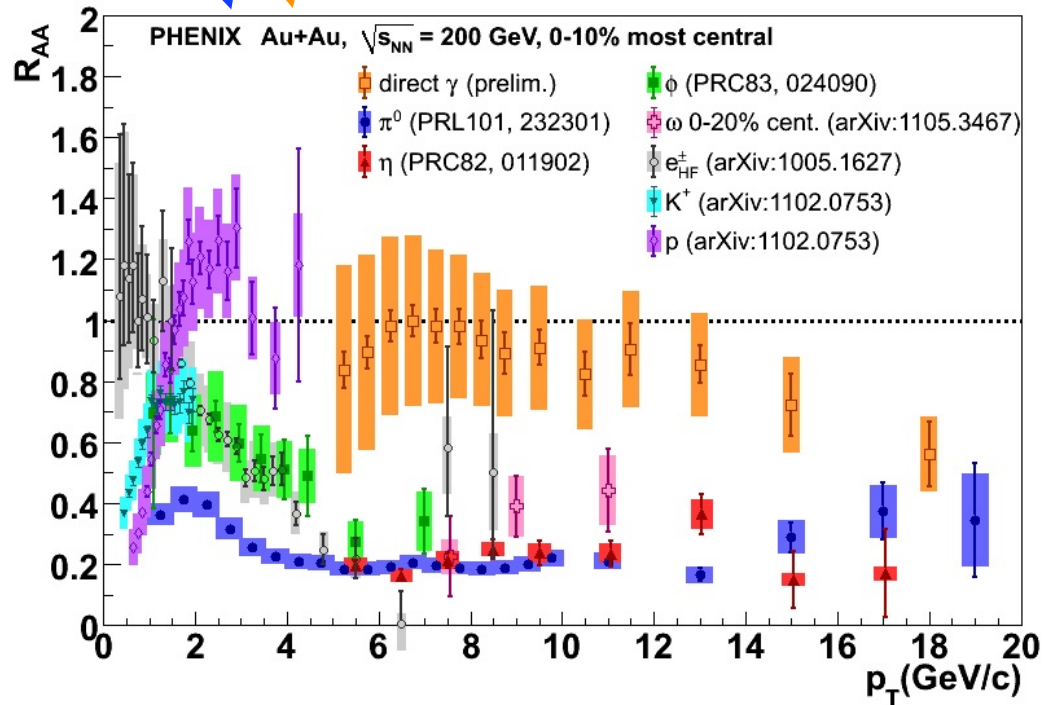


Overview on direct photon measurements

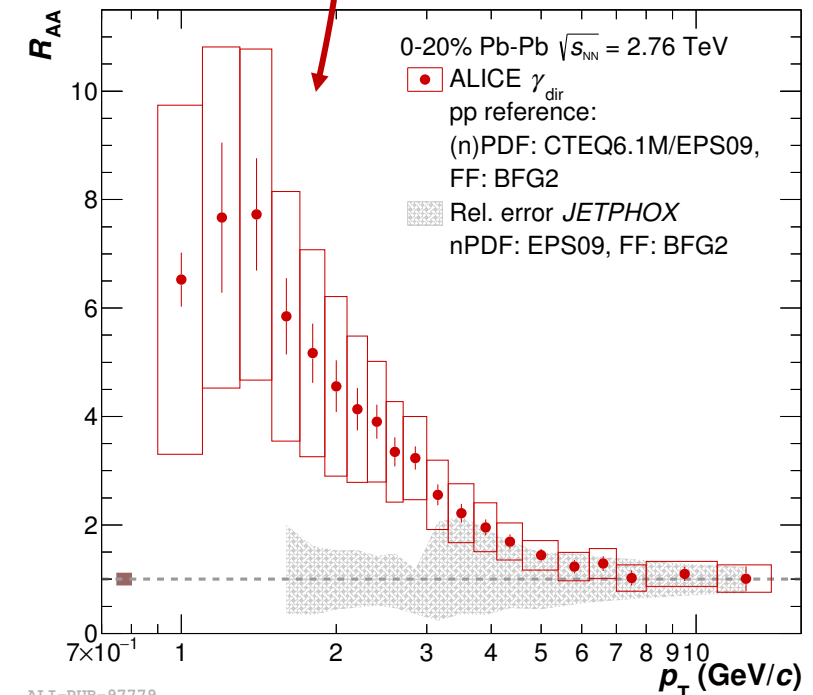


Different type of photons

1. Fragmentation and decay γ ($\pi^0 \rightarrow \gamma\gamma$): $R_{AA}(p_T) < 1$
2. Prompt γ : $R_{AA}(p_T) = 1$
3. Thermal γ : $R_{AA}(p_T) > 1$ QGP irradiation



PHENIX, 2013, [arXiv:1302.1833](https://arxiv.org/abs/1302.1833)



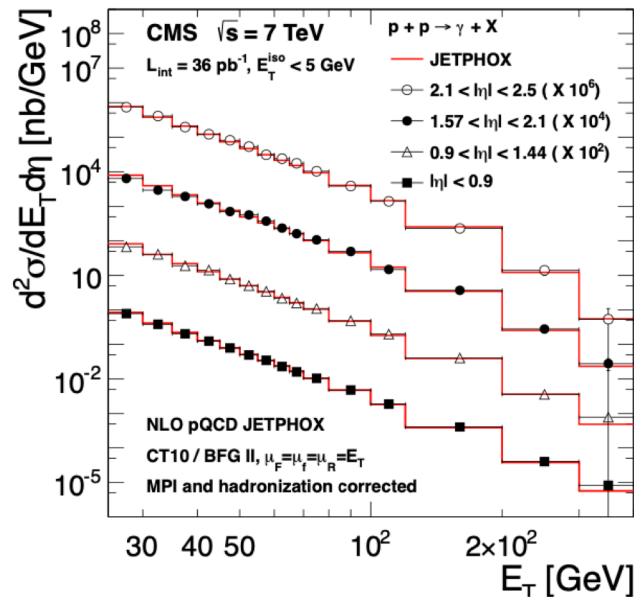
ALI-PUB-97779

ALICE, 2015, [arXiv:1512.04230](https://arxiv.org/abs/1512.04230)

Different origin = Different physics = different $R_{AA}(p_T)$

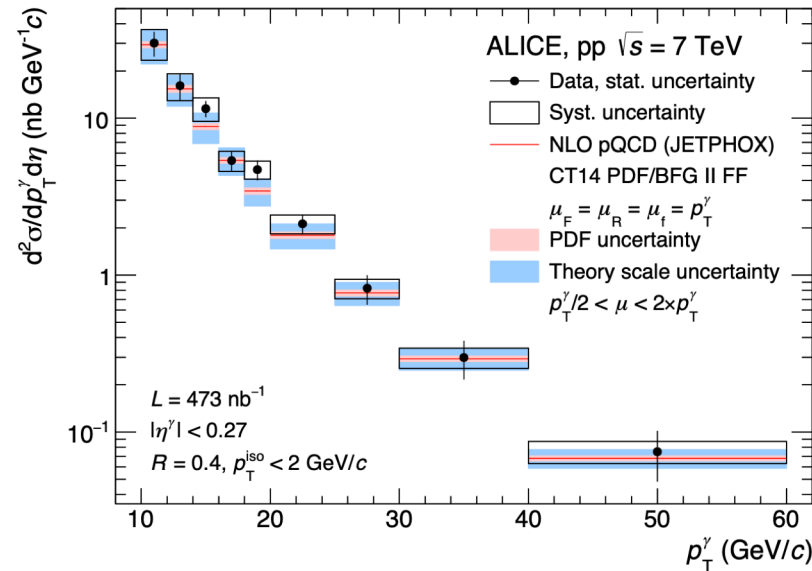
Isolated γ cross-section in pp

Measurements # photons $\rightarrow$ isolated γ cross section
 Comparison with NLO pQCD (JETPHOX) or other pQCD calculations
 Theoretical constraints



