ALICE 13TeV

- $\frac{1}{N_{trig}}\frac{d^2N_{pair}}{d\Delta\eta d\Delta\phi} = B(0,0)\left.\frac{S(\Delta\eta,\Delta\phi)}{B(\Delta\eta,\Delta\phi)}\right|_{p_{T,trig}\,,p_{T,assoc}}$ (3.1)
- $\frac{1}{N_{trig}}\frac{dN_{pair}}{d\Delta\phi} = \int_{1.6<|\Delta\eta|<1.8}\left(\frac{1}{N_{trig}}\frac{d^2N_{pair}}{d\Delta\eta d\Delta\phi}\right)\frac{1}{\delta_{\Delta\eta}}d\Delta\eta - C_{ZYAM}$ (3.2)
- $\boldsymbol{\delta_{\Delta\eta} = 2\times(1.8-1.6) = 0.4}$ → normalization factor
- $Y^{ridge} = \int_{|\Delta\phi|<|\Delta\phi_{min}|}\frac{1}{N_{trig}}\frac{dN_{pair}}{d\Delta\phi}d\Delta\phi$ (3.3)
  - The minimum yield(C_{ZYAM}) at $\Delta\phi = \Delta\phi_{min}$
- Near-side : $|\Delta\phi| < 1.28$ → (3.4) 위
- Y^{near} → near-side jet-like peak yield

CMS, ALICE

- Long-range : ALICE $\rightarrow$ $1.6 < |\Delta\eta| < 1.8$

  CMS $\rightarrow$ $2 < |\Delta\eta| < 4$
- High multiplicity : ALICE $\rightarrow 0\sim0.1\%$

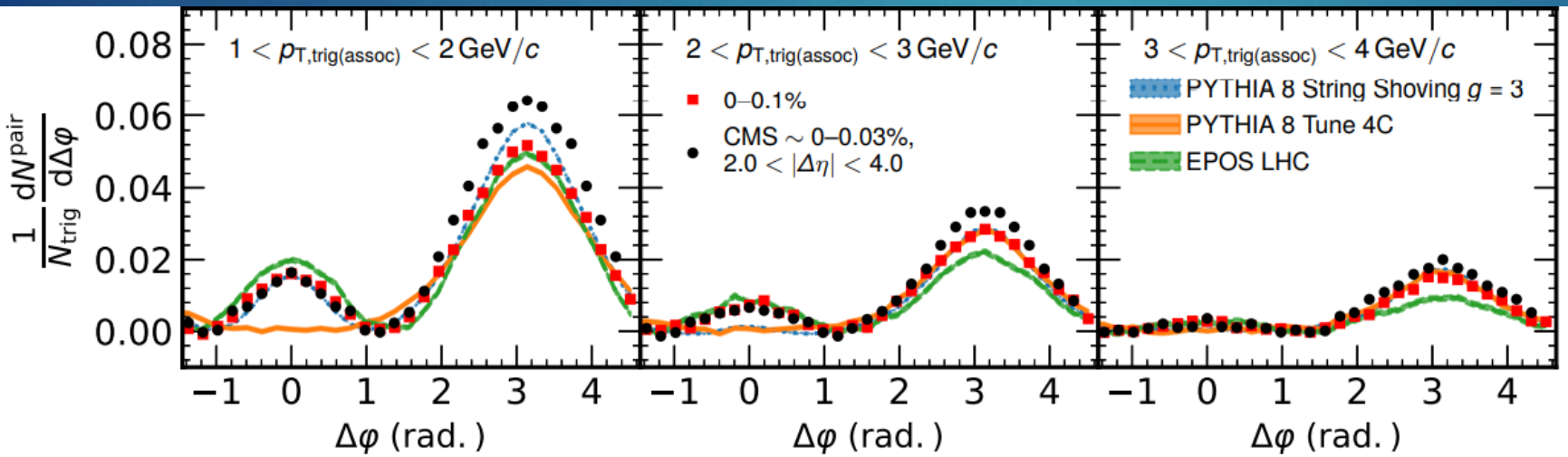
  CMS $\rightarrow$ $\mathrm{N}_{\mathrm{trk}}^{\mathrm{offline}} \geq 105$ $\rightarrow 0\sim0.03\%$
- 지금까지 CMS의 $\Delta\phi$ Correlation을 그릴 때에, 그냥 적분을 하였음.
  - ALICE의 (3.2)의 식을 이용하여 적분하여 다시 그려봐야 함.($\delta_{\Delta\eta}$)

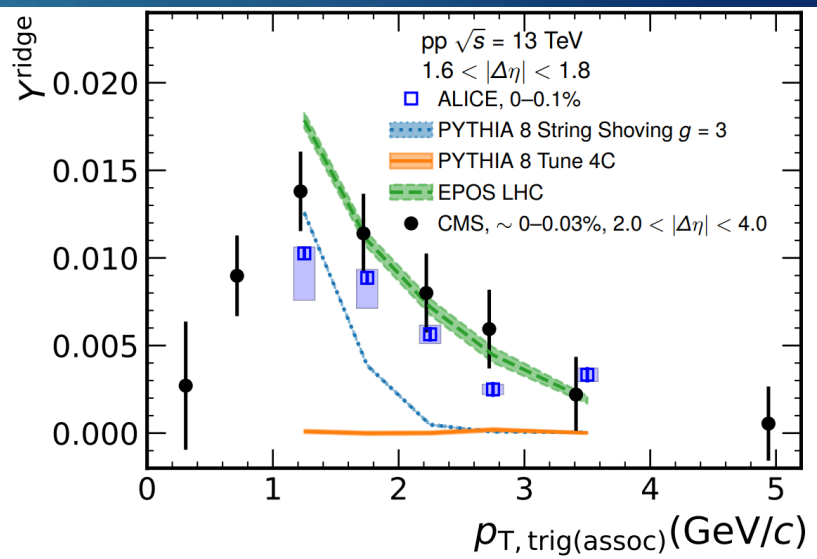
- CMS의 C_{ZYAM}은 있지만, ALICE는 C_{ZYAM}이 없어 $1 < p_t < 4$을 그릴 수 없음.

현재 계산식

- $\Delta\phi$ Correlation : $\frac{1}{N_{trig}}\frac{dN_{pair}}{d\Delta\phi} = \int_{1.6<|\Delta\eta|<1.8}\left[\int\left(\frac{d^2F}{p_T dp_T d\Delta\eta d\Delta\phi}\right)\frac{1}{\delta_{\Delta\eta}}p_T dp_T\right]d\Delta\eta - C_{ZYAM}$

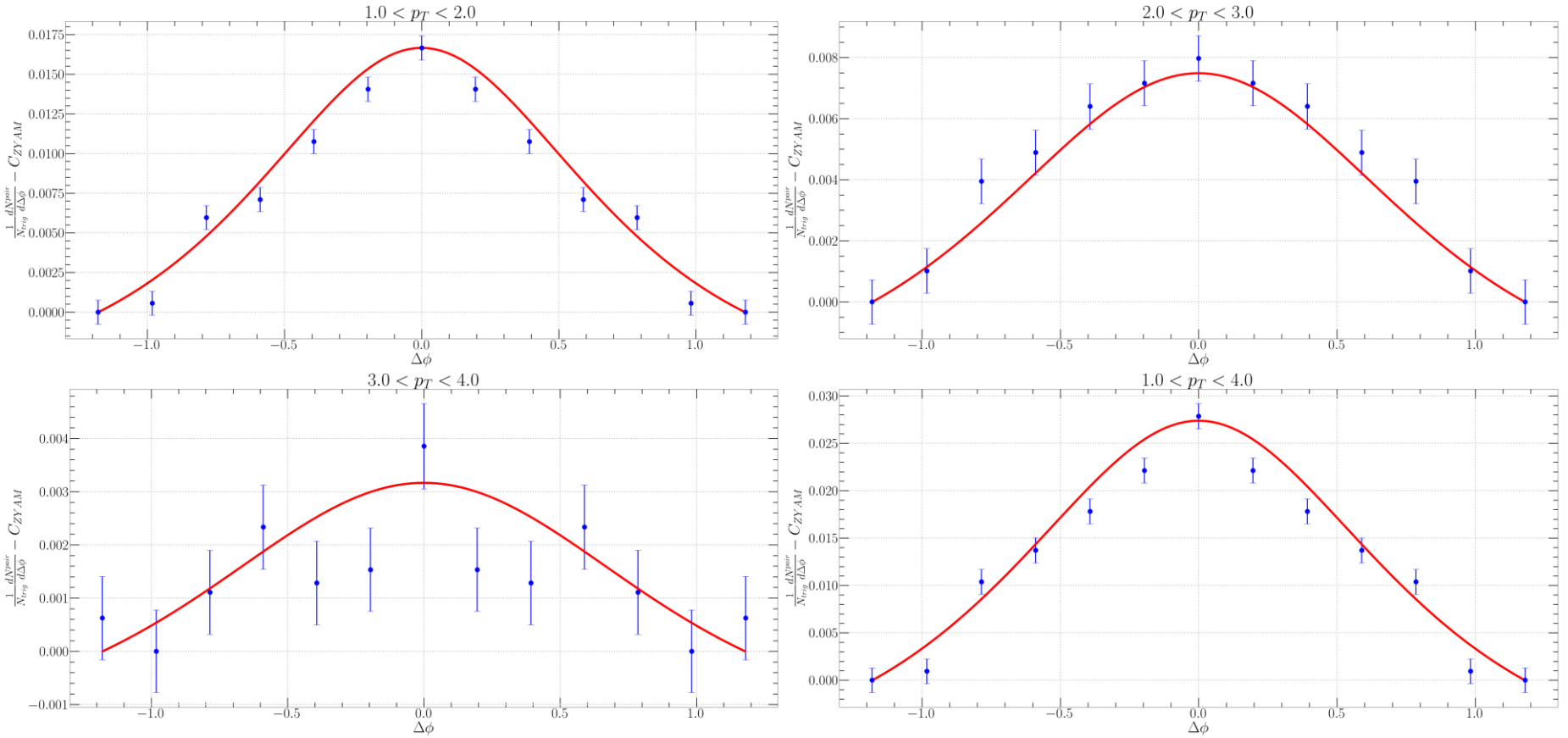
- $Y^{ridge} = \int_{-1.28<|\Delta\phi|<1.28}\left[\int_{1.6<|\Delta\eta|<1.8}\left(\int\frac{d^2F}{p_T dp_T d\Delta\eta d\Delta\phi}\,p_T dp_T\right)\frac{1}{\delta_{\Delta\eta}}d\Delta\eta\right]d\Delta\phi$





