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Supplementary material for "Nuclear modification factor of light neutral-meson spectra up to high p_T in p–Pb collisions at $\sqrt{s_{NN}} = 8.16$ TeV"

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Abstract

This note provides supplemental figures and analysis details for the paper "Nuclear modification factor of light neutral mesons up to high p_T in p–Pb collisions at $\sqrt{s_{NN}} = 8.16$ TeV" [1]. Details on the EMCal Level-1 triggers and the corresponding integrated luminosities of the p–Pb data set as well as example invariant mass and shower shape distributions are provided. In addition, the performance of the different reconstruction techniques to resolve the neutral meson invariant mass peaks as well as the overall reconstruction efficiency are shown. Furthermore, comparisons between the spectra obtained with the different reconstruction techniques to a combined fit are provided together with the fit parameters of the combined spectra. Contributions to the systematic uncertainty of the differential invariant cross section measurements as well as the nuclear modification factors of both mesons are tabulated for example transverse momentum ranges.

*See Appendix A for the list of collaboration members

1 Trigger rejection factors and data samples

The trigger rejection factors (RF) for the EMCal triggers are estimated through a fit to the ratio of the cluster energy spectra in their plateau regions above the respective trigger thresholds. Figure 1 shows these ratios for the low and high threshold EMCal Level-1 triggers EG2 and EG1 with error function fits at high energy (E) according to $RF(p_{\mathrm{T}}) = R_0 + \tau \cdot \mathrm{erf}\left(\frac{p_{\mathrm{T}} - p_{\mathrm{T},0}}{\sqrt{2} \cdot a}\right)$, with the global offset R_0, free parameters (τ, $p_{\mathrm{T},0}$, a) and the error function term $\mathrm{erf}(x) = \frac{2}{\sqrt{\pi}} \int_x^{\infty} e^{-t^2} \mathrm{d}t$. A similar procedure is performed for the PHOS triggers, where RF is determined on the ratio of the corrected π^0 meson spectra instead. The trigger rejection factors from these fits are given in Table 1 for all event triggers. For the high threshold triggers, RF is obtained from the product $RF_{\mathrm{EG2/MB}} \cdot RF_{\mathrm{EG1/EG2}}$ or $RF_{\mathrm{PHOS-L0/MB}} \cdot RF_{\mathrm{PHOS-L1/L0}}$. Uncertainties on RF are given as combined statistical and systematic uncertainties where the latter part was determined via variations of the low E fit range.

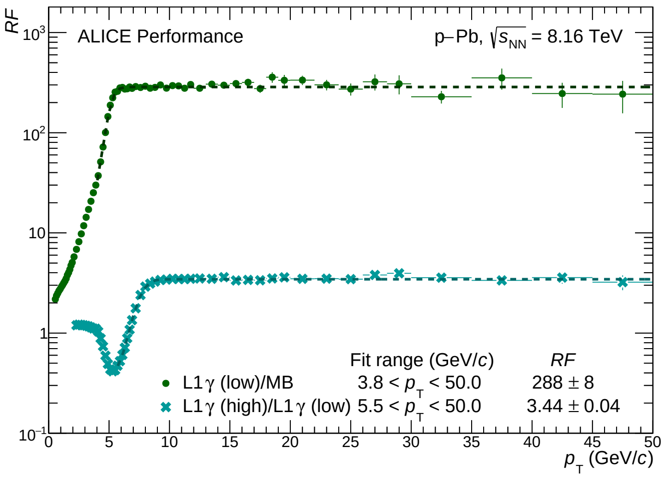

Fig. 1: Ratio of cluster spectra in EMCal Level-1 triggered data and minimum bias data in p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV. The dashed lines show the error function fits to the ratios, which are used to obtain the trigger rejection factors RF.

The integrated luminosities of each trigger sample and for each reconstruction method are calculated based on the MB cross section of $\sigma_{\mathrm{MB}} = (2.09(2.10) \pm 0.04)$ b for the p–Pb (Pb–p) collisions [2] as $\mathscr{L}_{\mathrm{int}} = RF \times N_{\mathrm{events}}/\sigma_{\mathrm{MB}}$ and are listed in Table 1. For PCM-EMC lower integrated lumiosities are reported due to the lack of TPC readout in two thirds of the triggered data. The pp collision data set at a centre-of-mass energy of $\sqrt{s} = 8$ TeV used in this analysis was recorded in 2012 and the respective integrated luminosities are listed in Table 1.