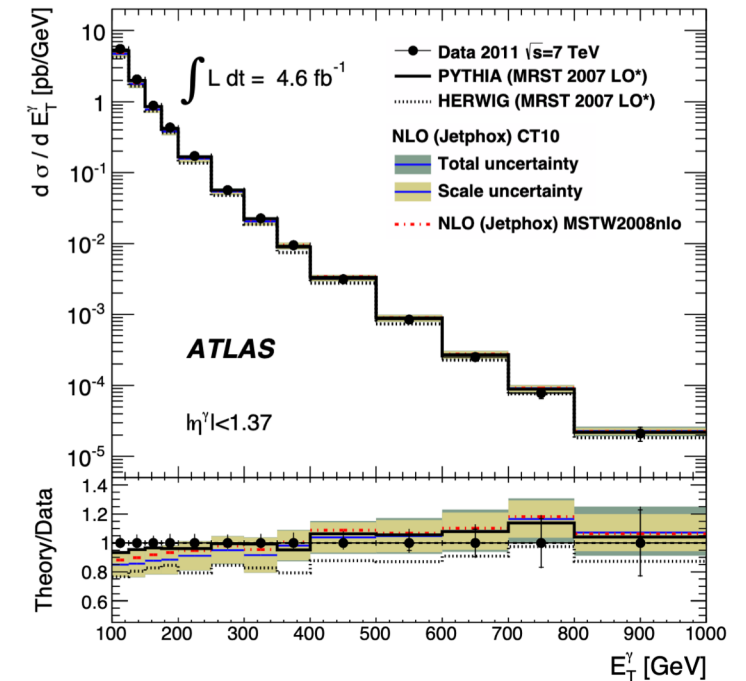
CMS, 2011, [arXiv:1108.2044](https://arxiv.org/abs/1108.2044)

pp 7 TeV



ALICE, 2019, [arXiv:1906.01371](https://arxiv.org/abs/1906.01371)

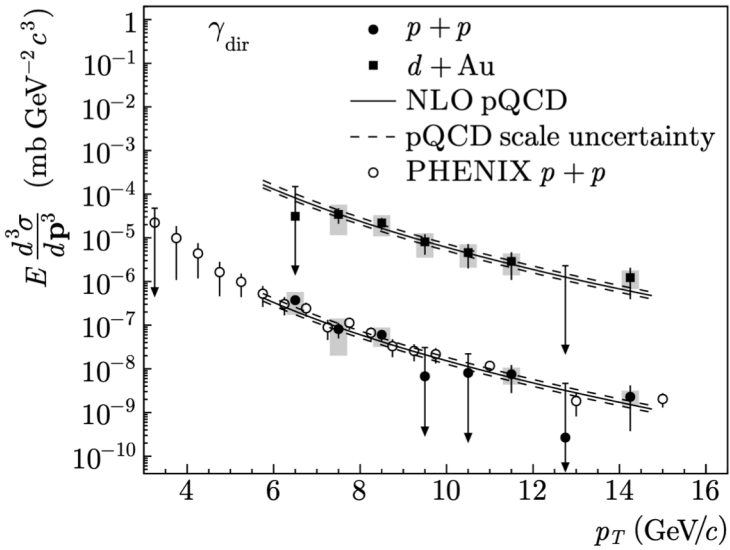
pp 7 TeV



ATLAS, 2014, [arXiv:1311.1440](https://arxiv.org/abs/1311.1440)

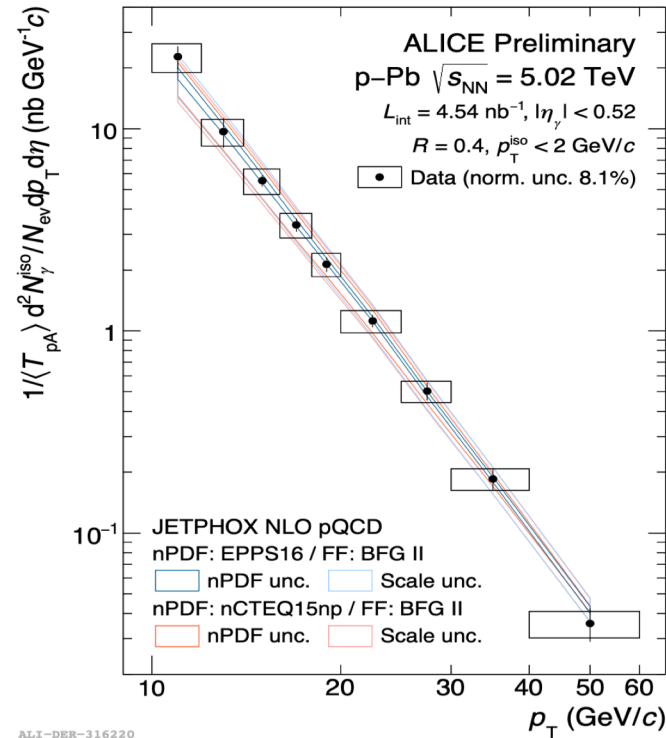
pp 7 TeV

Isolated γ cross-section in pA



STAR, 2010, [arXiv:0912.3838](https://arxiv.org/abs/0912.3838)

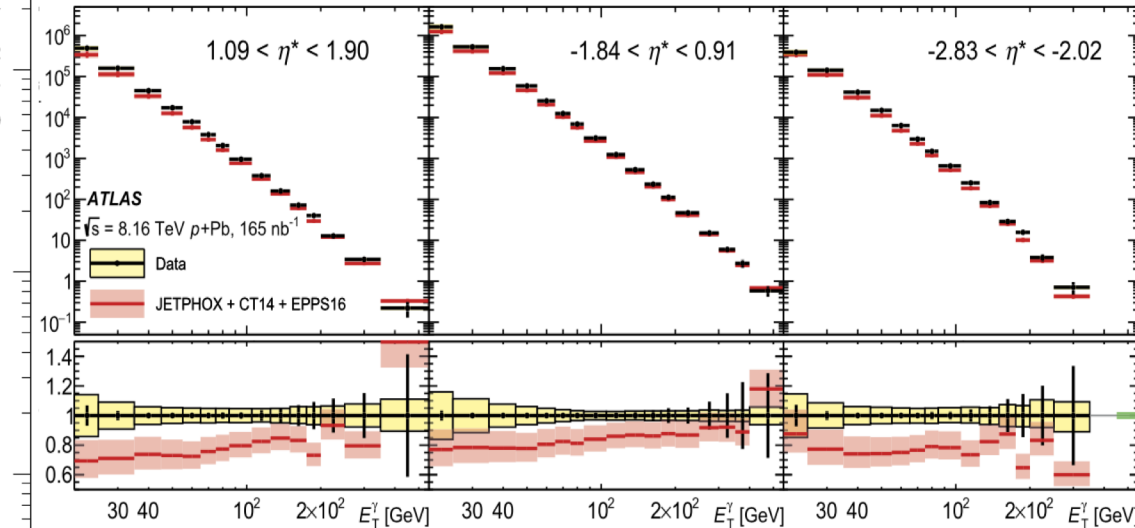
dAu 200 GeV



ALI-DER-316220

ALICE, 2018, ANA-741

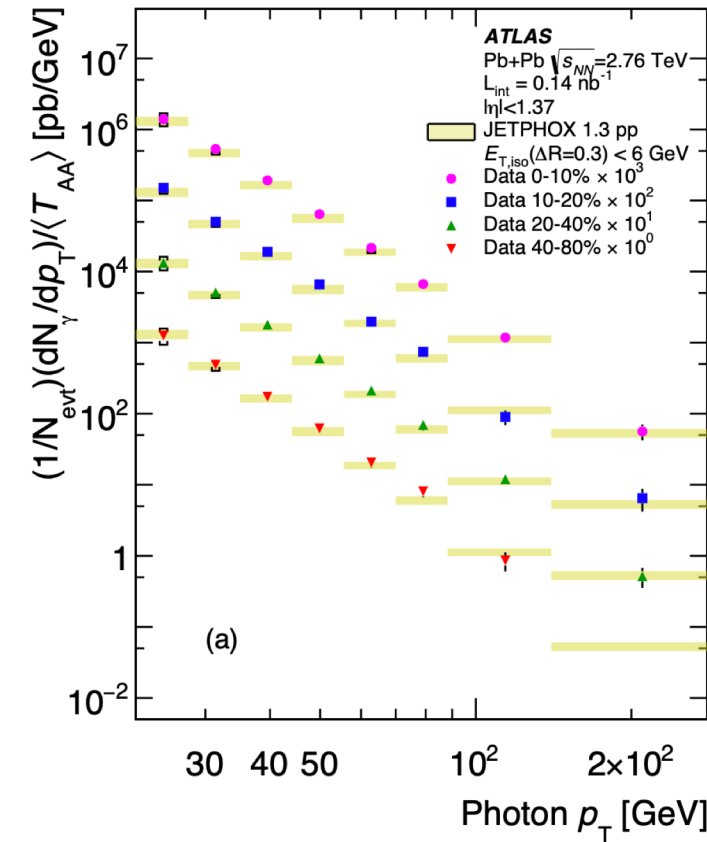
pPb 5.02 TeV



ATLAS, 2019, [arXiv:1903.02209](https://arxiv.org/abs/1903.02209)