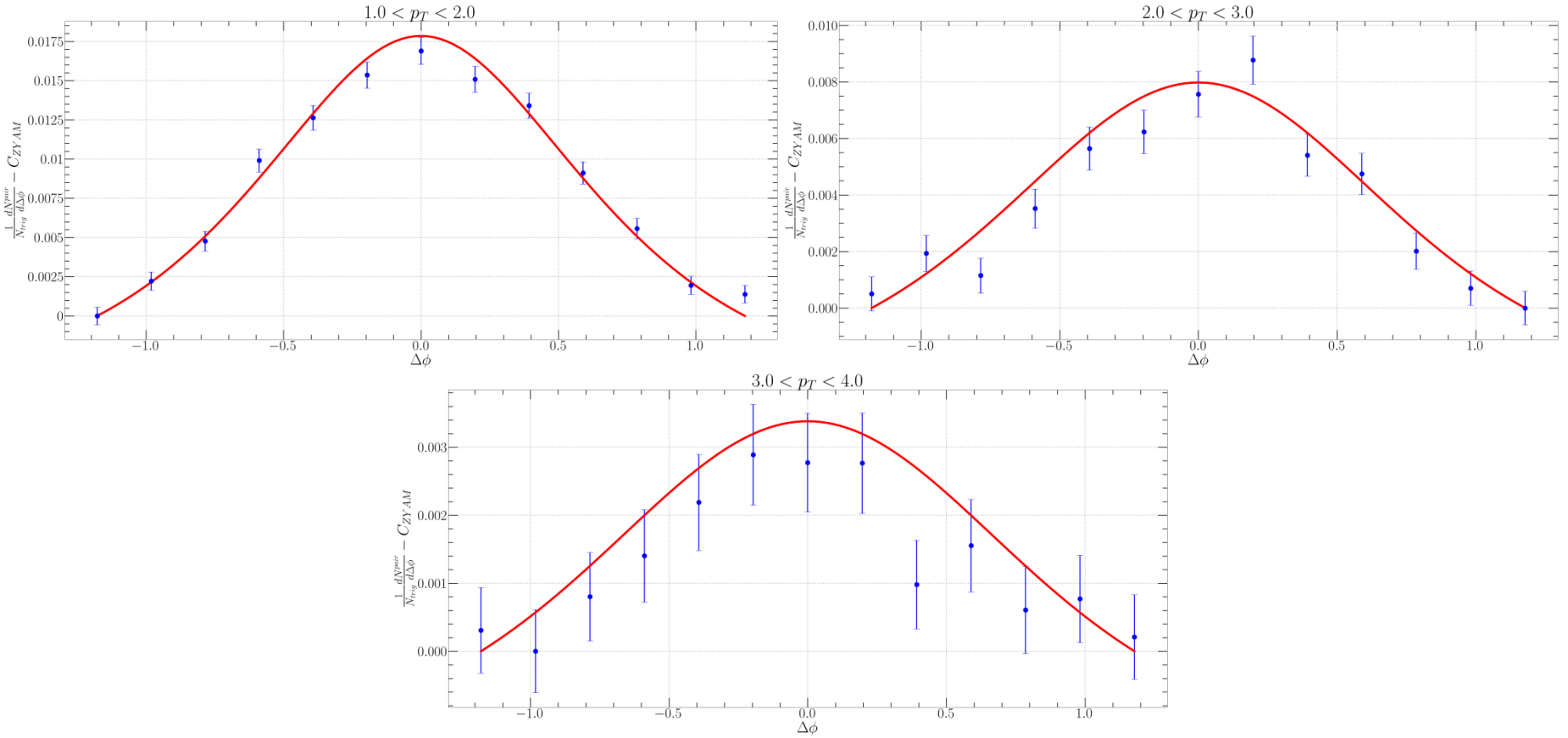
CMS

$$f_R < N_k > = 0.62e^{1.07p_T}$$

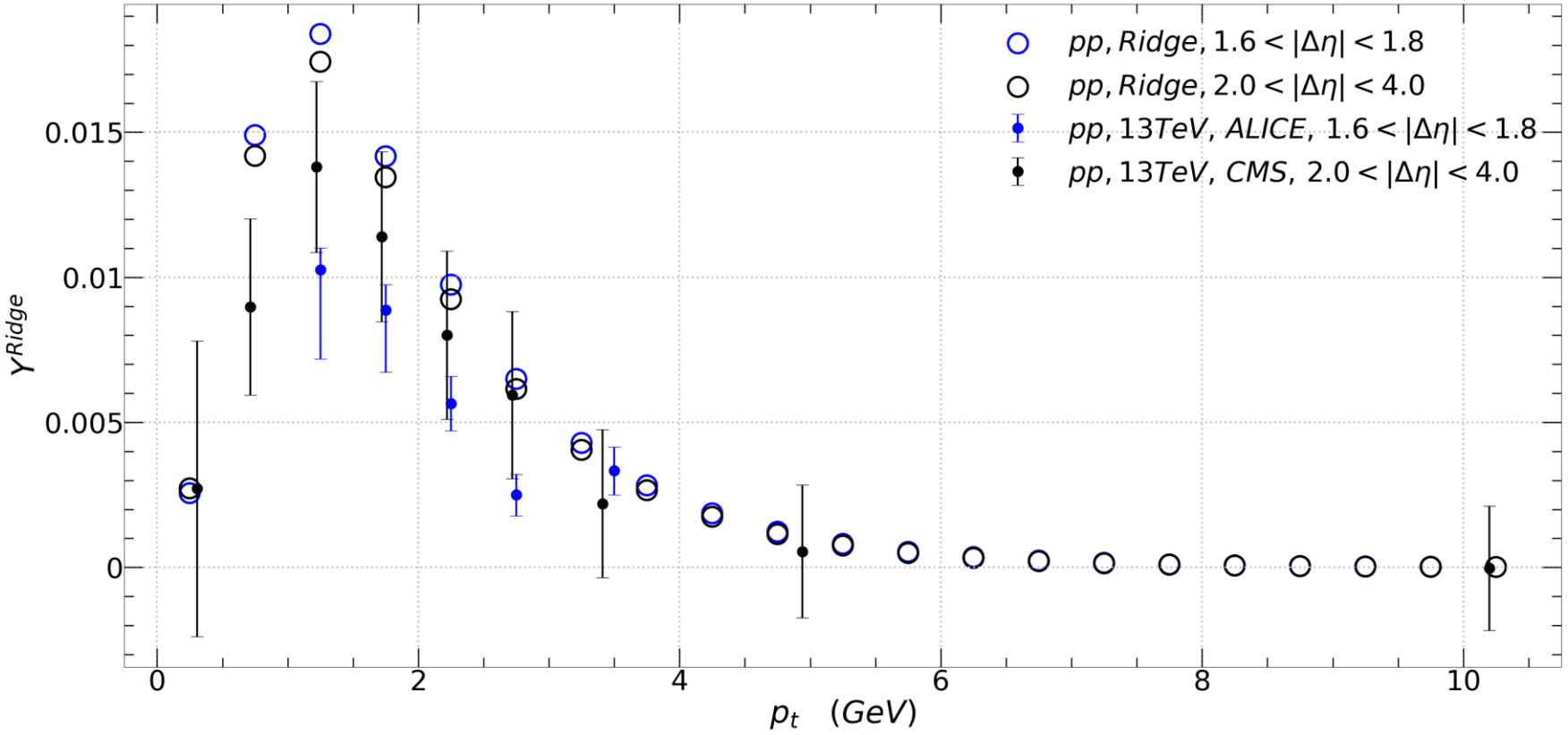


ALICE

$$f_R < N_k > = 0.62e^{1.07p_T}$$



Y^{Ridge}



$a = 8$

$\mathrm{T} = 0.55\ GeV$

$q = 0.7\ GeV$

$m_d = 0.9\ GeV$

$\sqrt{S_{nn}} = 13000\ GeV$

$\mathrm{A_{ridge}} = 0.0507517$

$f_R < N_k > = 0.62e^{1.07p_T}$

$a = 8$

$\mathrm{T} = 0.55\ GeV$

$q = 0.7\ GeV$

$m_d = 0.9\ GeV$

$\sqrt{S_{nn}} = 13000\ GeV$

$\mathrm{A_{ridge}} = 0.0507517$

$f_R\langle N_k \rangle = 0.62e^{1.07p_T}$

21.08.26 Fitting

$a = 4$

$\mathrm{T} = 0.63\ GeV$

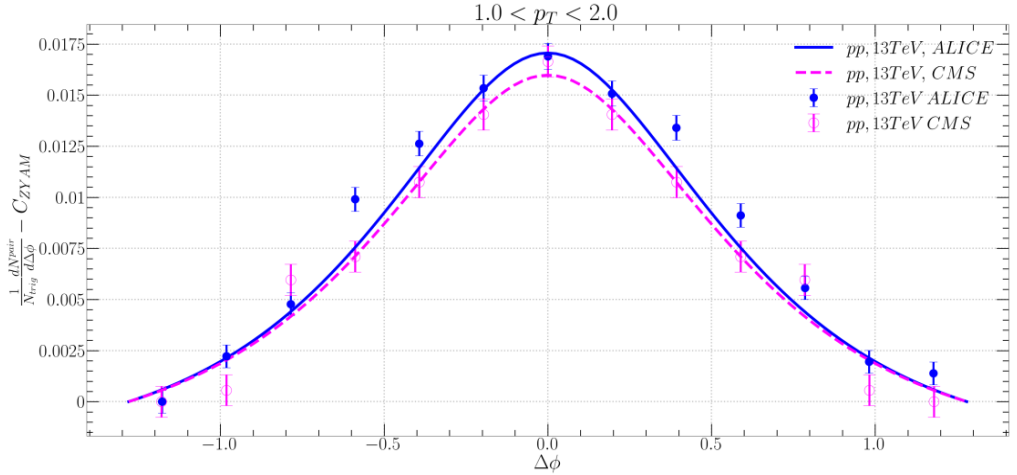
$q = 0.9\ GeV$

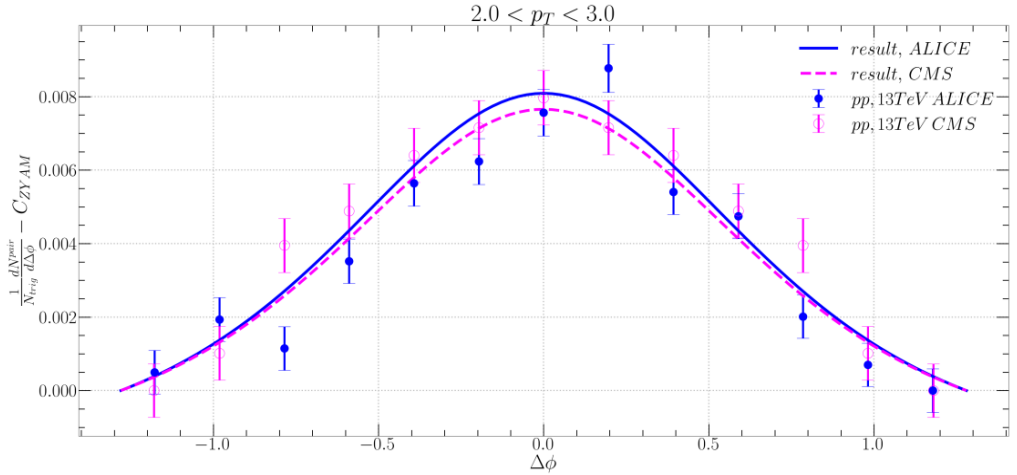
$m_d = 1\ GeV$

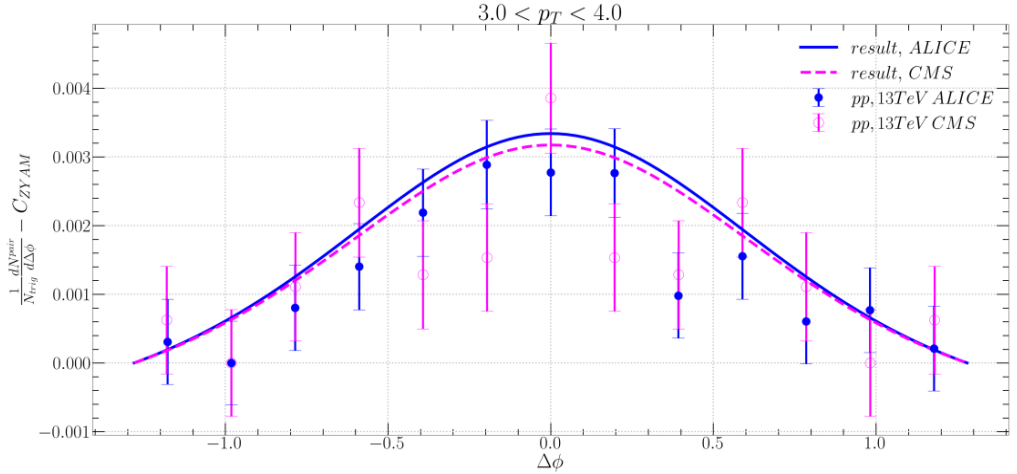
$\sqrt{S_{nn}} = 13000\ GeV$

