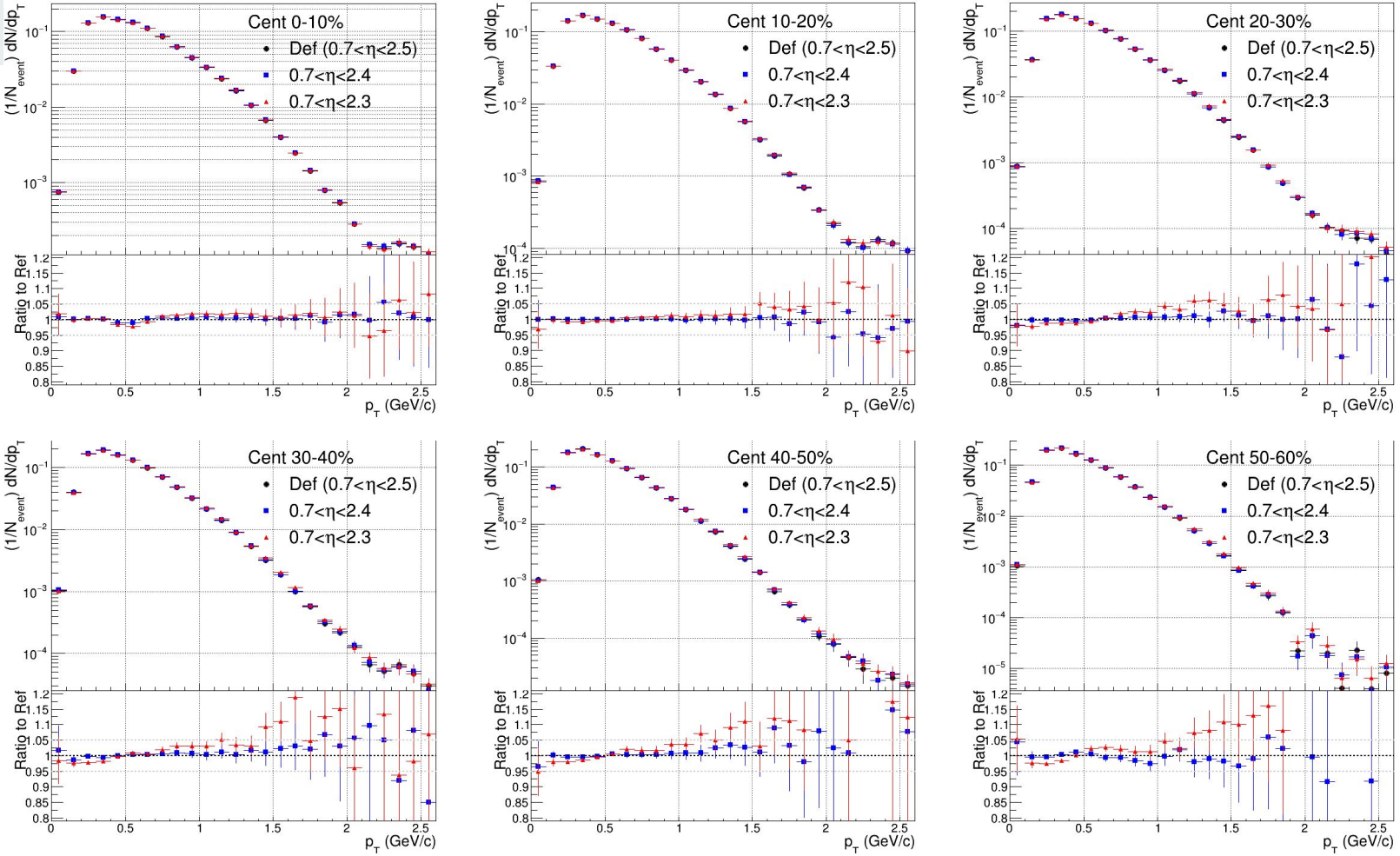
p_T-spectr
all Ch
eta<5.0
Run 8195




```
{ 115, 57, 41, 29, 20, 13, 8, 4, 0}; // 8185-8195 def
{ 107, 53, 38, 27, 19, 12, 7, 4, 0}; // eta 2.4
{ 102, 49, 36, 26, 18, 12, 7, 4, 0}; // eta 2.3
```

An agreement between different Reference RunId ranges (<5%)

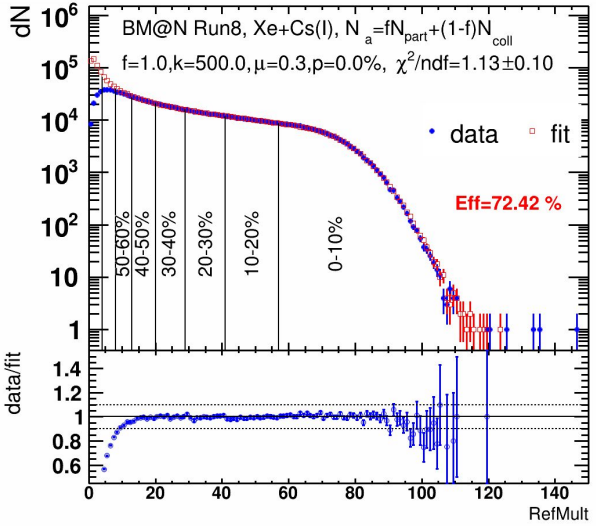
p_T-spectr
Proton
0.4<y<0.8
Run 8195



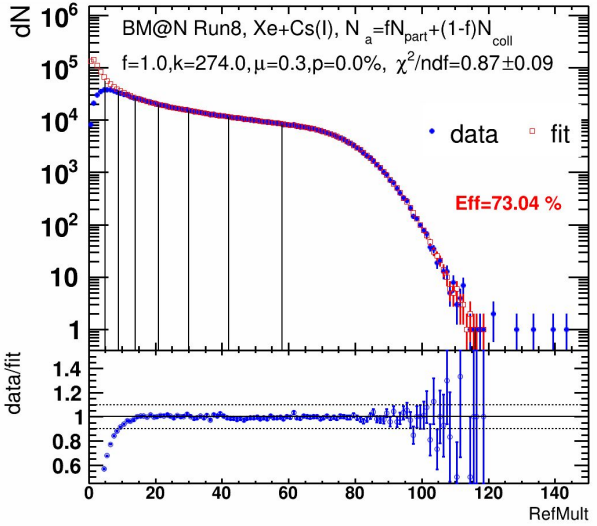
An agreement between different Reference RunId ranges (<5%)

Fit of RefMult for different DCA

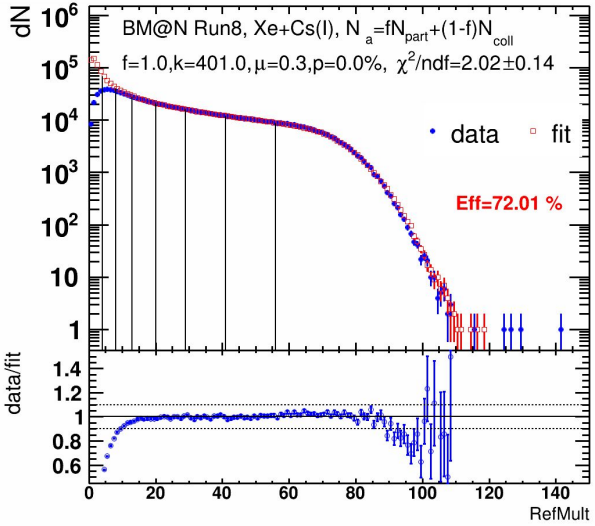
dca<1



dca<1.1

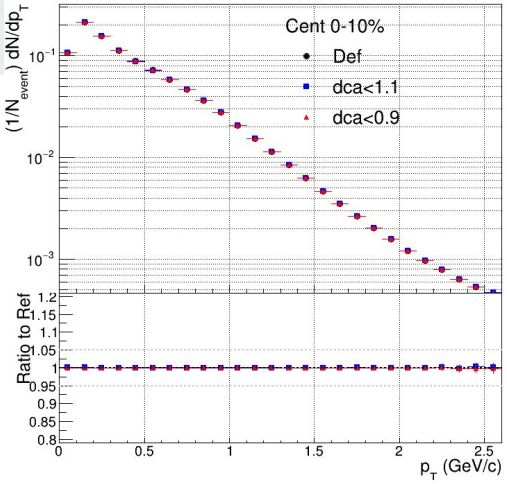


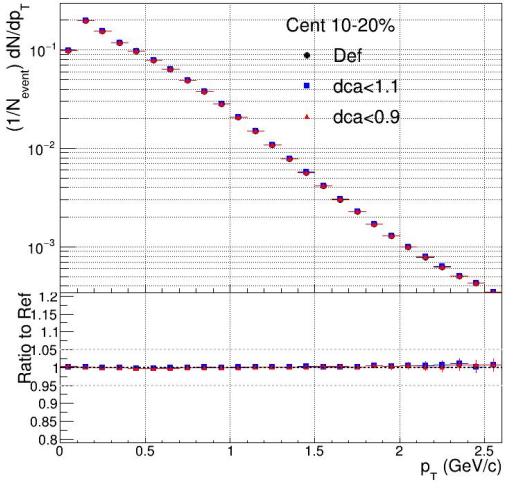
dca<0.9

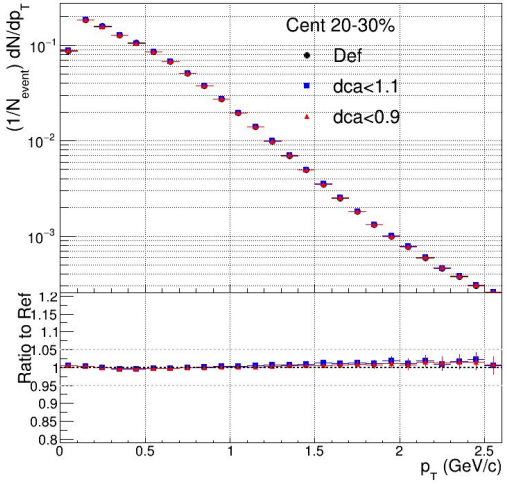


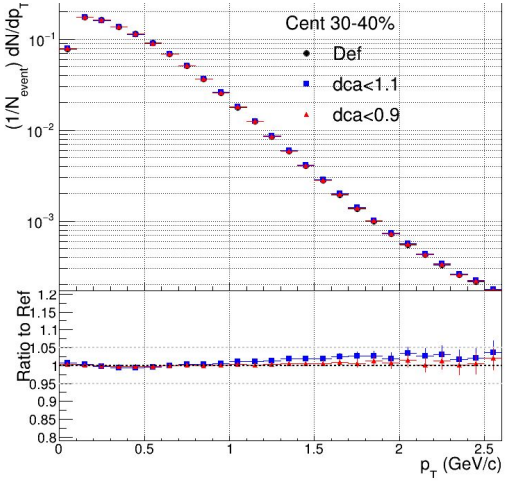

```
multiplicity_bin_edges = { 115, 57, 41, 29, 20, 13, 8, 4, 0}; // 8185-8195 def
multiplicity_bin_edges = { 116, 58, 42, 30, 21, 14, 9, 5, 0}; // dca 1.1
multiplicity_bin_edges = { 111, 56, 41, 29, 20, 13, 8, 4, 0}; // dca 0.9
```