pPb 8 TeV

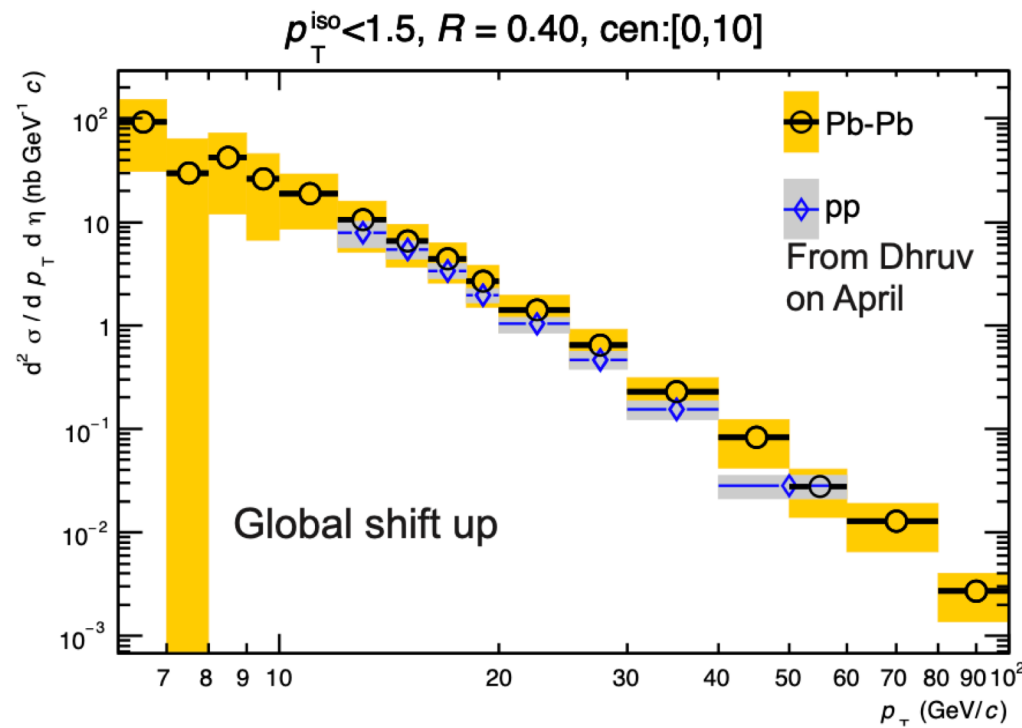
Isolated γ cross-section in AA



ATLAS, 2015, [arXiv:1506.08552](https://arxiv.org/abs/1506.08552)

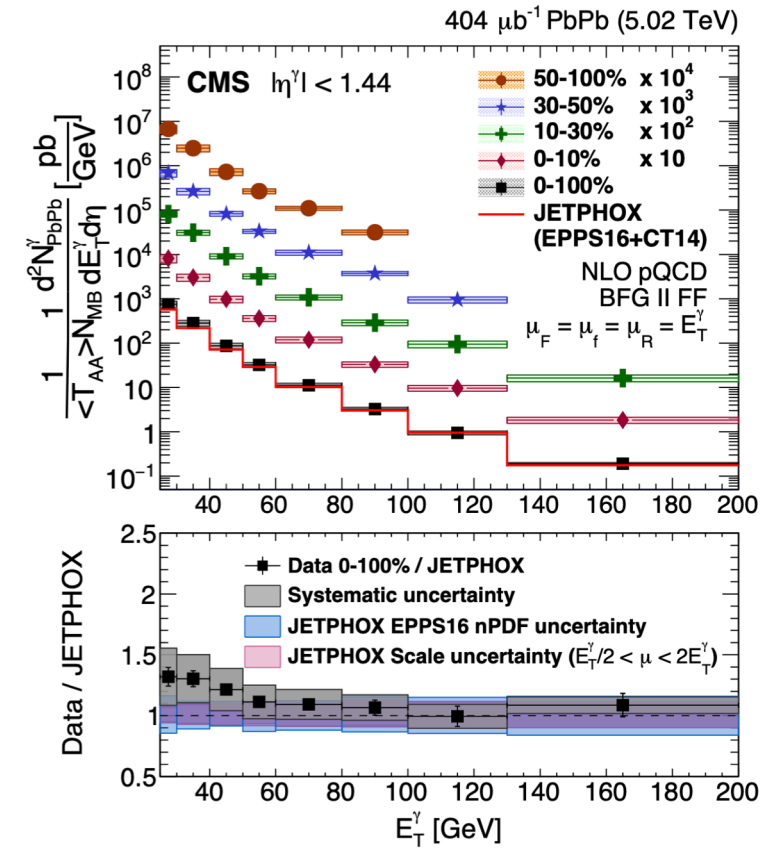
two pseudorapidity intervals
 $1.52 < |\eta| < 2.37$

PbPb 5.02 TeV



ALICE, 2021, Internal

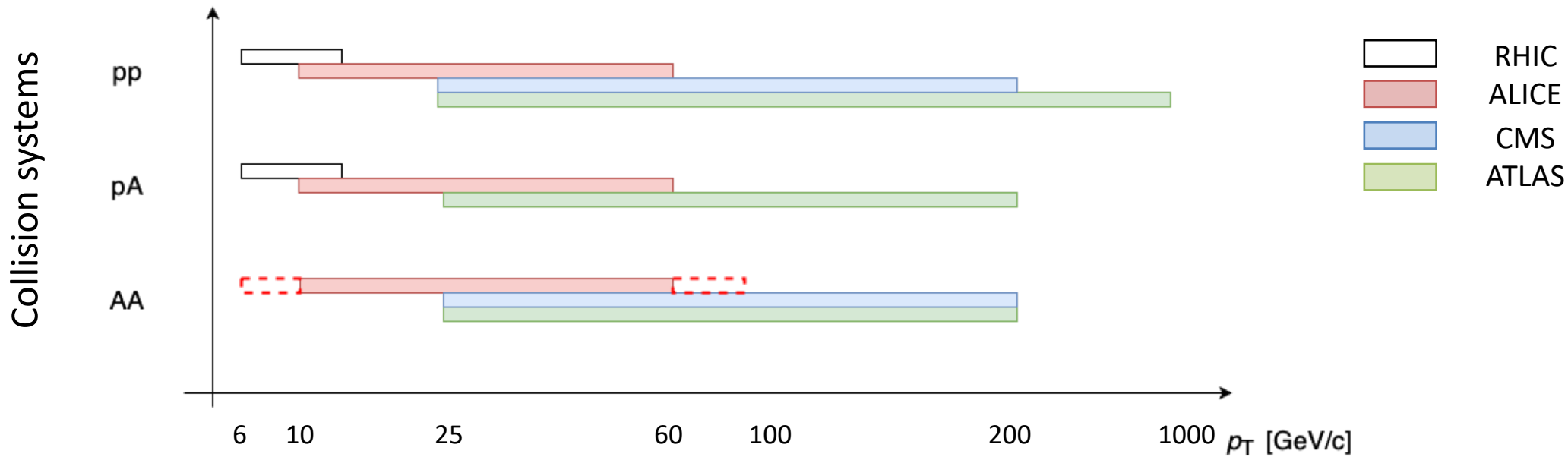
PbPb 5.02 TeV



CMS, 2020, [arXiv:2003.12797](https://arxiv.org/abs/2003.12797)

