Inclusive photo production of ϕ and K^{*0} in UPC Pb-Pb collisions at 5.36 TeV

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Outline :

1. Introduction
2. Motivation
3. Analysis details
4. Results
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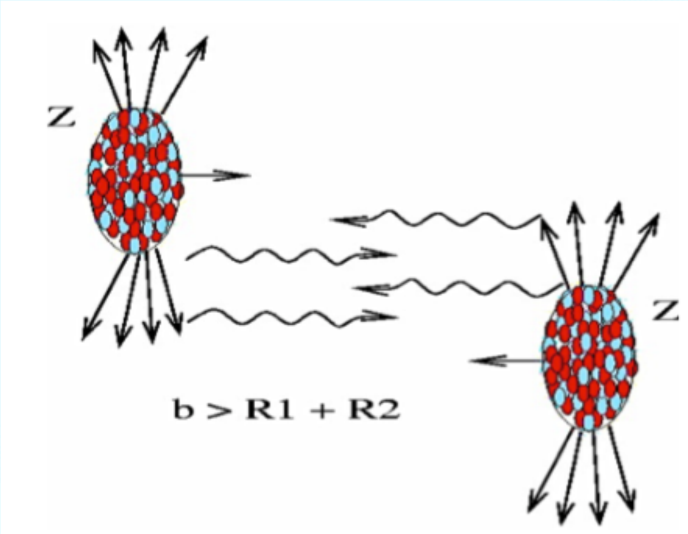
Introduction

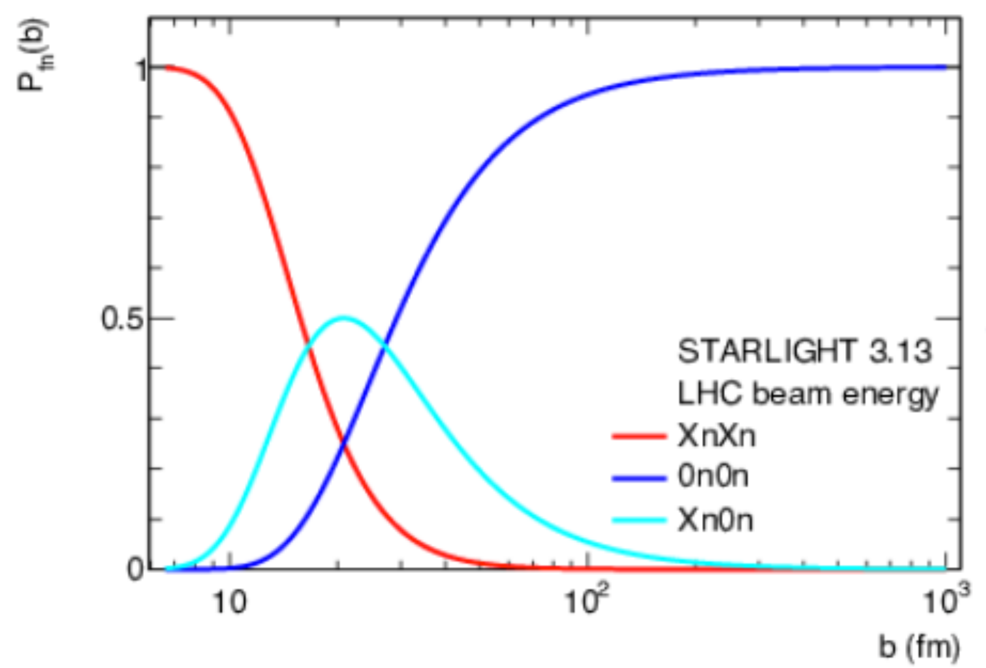
Ultra-peripheral collisions



➡Boosted nuclei and strong EM fields: source of virtual photons

➡Z^2 enhancement of cross sections for A w.r.t. p beams

➡ Photon can fluctuate into quark-antiquark pair (dipole) that scatters elastically from a target nucleus, emerging as a real vector meson



➡Coherent and incoherent vector meson photo-production

- ➡ **Coherent**: photon couples coherently to all nucleons (whole nucleus)
- ➡ **Incoherent**: photon couples to a single nucleon , target ion breaks, usually neutron emission

0n0n : no activity in either ZDC arm

Xn0n: activity in one ZDC arm

XnXn: activity in both ZDC arms

https://www.annualreviews.org/doi/10.1146/annurev-nucl-030320-033923

Motivation

Inclusive non-diffractive photoproduction of ρ(770)0, K*(892)0 and ϕ(1020) mesons in ep collisions at HERA

❖ γp CMS energy = 210 GeV

❖ The spectra is fitted with Power-law function

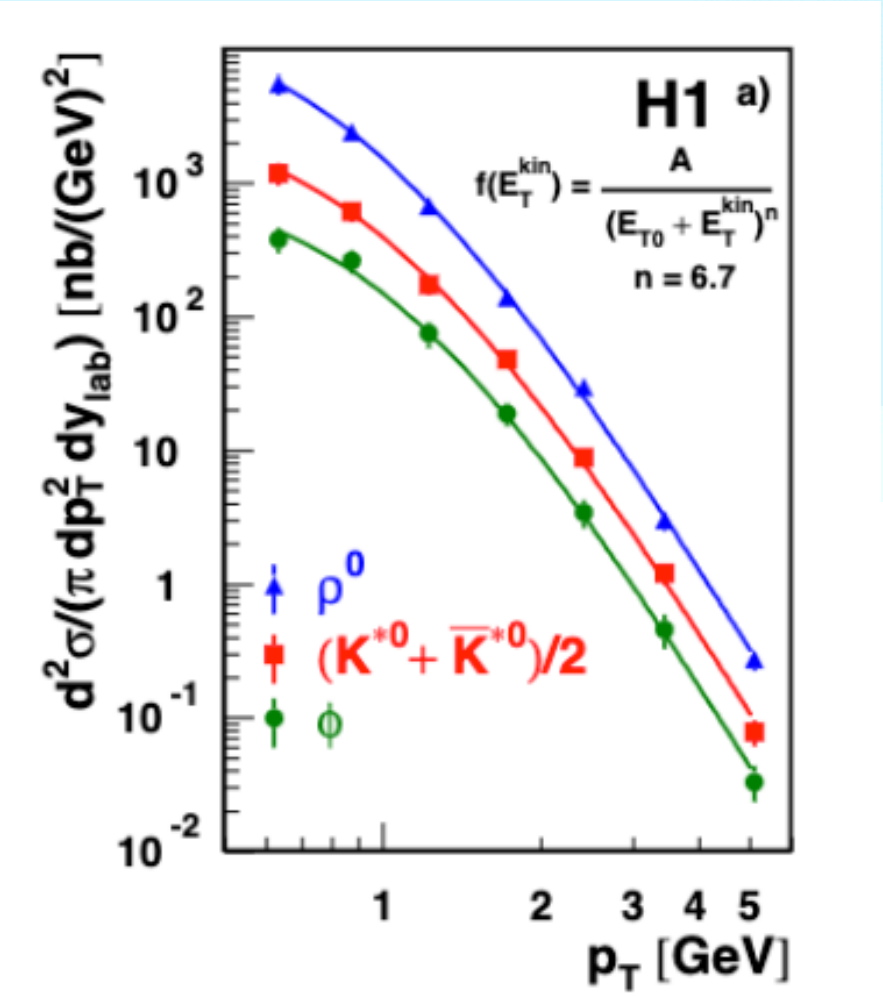
❖ Irrespective of their mass and lifetime these resonance are produced at the same average transverse kinetic energy, which supports a thermodynamic picture of hadronic interactions.

$$E_T^{Kin} = \sqrt{m_0^2 + p_T^2} - m_0$$

	ρ	K^{*0}	ϕ
$< E_T^{Kin} >$	0.287 ± 0.018	0.313 ± 0.020	0.314 ± 0.022

Experiment	Measurement	$R(\phi/K^{*0})$
H1	γp, $\langle W \rangle = 210$ GeV, $\lvert y_{lab} \rvert < 1$	0.354 ± 0.060
STAR	pp, $\sqrt{s} = 200$ GeV, $\lvert y \rvert < 0.5$	0.35 ± 0.05
	Au-Au, $\sqrt{s_{NN}} = 200$ GeV, $\lvert y \rvert < 0.5$	0.63 ± 0.15
ALICE	pp 5.02 TeV |y| < 0.5	0.346
	pp 13 TeV |y| < 0.5	0.356
	p-Pb 8.16 TeV |y| < 0.5	0.406
	Pb-Pb 5.02 TeV |y| < 0.5 (70-80 %)	0.476
	Pb-Pb 5.02 TeV |y| < 0.5 (0-10 %)	0.757

*ALICE and STAR results are for hadronic interaction



https://doi.org/10.1016/j.physletb.2009.02.016

Data set and Analysis details

Data Set : UD_LHC23_pass2_upc_SingleGap_final (Train no. 205481)

Event Selection :

Only PV Tracks

Eta range of tracks: $|\eta| < 0.9$

Max No. of tracks: 150

1. Double gap

   FT0A Amplitude < 50 & ZNA Energy < 1

   FT0C Amplitude < 100 & ZNC Energy < 1

2. Single gap events

   1. Gap Side A:

      FT0A & FV0A Amplitude < 50 & ZNA Energy < 1

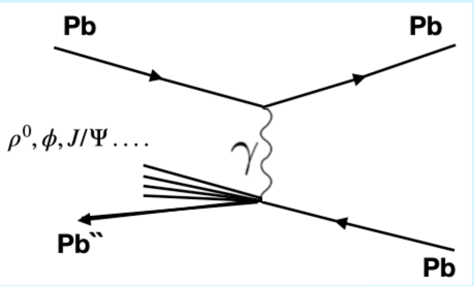
      FT0C Amplitude > 100 || ZNC Energy > 1

   2. Gap Side C:

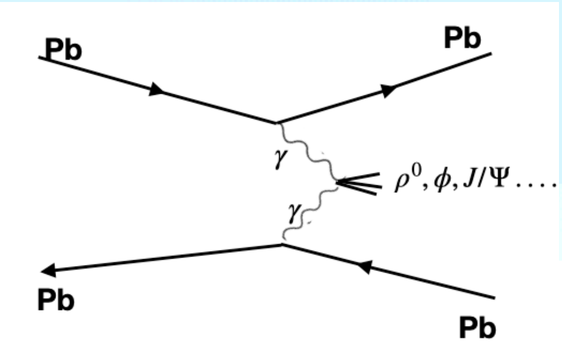
      FT0C Amplitude < 100 & ZNC Energy < 1