$\mathrm{A_{ridge}} = 0.040276$

$f_R\langle N_k \rangle = 0.585e^{0.81p_T}$







$\Delta\phi$ Correlation

21.08.26 Fitting

$a = 4$

$T = 0.63\ GeV$

$q = 0.9\ GeV$

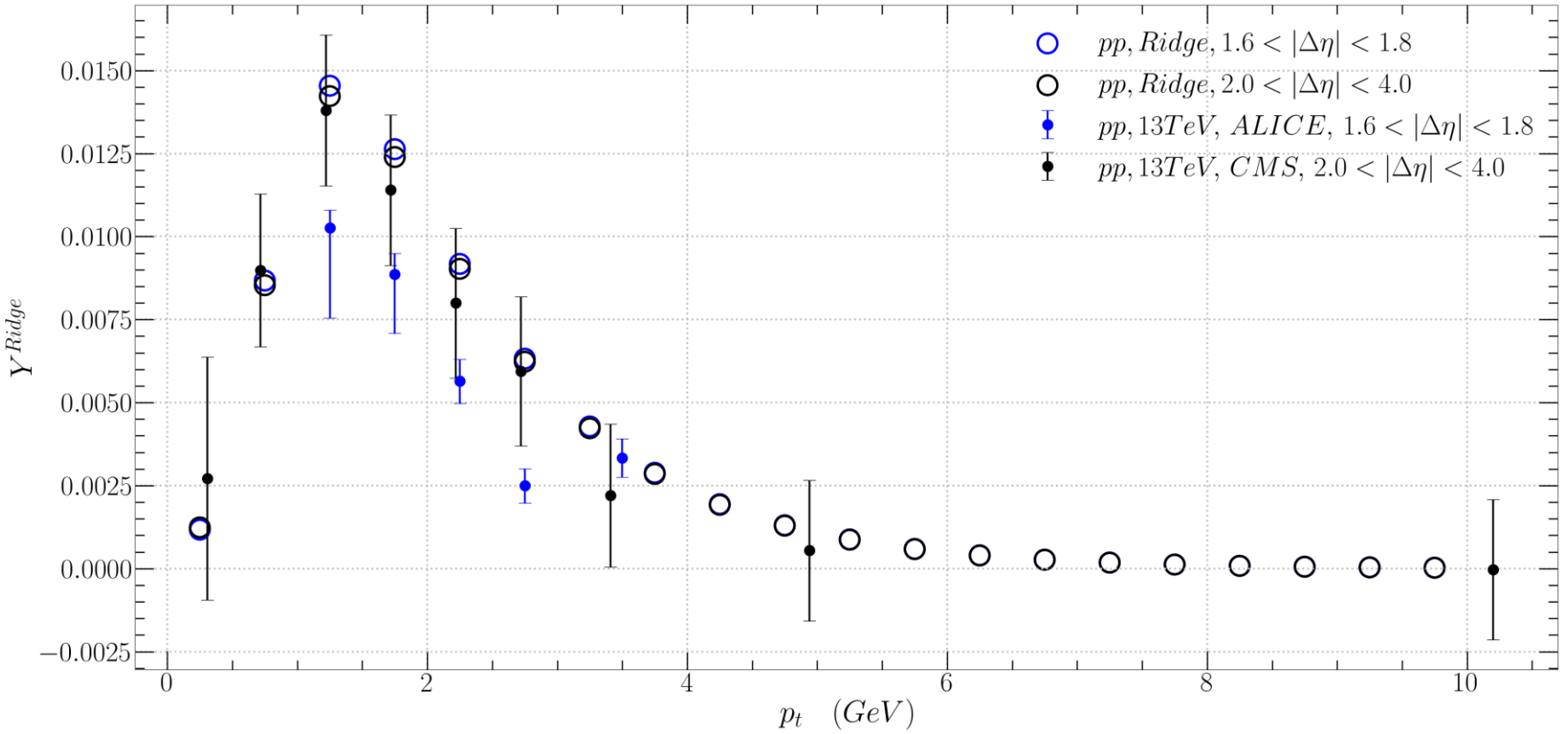
$m_d = 1\ GeV$

$\sqrt{S_{nn}} = 13000\ GeV$

$A_{ridge} = 0.040276$

$f_R\langle N_k \rangle = 0.585e^{0.81p_T}$

Y^{Ridge}



21.08.26 Fitting

$a = 4$

$\mathrm{T} = 0.63\ GeV$

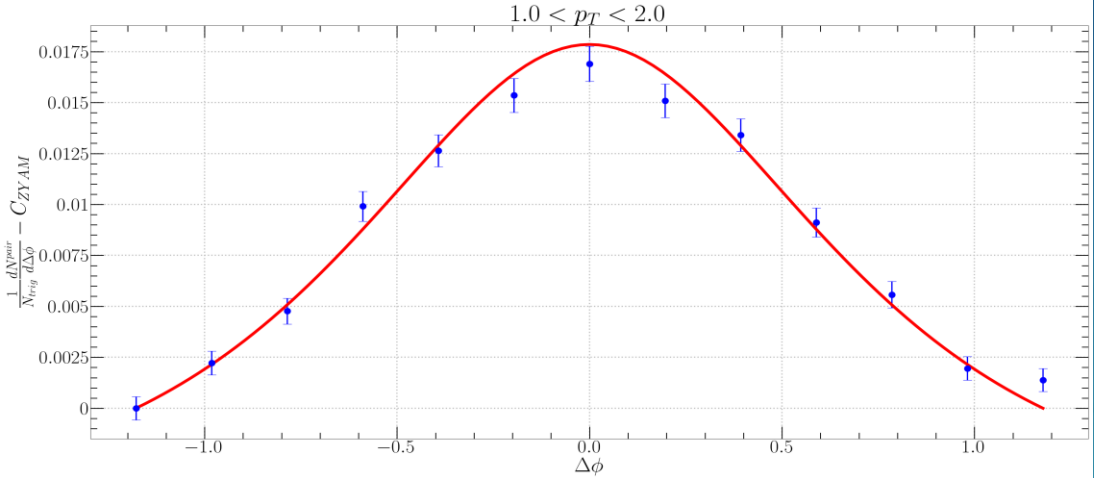
$q = 0.9\ GeV$

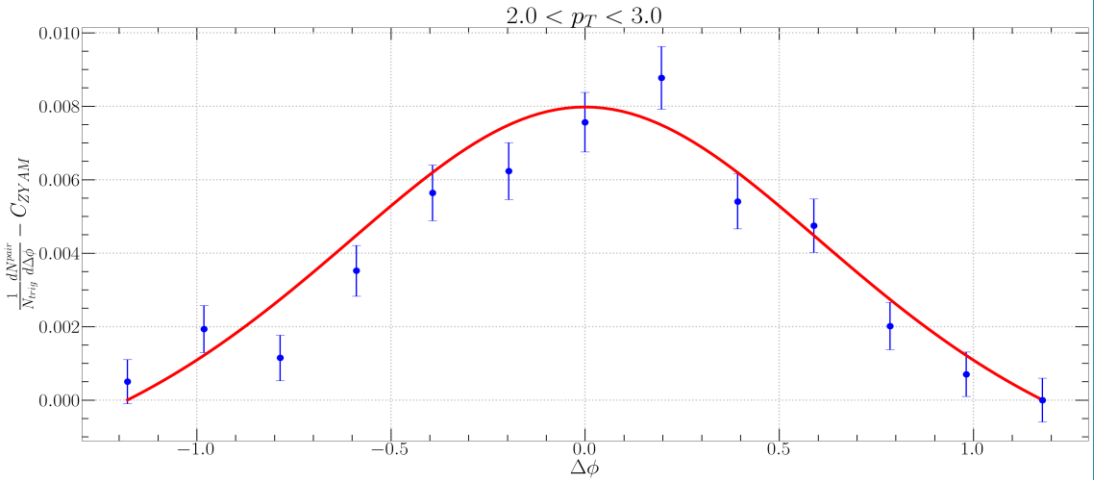
$m_d = 1\ GeV$

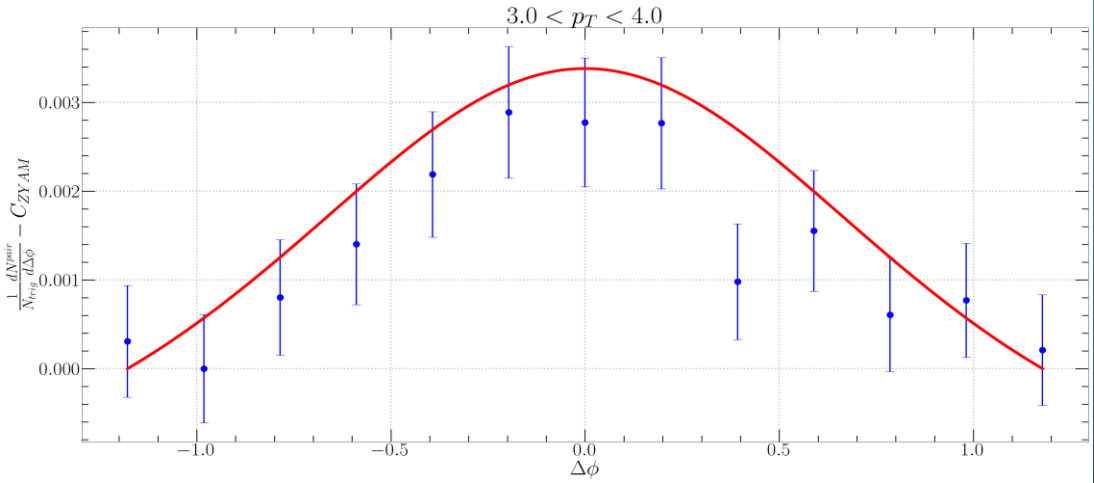
$\sqrt{S_{nn}} = 13000\ GeV$

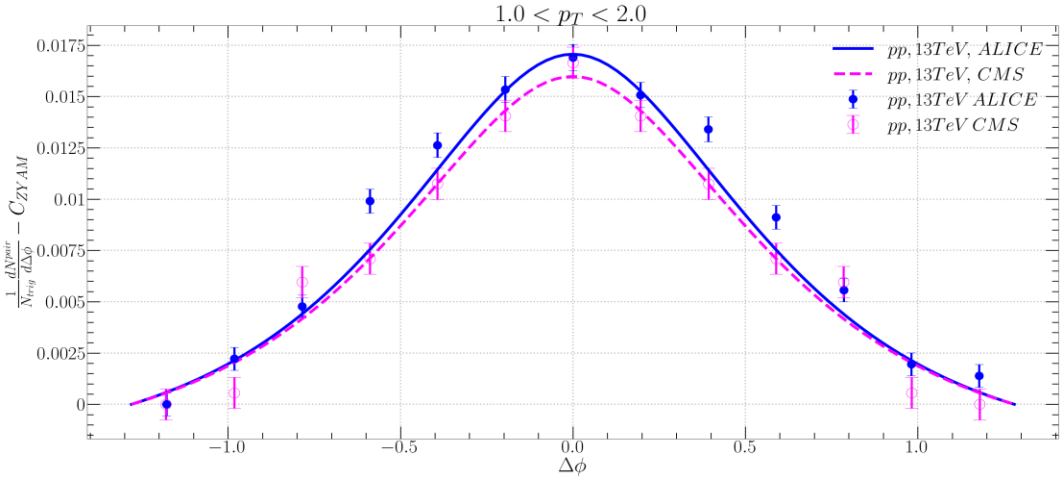
$\mathrm{A_{ridge}} = 0.040276$

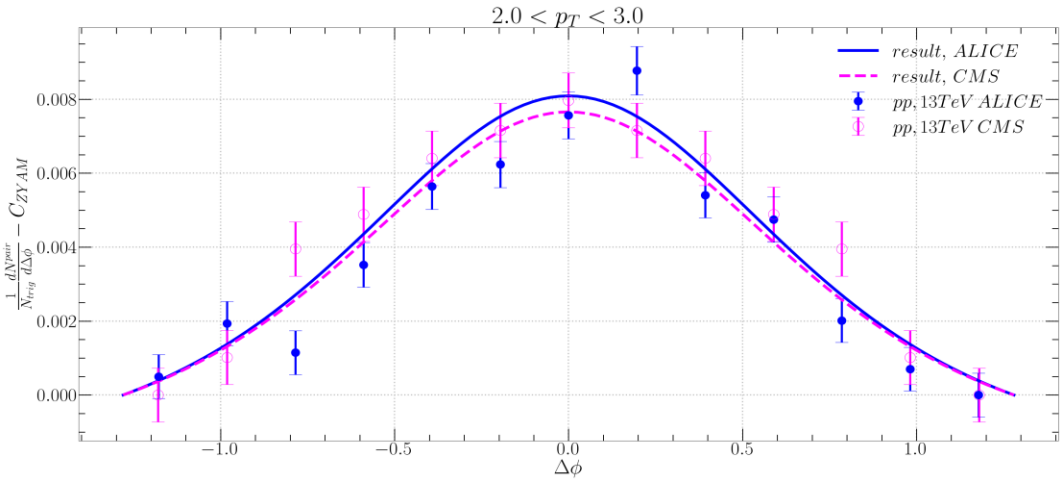
$f_R\langle N_k \rangle = 0.585e^{0.81p_T}$