			$\mathscr{L}_{\mathrm{int}}$ (nb^{-1})			
System	Trigger	*RF*	EMC & mEMC	PCM-EMC	PCM	PHOS
p–Pb	MB	-	0.018(0.041)	0.018	0.022	0.036
	EMCal L1 (low)	288 ± 8	0.206 ± 0.005	0.081 ± 0.002	-	-
	EMCal L1 (high)	852 ± 38	5.67 ± 0.16	1.42 ± 0.04	-	-
	PHOS L0	$(1.66 \pm 0.01) \times 10^3$	-	-	-	1.686 ± 0.014
	PHOS L1	$(1.58 \pm 0.03) \times 10^4$	-	-	-	6.42 ± 0.12
pp	MB	-	1.94	1.94	2.17	1.25
	EMCal/PHOS L0	64.6 ± 1.0	39.4 ± 1.0	39.4 ± 1.0	-	136 ± 17
	EMCal L1	$(14.7 \pm 0.6) \times 10^3$	606 ± 16	606 ± 16	-	-

Table 1: Trigger rejection factor *RF* and total integrated luminosities based on the individual samples for the different reconstruction methods and triggers in pp collisions at $\sqrt{s} = 8$ TeV and p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV. The uncertainties reflect the systematic uncertainty of the *RF* determination. The uncertainty associated with the determination of the MB cross section of 1.9% for p–Pb and 2.6% for pp is not included. The value in brackets corresponds to the high luminosity minimum bias data sample where TPC tracking is not available.

2 Invariant mass and shower shape distributions

The two-photon invariant mass distribution, $M_{\gamma\gamma}$, around the neutral pion and η meson rest mass [3] reconstructed with the PCM, EMC, PCM-EMC and PHOS methods are shown in Figure 2. For the PHOS technique, the combinatorial background, obtained from event mixing, is subtracted after scaling with a second order polynomial determined on the ratio of signal and background in order to remove its dependence on the detector acceptance. For the remaining techniques, the combinatorial background is subtracted after scaling to the right-hand side of the signal peak. A residual correlated background arising from residual jet-like correlations is contained in the mixed-event subtracted distributions, which can be described by a linear function and subtracted. This linear function is included in the signal fit function, which is defined as

$$y = A \cdot \left\{ G(M_{\gamma\gamma}) + \exp\left(\frac{M_{\gamma\gamma} - M_{\pi^0,\eta}}{\lambda} \right) \left[1 - G(M_{\gamma\gamma}) \right] \theta(M_{\pi^0,\eta} - M_{\gamma\gamma}) \right\} + B + C \cdot M_{\gamma\gamma} \tag{1}$$

$$\text{with } G(M_{\gamma\gamma}) = \exp\left[-0.5 \left(\frac{M_{\gamma\gamma} - M_{\pi^0,\eta}}{\sigma_{M_{\gamma\gamma}}} \right)^2 \right], \tag{2}$$

where the signal is described by a Gaussian distribution $G(M_{\gamma\gamma})$ around the mean value $M_{\pi^0,\eta}$ with a width of $\sigma_{M_{\gamma\gamma}}$. A one-sided exponential tail for $M_{\gamma\gamma} < M_{\pi^0,\eta}$ is enabled with a Heaviside function (θ) and describes the smearing of the distribution due to electron bremsstrahlung for PCM or late photon conversions for EMC and PCM-EMC. An additional exponential tail term for $M_{\gamma\gamma} > M_{\pi^0,\eta}$ is introduced for the analysis of the EMCal-triggered data to account for cluster overlap and resolution effects smearing the reconstructed invariant mass to larger values. The residual correlated background is described with the linear function given by $B + C \cdot M_{\gamma\gamma}$. The combined combinatorial and residual background is indicated in Figure 2 by open gray circles, while the signal is shown with solid red markers and the signal fit is given by the blue line. The integration ranges for the raw yield extraction are indicated by vertical dashed lines. Figure 3 shows the invariant mass peak positions and peak widths (FWHM), obtained from the fits according to Equation 2, for the different reconstruction methods PCM, PHOS, EMC, and PCM-EMC and for both neutral mesons. Example shower shape distributions (σ^2_{long}) used for the mEMC analysis are shown in Figure 4 for two p_{T} intervals. The top panels visualize the composition of the overall distribution based on PYTHIA 8 Monte Carlo simulations with contributions from the signal (π^0) and from background sources (η, γ, $e^{\pm}$, and hadrons). The bottom panels shows the performance of the simulation to describe the distribution in data.