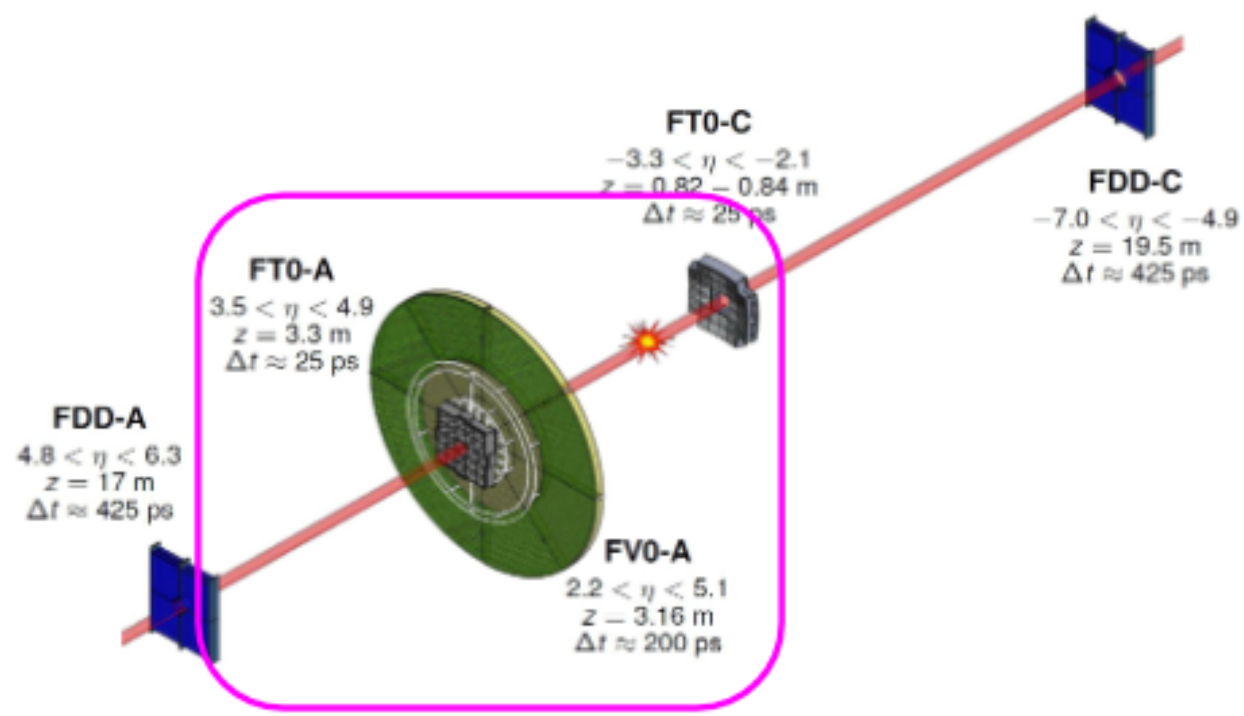
      FT0A > 50 || FV0A > 50 || ZNA Energy > 1

Single gap events



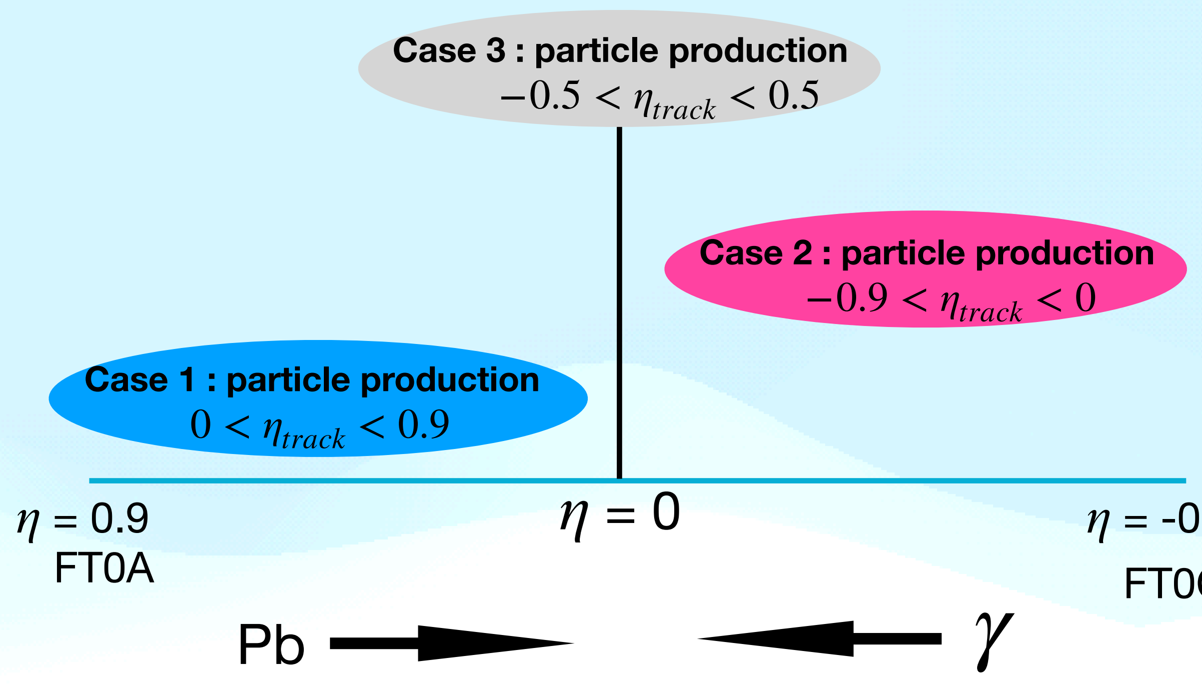
Double gap events





Events and Track Selection

Gap Side A : Pb-γ collisions



Event are further divided according to the cut on track η

1. $0 < \eta_{track} < 0.9$ (no track in other η region)
2. $-0.9 < \eta_{track} < 0$ (no track in other η region)
3. $-0.5 < \eta_{track} < 0.5$ (no track in other η region)

Track Selection criteria:

DCA_z < 0.1 cm

χ^2_{TPC}/cluster < 4

χ^2_{ITS}/cluster < 36

TPCNClsFindable() > 70

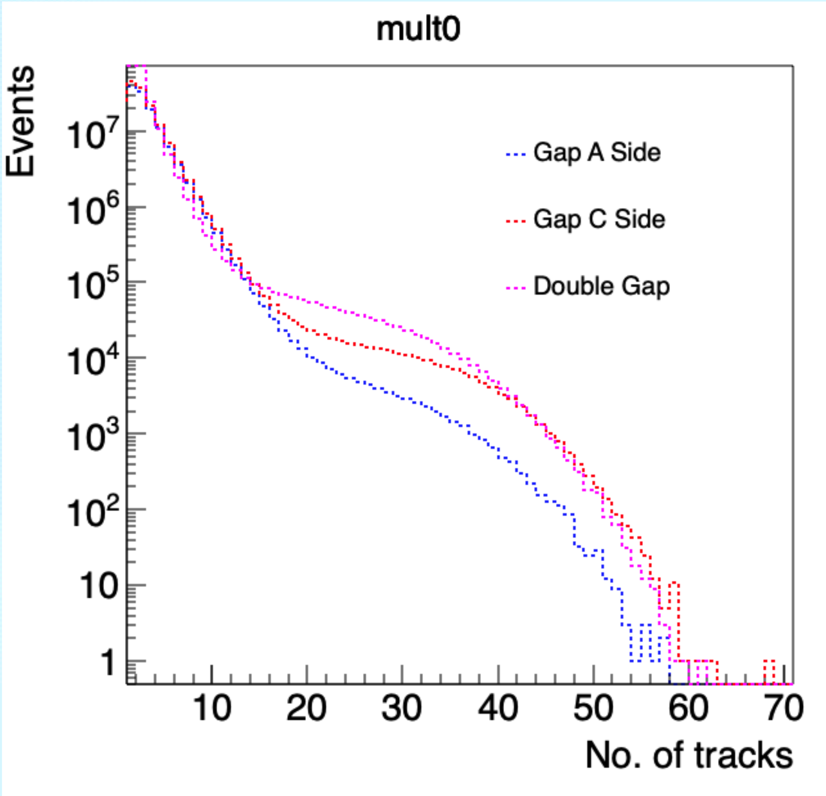
p_T > 0.15 GeV/c

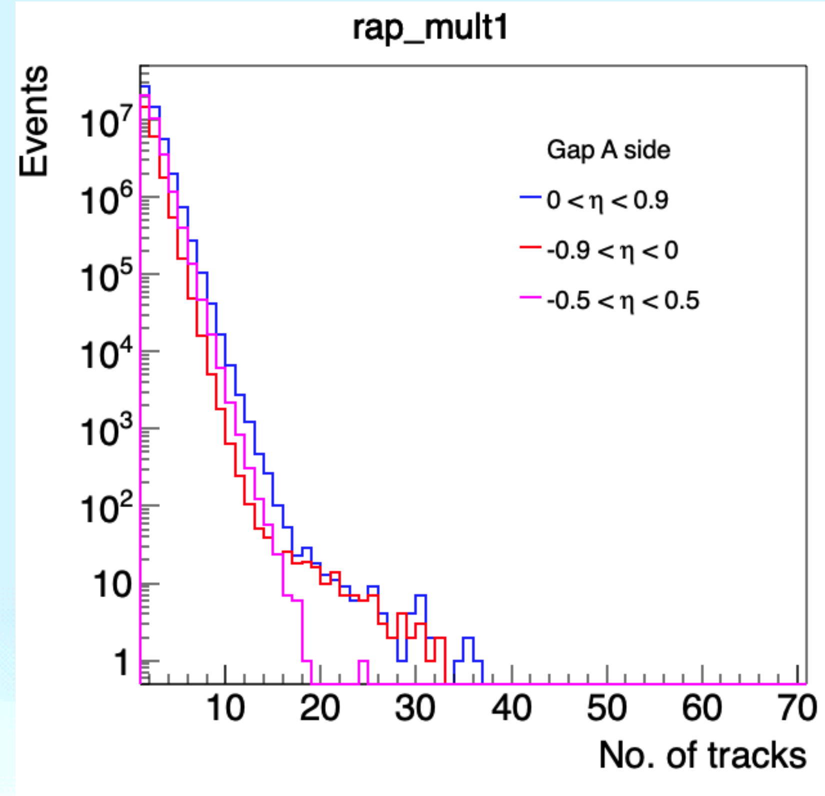
Particle Selection: TPC $n\sigma$ < 3 (only TPC tracks),

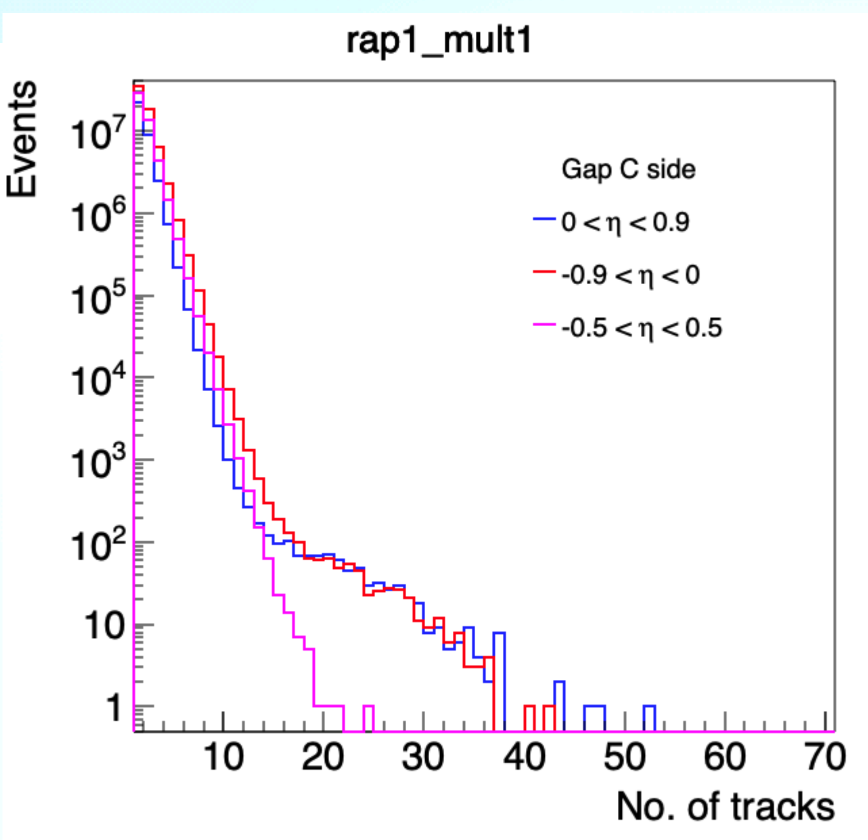
If TOF information is available : $\sigma^2_{TPC} + \sigma^2_{TOF} < 9$