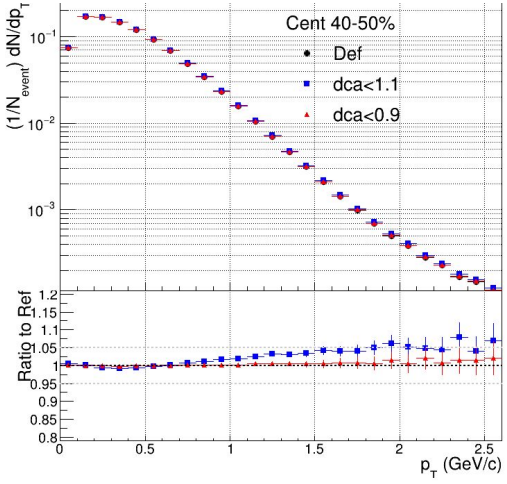
p_T-spectr
all Ch
eta<5.0
Run 8195

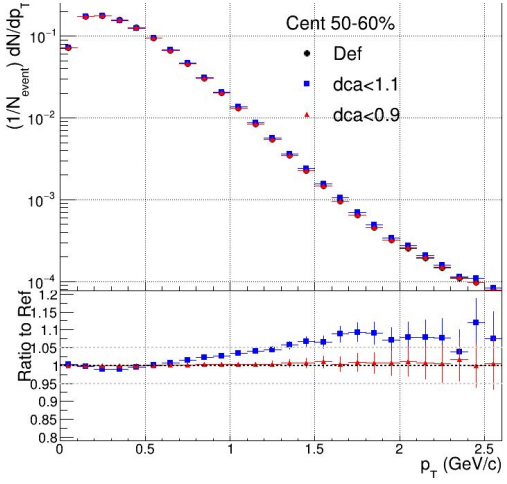










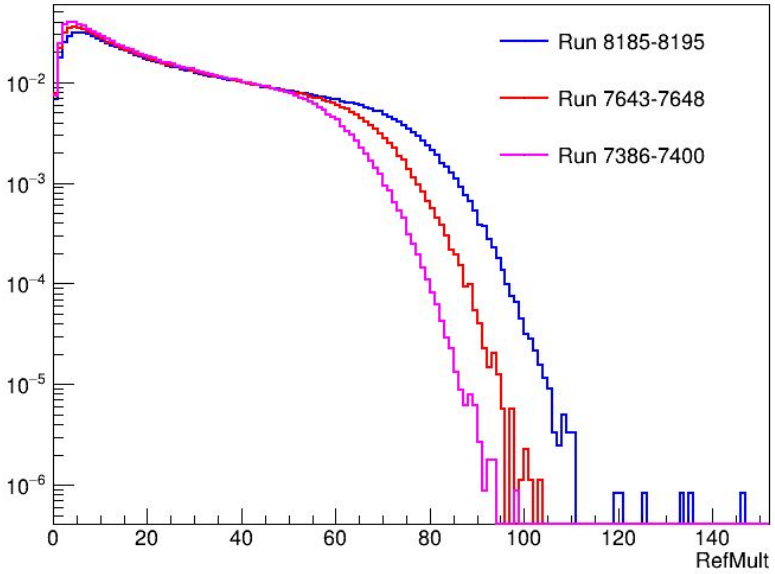


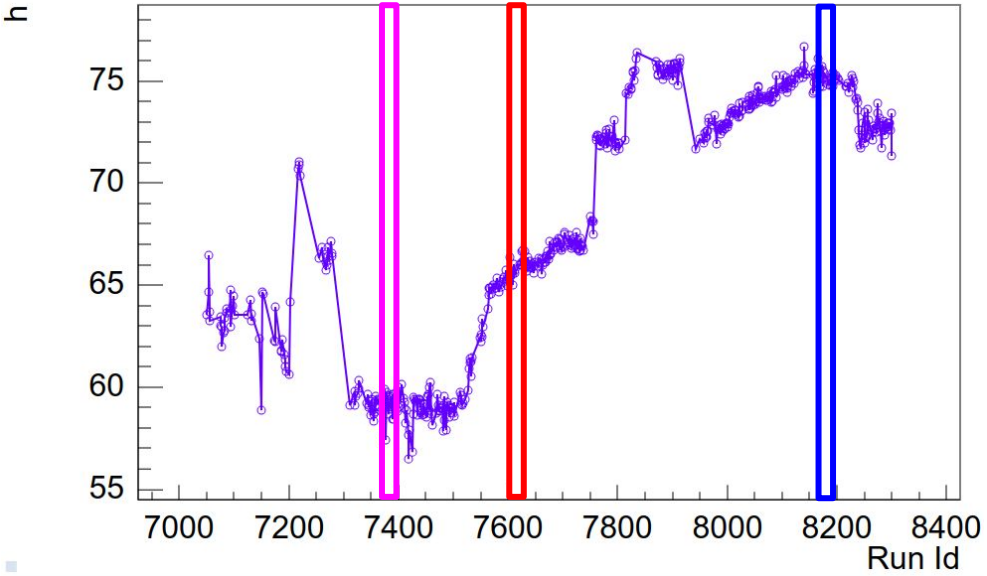


Various reference RunId

Various reference RunId (for RefMult)

RefMult:
- $0.05<p_T<2.0$
- $0.7<eta<2.5$
- $DCA_R<1.0$ cm





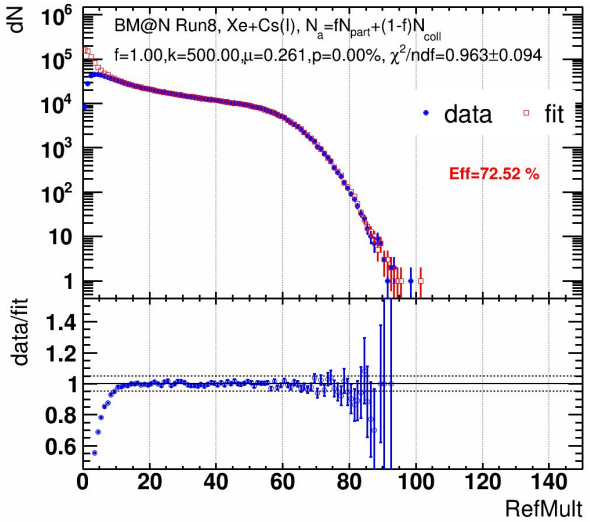
Main Reference RunId ranges: 8150-8200

Additional ranges [7386-7400], [7643-7648] chosen to test for range dependence.

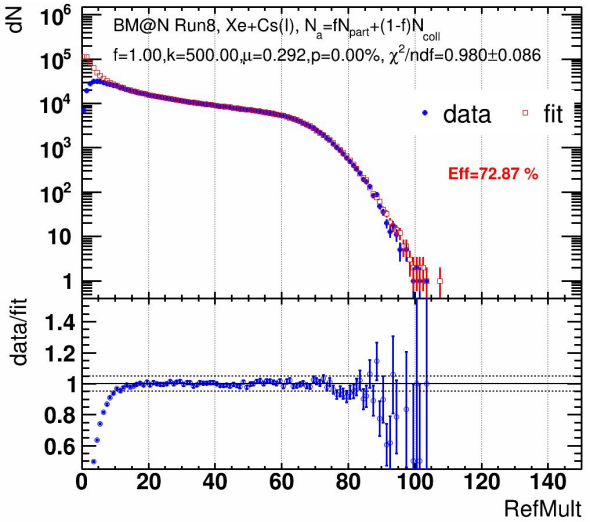
Fit various reference RunId (for RefMult)

RefMult:
- $0.05<p_T<2.0$
- $0.7<eta<2.5$
- $DCA_R<1.0$ cm

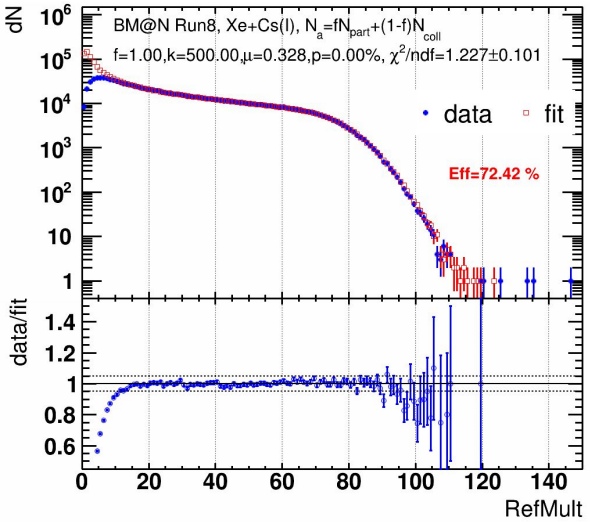
7386-7400



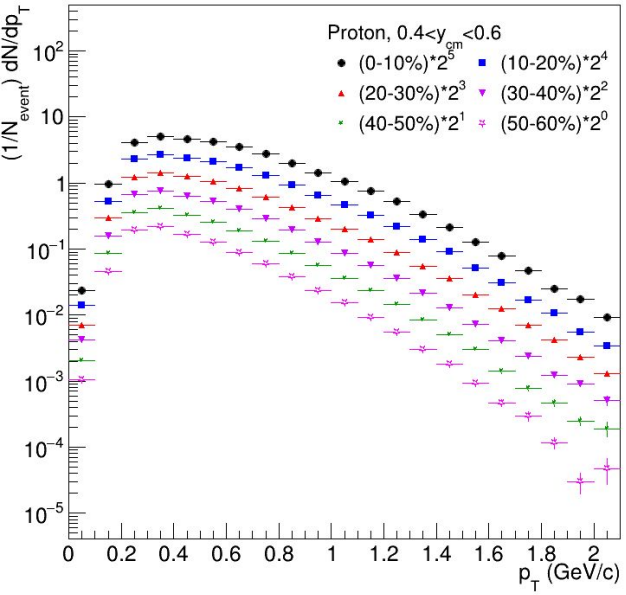
7643-7648

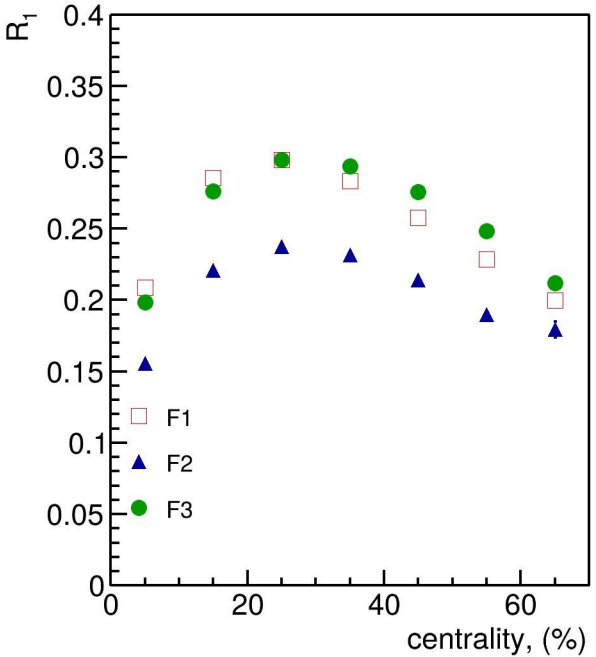


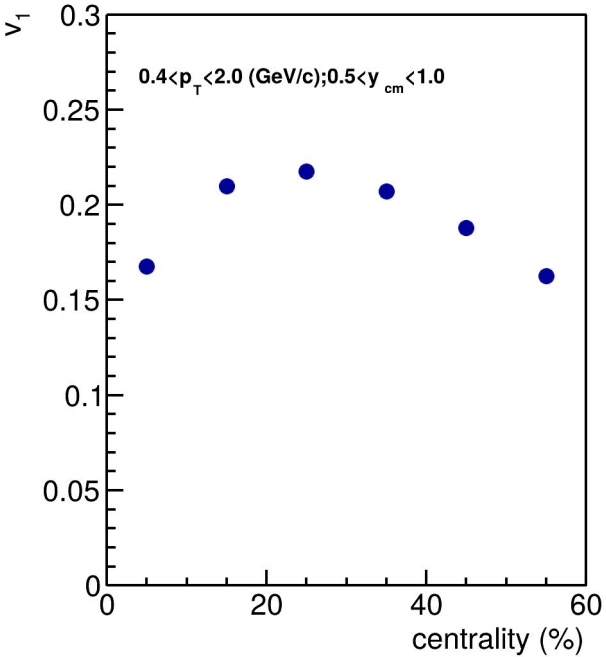
8185-8195
(8150-8200)