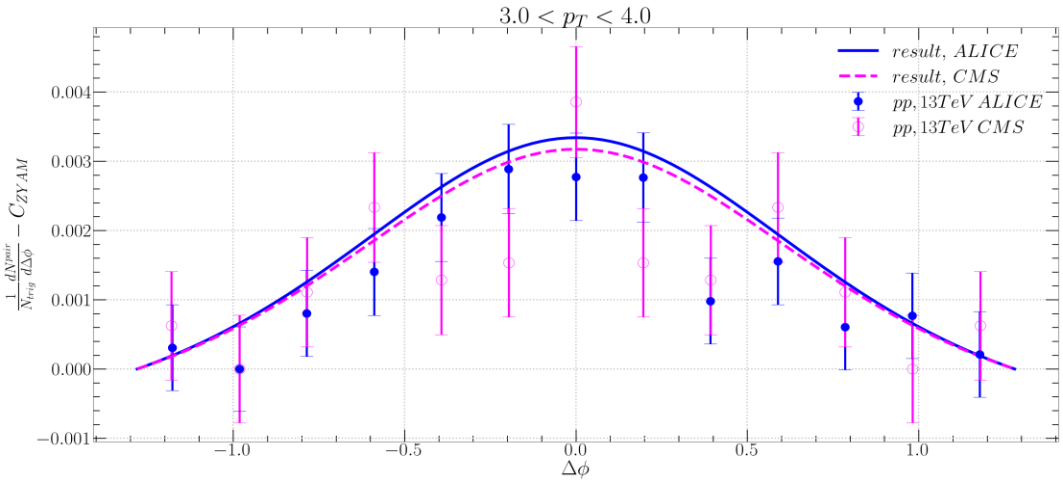

1.0 < p_T < 2.0
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$

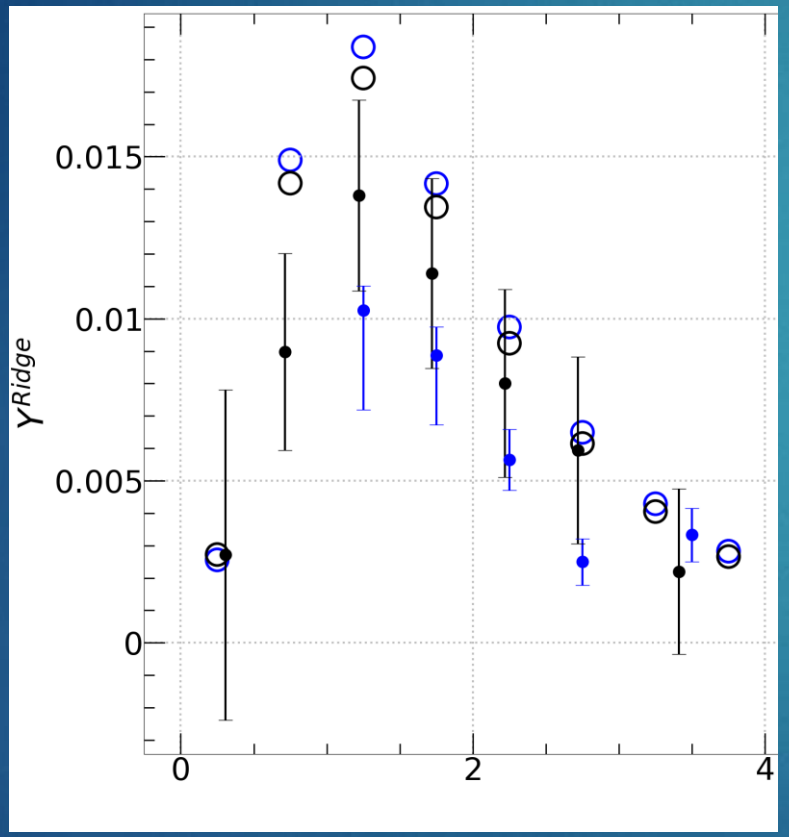

2.0 < p_T < 3.0
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$

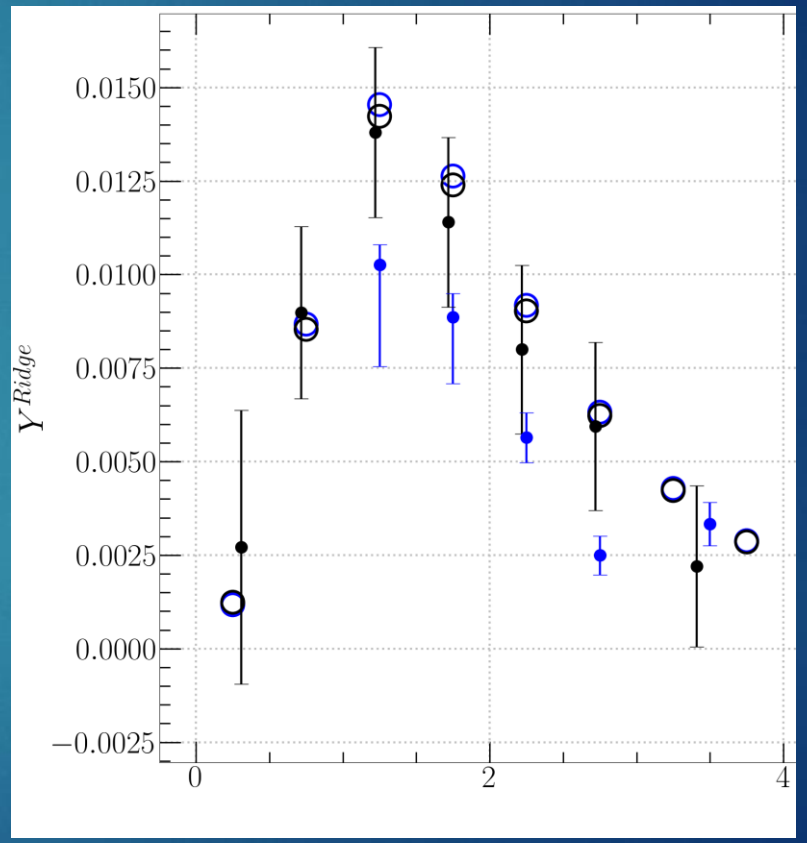

3.0 < p_T < 4.0
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$


1.0 < p_T < 2.0
$pp, 13TeV, ALICE$
$pp, 13TeV, CMS$
$pp, 13TeV\ ALICE$
$pp, 13TeV\ CMS$
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$


2.0 < p_T < 3.0
$result, ALICE$
$result, CMS$
$pp, 13TeV\ ALICE$
$pp, 13TeV\ CMS$
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$


3.0 < p_T < 4.0
$result, ALICE$
$result, CMS$
$pp, 13TeV\ ALICE$
$pp, 13TeV\ CMS$
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$


0.015
0.01
0.005
0
Y^{Ridge}
0
2
4


0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
−0.0025
Y^{Ridge}
0
2
4

$Y^{Ridge} \rightarrow$ ALICE

$$\frac{1}{N_{trig}}\frac{dN_{pair}}{d\Delta\phi} = \int_{1.6<|\Delta\eta|<1.8}\left(\frac{1}{N_{trig}}\frac{d^2N_{pair}}{d\Delta\eta d\Delta\phi}\right)\frac{1}{\delta_{\Delta\eta}}d\Delta\eta - C_{ZYAM} \quad (3.2)$$

$$Y^{ridge} = \int_{|\Delta\phi|<|\Delta\phi_{min}|}\frac{1}{N_{trig}}\frac{dN_{pair}}{d\Delta\phi}d\Delta\phi \quad (3.3)$$

$$= \int_{|\Delta\phi|<|\Delta\phi_{min}|}\left[\int_{1.6<|\Delta\eta|<1.8}\left(\frac{1}{N_{trig}}\frac{d^2N_{pair}}{d\Delta\eta d\Delta\phi}\right)\frac{1}{\delta_{\Delta\eta}}d\Delta\eta - C_{ZYAM}\right]d\Delta\phi$$

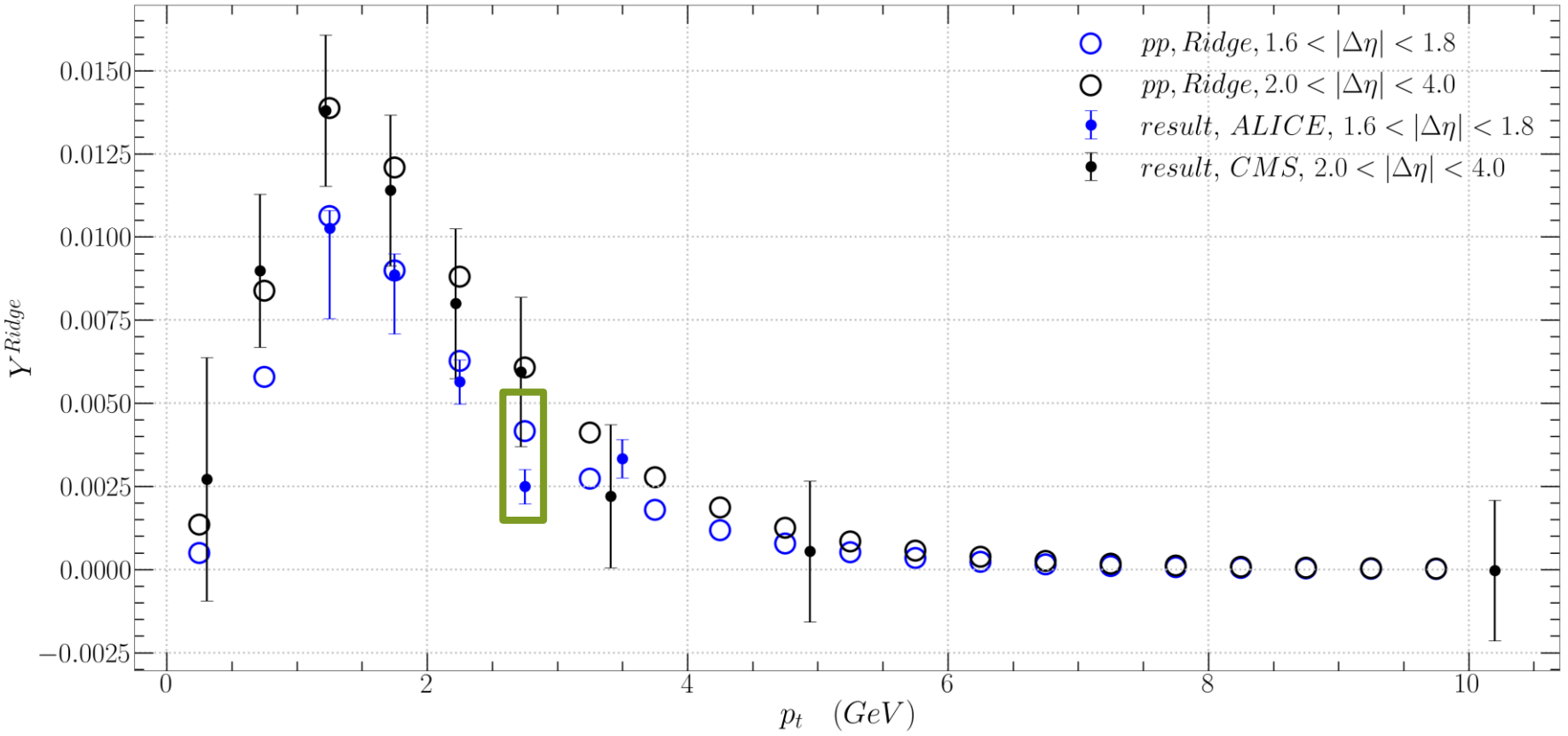
Y^{Ridge} → CMS

$$\frac{1}{N_{trig}}\frac{dN_{pair}}{d\Delta\phi} = \int_{1.6<|\Delta\eta|<1.8}\left(\frac{1}{N_{trig}}\frac{d^2N_{pair}}{d\Delta\eta d\Delta\phi}\right)\frac{1}{\delta_{\Delta\eta}}d\Delta\eta - C_{ZYAM} \quad (3.2)$$

$$Y^{ridge} = \int_{|\Delta\phi|<|\Delta\phi_{min}|}\frac{1}{N_{trig}}\frac{dN_{pair}}{d\Delta\phi}d\Delta\phi \quad (3.3)$$

$$= \int_{|\Delta\phi|<|\Delta\phi_{min}|}\left[\int_{1.6<|\Delta\eta|<1.8}\left(\frac{1}{N_{trig}}\frac{d^2N_{pair}}{d\Delta\eta d\Delta\phi}\right)\frac{1}{\delta_{\Delta\eta}}d\Delta\eta\right]d\Delta\phi$$

Y^{Ridge}



21.08.26 Fitting

$a = 4$

$\mathrm{T} = 0.63\ GeV$

$q = 0.9\ GeV$

$m_d = 1\ GeV$

$\sqrt{S_{nn}} = 13000\ GeV$

$\mathrm{A_{ridge}} = 0.040276$

$f_R\langle N_k \rangle = 0.585e^{0.81p_T}$

Application of the Momentum Kick Model to PbPb Collisions at $\sqrt{s_{NN}} = 2.76$ TeV at the LHC