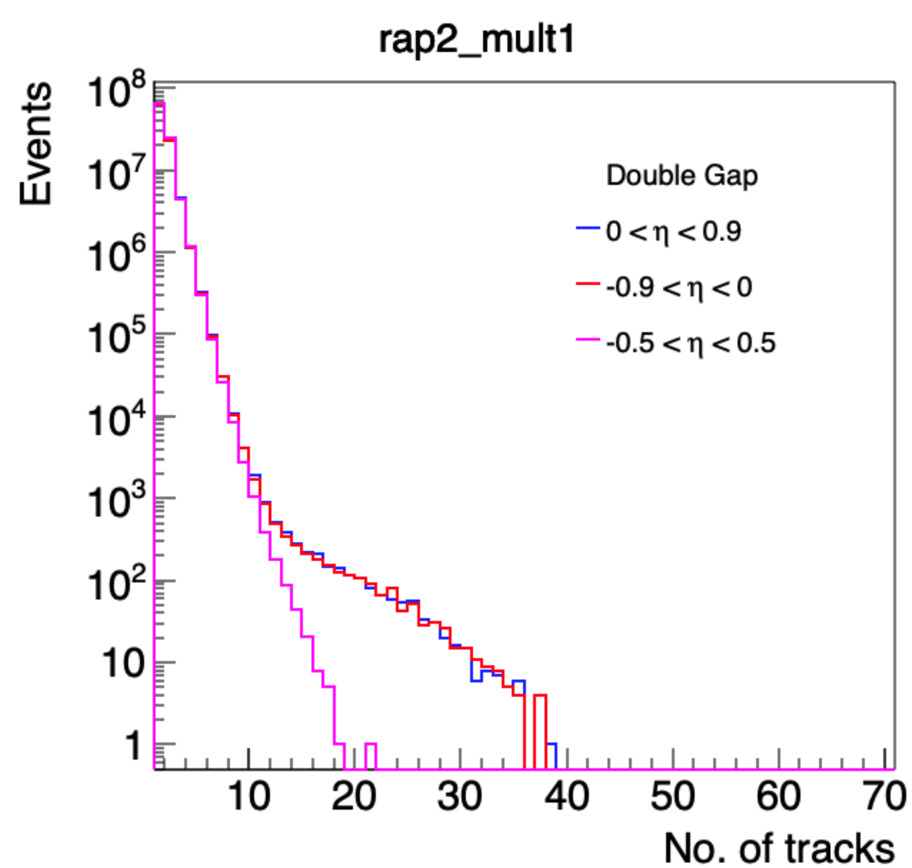
	Gap A Side	Gap C Side	Double Gap
Total Event	83.3m	104m	127m
0<η< 0.9	23.6m	12.4m	30m
-0.9<η<0	8.7m	28.3m	29m
-0.5<η< -0.5	15.7m	20m	30.5m