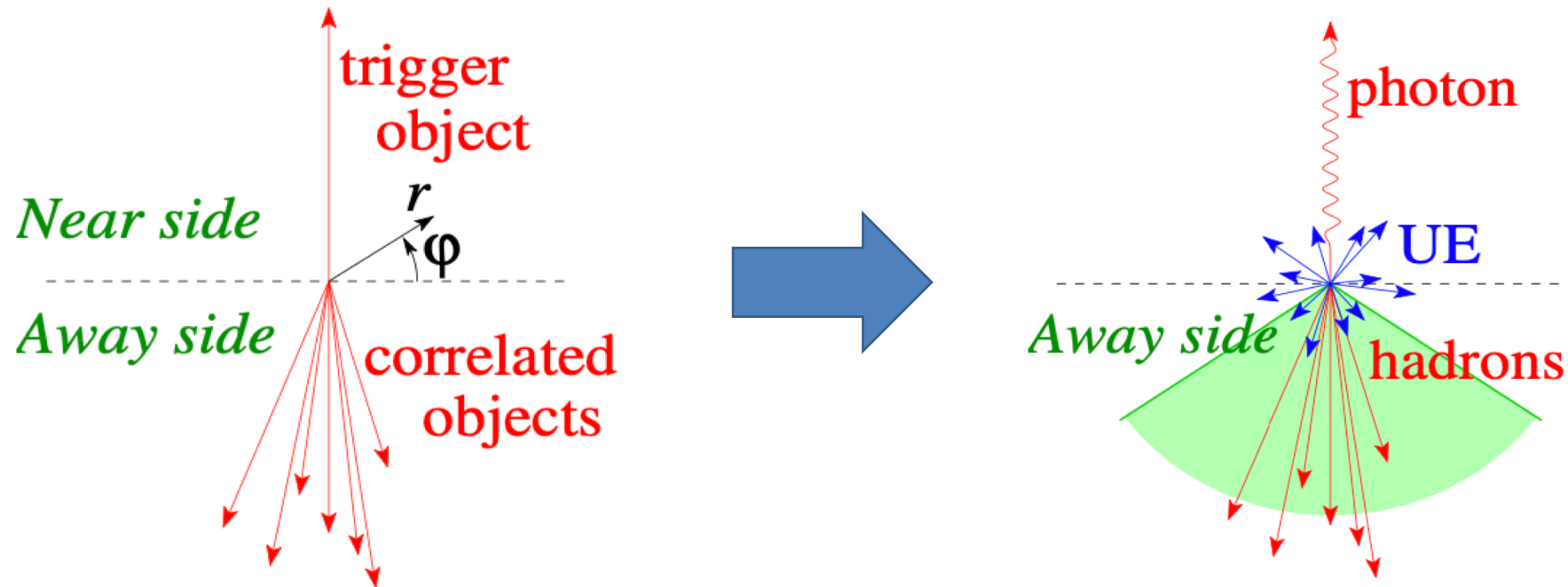
PbPb 5.02 TeV

Isolated γ cross-section



	PHENIX-STAR	ALICE	ATLAS	CMS
p_T	$3 < p_T < 17$ GeV	$10 < p_T < 60$ GeV	$25 < p_T < 200$ GeV	$25 < p_T < 200$ GeV
Collision system and $\sqrt{s_{NN}}$	pp 200 GeV dAu 200 GeV AuAu 200 GeV	pp 7, 13 TeV pPb 5.02 TeV PbPb 5.02 TeV	pp 7 TeV pPb 8 TeV PbPb 2.76 TeV	pp 7 TeV PbPb 5.02 TeV

Photon-X correlations



Trigger object is always direct photon.

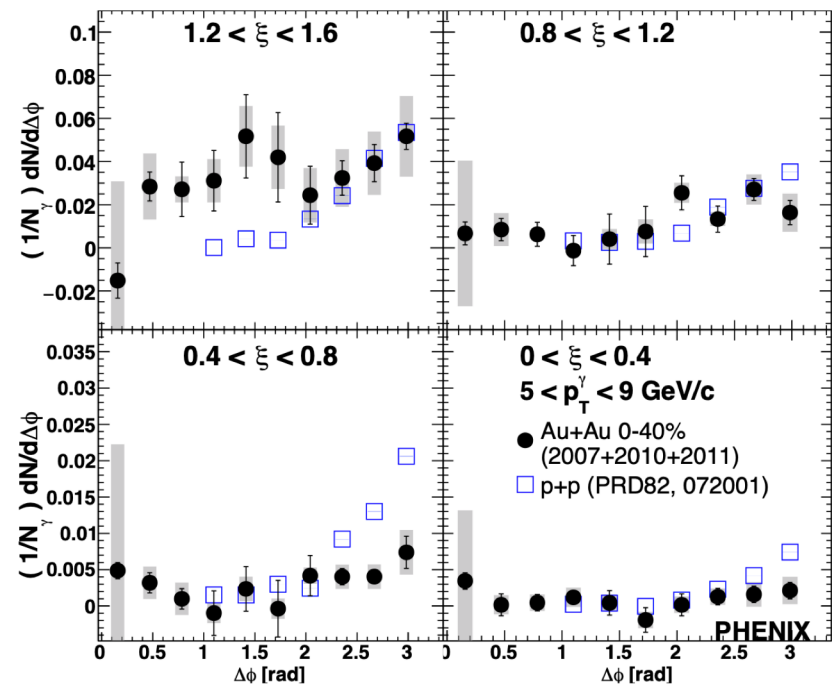
Direct photon selected with Isolation method

Events with prompt photons associated to a jet from a quark or a gluon back-to-back

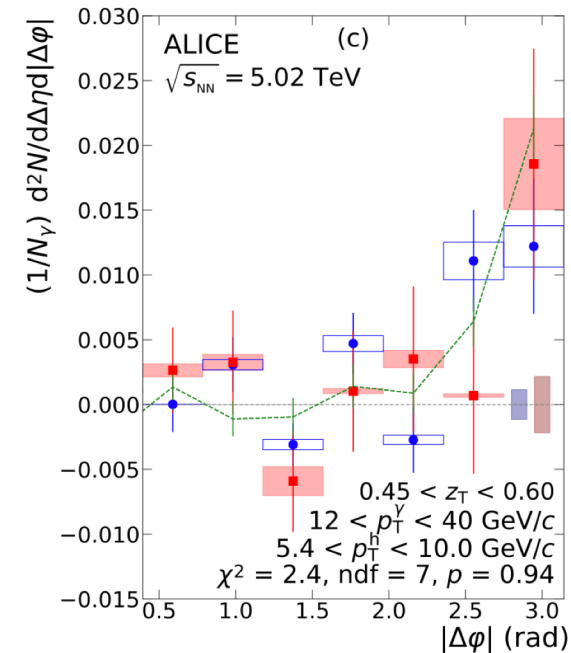
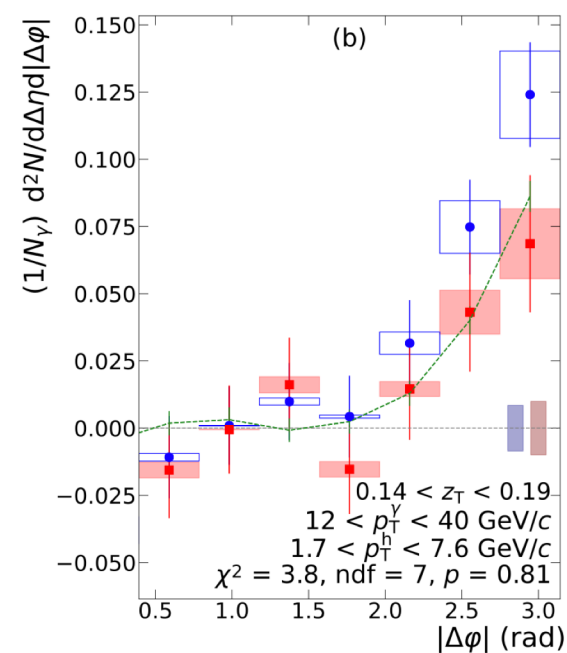
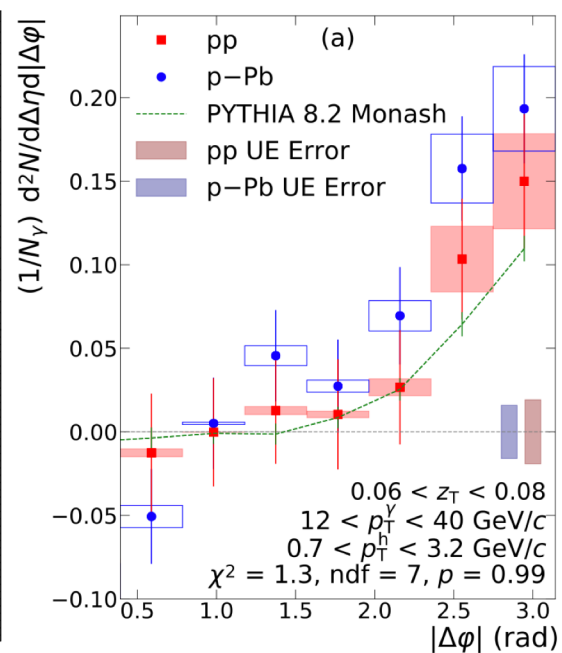
Correlation of γ with particle in the away side: hadron or jet

Photon-hadron correlations

- $\Delta\varphi = (\varphi^{trig} - \varphi^{ass})$
- $z_T = p_T^{hadr} / p_T^\gamma$ or $\xi = \ln(1/z_T)$