Taewook YOUN* and Jin-Hee YOON†

Department of Physics, Inha University, Incheon 22212, Korea

Physical parameter	CMS (PbPb)
N_{jet}	$0.873 + 0.15\langle p_T^{\text{trig}} \rangle$
T_{jet}	$0.228 + 0.072\langle p_T^{\text{trig}} \rangle$ GeV
σ_{ϕ_0}	0.5
m_a	1.1 GeV
q	0.7 GeV
$f_R\langle N_k \rangle$	f_R: $e^{-1.395/\langle p_T^{\text{trig}} \rangle}$ $\langle N_k \rangle$: $20.2e^{-0.207\langle p_T^{\text{trig}} \rangle}$
f_J	0.632
a	0.5
T	0.6 GeV
m_d	1.0 GeV

$$f_R = e^{-6.084/p_T}$$
$$\langle N_k \rangle = 630e^{-0.9p_T}$$

$\Delta\phi$ Correlation

21.08.31 Fitting

$a = 3$

$\mathrm{T} = 0.55\ GeV$

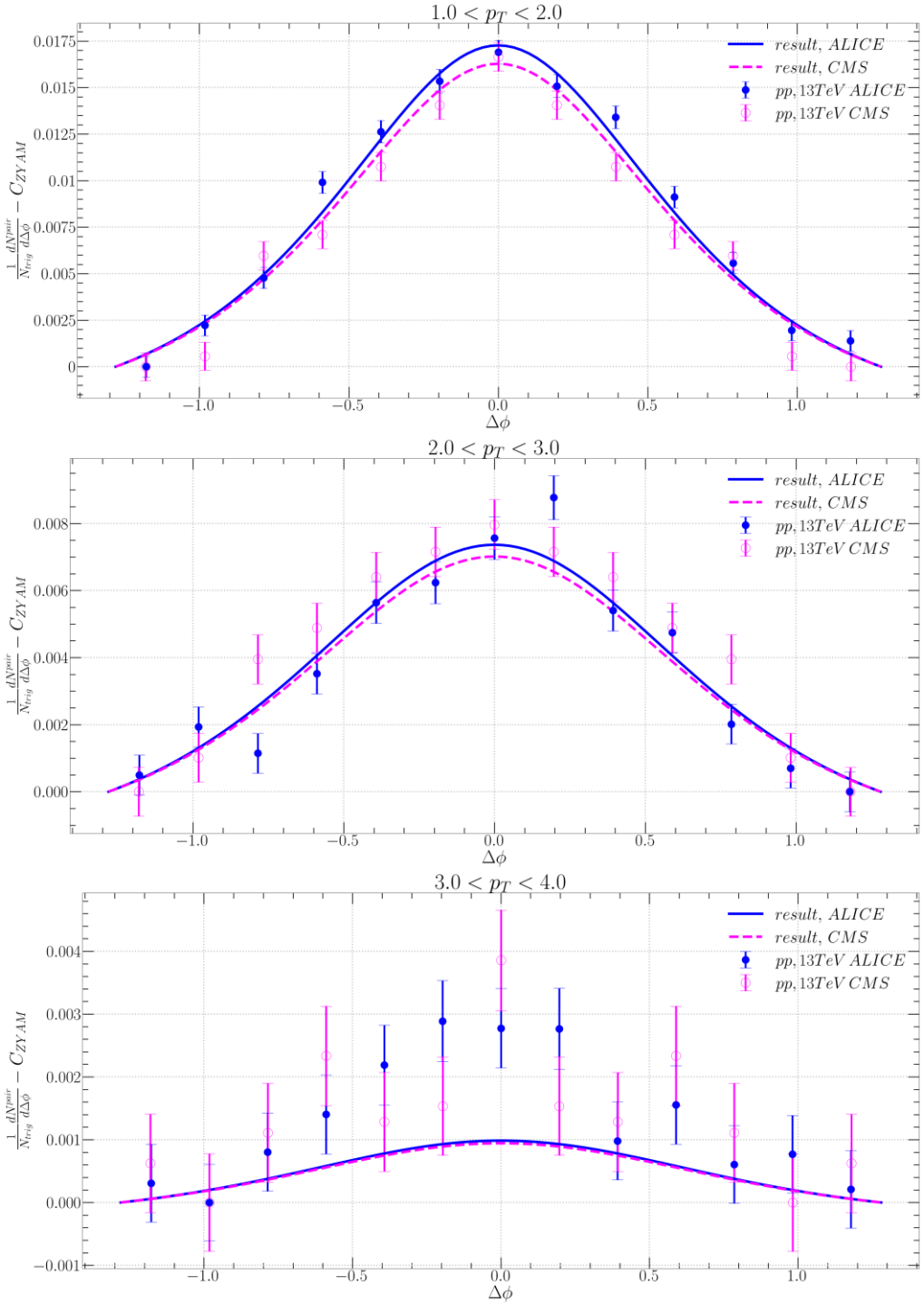
$q = 0.8\ GeV$

$m_d = 1\ GeV$

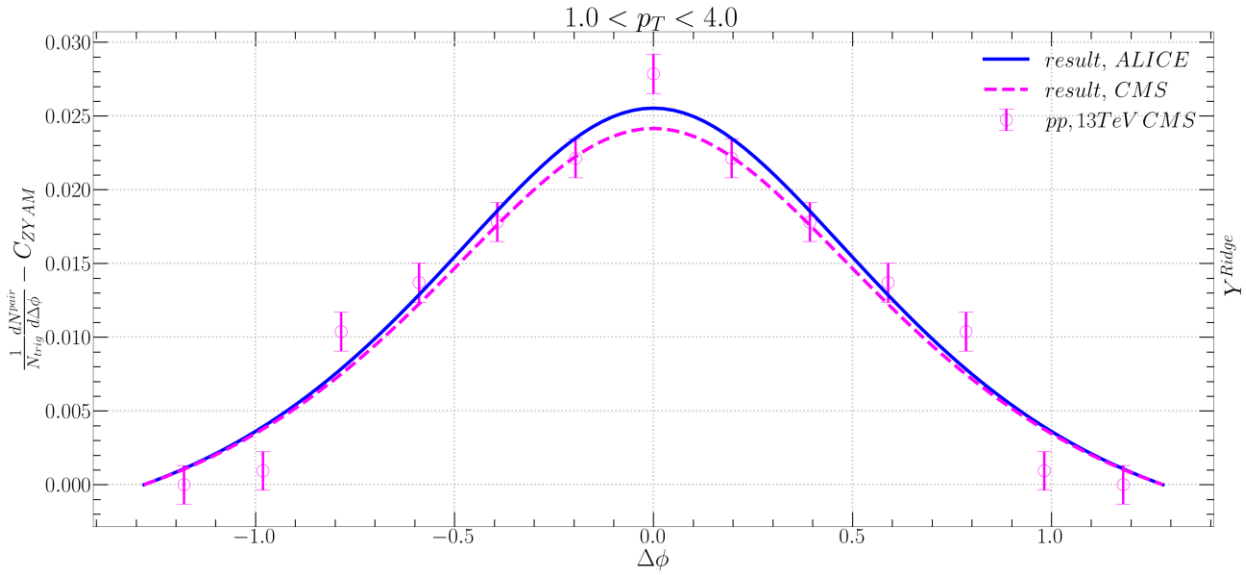
$\sqrt{S_{nn}} = 13000\ GeV$

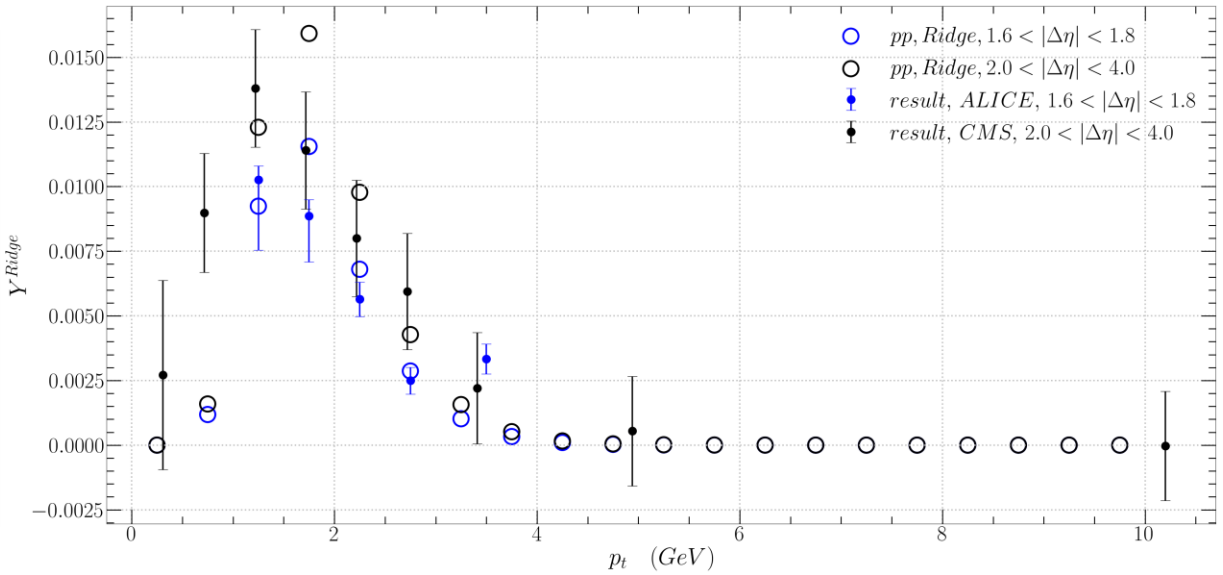
$\mathrm{A_{ridge}} = 0.048223$

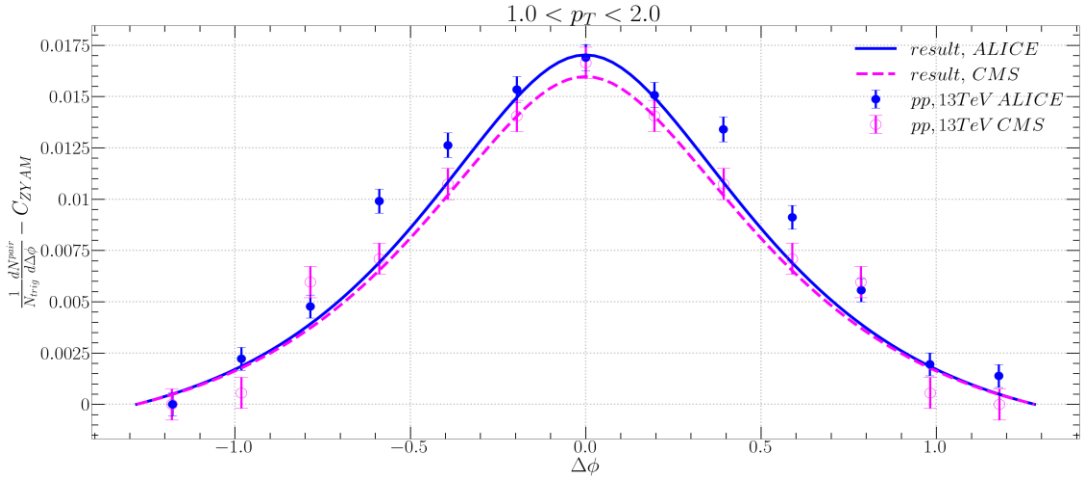
$f_R\langle N_k\rangle = 630e^{-6.084/p_T - 0.9p_T}$

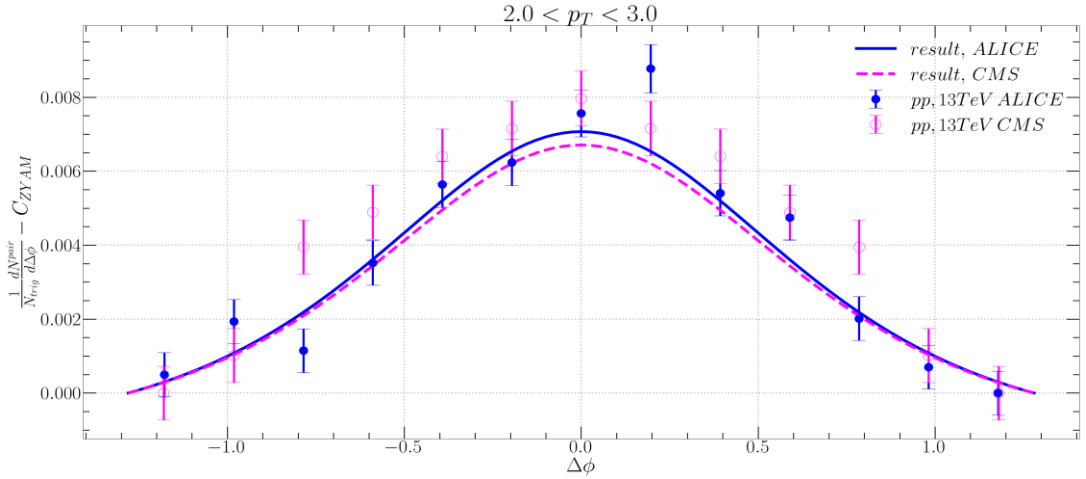


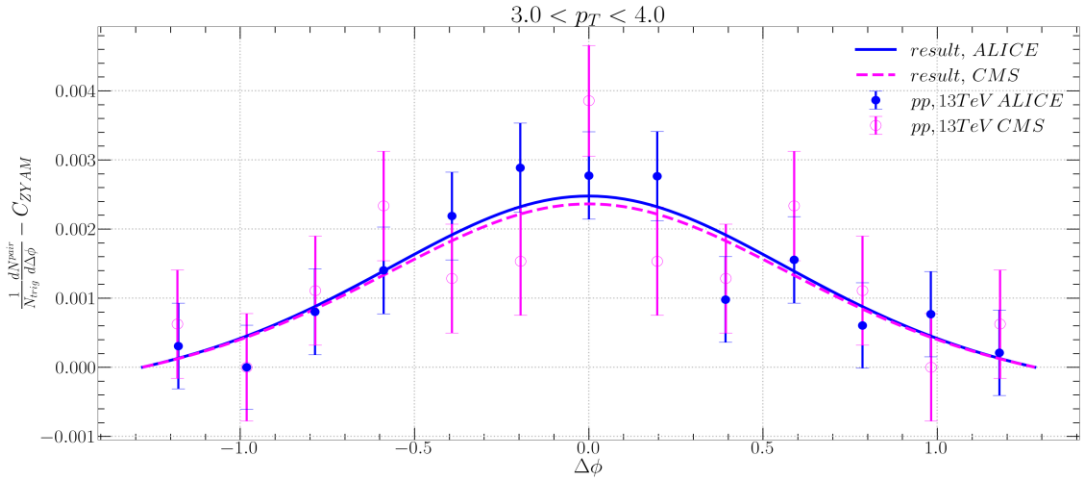
Y^{Ridge}


$1.0 < p_T < 4.0$
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$
result, ALICE
result, CMS
pp, 13TeV CMS