Multiplicity distribution



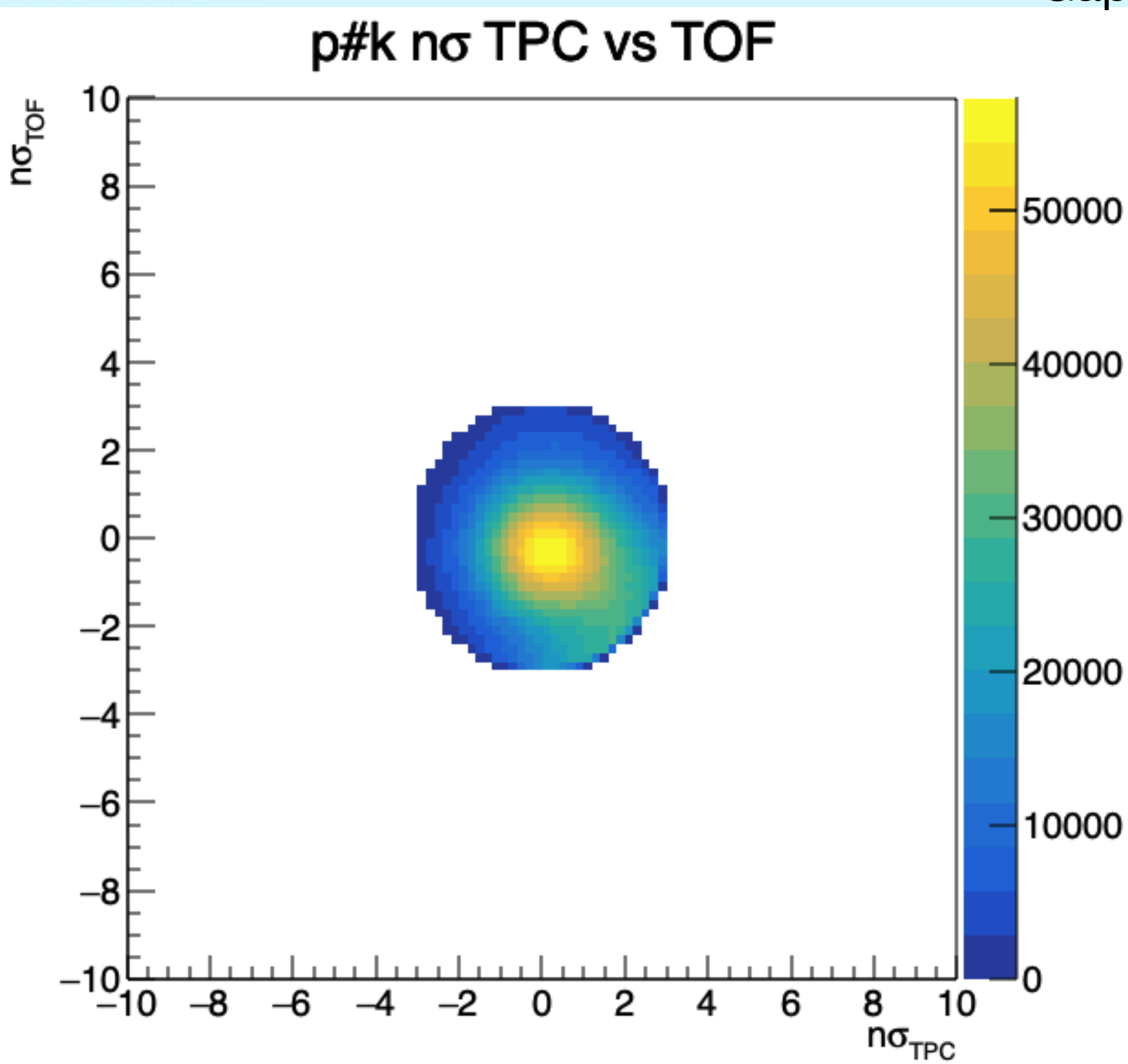


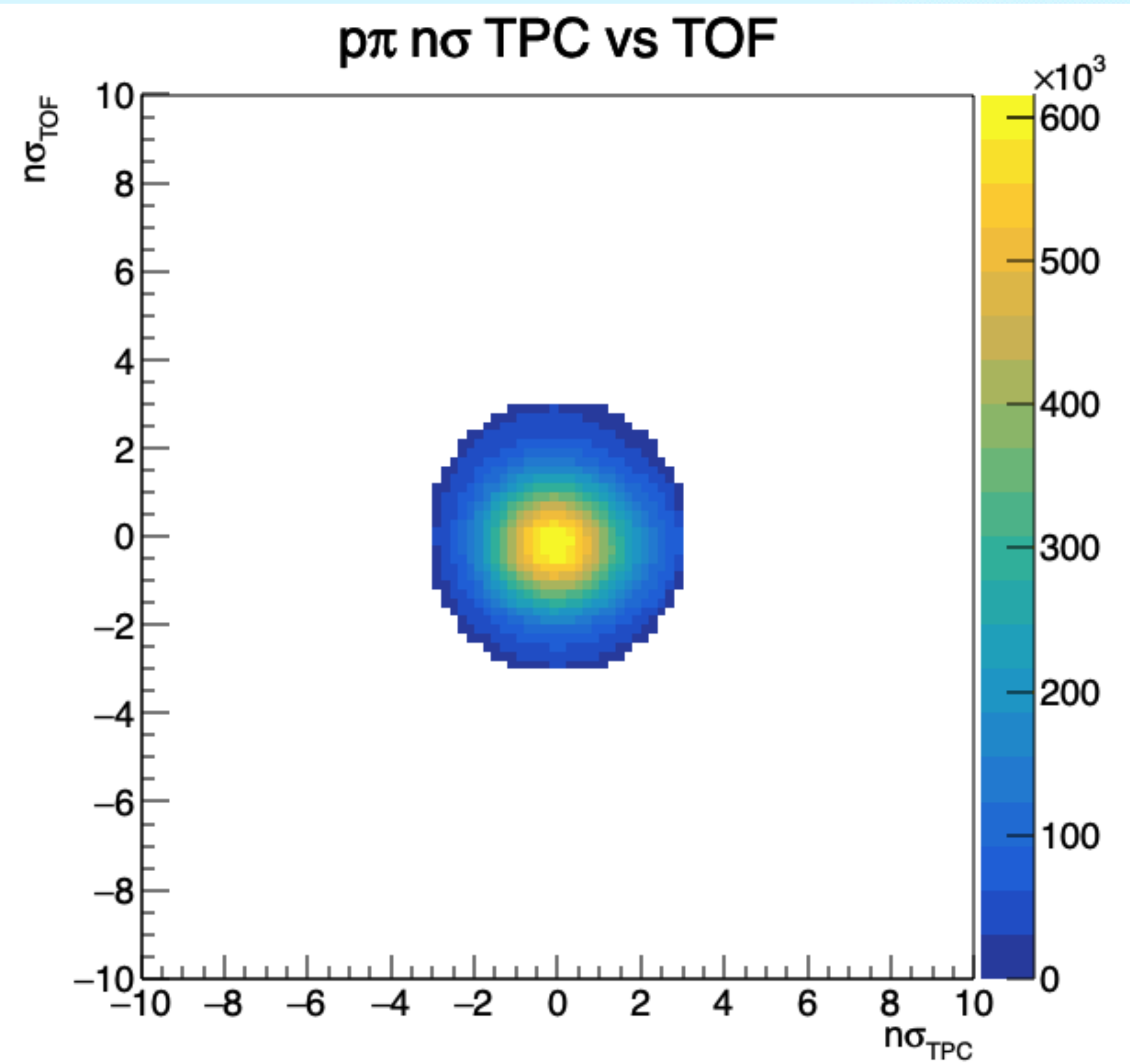




n_σ distribution of K and π

Gap A side



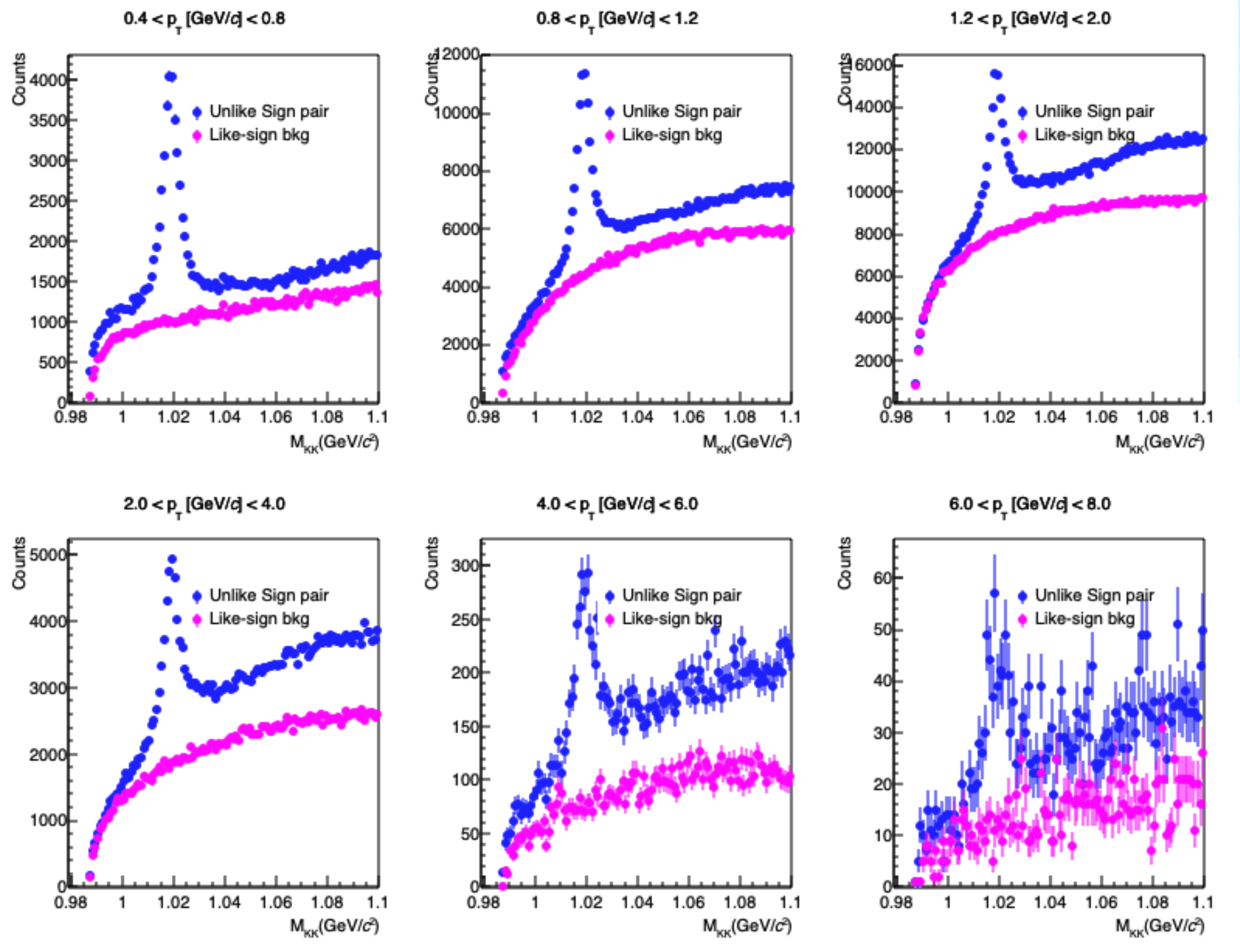


Particle Selection: TPC $n\sigma < 3$ (only TPC tracks),

If TOF information is available : $\sigma^2_{TPC} + \sigma^2_{TOF} < 9$

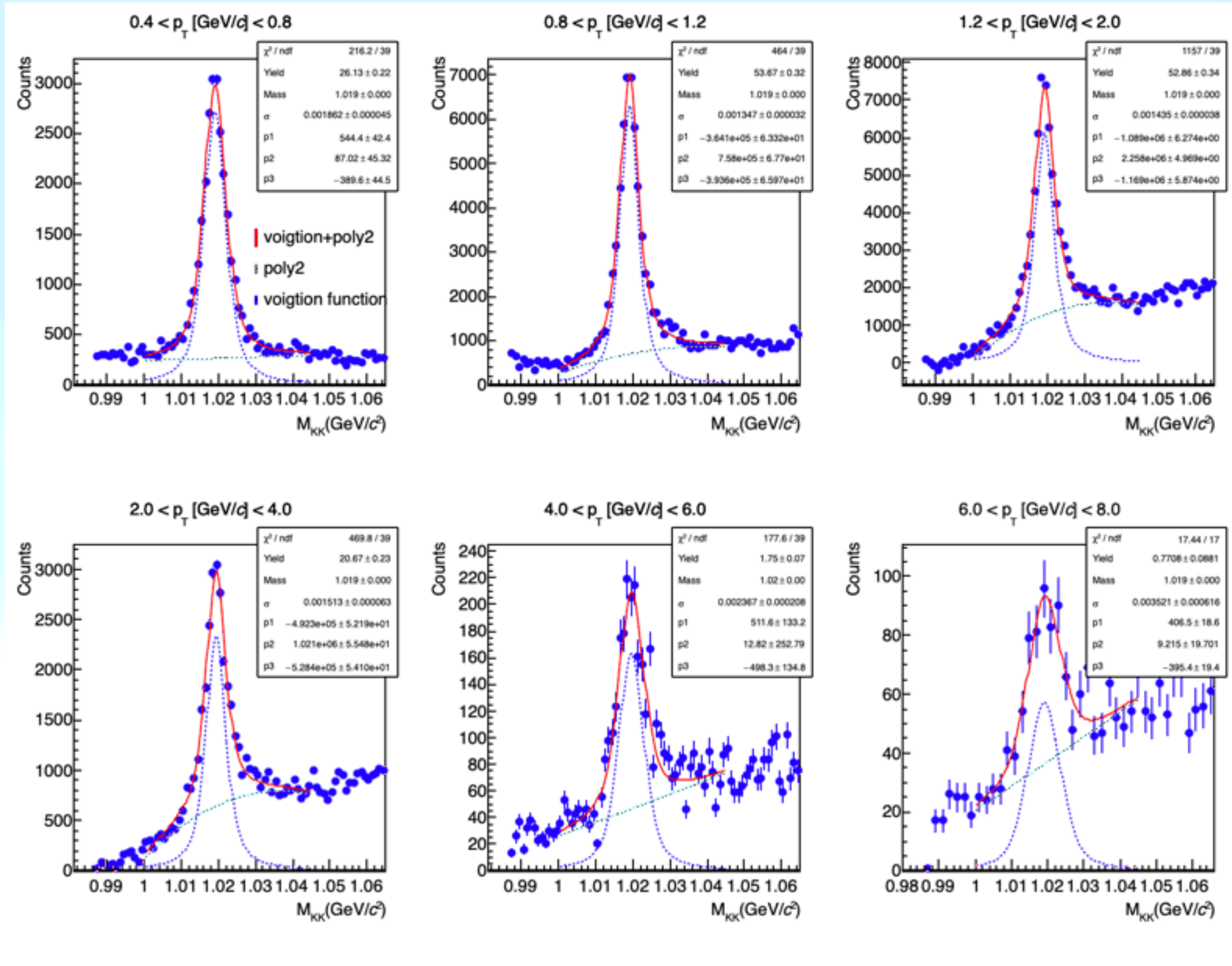
Inv. Mass Distribution KK pair

Gap A side