Physical signals (p_T, resolution R_1 and v_1) as a function of centrality



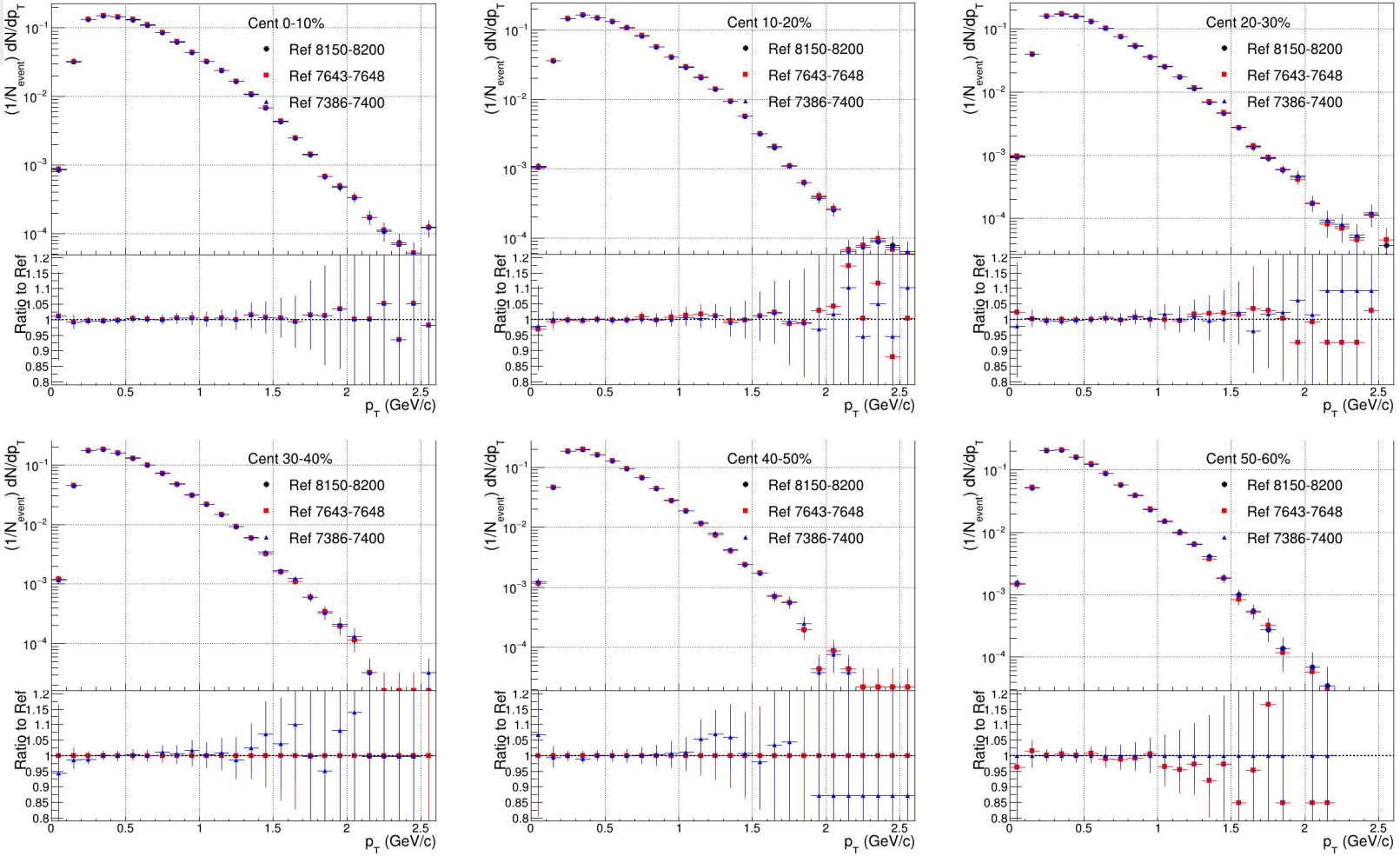




Physical observables such as p_T, R_1 and v1 depend on centrality

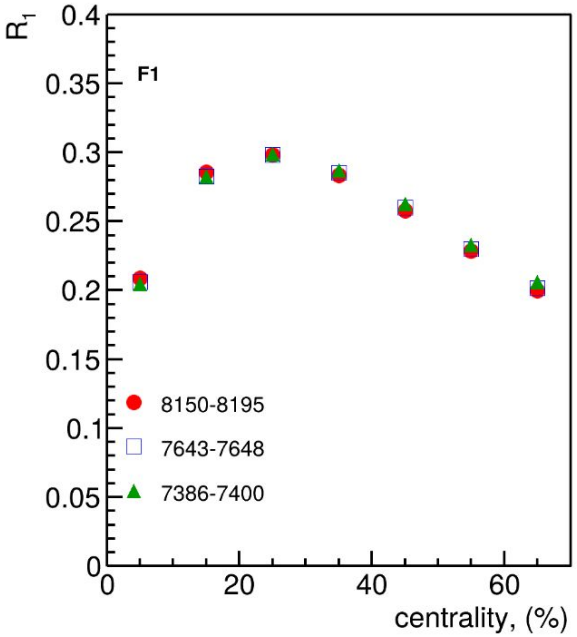
We use this to test different Reference RunId ranges

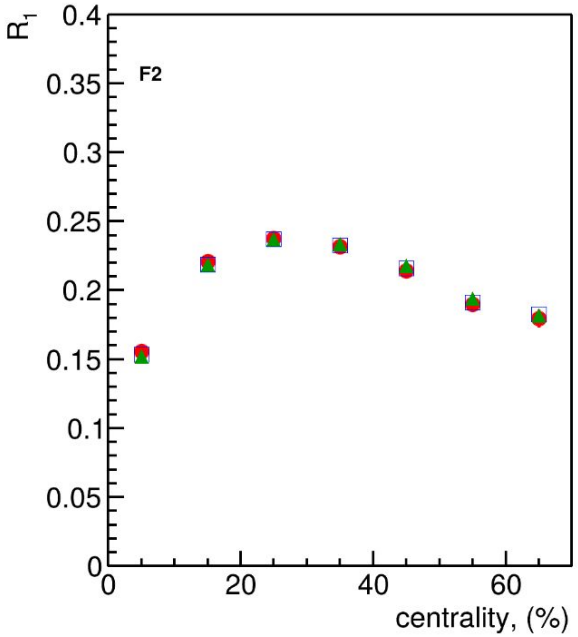
p_T-spectr
Proton
0.4<y<0.8
Run 8195

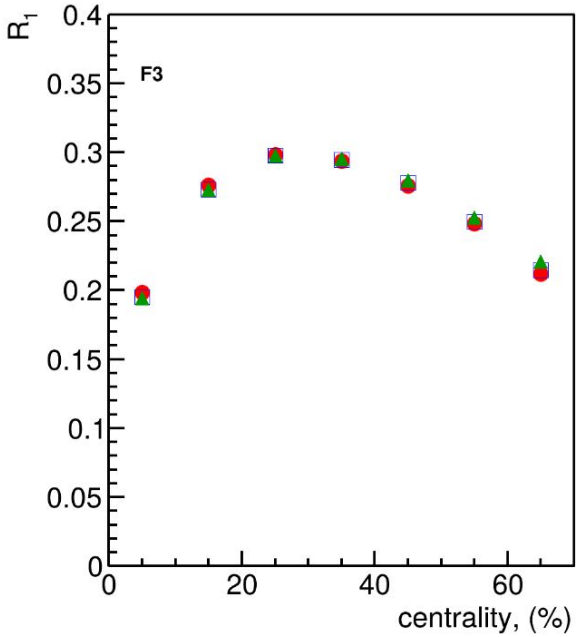


An agreement between different Reference RunId ranges (1-5%)

R1 for different RefRunId in centrality determination

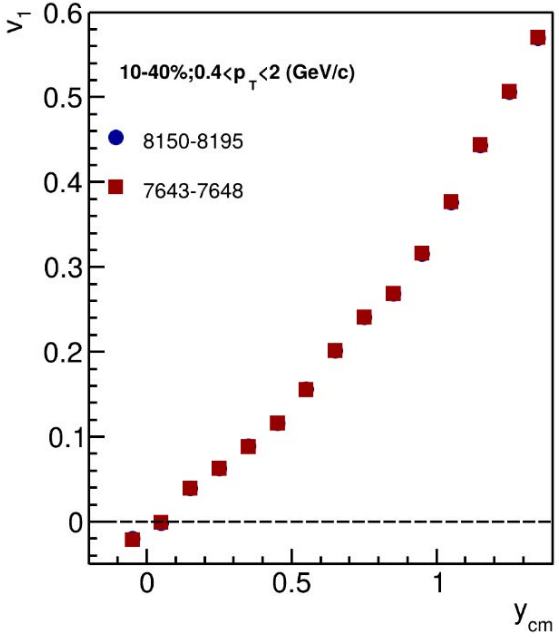


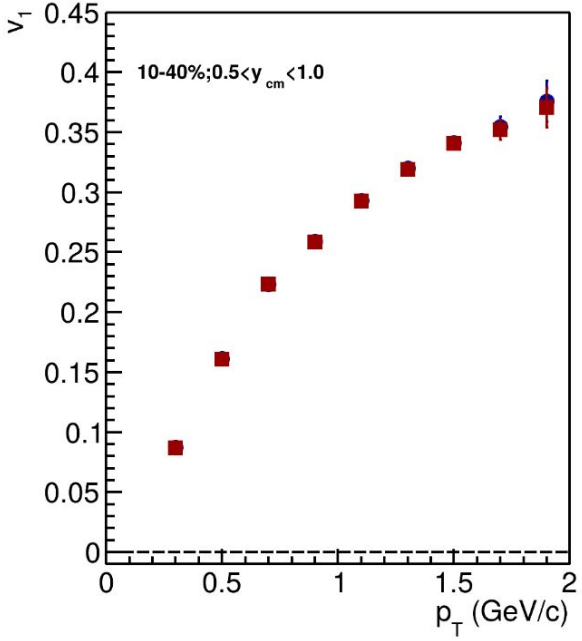


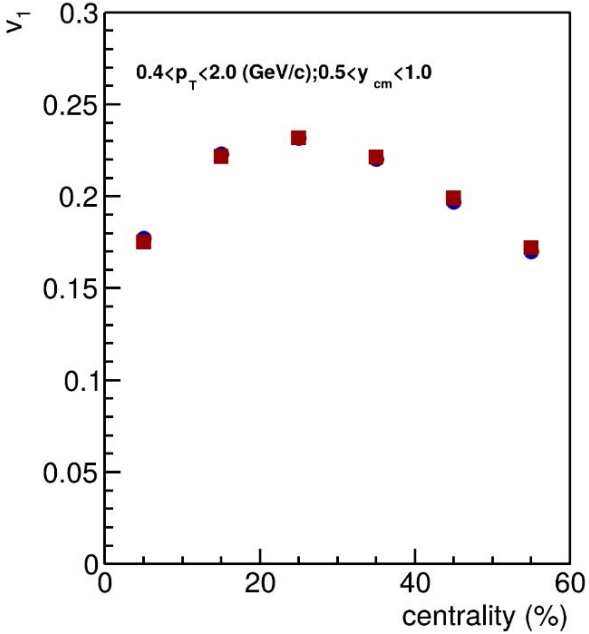


An agreement between different Reference RunId ranges (1-3%)

v1 for different RefRunId in centrality determination

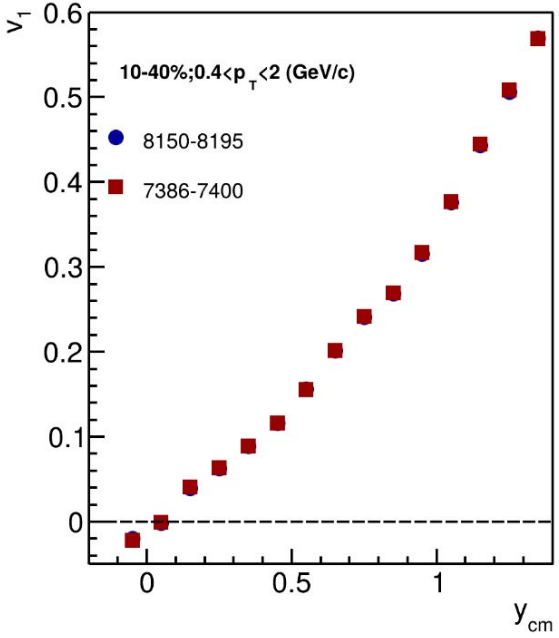


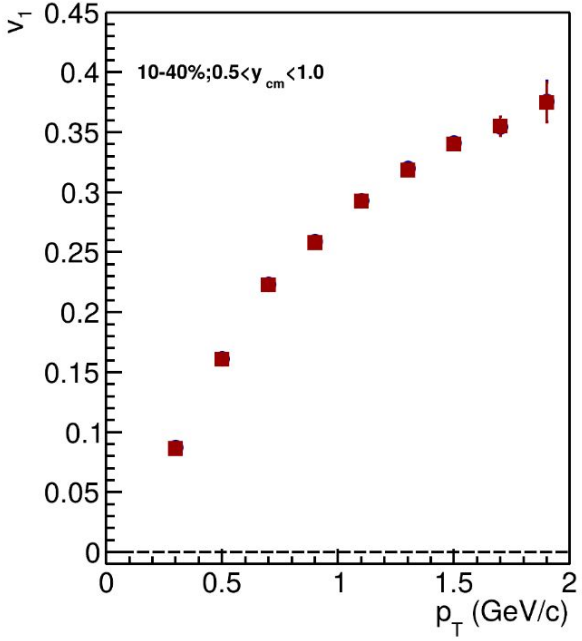


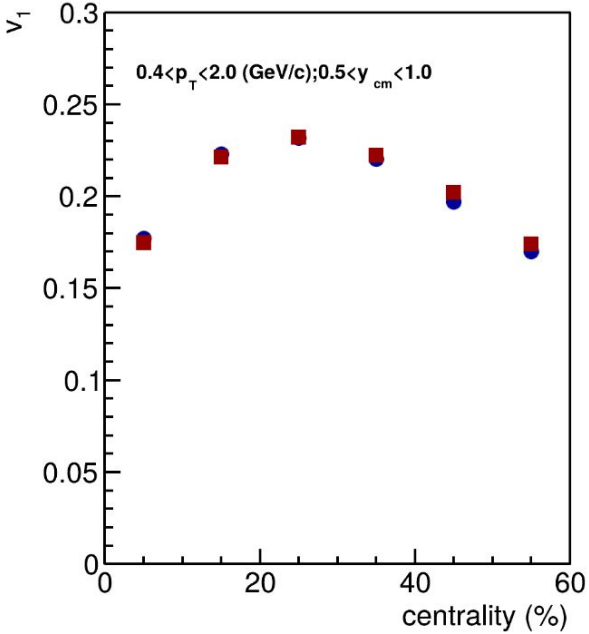


An agreement between different Reference RunId ranges (1-3%)