Y^{Ridge}
p_t (GeV)
pp, Ridge, $1.6 < |\Delta\eta| < 1.8$
pp, Ridge, $2.0 < |\Delta\eta| < 4.0$
result, ALICE, $1.6 < |\Delta\eta| < 1.8$
result, CMS, $2.0 < |\Delta\eta| < 4.0$







$\Delta\phi$ Correlation

21.08.31 Fitting -2

$a = 3$

$\mathrm{T} = 0.61\ GeV$

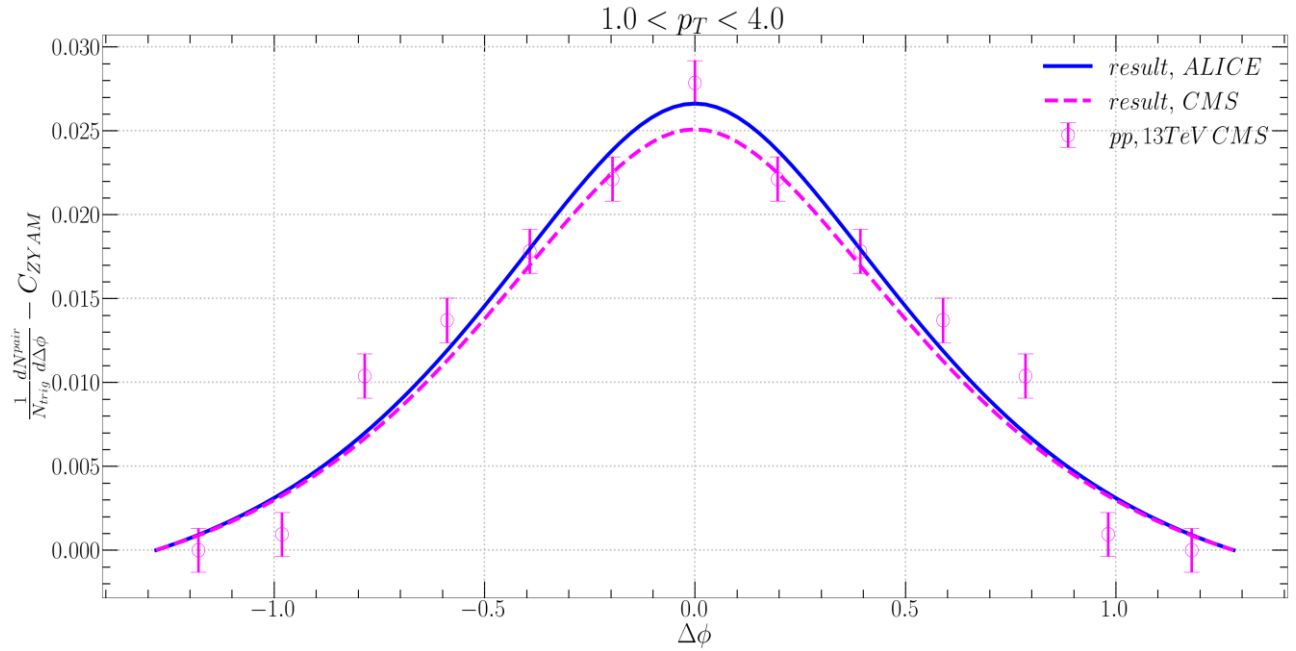
$q = 0.96\ GeV$

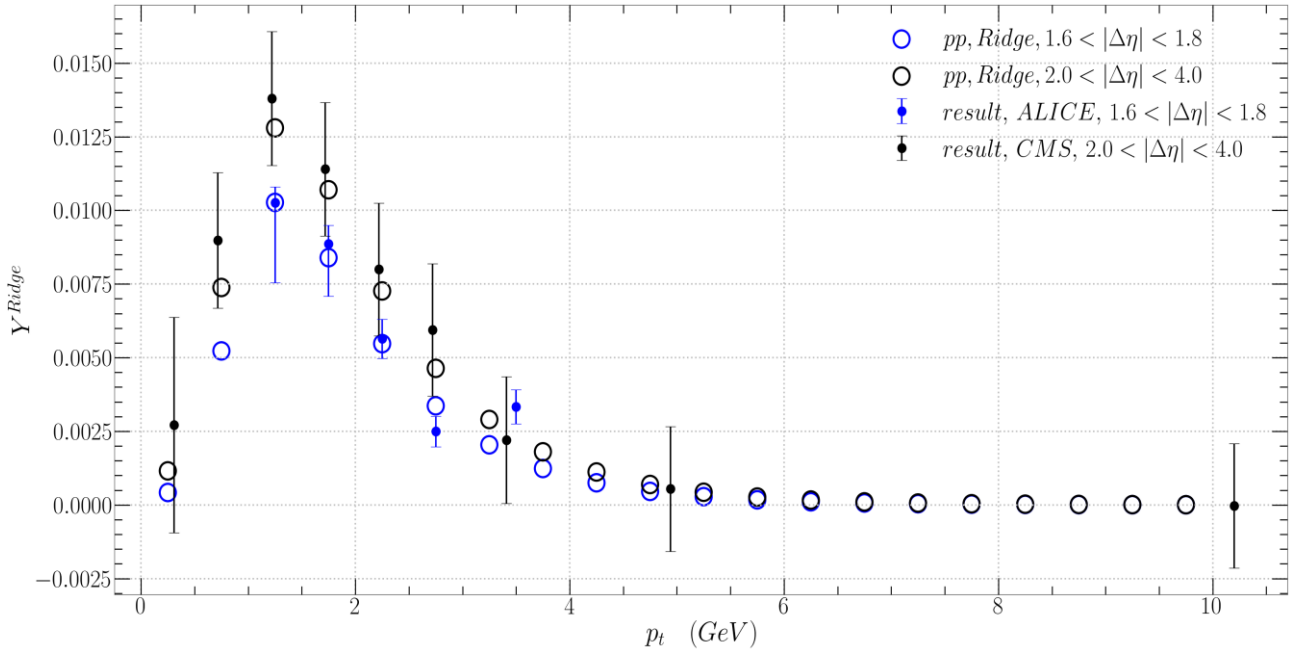
$m_d = 1\ GeV$

$\sqrt{S_{nn}} = 13000\ GeV$

$\mathrm{A_{ridge}} = 0.0410025$

$f_R\langle N_k \rangle = 0.6e^{0.7p_T}$





$\Delta\phi$ Correlation

21.08.31 Fitting -2

$a = 3$

$T = 0.61\ GeV$

$q = 0.96\ GeV$

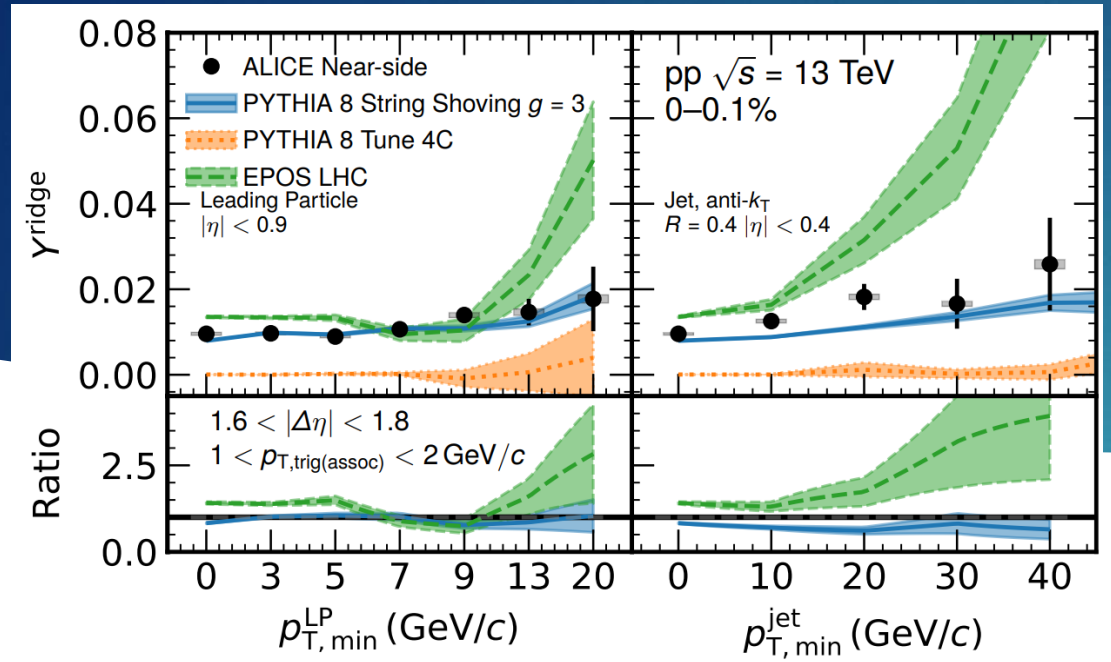
$m_d = 1\ GeV$

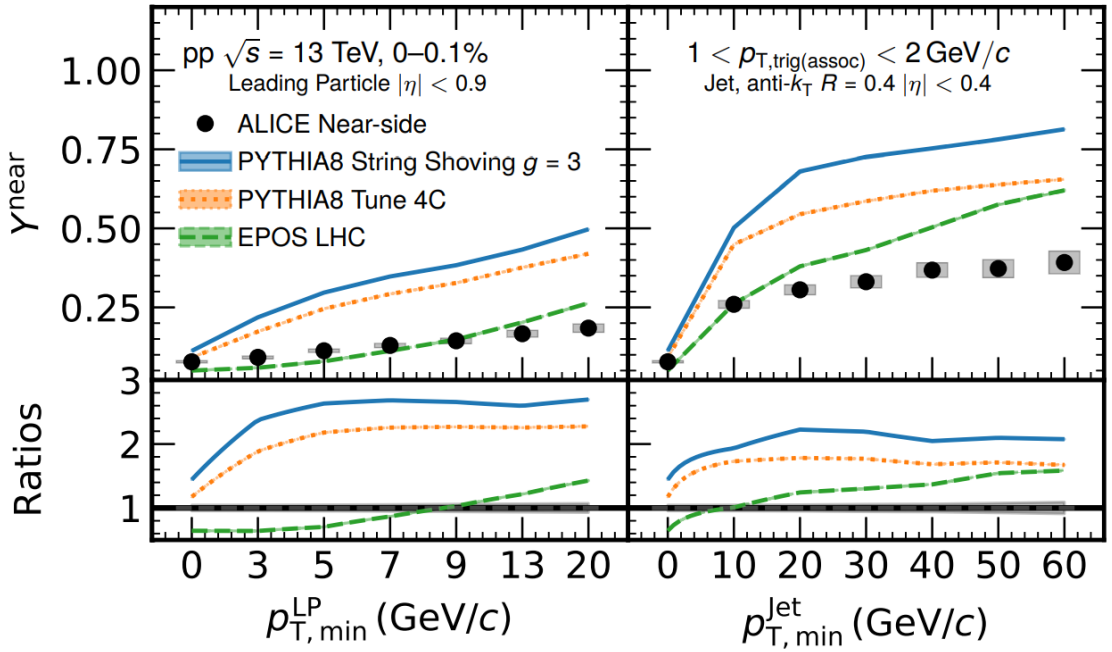
$\sqrt{S_{nn}} = 13000\ GeV$

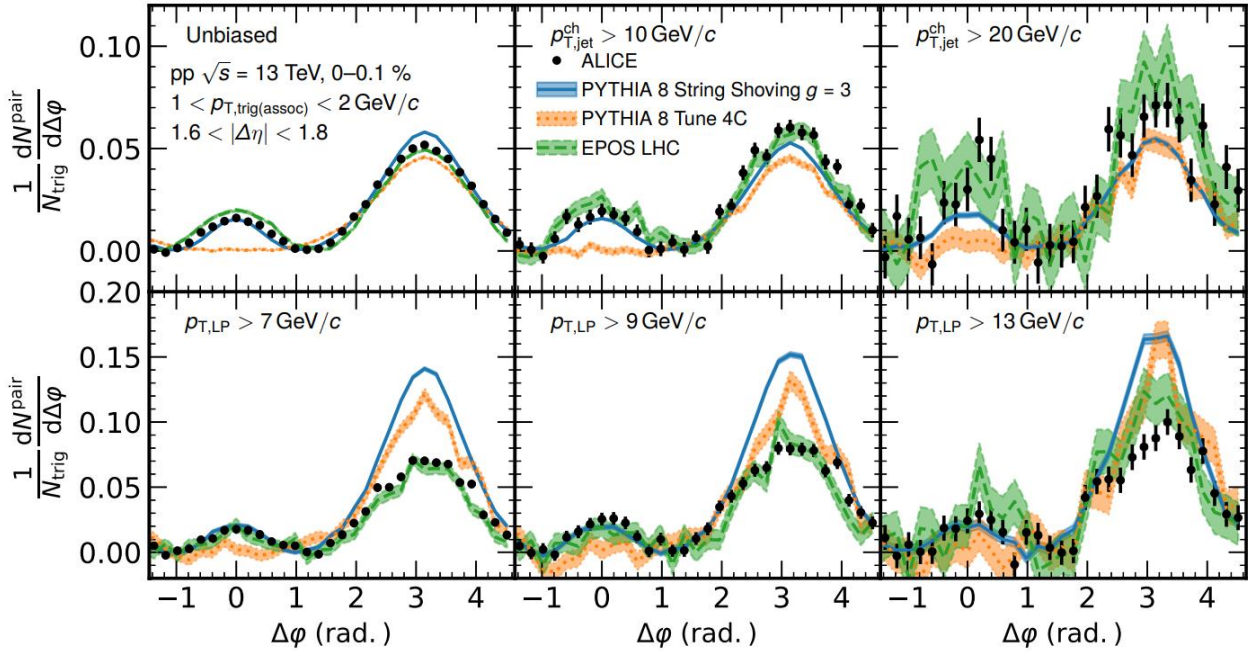
$A_{ridge} = 0.0410025$

$f_R\langle N_k\rangle = 0.6e^{0.7p_T}$

Good Fit at ALICE data


ALICE Near-side
PYTHIA 8 String Shoving g = 3
PYTHIA 8 Tune 4C
EPOS LHC
Leading Particle
$|\eta| < 0.9$
pp $\sqrt{s}$ = 13 TeV
0–0.1%
Jet, anti-k_T
R = 0.4 $|\eta| < 0.4$
$1.6 < |\Delta\eta| < 1.8$
$1 < p_{T,trig(assoc)} < 2$ GeV/c
Y^{ridge}
Ratio
$p_{T,min}^{LP}$ (GeV/c)
$p_{T,min}^{jet}$ (GeV/c)


pp $\sqrt{s}$ = 13 TeV, 0–0.1%
Leading Particle $|\eta| < 0.9$