Inv. Mass Distribution KK pair

Gap A side

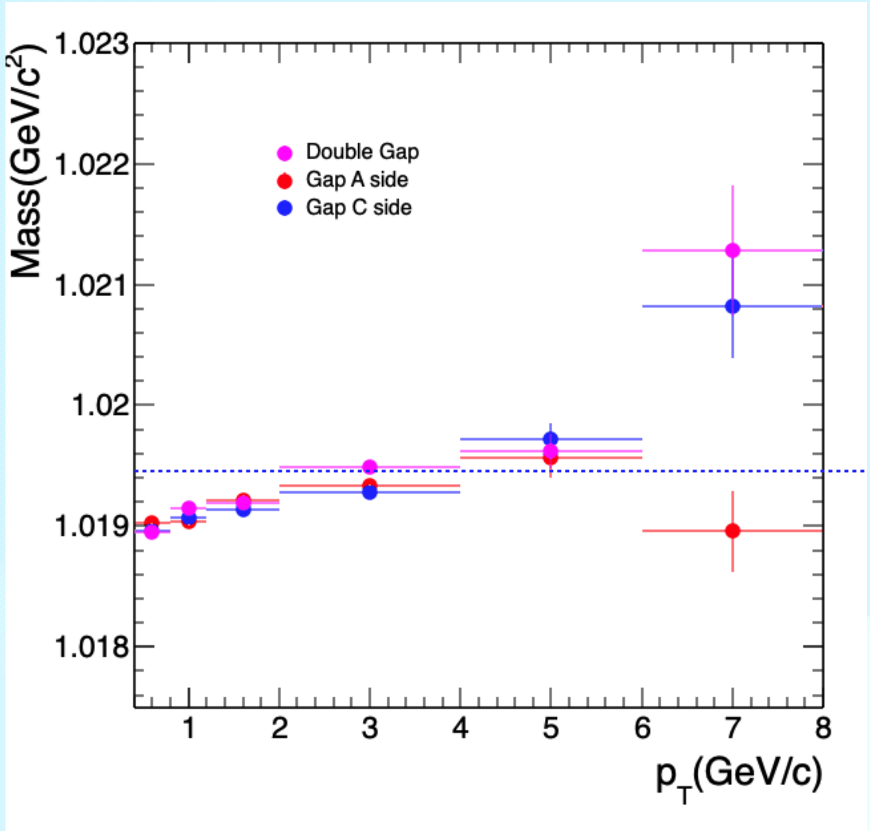


Fit function: Voigtian function for signal + Poly2

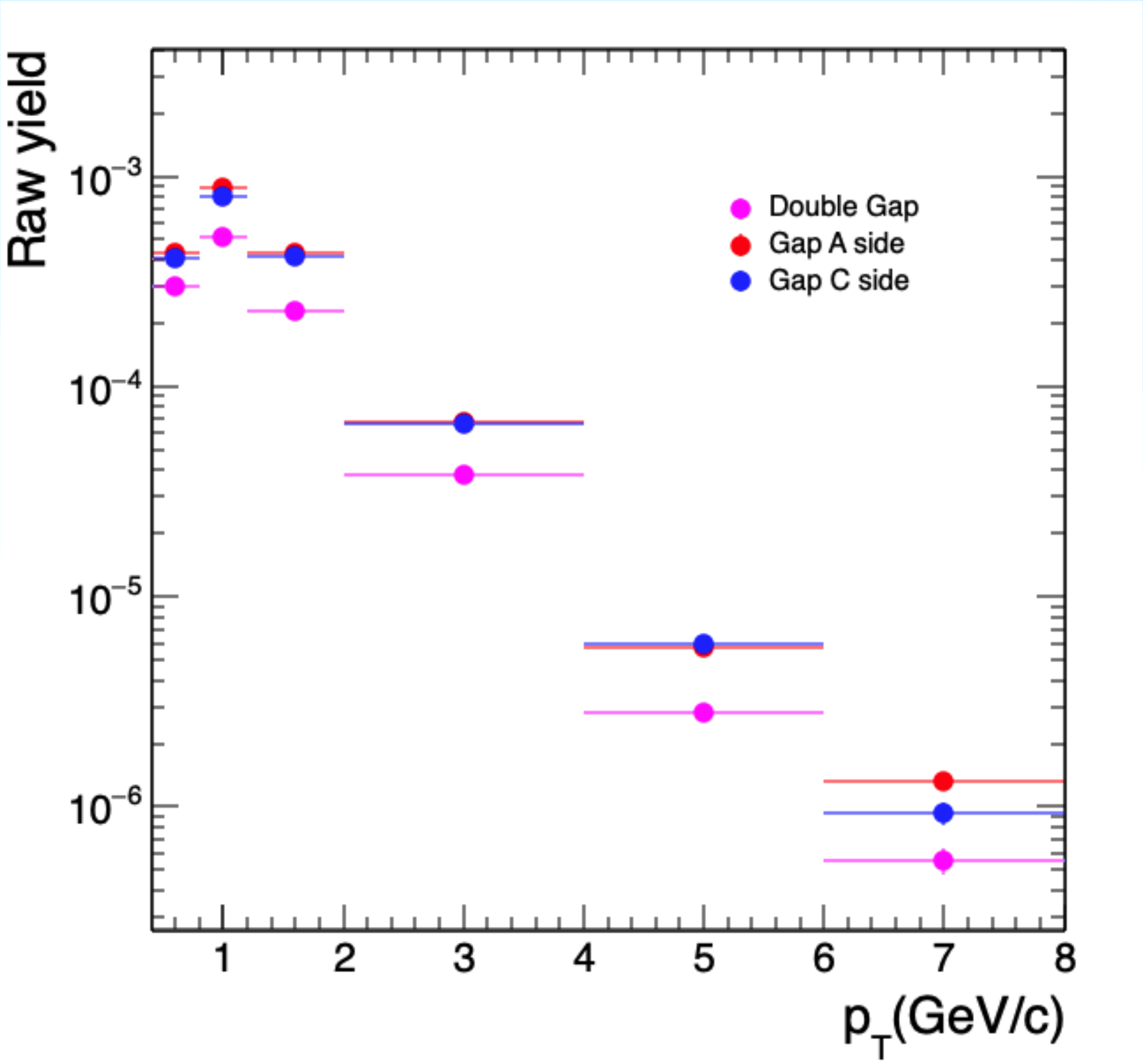
$$\frac{dN}{dm_{KK}} = \frac{A\Gamma}{(2\pi)^{3/2}\sigma} \exp\left[\frac{-(m_{KK}-M)^2}{2\sigma^2}\right]\frac{1}{(m_{KK}-M)^2+\sigma^2/4} + Am_{KK}^2 + Bm_{KK} + C$$

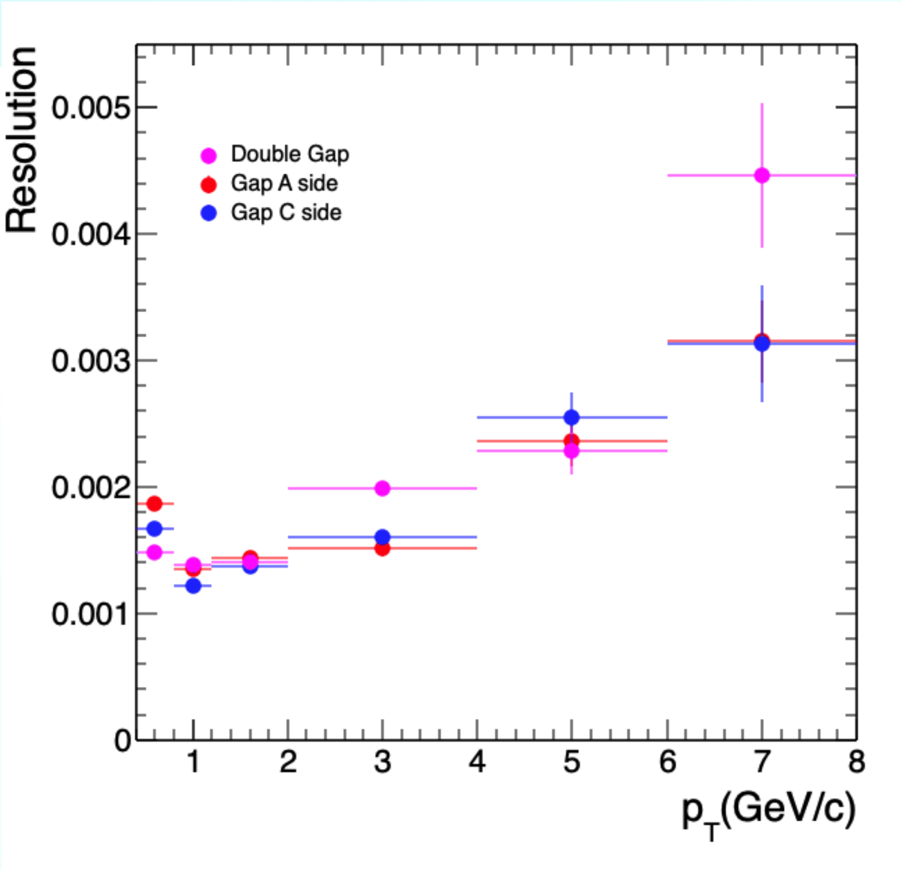
Width is fixed to PDG value while fitting