$\sqrt{s} = 200$ GeV



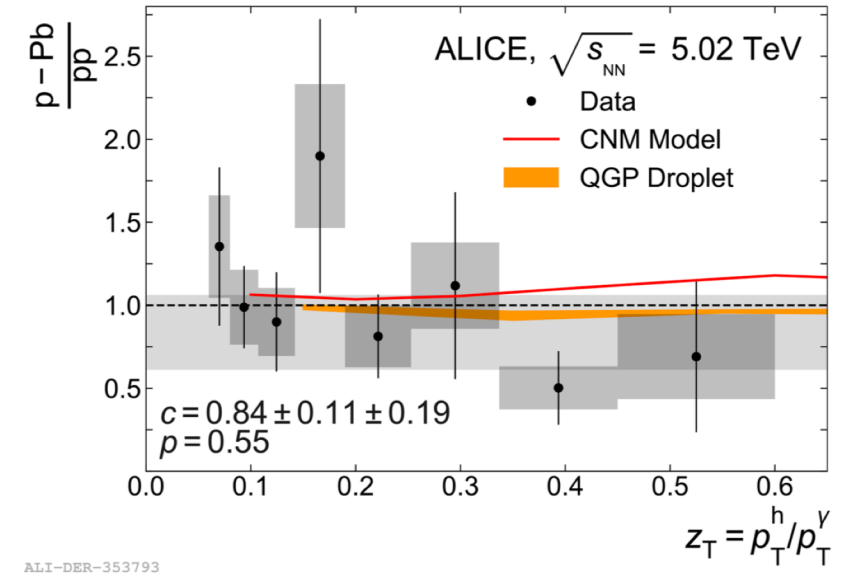
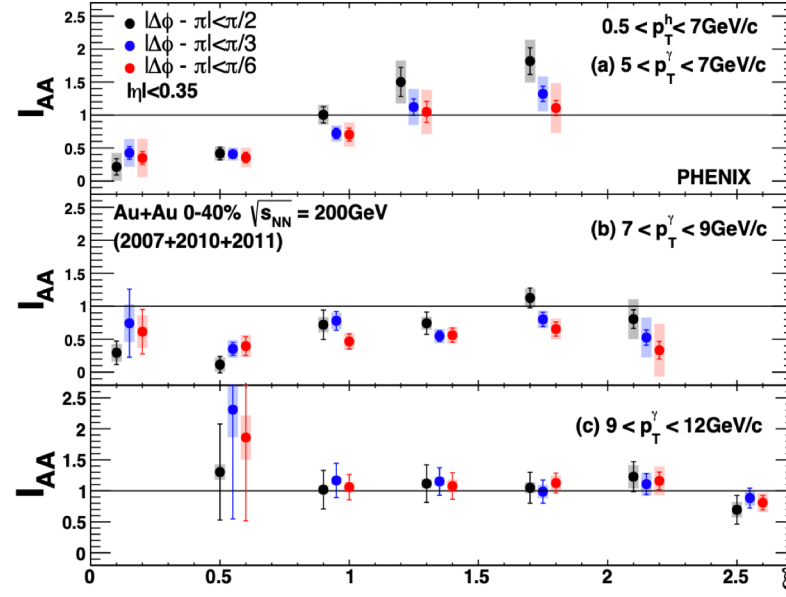
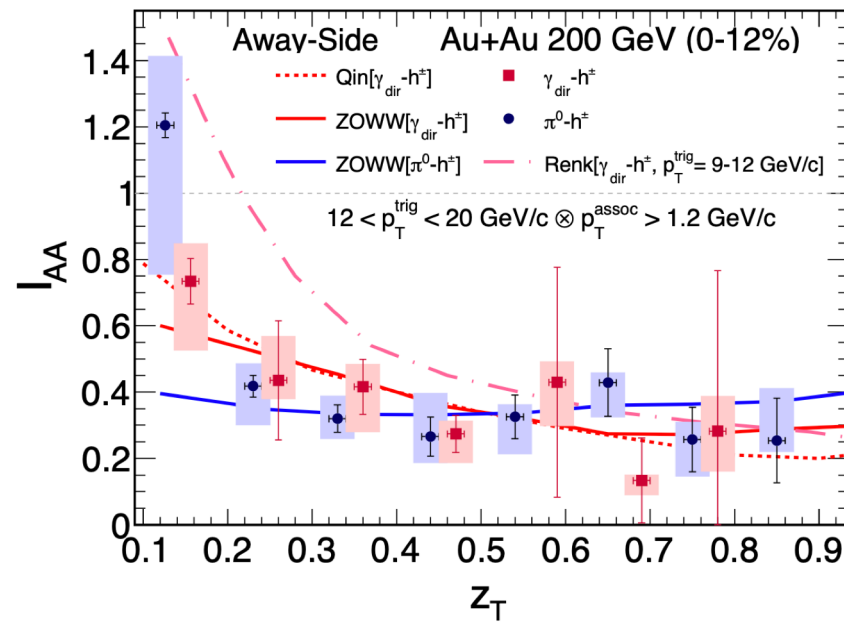
ALICE, 2020, [arXiv:2005.14637](https://arxiv.org/abs/2005.14637)

$\sqrt{s} = 5$ TeV

I_{AA}

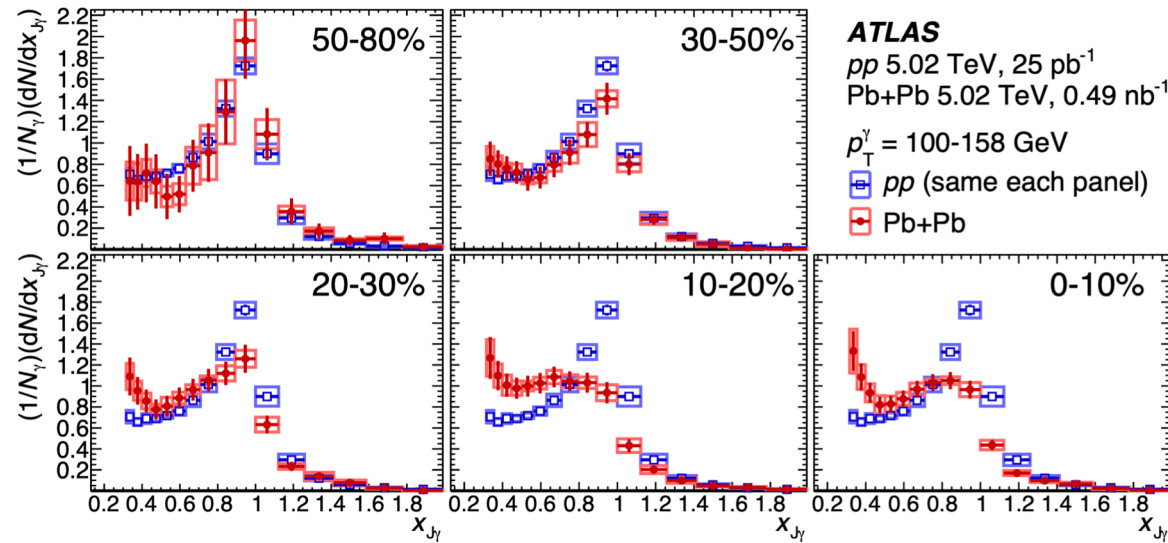
$$I_{AA} = Y_{AA}/Y_{pp} \approx D(z_T)_{AA}/D(z_T)_{pp},$$