v1 for different RefRunId in centrality determination

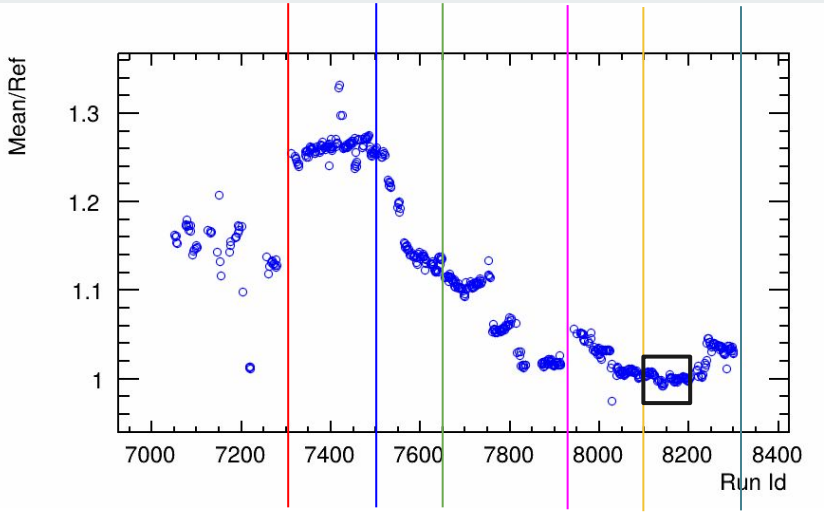




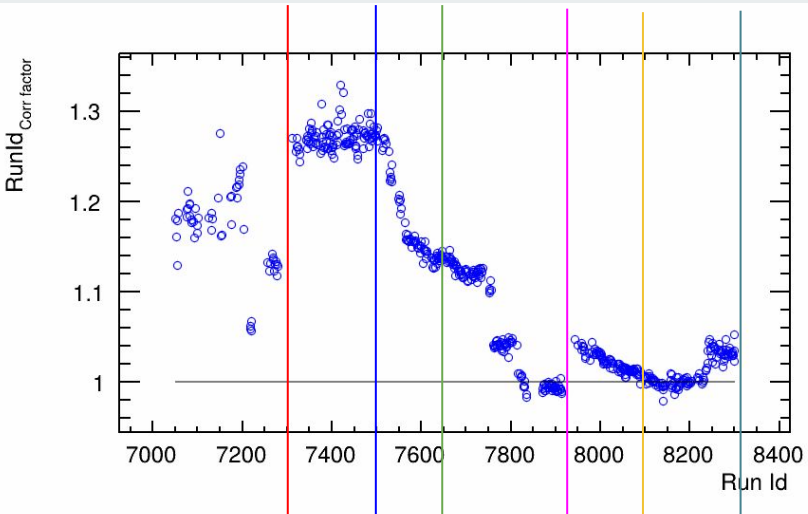


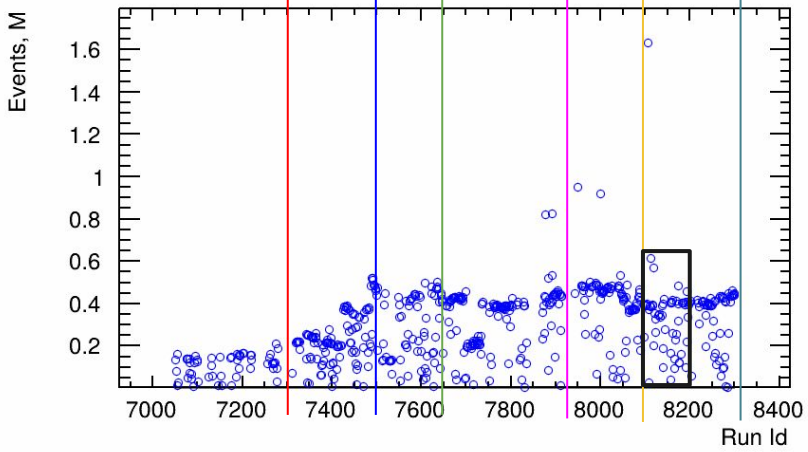
An agreement between different Reference RunId ranges (1-3%)

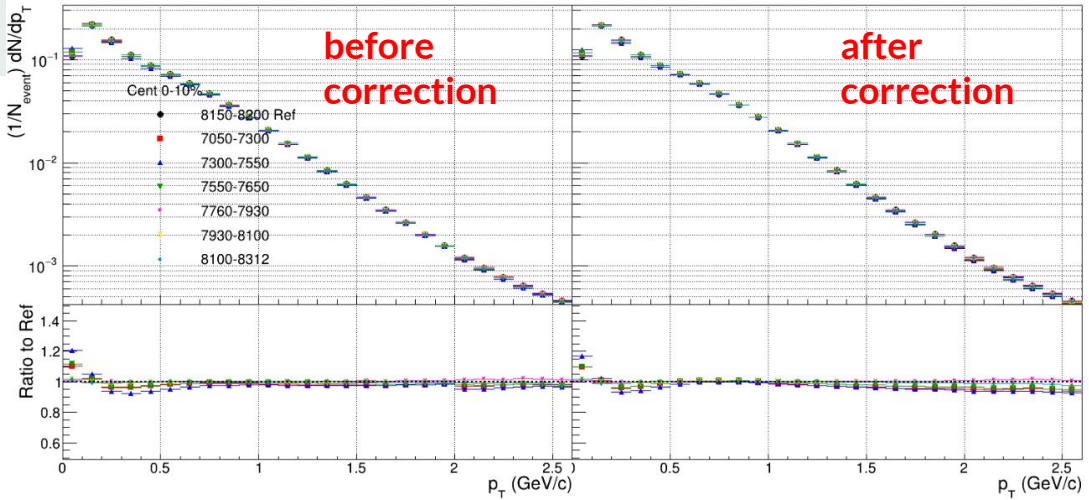
Various RunId groups

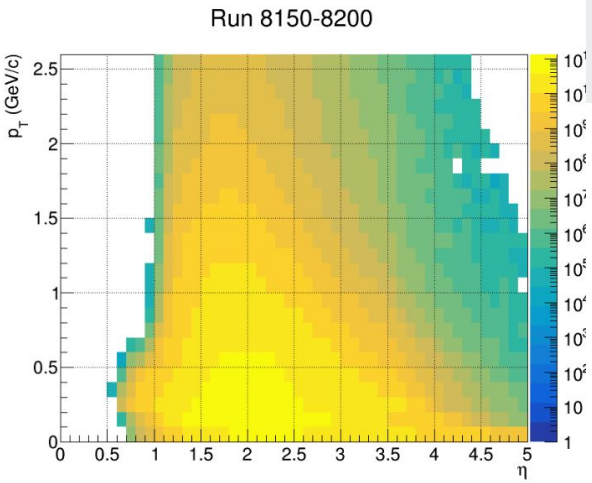

Mean/Ref
1.3
1.2
1.1
1
7000
7200
7400
7600
7800
8000
8200
8400
Run Id

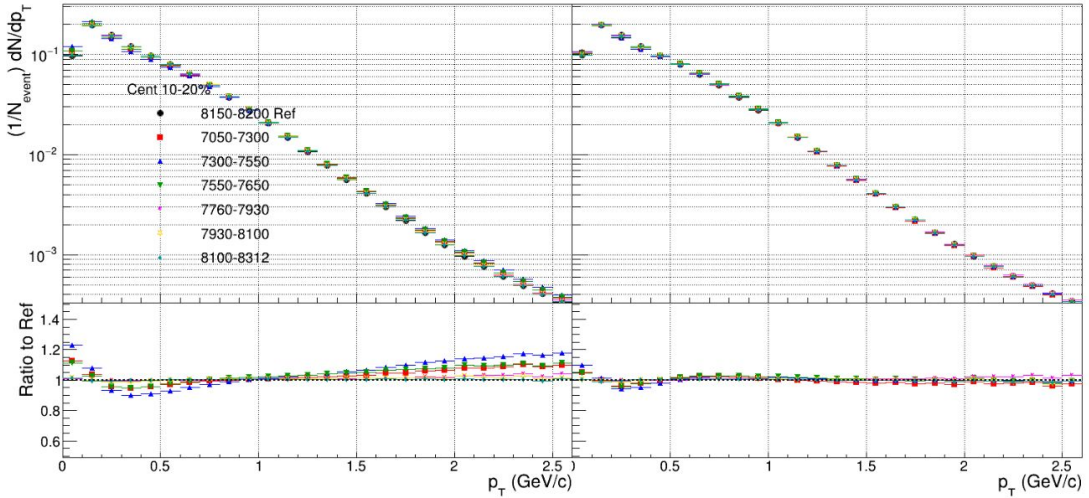

8150-8200 Ref
7050-7300
7300-7550
7550-7650
7760-7930
7930-8100
8100-8312

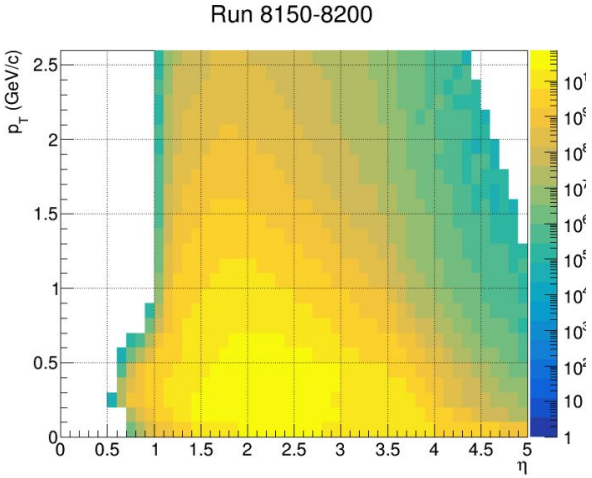

RunId$_{Corr\ factor}$
1.3
1.2
1.1
1
7000
7200
7400
7600
7800
8000
8200
8400
Run Id

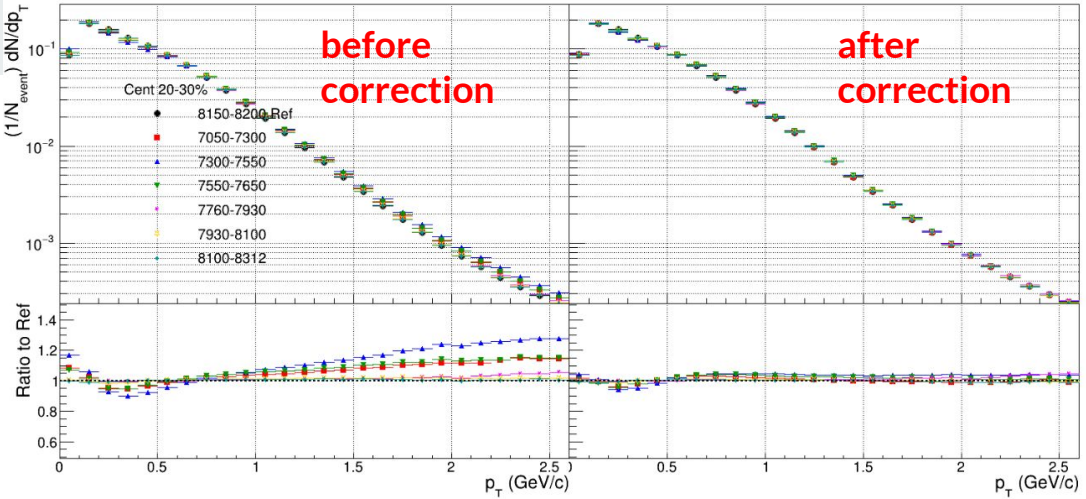

Events, M
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
7000
7200
7400
7600
7800
8000
8200
8400
Run Id