raw yield, mass and resolution distribution



$$\text{Raw Yield} = \frac{1}{N_{event}} \frac{d^2N}{dp_T dy}$$

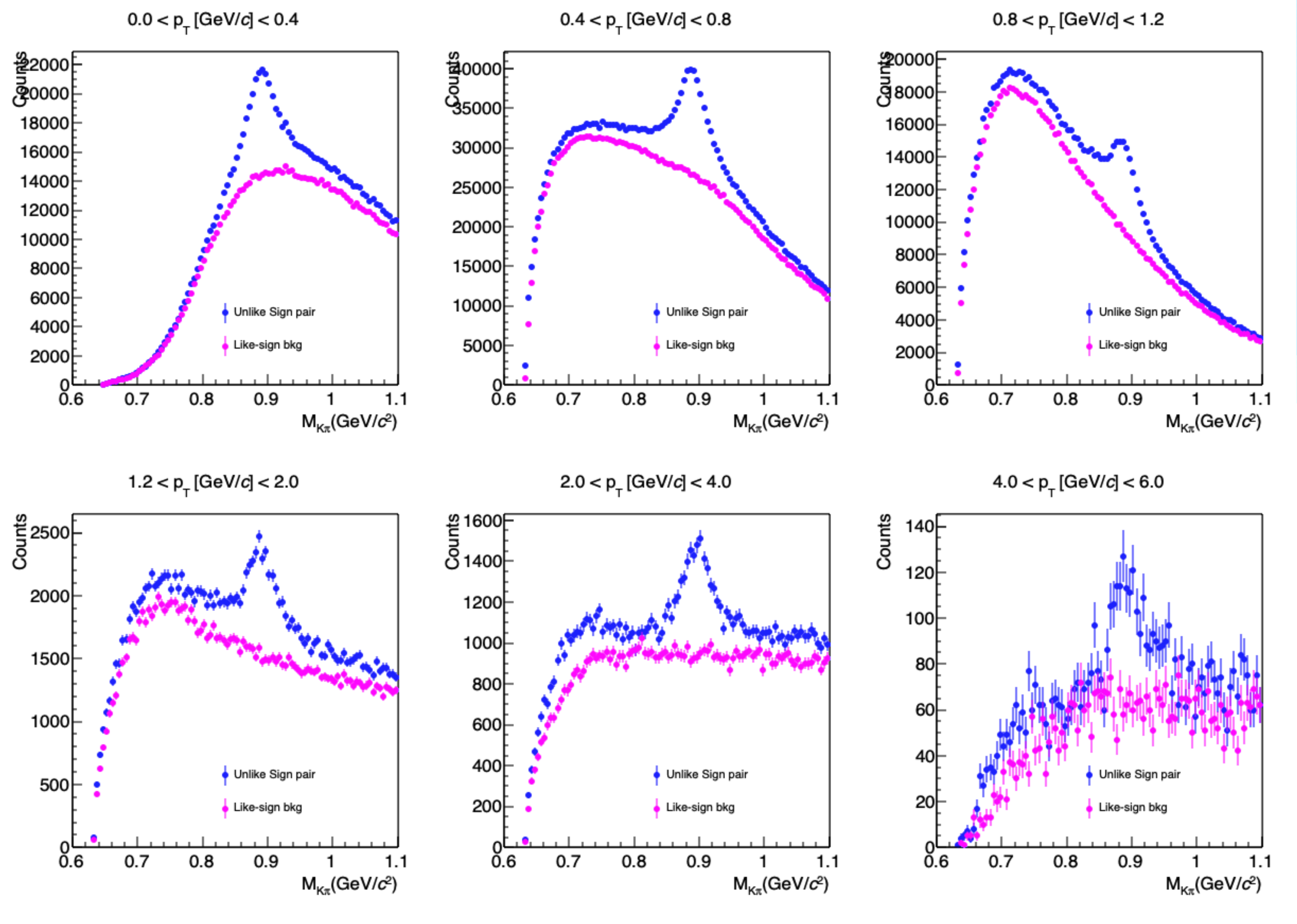




❖Mass and resolution consistence with PDG value and among different gap events

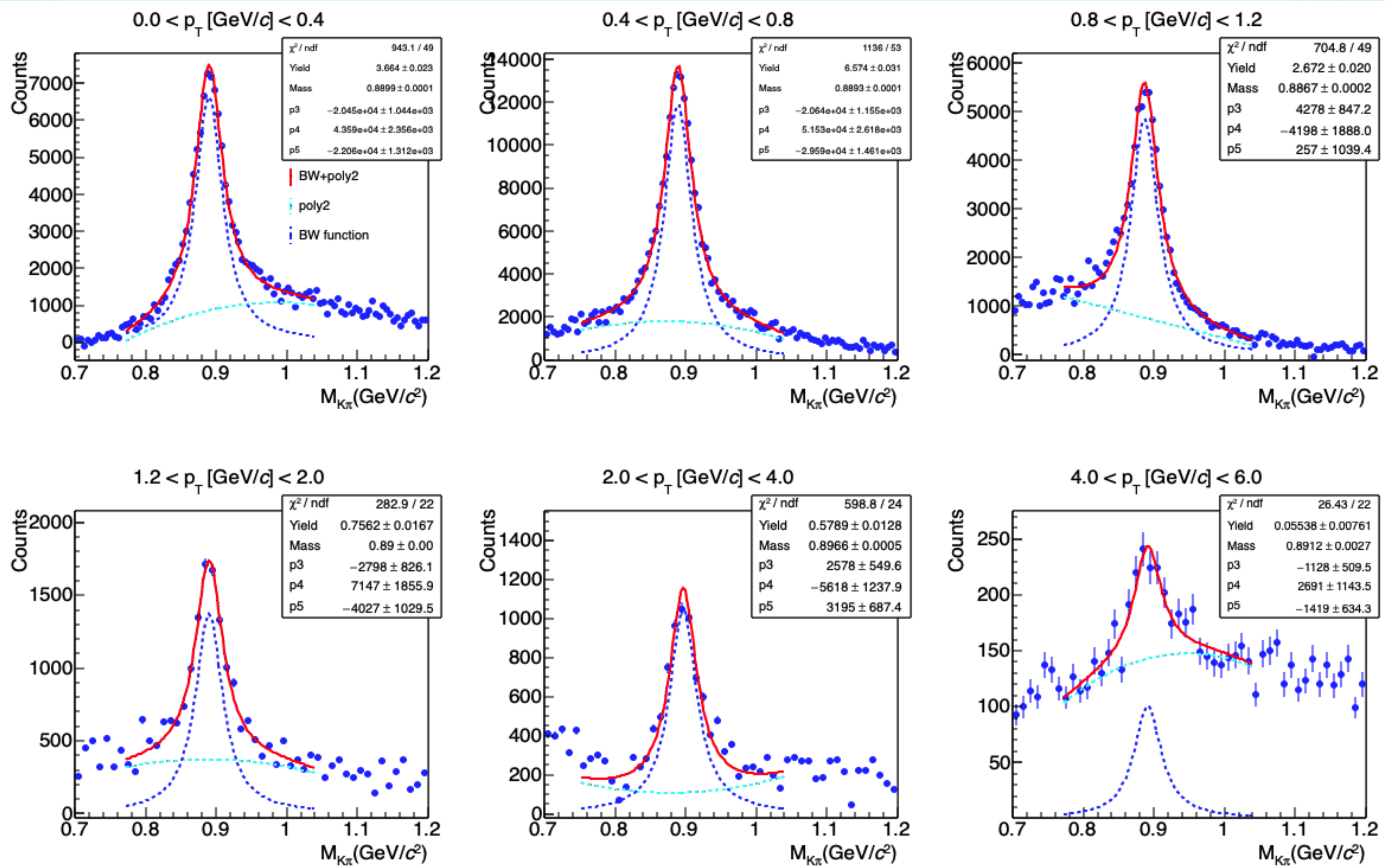
Inv. Mass Distribution Kπ pair

Gap A side



Inv. Mass Distribution Kπ pair

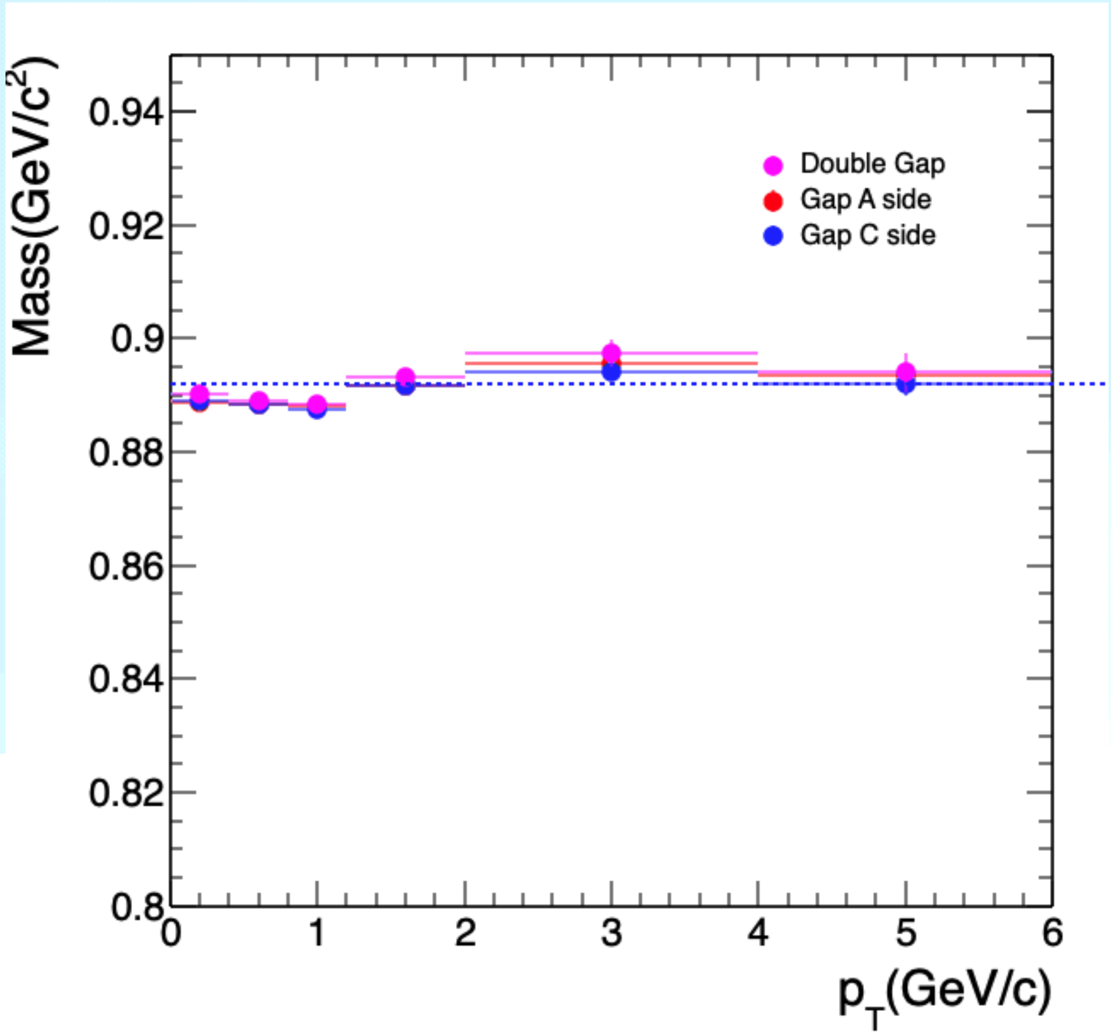
Gap A side

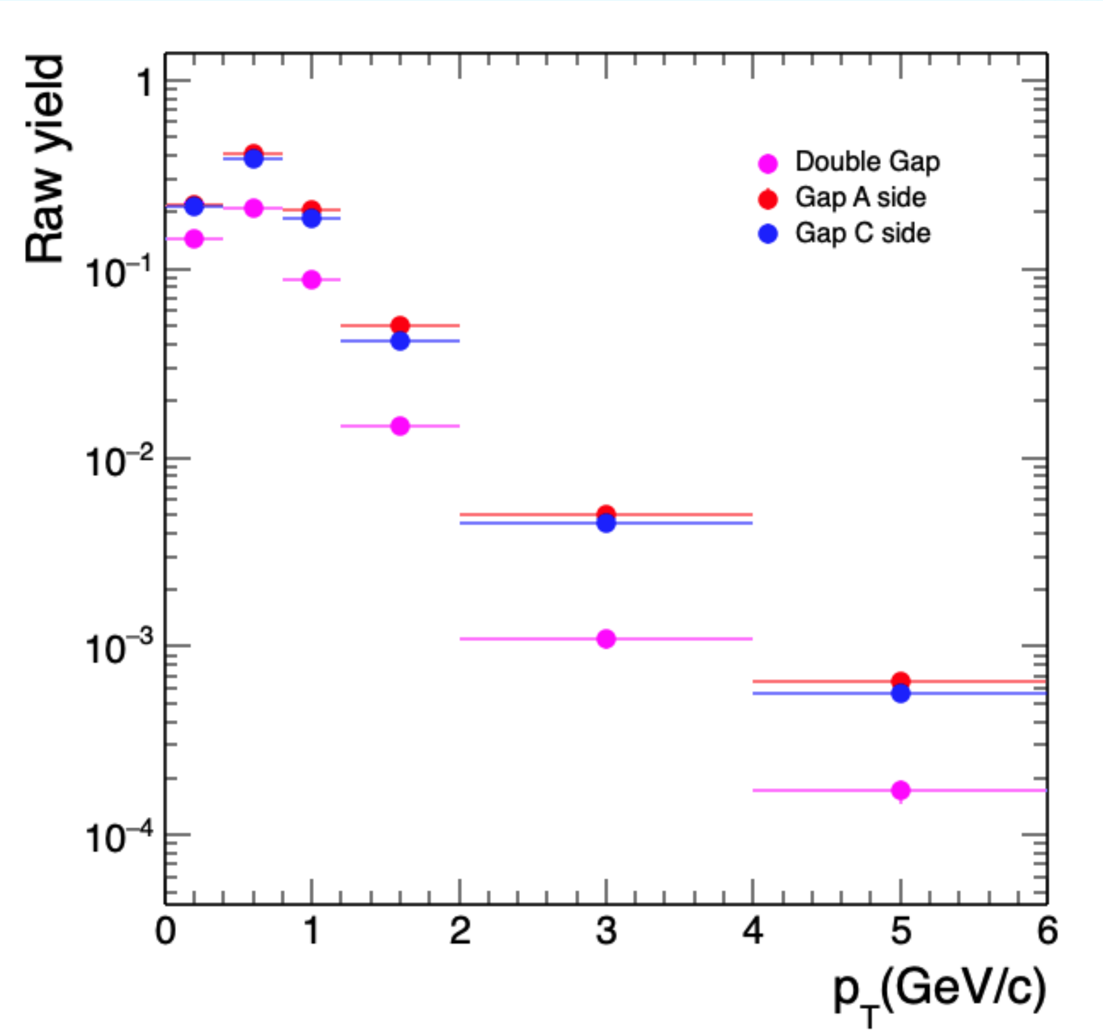


❖BW function is used to fit the signal

❖Width is fixed to PDG value

raw yield and mass distribution