$1 < p_{T,trig(assoc)} < 2$ GeV/c
Jet, anti-k_T R = 0.4 $|\eta| < 0.4$
ALICE Near-side
PYTHIA8 String Shoving g = 3
PYTHIA8 Tune 4C
EPOS LHC
Y^{near}
Ratios
$p_{T,min}^{LP}$ (GeV/c)
$p_{T,min}^{Jet}$ (GeV/c)


Unbiased
pp $\sqrt{s}$ = 13 TeV, 0–0.1 %
$1 < p_{T,trig(assoc)} < 2$ GeV/c
$1.6 < |\Delta\eta| < 1.8$
$p_{T,jet}^{ch} > 10$ GeV/c
ALICE
PYTHIA 8 String Shoving g = 3
PYTHIA 8 Tune 4C
EPOS LHC
$p_{T,jet}^{ch} > 20$ GeV/c
$p_{T,LP} > 7$ GeV/c
$p_{T,LP} > 9$ GeV/c
$p_{T,LP} > 13$ GeV/c
$\frac{1}{N_{trig}} \frac{dN^{pair}}{d\Delta\varphi}$
$\Delta\varphi$ (rad.)

ALICE와 CMS의 데이터가 차이가 나므로 따로 Fitting 진행.

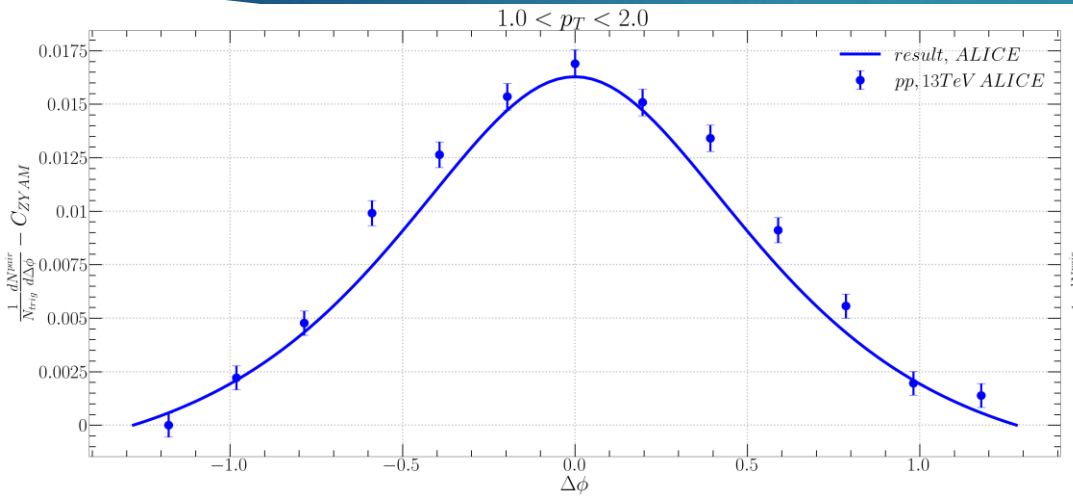
ALICE Fitting Parameters

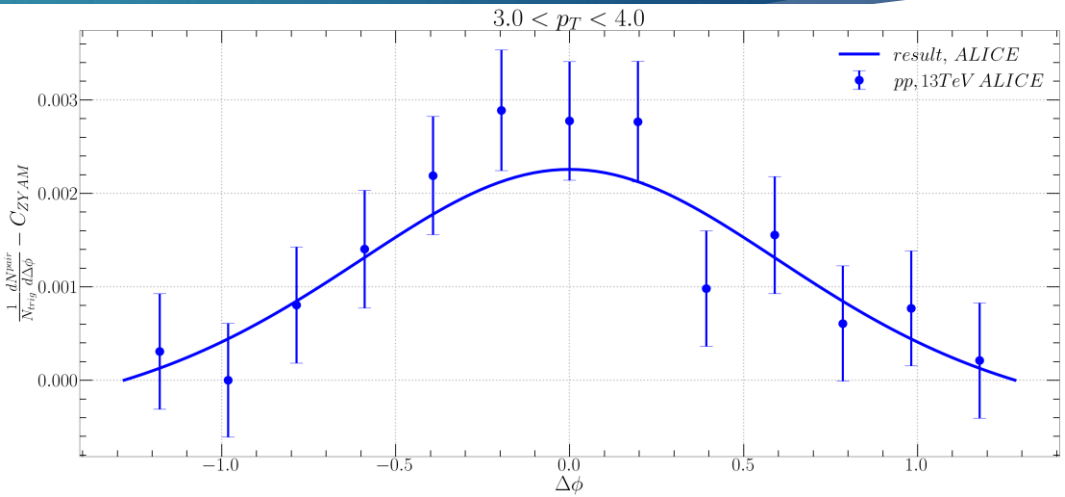
- $a = 2.2$
- $\mathrm{T} = 0.51\ GeV$
- $q = 0.8\ GeV$
- $m_d = 1\ GeV$
- $\sqrt{S_{nn}} = 13000\ GeV$
- $\mathrm{A_{ridge}} = 0.052779$
- $f_R\langle N_k \rangle = 0.5e^{p_T}$

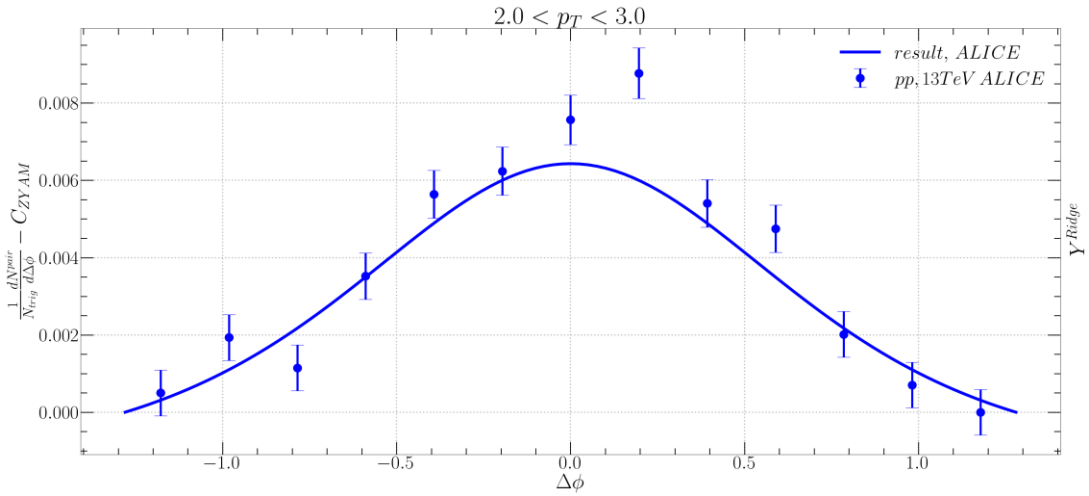
CMS Fitting Parameters

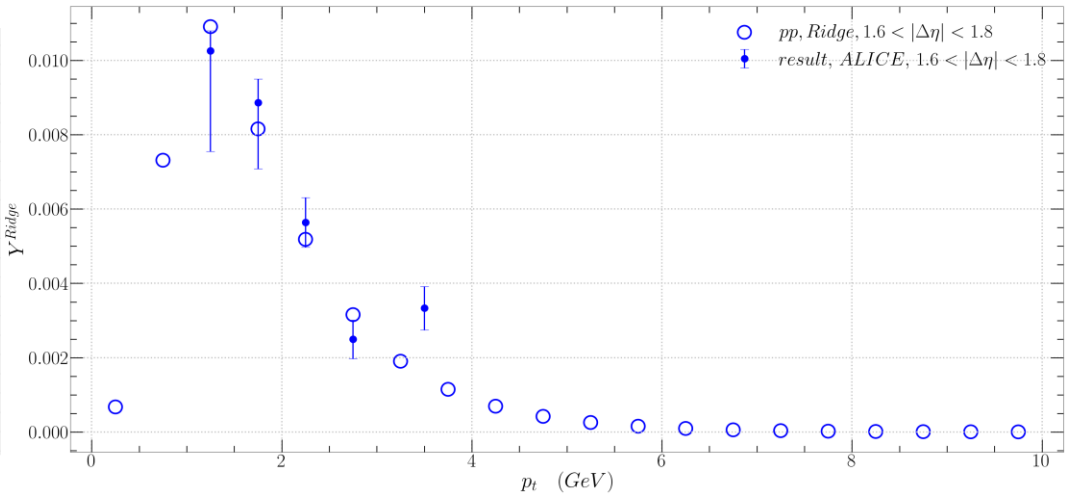
- $a = 3$
- $\mathrm{T} = 0.51\ GeV$
- $q = 0.85\ GeV$
- $m_d = 1\ GeV$
- $\sqrt{S_{nn}} = 13000\ GeV$
- $\mathrm{A_{ridge}} = 0.056137$
- $f_R\langle N_k \rangle = 0.36e^{1.15p_T}$