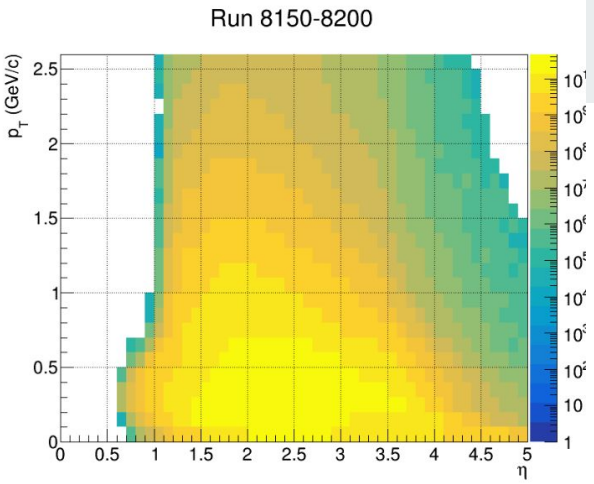

before correction
after correction
Cent 0-10%
8150-8200 Ref
7050-7300
7300-7550
7550-7650
7760-7930
7930-8100
8100-8312
Ratio to Ref
p_T (GeV/c)

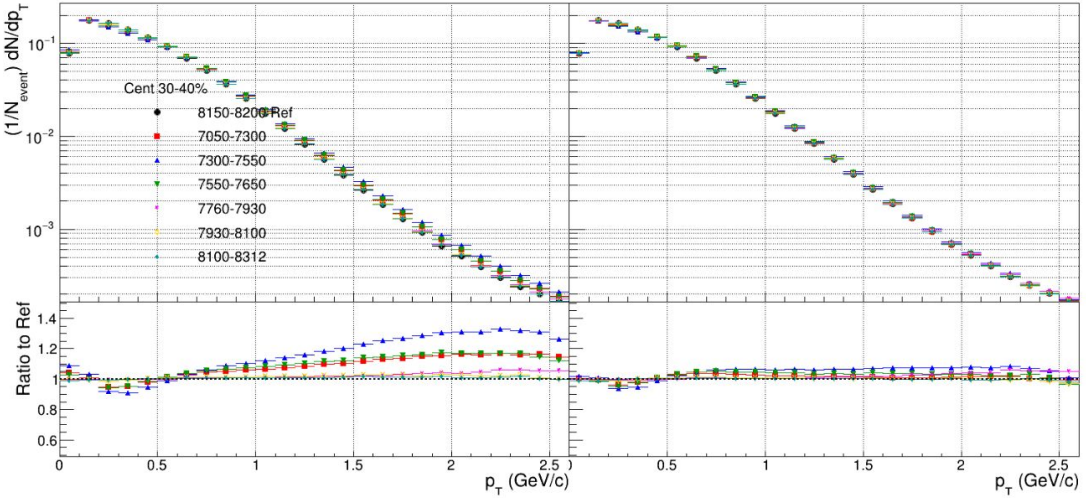

Run 8150-8200
p_T (GeV/c)
η

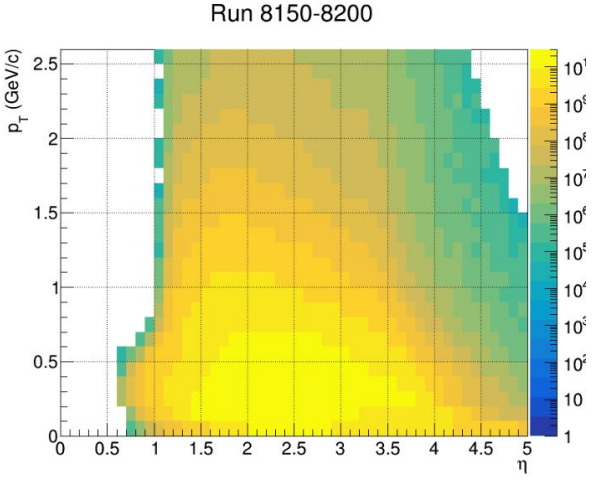

Cent 10-20%
8150-8200 Ref
7050-7300
7300-7550
7550-7650
7760-7930
7930-8100
8100-8312
Ratio to Ref
p_T (GeV/c)

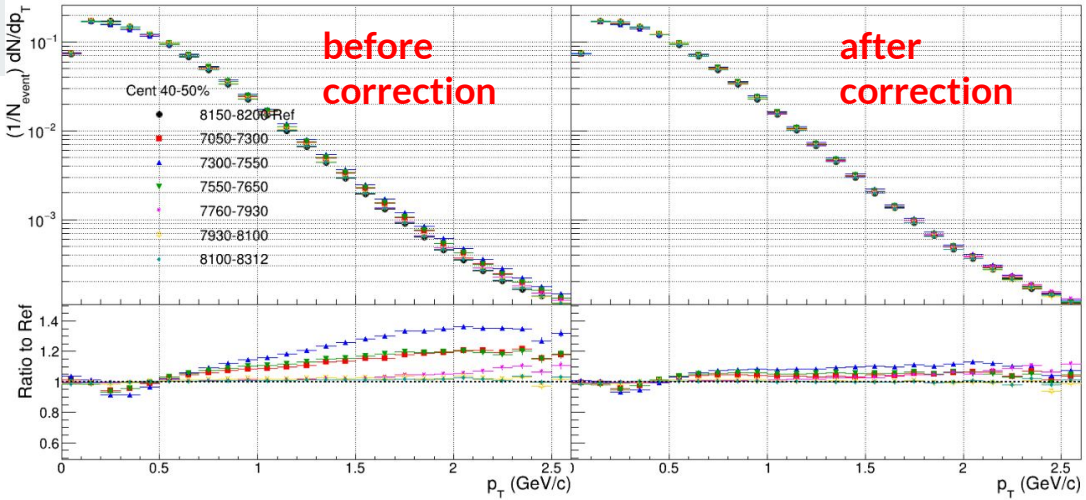

Run 8150-8200
p_T (GeV/c)
η

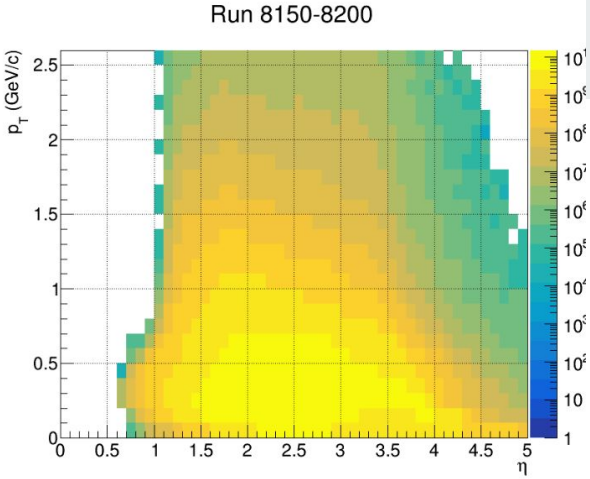

before correction
after correction
Cent 20-30%
8150-8200 Ref
7050-7300
7300-7550
7550-7650
7760-7930
7930-8100
8100-8312
(1/N_event) dN/dp_T
Ratio to Ref
p_T (GeV/c)

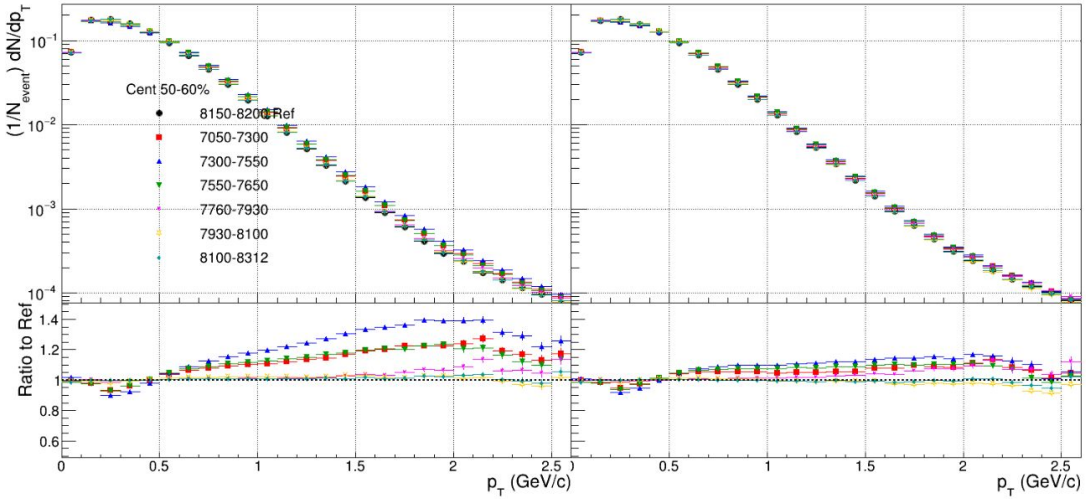

Run 8150-8200
p_T (GeV/c)
η

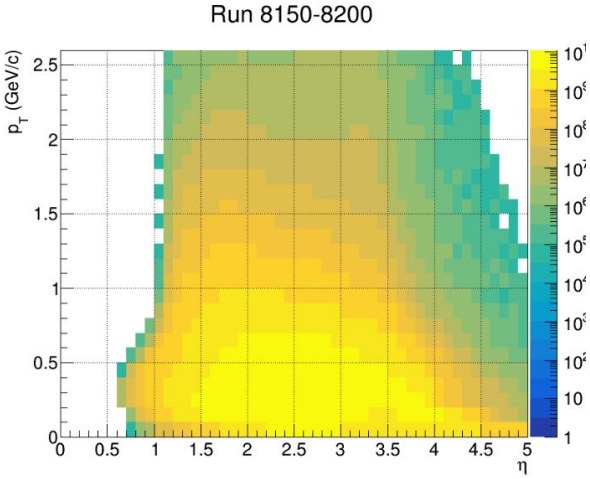

Cent 30-40%
8150-8200 Ref
7050-7300
7300-7550
7550-7650
7760-7930
7930-8100
8100-8312
(1/N_event) dN/dp_T
Ratio to Ref
p_T (GeV/c)


Run 8150-8200
p_T (GeV/c)
η


before correction
after correction
Cent 40-50%
8150-8200 Ref
7050-7300
7300-7550
7550-7650
7760-7930
7930-8100
8100-8312
$(1/N_{event})\ dN/dp_T$
Ratio to Ref
p_T (GeV/c)


Run 8150-8200
p_T (GeV/c)
η


Cent 50-60%
8150-8200 Ref
7050-7300
7300-7550
7550-7650
7760-7930
7930-8100
8100-8312
$(1/N_{event})\ dN/dp_T$
Ratio to Ref
p_T (GeV/c)


Run 8150-8200
p_T (GeV/c)
η

Очень старые слайды

MC-Glauber parameters

Main functions: **runAndSaveNtuple(nEvents, sysA, sysB, signn, sigwidth, mind, omega, noded, fname);**

Параметр	Описание	
sysA, sysB	Ядра	Xe, Xe124, CsI, …
signn	σ_{NN} в mb; если <0, то как $\sqrt{s_{NN}}$ в ГэВ	28.0 mb
sigwidth	ширина флуктуаций σ_{NN}	sigwidth < 0 нет флуктуаций σ_{NN} sigwidth > 0 флуктуации σ_{NN} , гаус шириной sigwidth
mind	Минимальное расстояние между нуклонами (fm)	обычно 0.4
omega	Параметр NN-профиля (форма перекрытия)	0 - HS: $P(b) = \Theta(b_{max} - b)$ 0<ω<2 - Gamma: $P(b) = 1 - \Gamma(1/\omega, b^2\omega/R^2)$ 7 - HIJING 8 - PYTHIA 9-11 - Trento
noded	Шаг решетки для размещения нуклонов (fm)	≤0 - непрерывное распределение