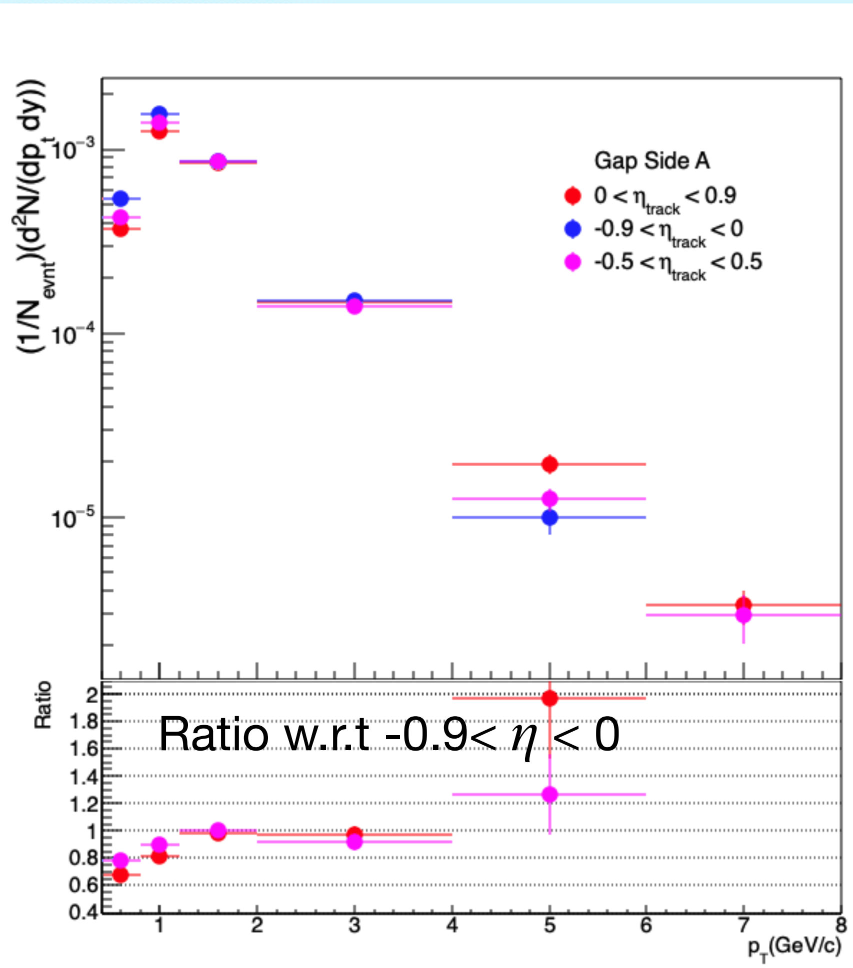


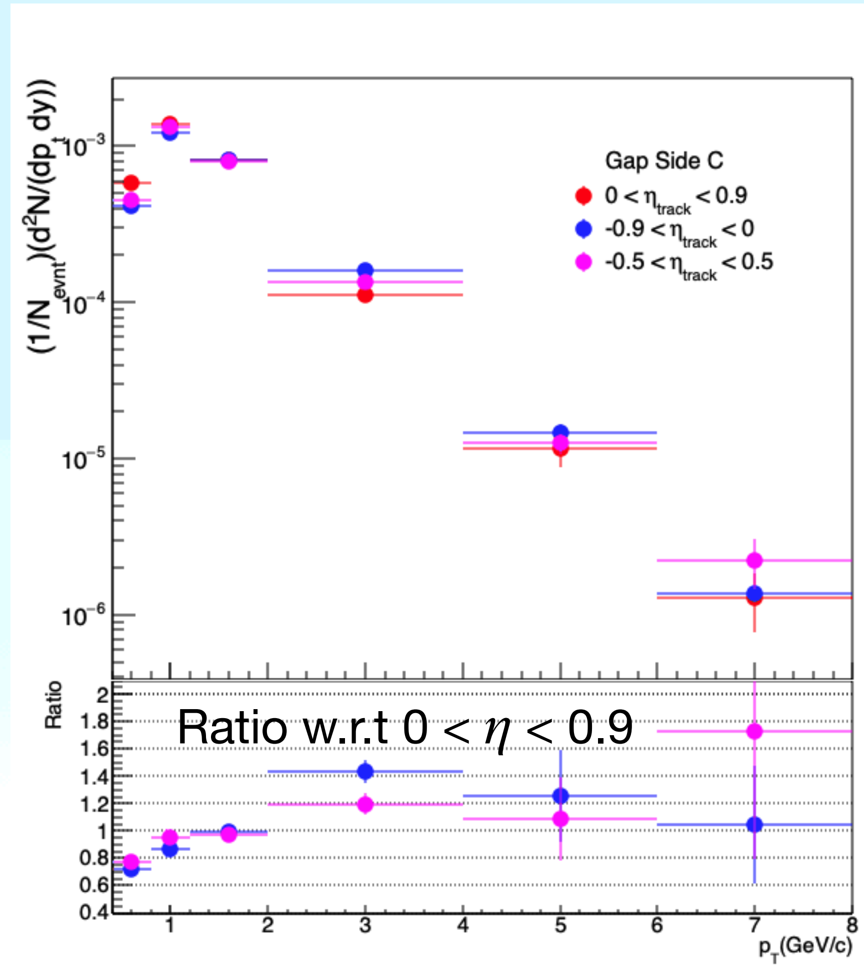


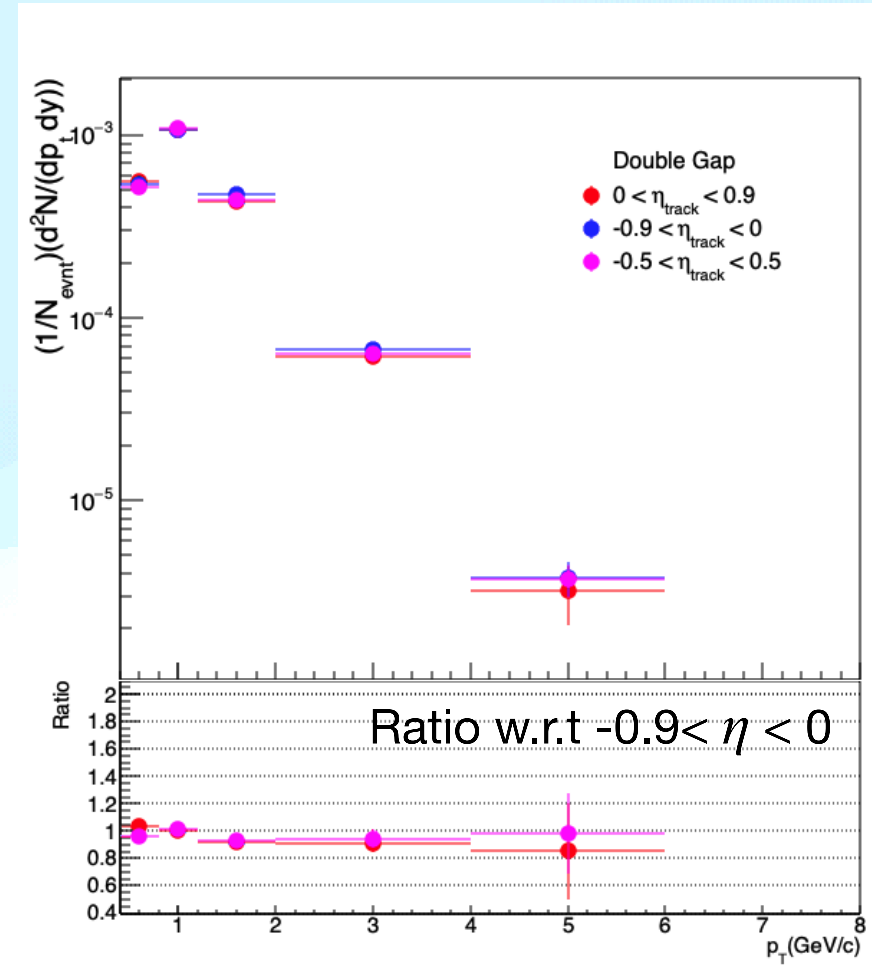
$$\text{Raw Yield} = \frac{1}{N_{event}} \frac{d^2N}{dp_T dy}$$

❖Mass consistence with PDG value and among different gap events.

Rapidity dependant raw p_T spectra ϕ

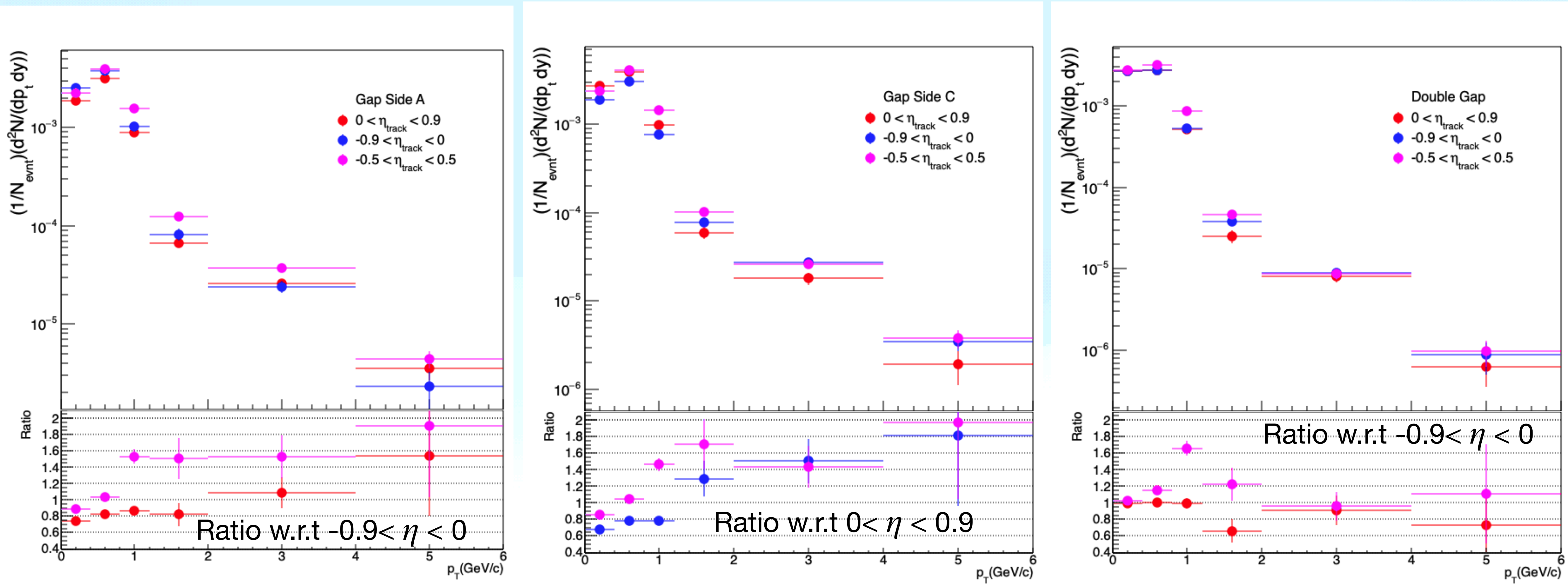






❖ Asymmetry in spectra is observed at low p_T for Gap Side A and Gap Side C.

Rapidity dependant raw p_T spectra K^{*0}



❖ Asymmetry in spectra is observed at low p_T for Gap Side A and Gap Side C (forward/backward rapidity).