ALICE 13TeV $\Delta\phi$ Correlation, Y^{Ridge}

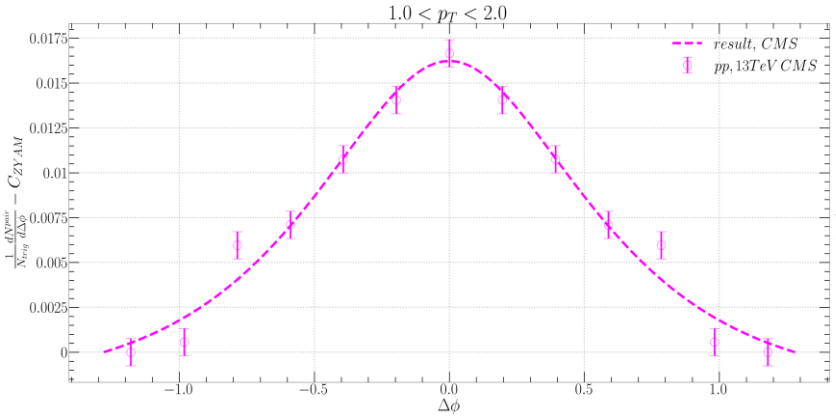


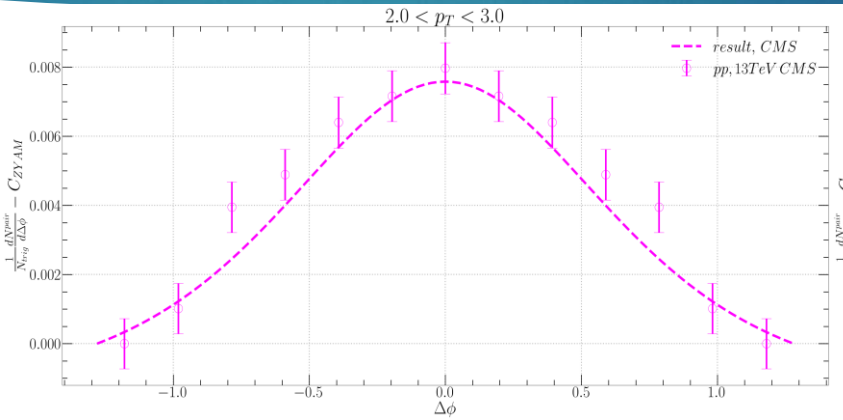


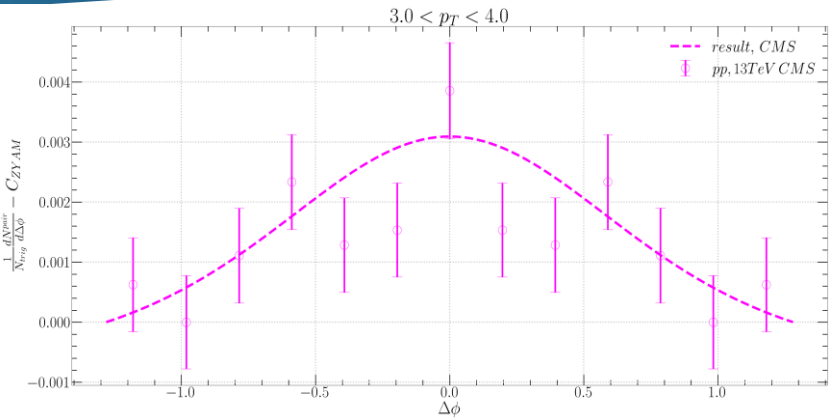


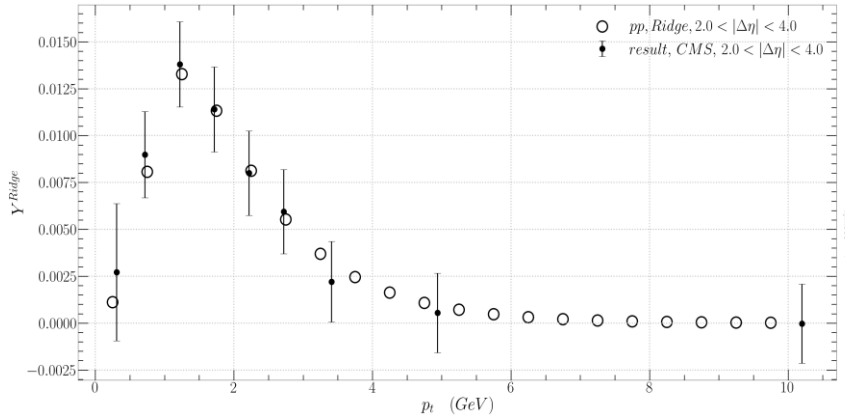


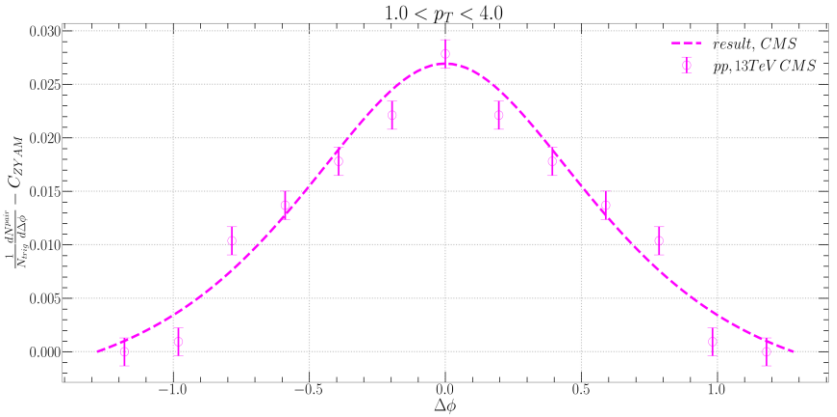
CMS 13TeV $\Delta\phi$ Correlation, Y^{Ridge}











	PHENIX (AuAu)	CMS (PbPb, pp)
N_{jet}	$0.15 + 0.10\left\langle p_T^{trig}\right\rangle$	$\alpha + \beta\left\langle p_T^{trig}\right\rangle$
f_R	$f_R\langle N_k\rangle$=3.0	$e^{-\gamma/\left\langle p_T^{trig}\right\rangle}$
$\langle N_k\rangle$		$\delta e^{-\epsilon\left\langle p_T^{trig}\right\rangle}$
		divide 2 parts
q	0.8 GeV	$\zeta e^{-\eta/\left\langle p_T^{trig}\right\rangle}$ GeV
	RHIC energy	LHC energy

21.09.02 Fitting

$a = 6$

$\mathrm{T} = 0.6\ GeV$

$q = 1.5e^{-0.76p_T}\ GeV$

$m_d = 1\ GeV$

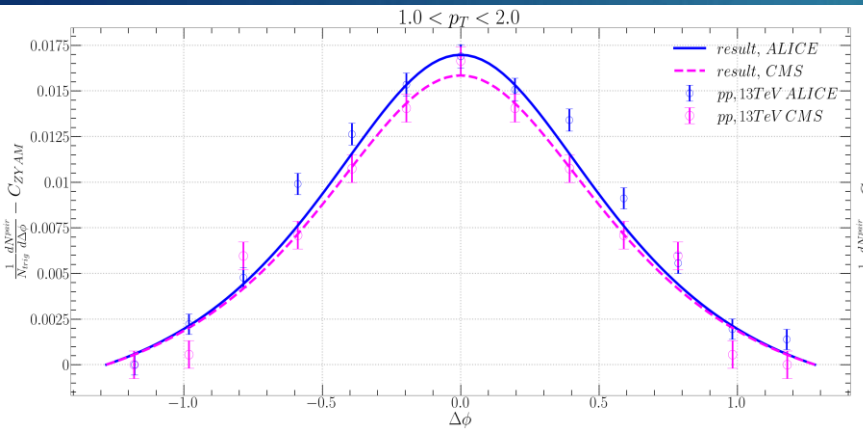
$\sqrt{S_{nn}} = 13000\ GeV$

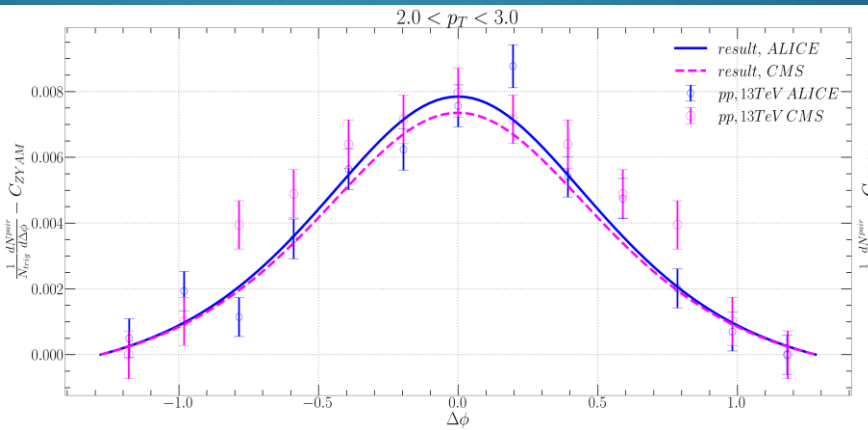
$\mathrm{A_{ridge}} = 0.045591$

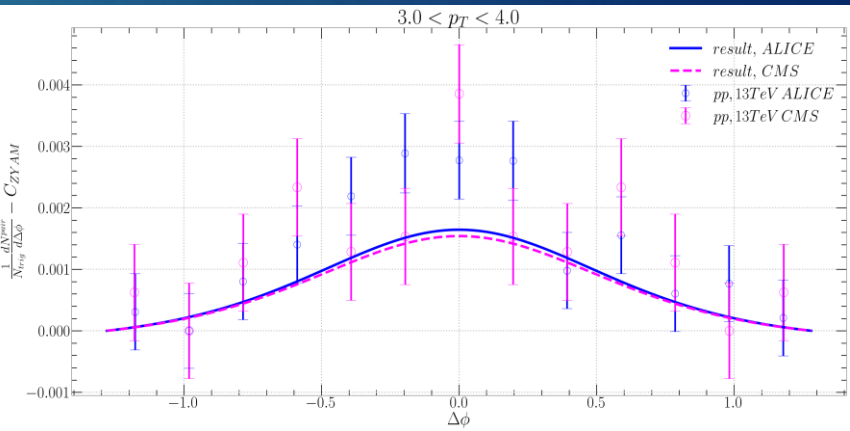
$f_R = \mathrm{e}^{-2/p_T}$

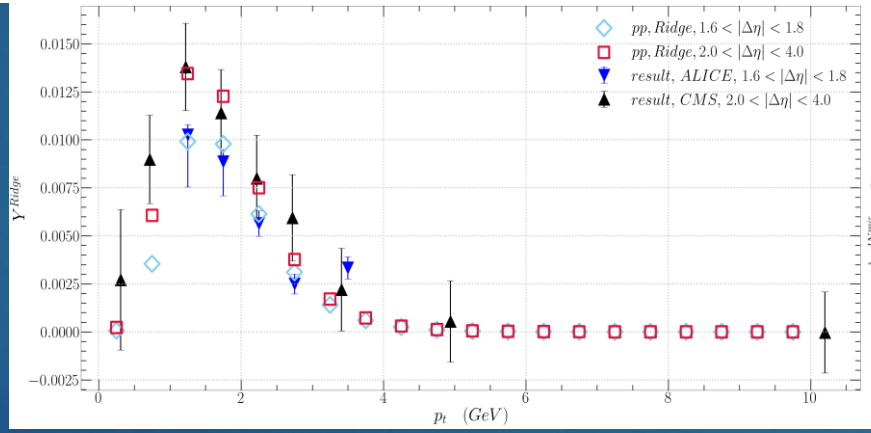
$\langle N_k\rangle = 11.5e^{-0.3p_T}$

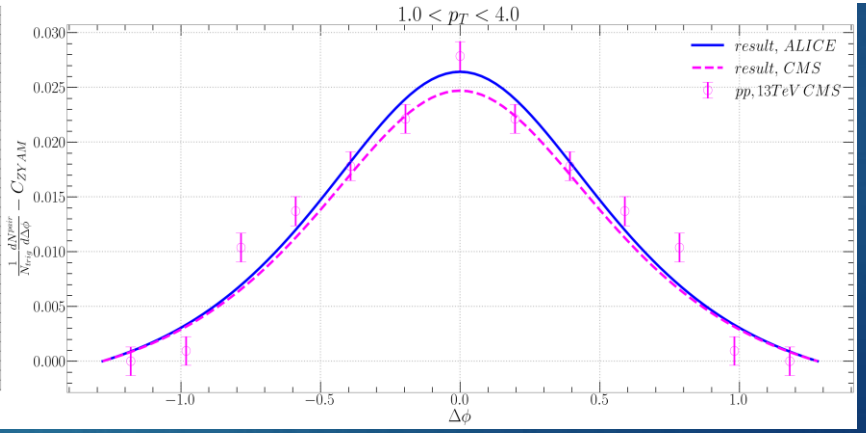
Fitting 결과


$1.0 < p_T < 2.0$
result, ALICE
result, CMS
pp, 13TeV ALICE
pp, 13TeV CMS
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$


$2.0 < p_T < 3.0$
result, ALICE
result, CMS
pp, 13TeV ALICE
pp, 13TeV CMS
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$


$3.0 < p_T < 4.0$
result, ALICE
result, CMS
pp, 13TeV ALICE
pp, 13TeV CMS
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$


pp, Ridge, $1.6 < |\Delta\eta| < 1.8$
pp, Ridge, $2.0 < |\Delta\eta| < 4.0$
result, ALICE, $1.6 < |\Delta\eta| < 1.8$
result, CMS, $2.0 < |\Delta\eta| < 4.0$
Y^{Ridge}
p_t (GeV)


$1.0 < p_T < 4.0$
result, ALICE
result, CMS
pp, 13TeV CMS
$\frac{1}{N_{trig}}\frac{dN^{pair}}{d\Delta\phi} - C_{ZYAM}$
$\Delta\phi$