MC-Glauber: TGlauNucleus parameters

Xe124: {fN = 124; fR = 5.431; fA = 0.5978; fW = 0; fF = 8; fZ=54; fBeta2=0.212; fBeta4=-0.018;}

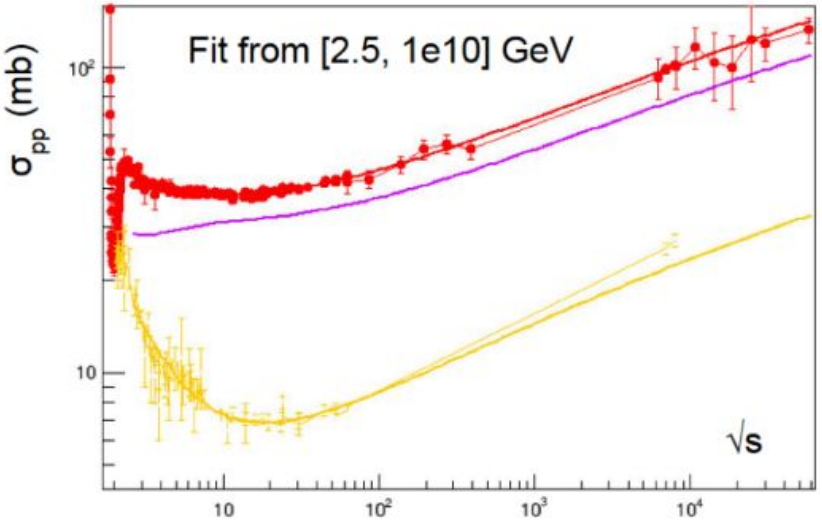
Параметр	Описание
fN	число нуклонов (A)
fZ	число протонов (Z)
fR	радиус (3pF)
fA	параметр диффузности
fW	параметр формы
fBeta2	параметр деформации β_2
fBeta4	параметр деформации β_4
fMaxR	макс. радиус (обычно 2R)
fF	тип профиля плотности (0-16, 90, 99)

fF	Профиль
0	экспоненциальный (протон)
1	3pF (Ферми)
2	3pG (гауссов)
3, 4	Хюльтен (дейтрон)
5	эллипсоид (box)
6	из файла конфигураций
7	деформированный (box + MathMore)
8	деформированный (TF2)
9, 10	гауссов / двойной гауссов протон
11	3pF раздельно p/n
12	3pF + полином (reweighted)
13	Pb reweighted p/n
14	деформированный + reweighted
15	гармонический осциллятор
16	Odat (WS + осцилляторная поправка)
90	из TGraph
99	Trajectum

Cross Section Values for FXT

Step 3

- Subtract elastic from total to get the inelastic cross section



Full

Elastic

Inelastic=Full-elastic

Proposed Nucleon+nucleon Inelastic Cross Sections for FXT

Fit from [2.5, 1e10] GeV

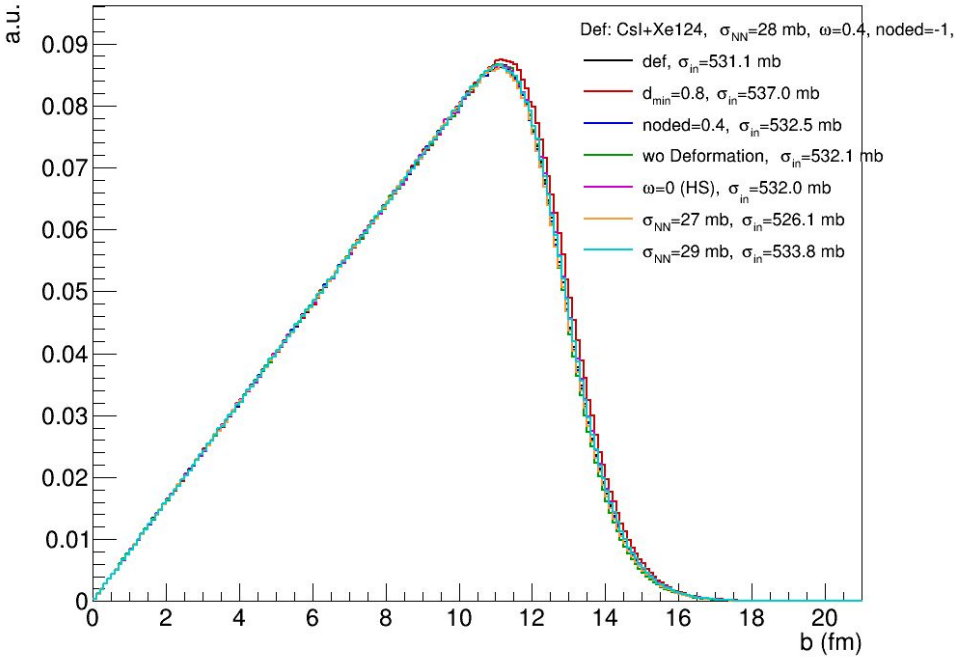
√s Energy (GeV)	σ_{inel} (mb)
3.0	28.1 +/- 0.2
3.2	28.0 +/- 0.2
3.5	28.17 +/- 0.15
3.9	28.50 +/- 0.11
4.5	29.00 +/- 0.08
5.2	29.50 +/- 0.07
6.2	30.02 +/- 0.06
7.2	30.39 +/- 0.05
7.7	30.54 +/- 0.05

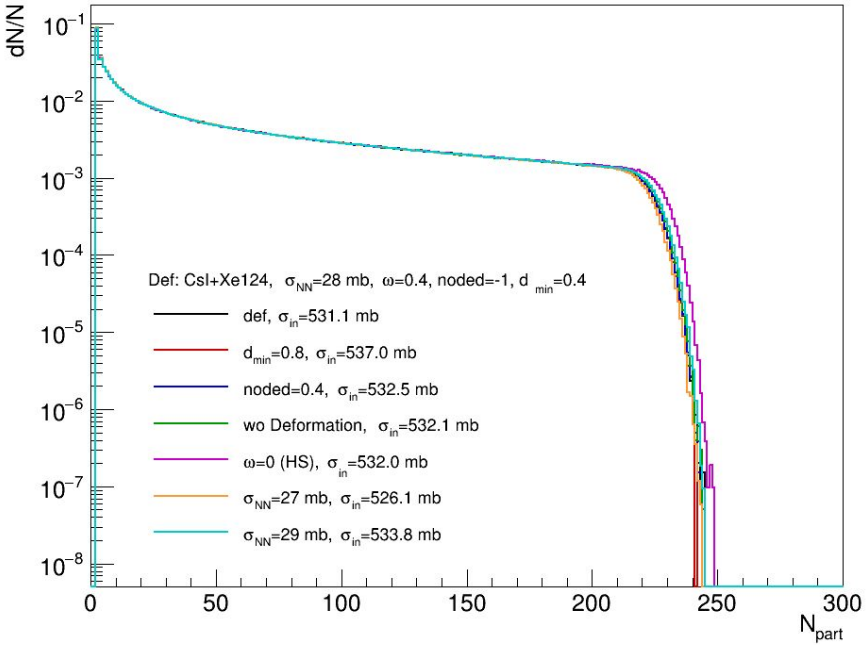
- Uncertainties calculated using a 68% confidence interval on the total cross section from the fit, propagated with the 68% ci on the elastic cross section from the fit.
- I'd appreciate an independent check on the uncertainties.