Summary:

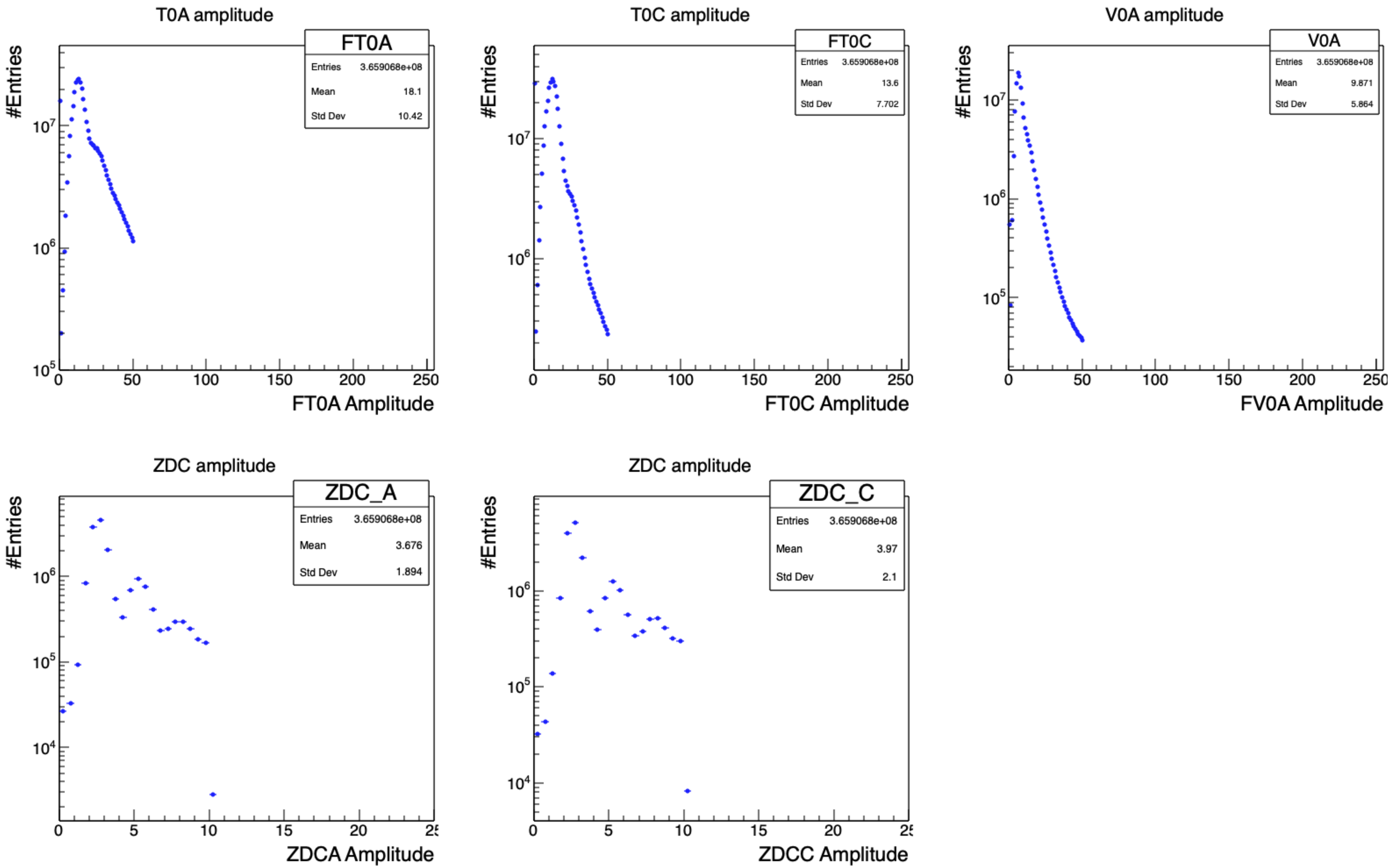
- ❖ The ϕ and K^{*0} signal is obtained for single gap and double gap events.
- ❖ The obtained mass of ϕ and K^{*0} from the fit are consistent with the PDG mass.
- ❖ Raw spectra are compared among different gap events.
- ❖ ϕ and K^{*0} Spectra is obtained for forward(+ve) and backward(-ve) pseudorapidity.
- ❖ Asymmetry in spectra is observed at low p_T for Gap Side A and Gap Side C (forward/backward rapidity).

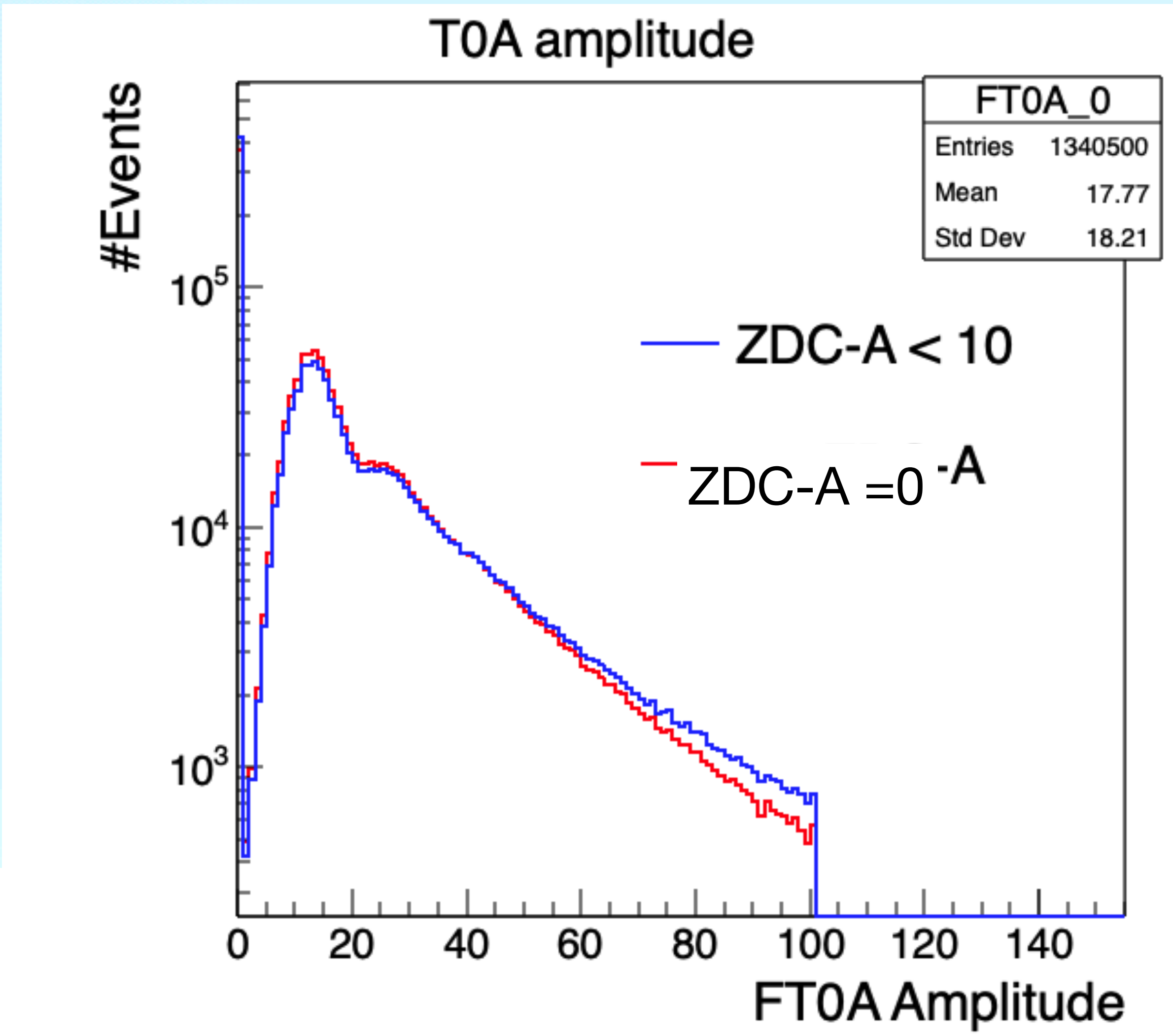
Outlook:

- ❖ Spectra will be corrected with Efficiency x Acceptance (Waiting for MC production).
- ❖ dN/dy and $\langle p_T \rangle$ will be measured.
- ❖ Results will be compared with model predictions.

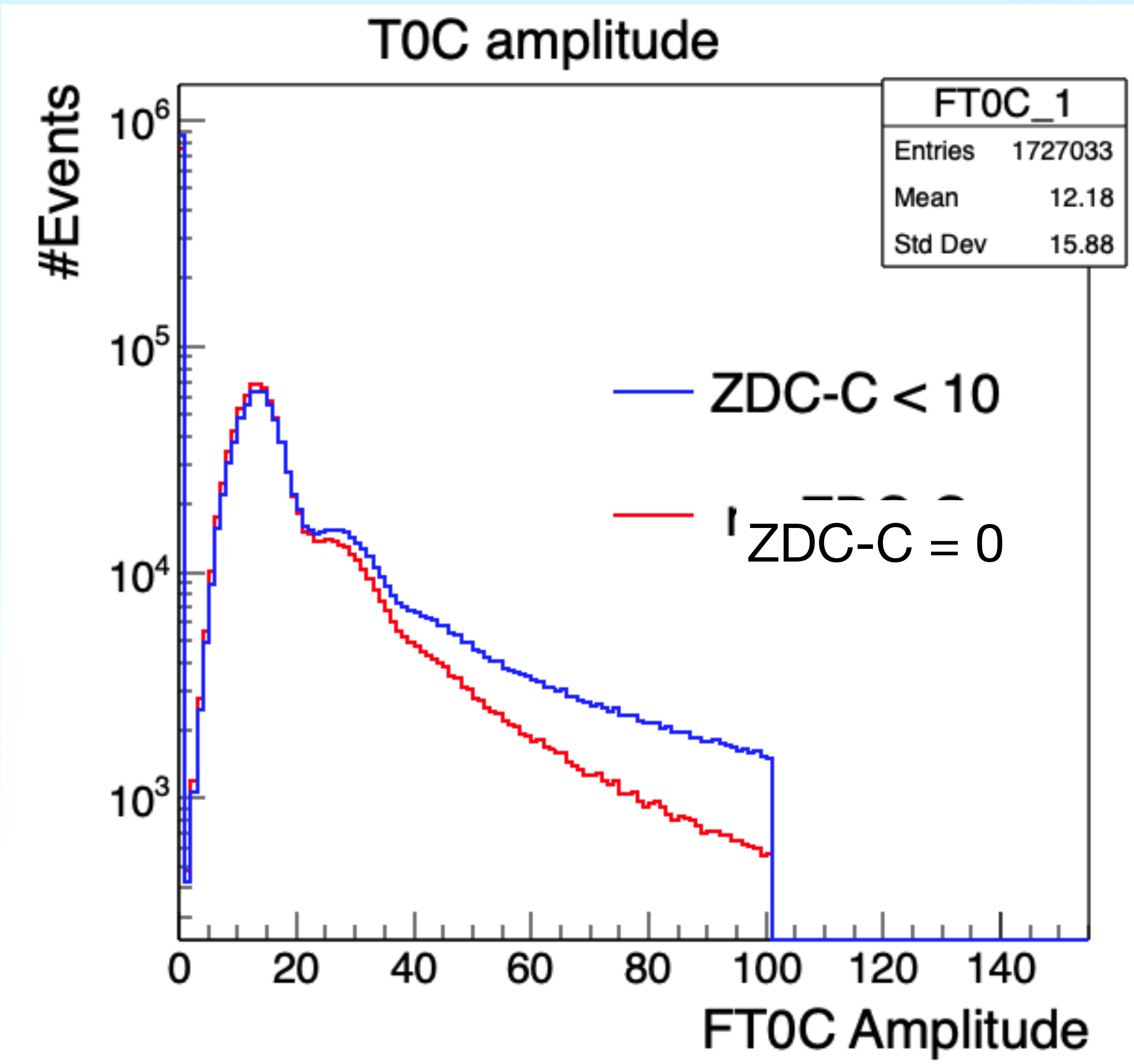
Backup

FIT Amplitude





T0A amplitude
FT0A_0
Entries 1340500
Mean 17.77
Std Dev 18.21
#Events
ZDC-A < 10
ZDC-A =0
FT0A Amplitude



T0C amplitude
FT0C_1
Entries 1727033
Mean 12.18
Std Dev 15.88
#Events
ZDC-C < 10
ZDC-C = 0
FT0C Amplitude