Where Y = integrated away-side charged-hadron yields



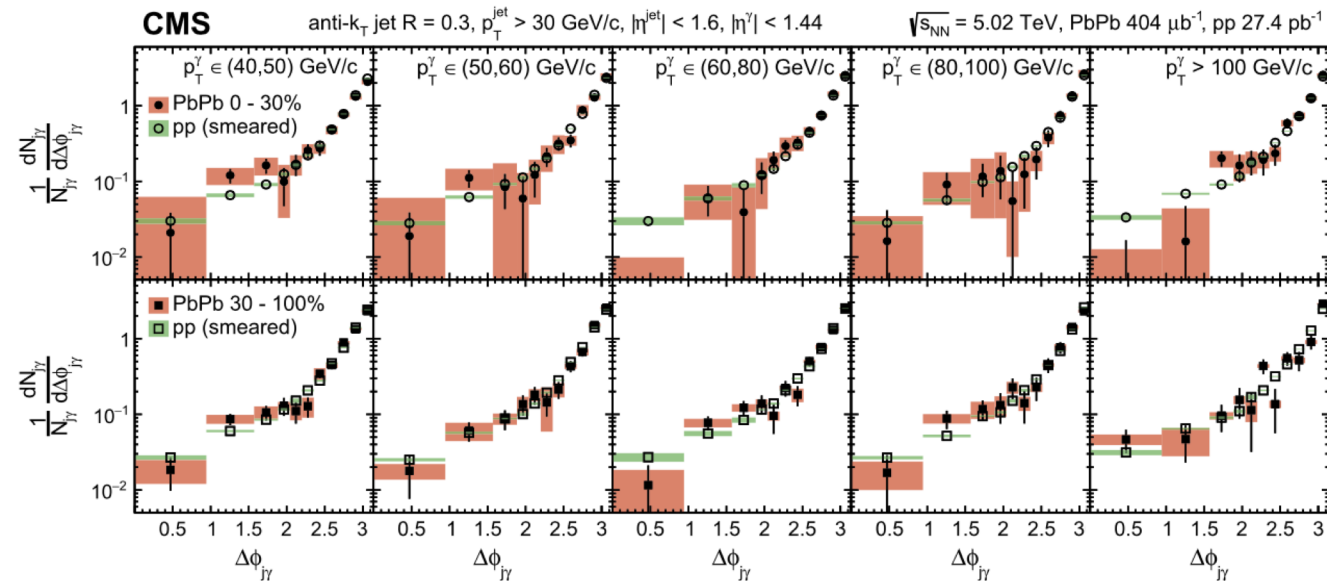
Photon-jet correlations

- $\Delta\varphi = (\varphi^{trig} - \varphi^{ass})$
- $z_T = p_T^{jet}/p_T^\gamma$ or $\xi = \ln(1/z_T)$



ATLAS, 2018, [arXiv:1809.07280](https://arxiv.org/abs/1809.07280)

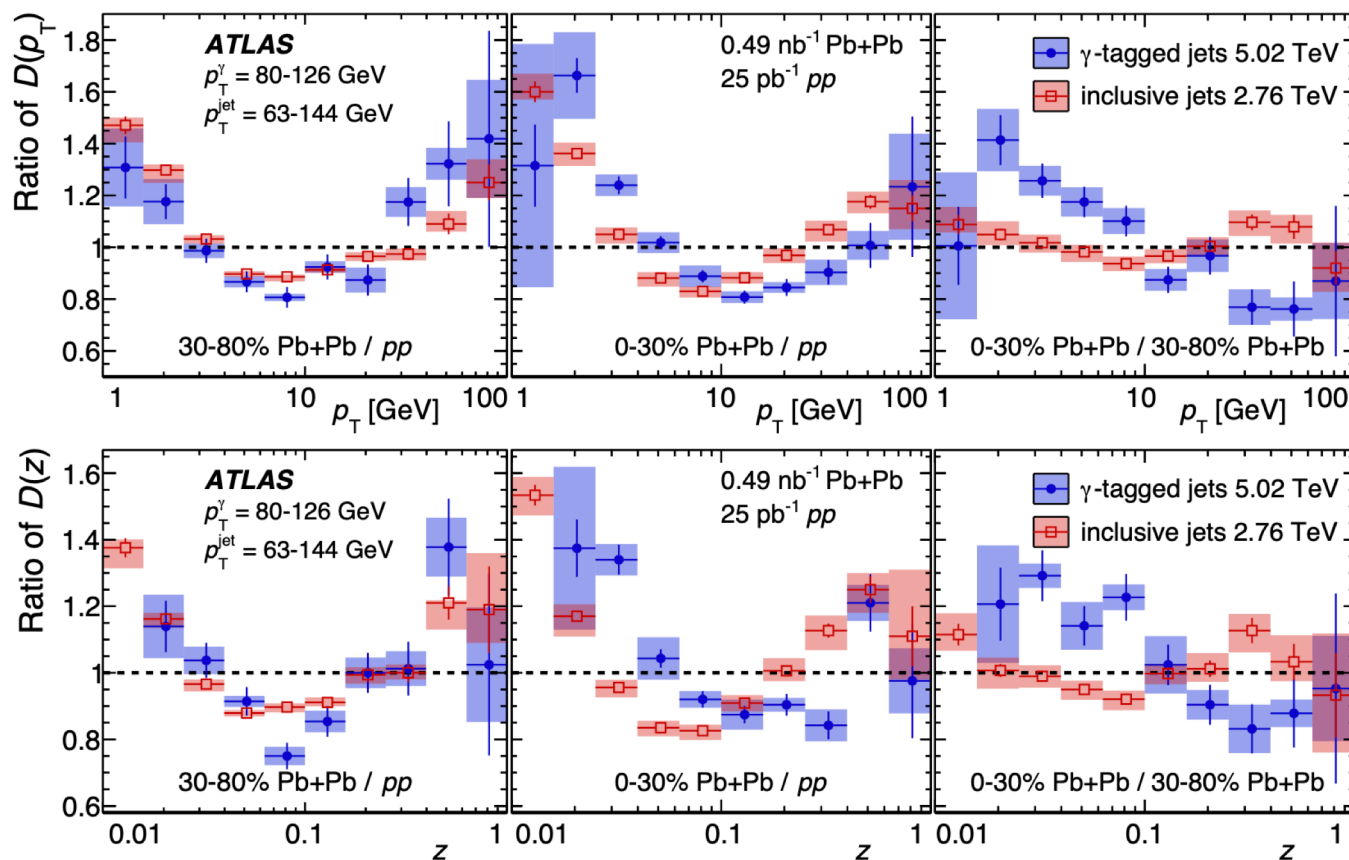
Different p_T^γ ranges



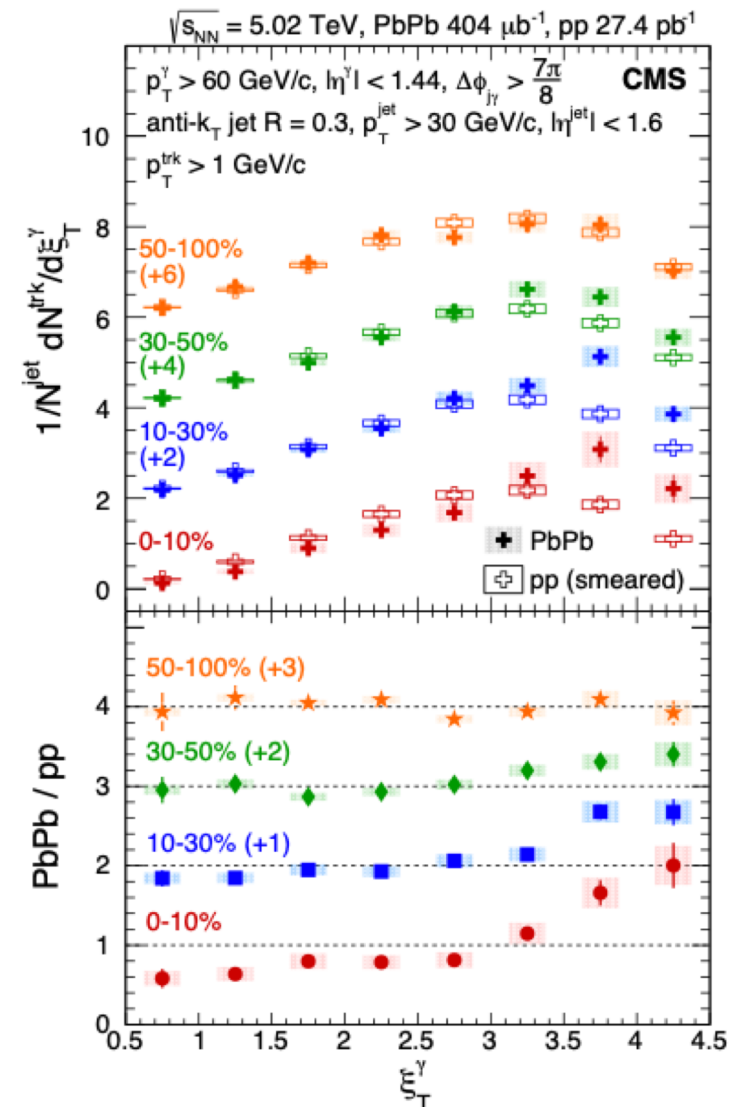
CMS, 2017, [Phys. Lett. B 785 \(2018\) 14](https://arxiv.org/abs/1708.08769)

Photon-jet correlations

- $D(z_T)$ fragmentation function
- $z_T = p_T^{\text{jet}} / p_T^\gamma$ or $\xi = \ln(1/z_T)$