→ We've previously used 30.8 mb at 7.7 GeV

Uncertainty for extracted inelastic cross section will be revisited

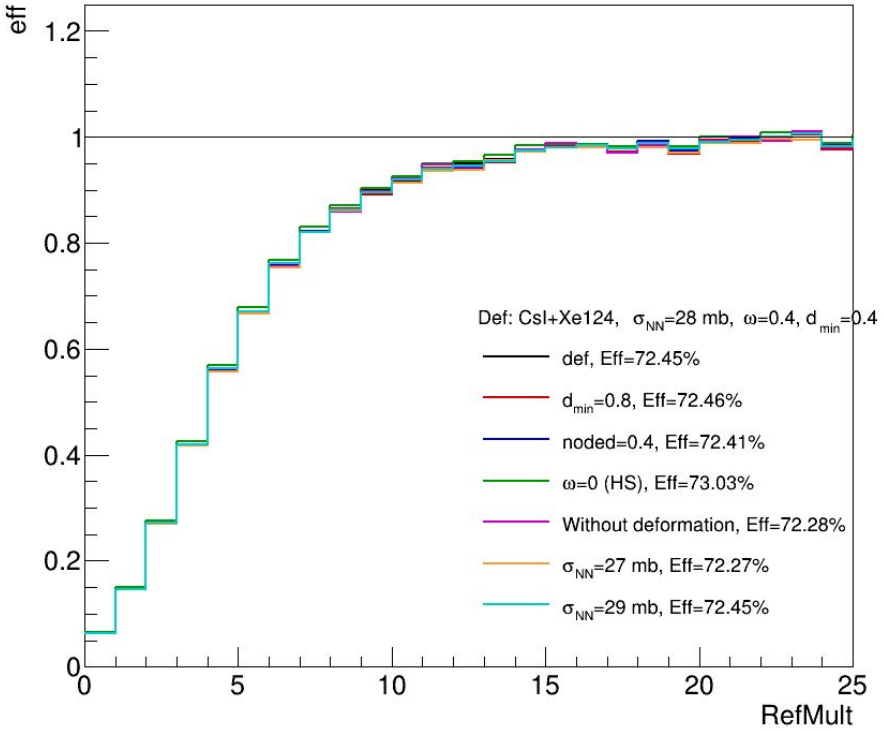
runAndSaveNtuple parametrs

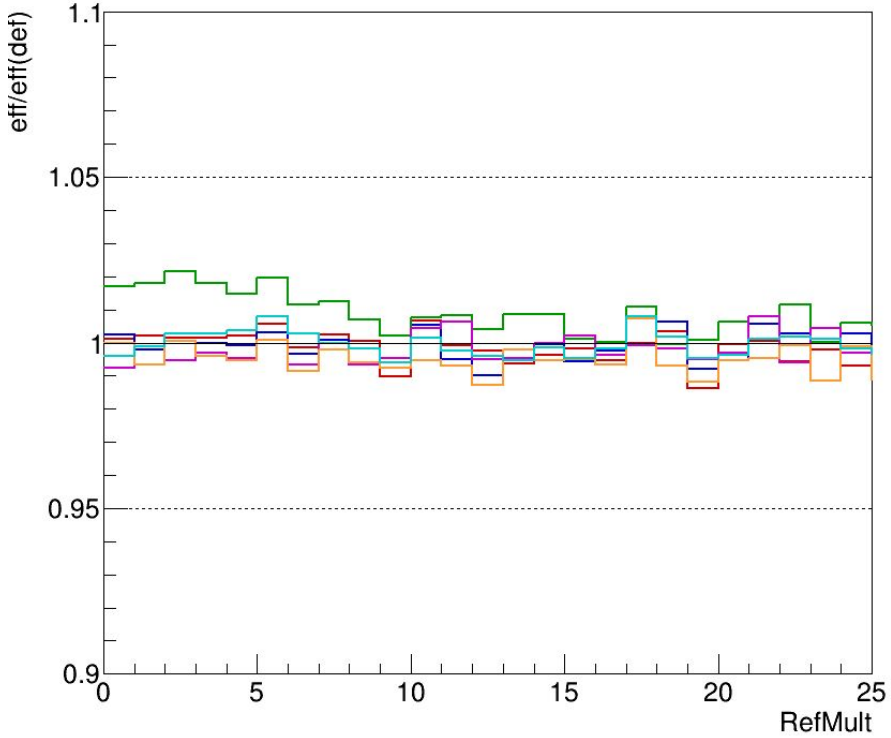




Sigma (min;max): 5260 - 5370

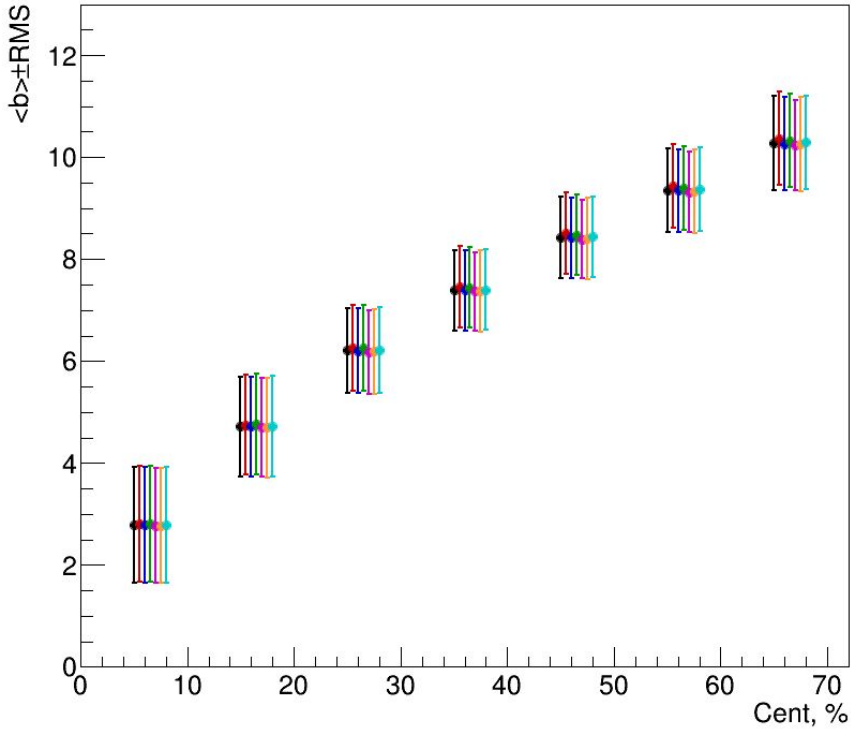
runAndSaveNtuple parametrs

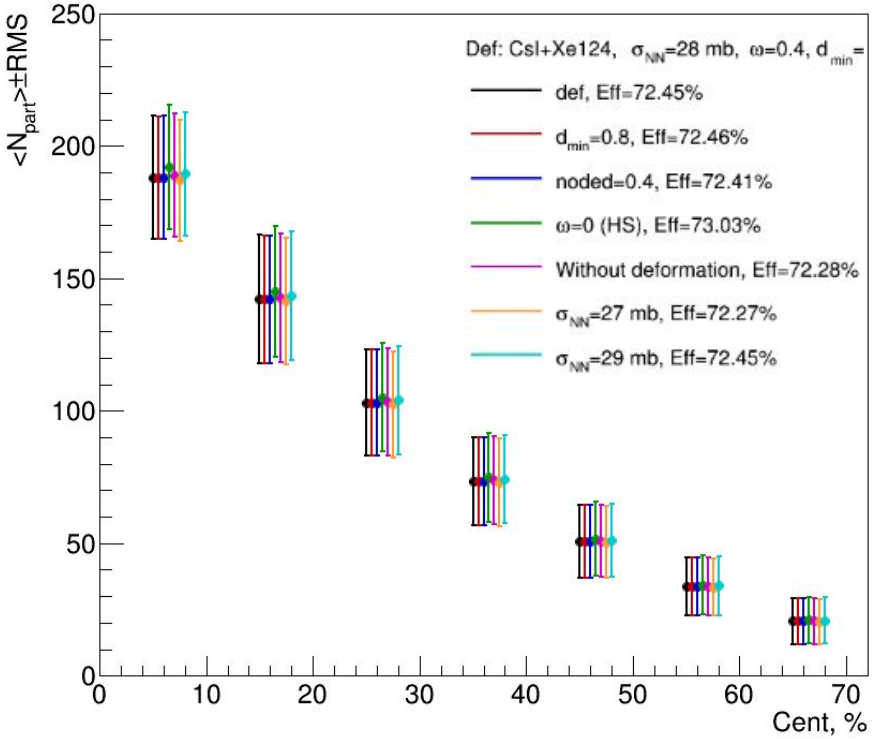




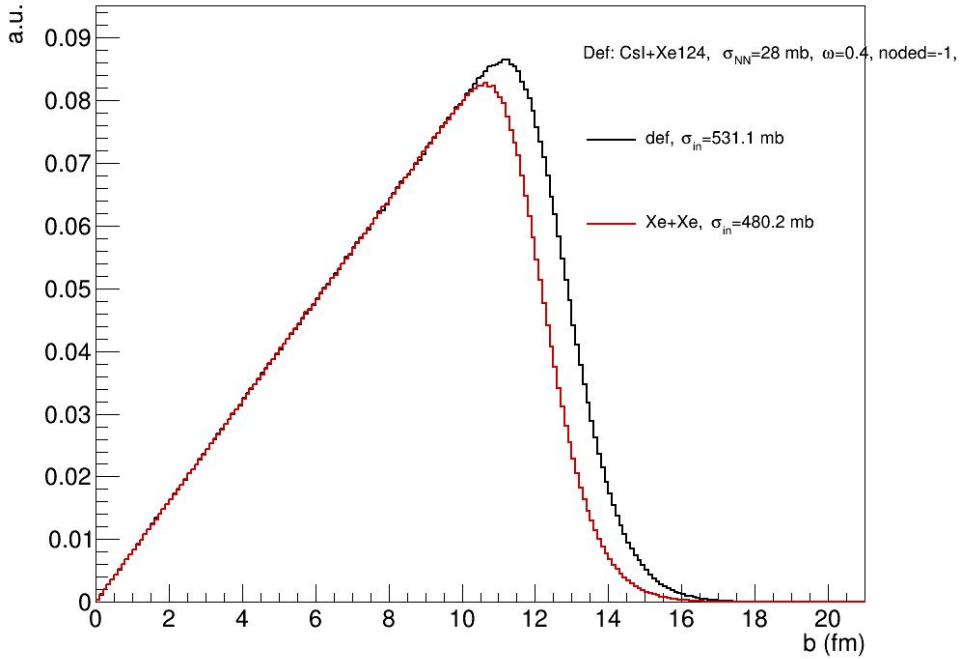
Eff: 72.27 - 73.03 %

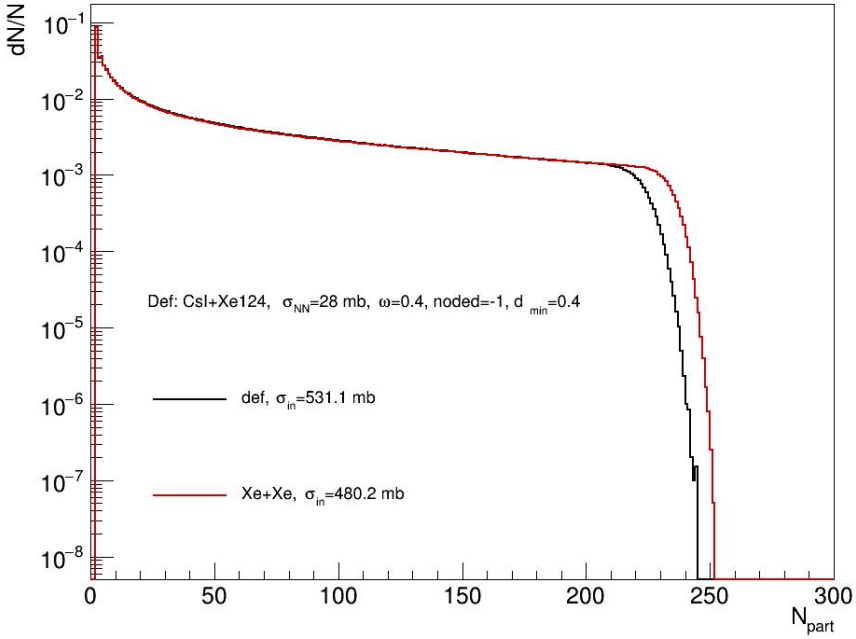
runAndSaveNtuple parametrs



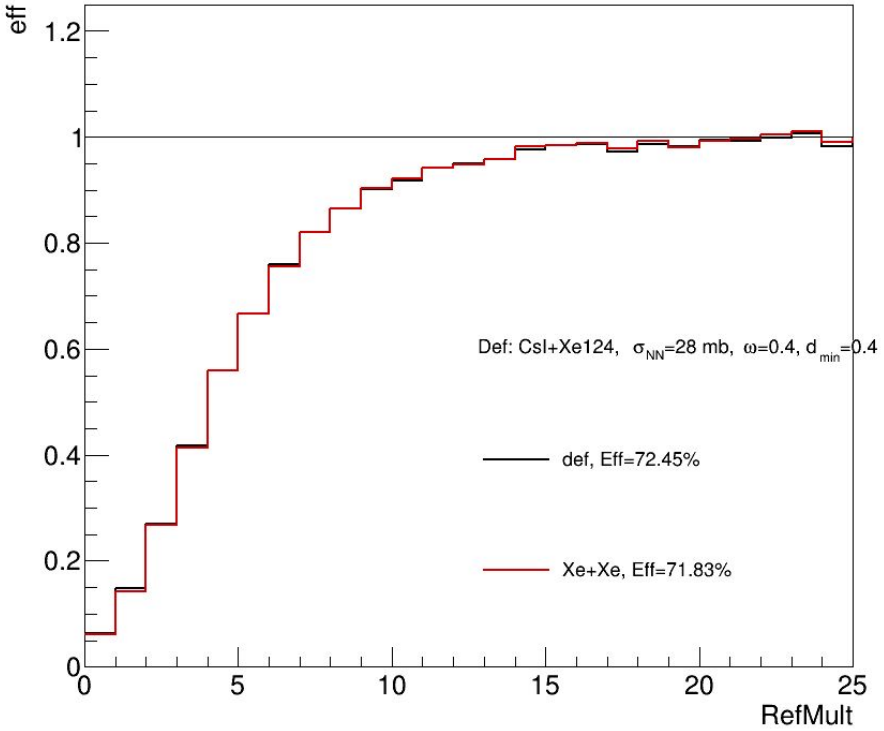


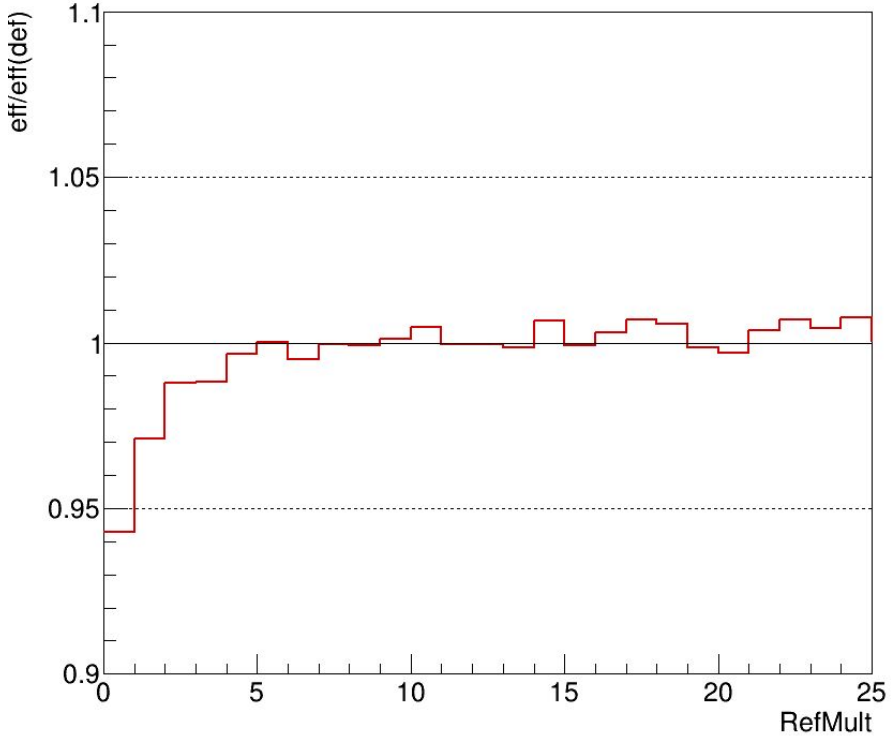
Xe+Xe vs CsI+Xe124