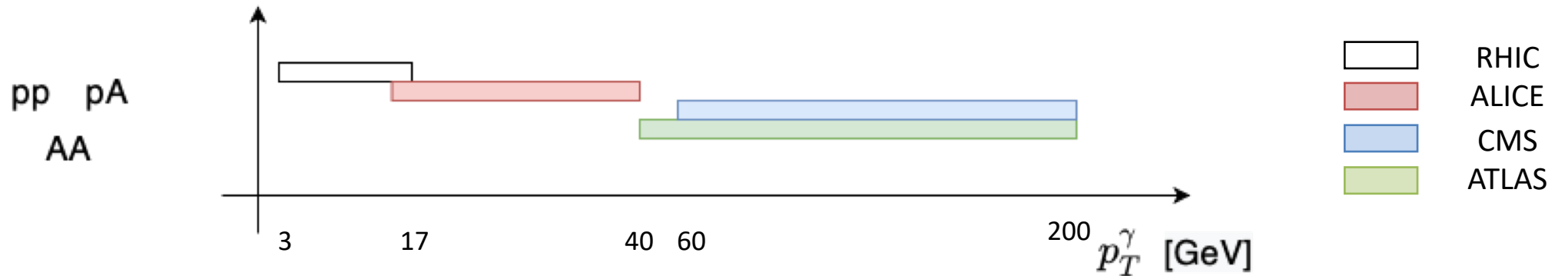


ATLAS, 2018, [arXiv:1809.07280](https://arxiv.org/abs/1809.07280)



CMS, 2018, [arXiv:1801.04895](https://arxiv.org/abs/1801.04895)

Correlations



	PHENIX-STAR	ALICE	ATLAS (γ -jet)	CMS (γ -jet)
p_T^γ	$3 < p_T^\gamma < 17$ GeV	$12 < p_T^\gamma < 40$ GeV	$60 < p_T^\gamma < 200$ GeV	$40 < p_T^\gamma < 200$ GeV
Collision system and $\sqrt{s_{NN}}$	pp 200 GeV AuAu 200 GeV	pp 5.02 TeV pPb 5.02 TeV PbPb 5.02 TeV	pp 2.76 TeV PbPb 5.02 TeV	pp 2.76 TeV pPb (prel) 5.02 TeV PbPb 5.02 TeV

Updates on gamma-hadrons correlations

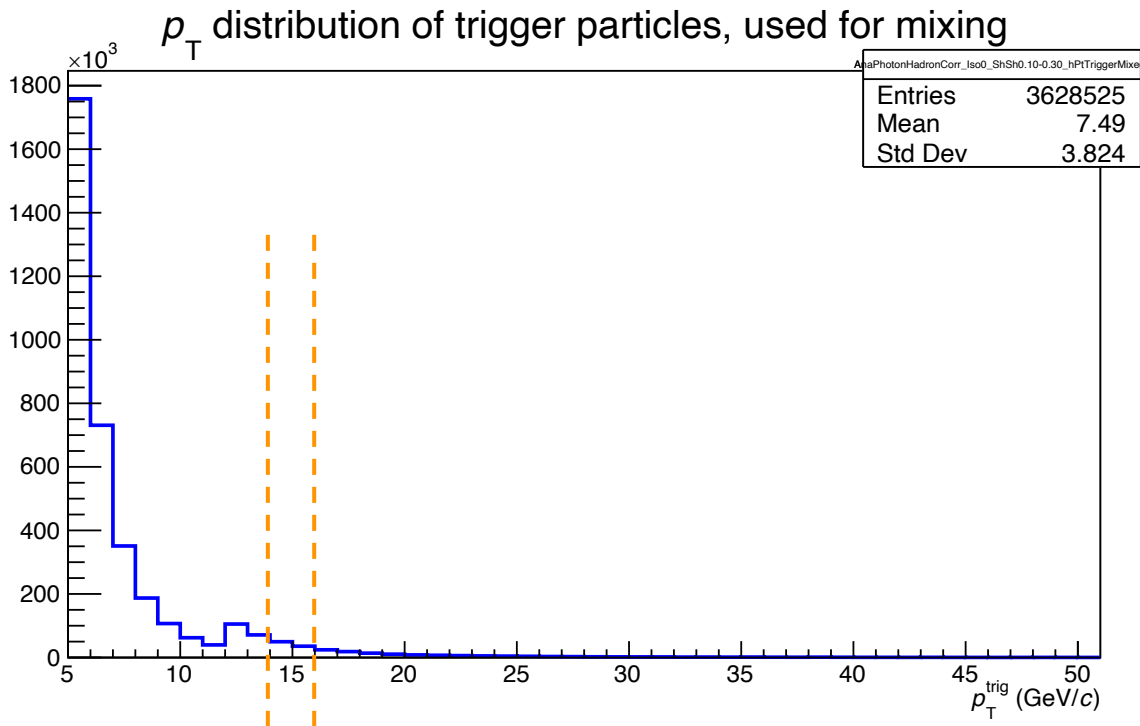
UE event subtraction

- Normalize Same Event in a defined p_T^{trig} bin (e.g [14-16] GeV/c)
- Normalize Mixed Event:

2 OPTIONS:

1. In a defined p_T^{trig} bin
2. Over all the p_T^{trig} range

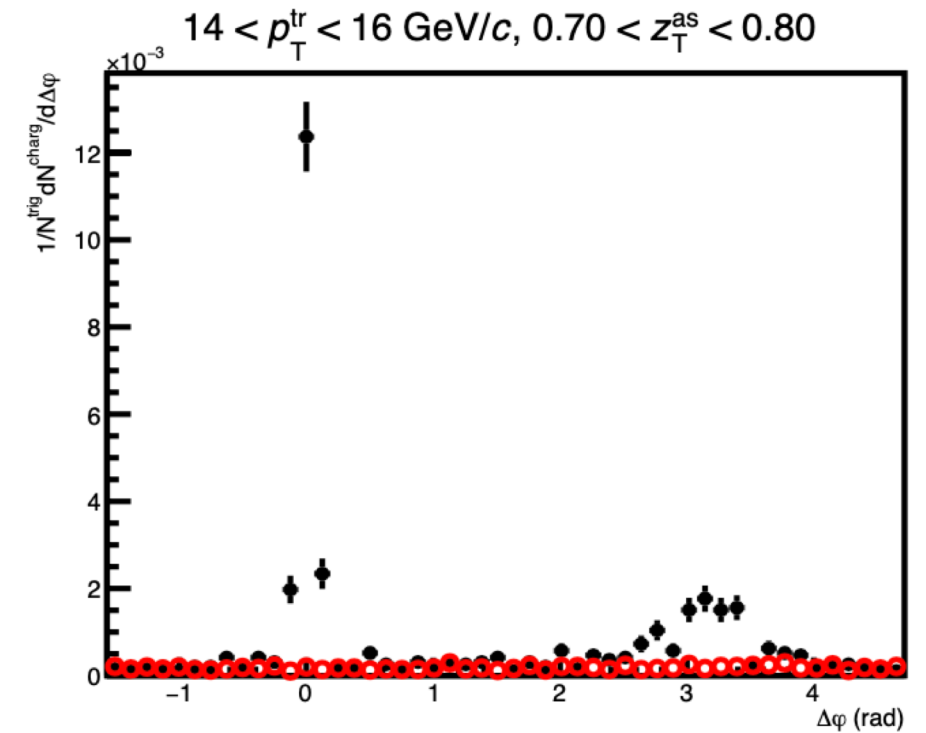
Mixed event normalization



Mixed
normalization factor

=

Integrate over a p_T^{trig} bin
[14-16] GeV/c

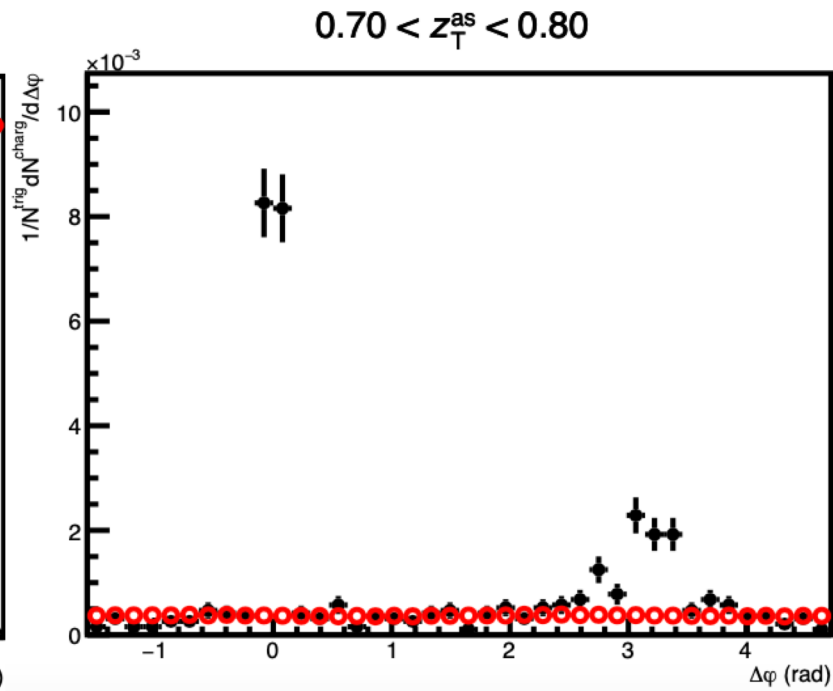
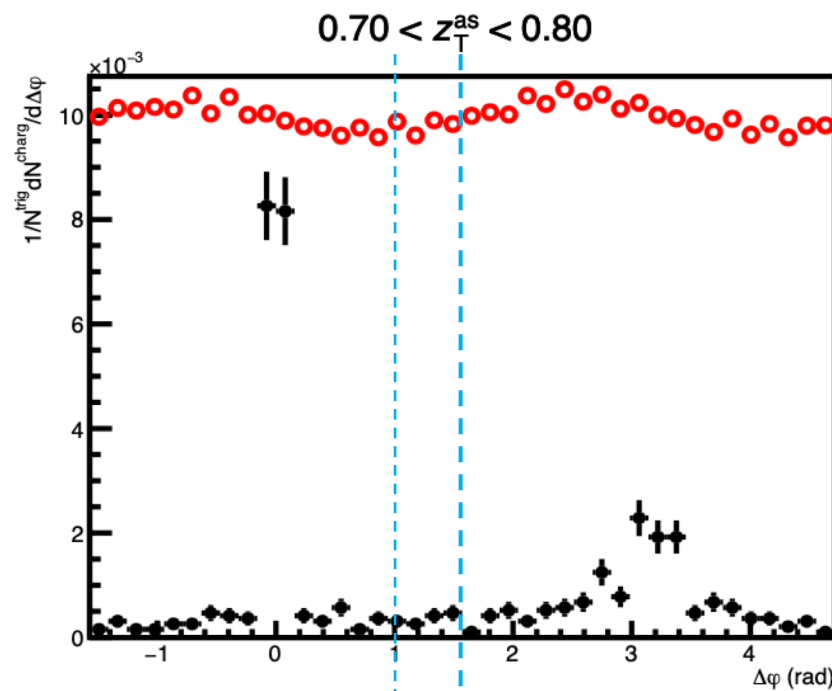
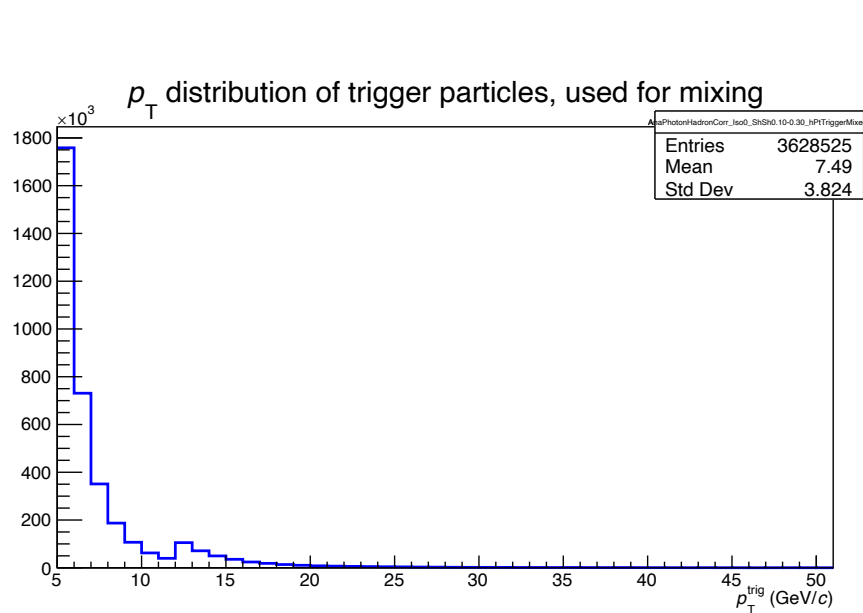


Mixed is over Same

=

Directly
UE subtraction

Mixed event normalization



Mixed
normalization factor

=

Integrate over
all p_T^{trig} range

Mixed is bigger than Same

=

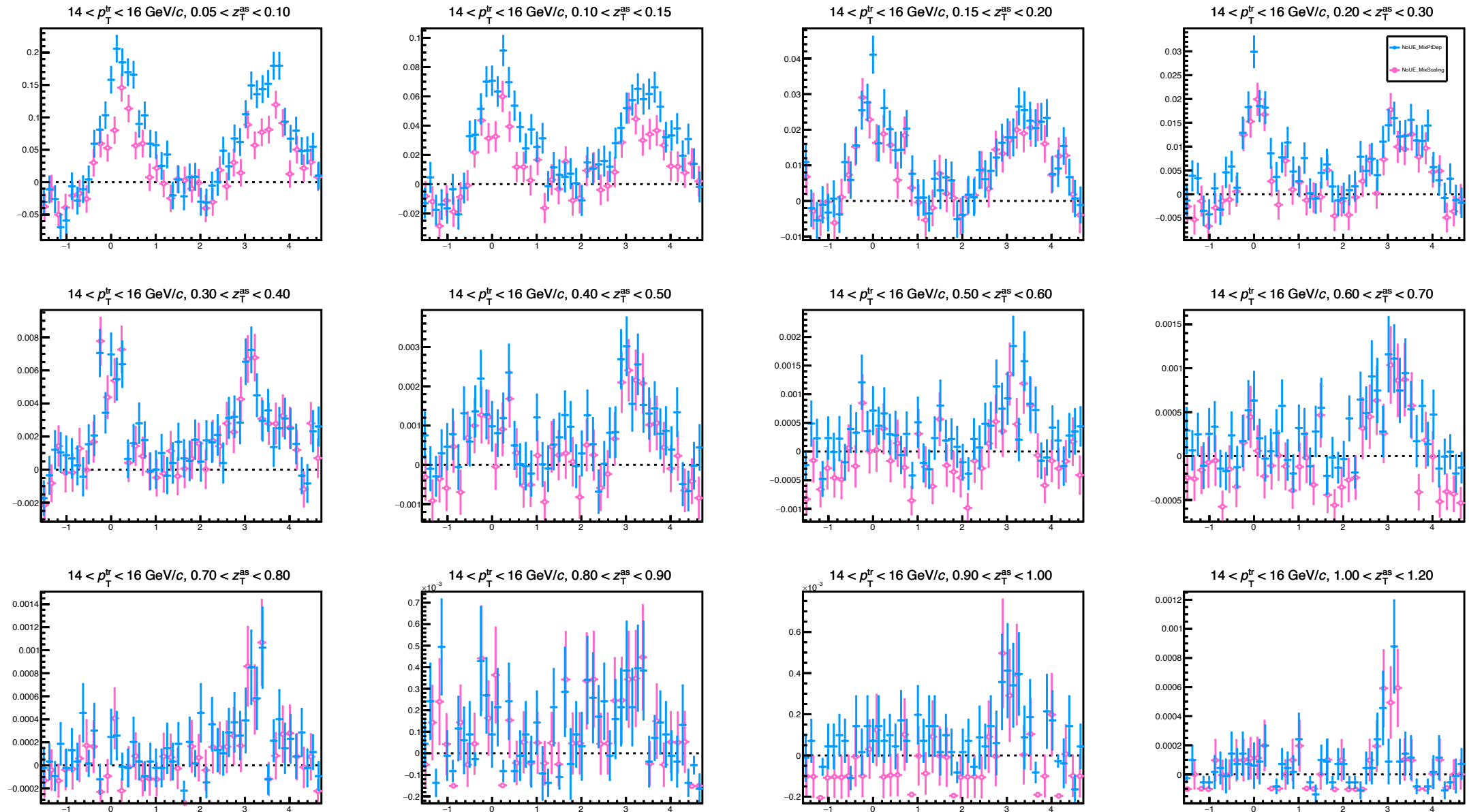
Mixed scaled by $\frac{Int_Same}{Int_Mix}$
In range [1; 1.5]

Mixed is over Same

=

UE subtraction

Signal without UE for the 2 methods



Thank you for the attention!