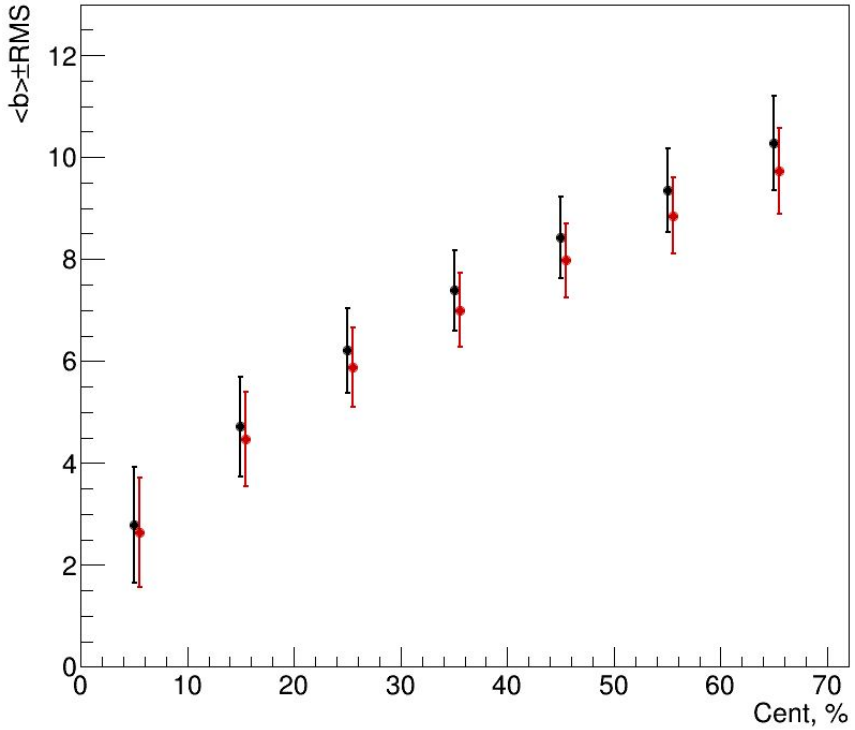


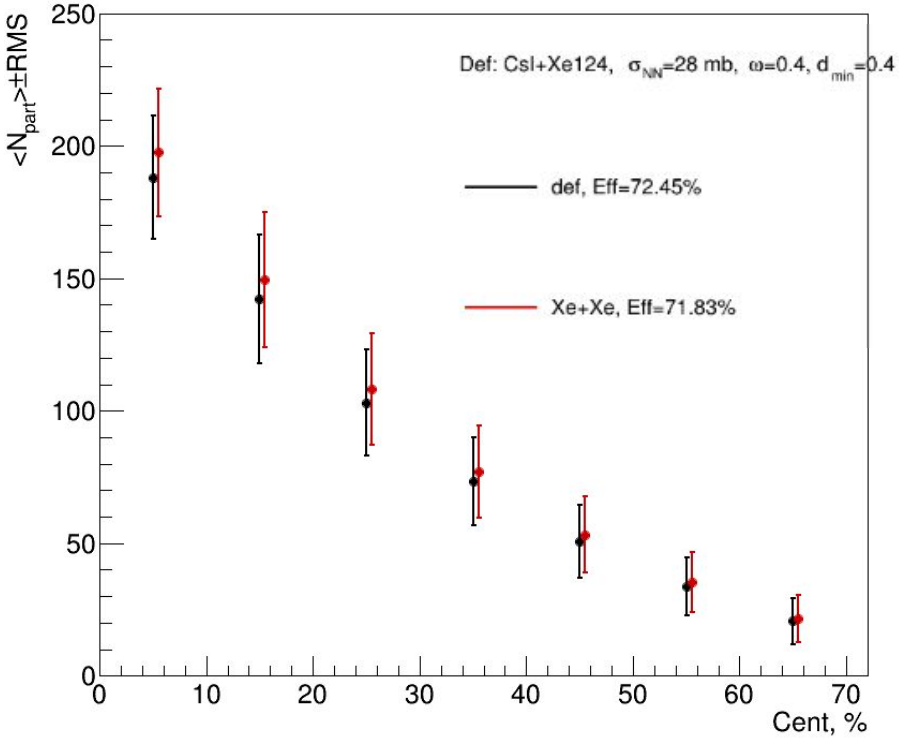
Xe+Xe vs CsI+Xe124



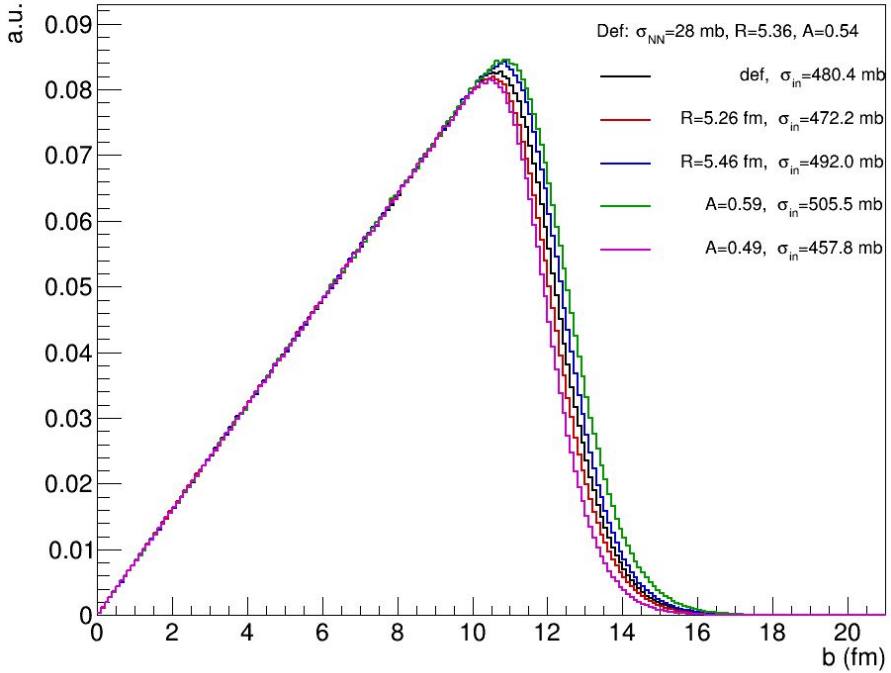


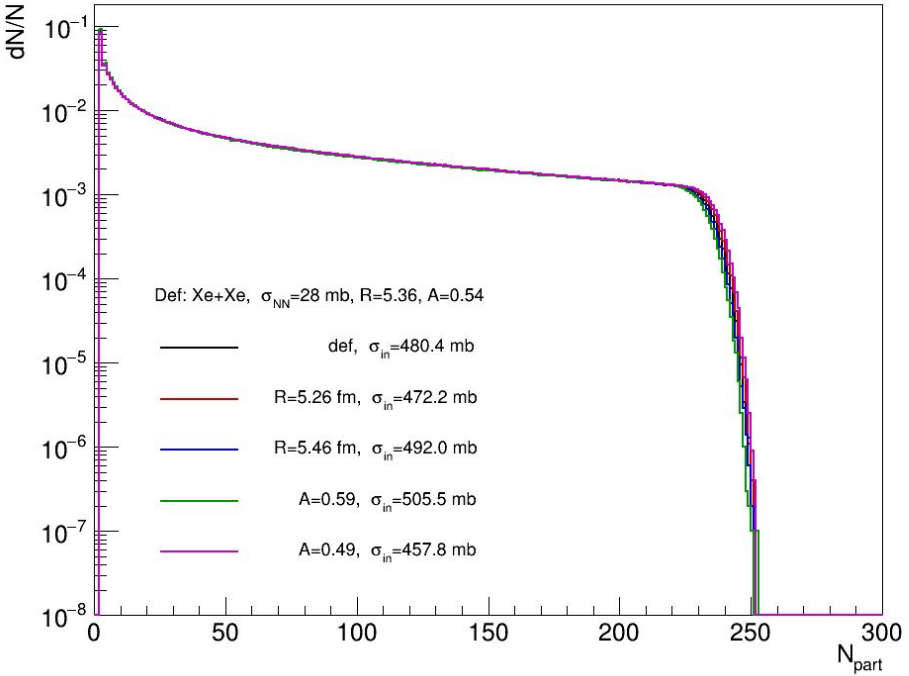
Xe+Xe vs CsI+Xe124



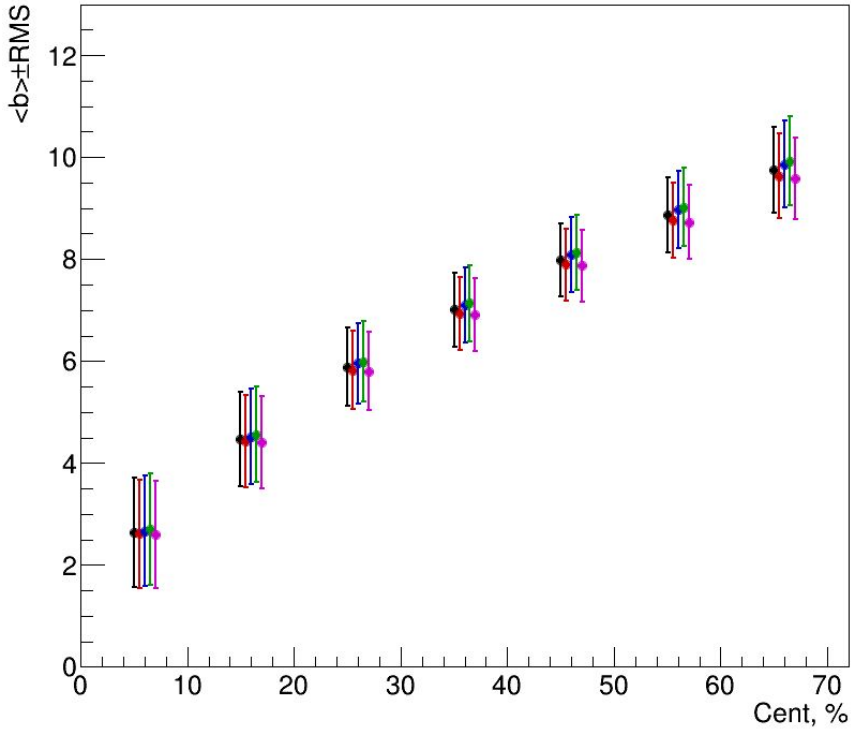


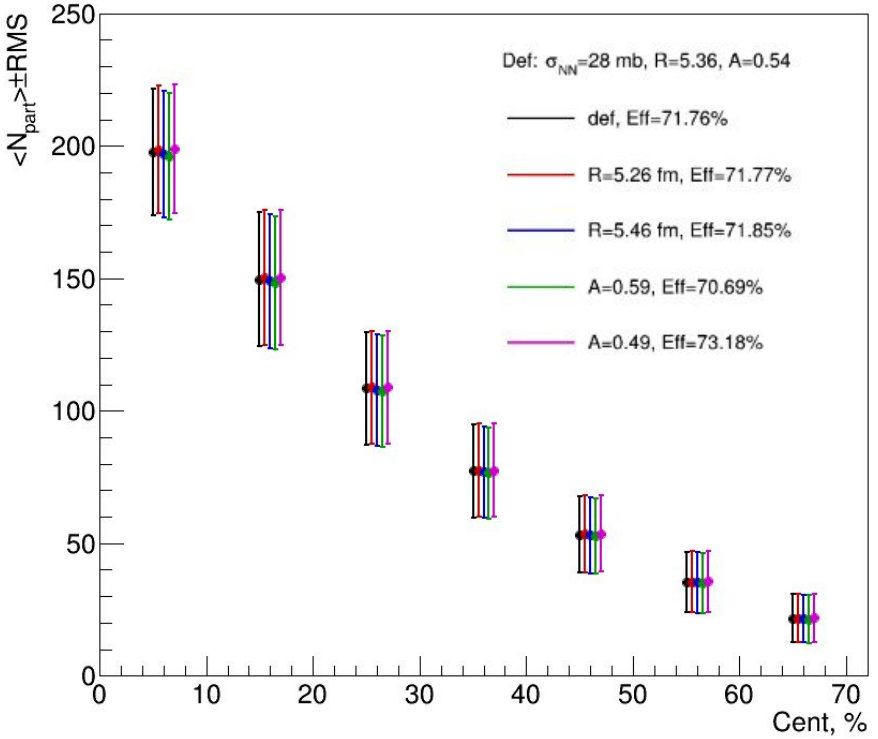
TGlauNucleus parameters (old)





TGlauNucleus parameters





Эффективность

Глаубер (из систематик)

$$\varepsilon_{\mathrm{int}}^{\mathrm{Gl}} = 72.4^{+0.9}_{-1.6}\%. \label{eq:glauber-systematic-efficiency}$$

Гамма-фит (из систематик)

$$\varepsilon_{\mathrm{int}}^{\mathrm{Gl}} = 72.8^{+1.1}_{-1.4}\,\%, \label{eq:gamma-systematic-efficiency}$$