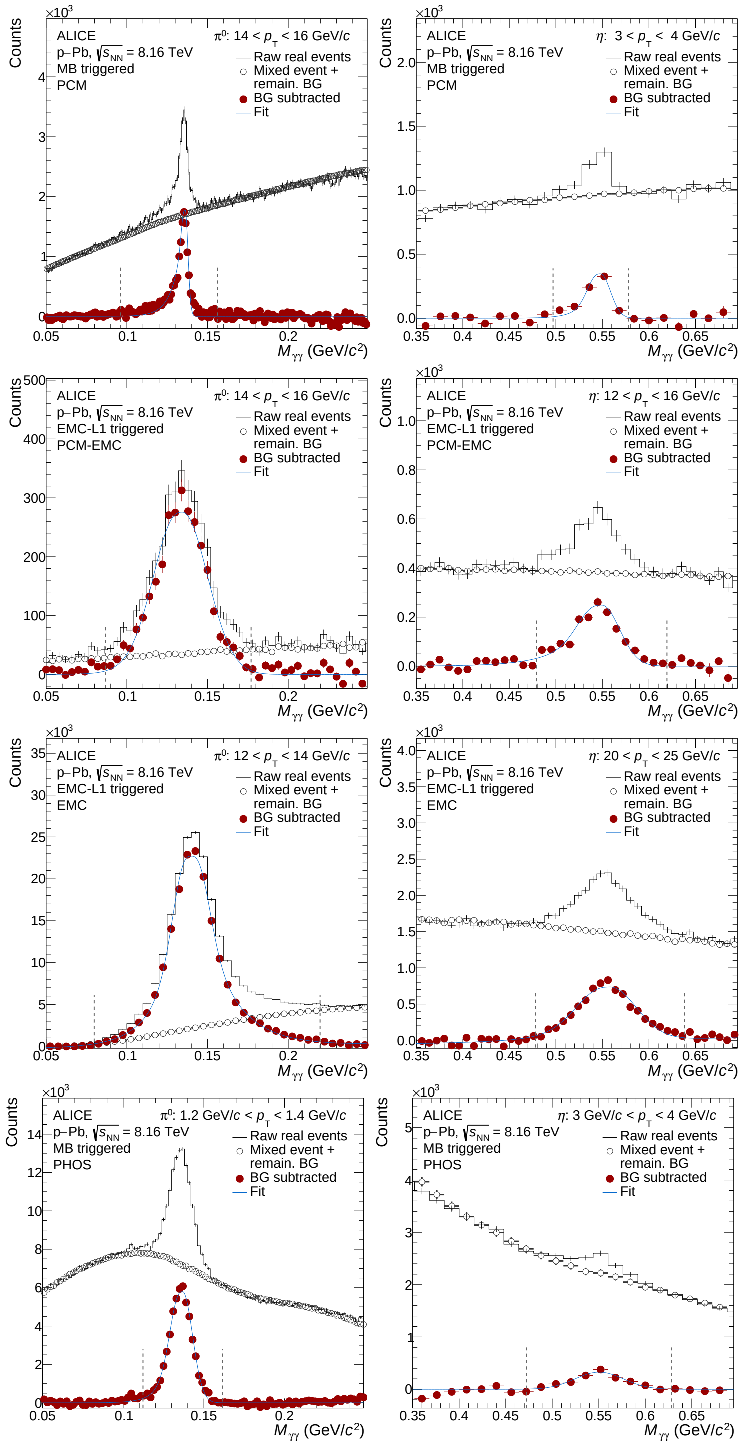

Fig. 2: Invariant mass distributions for example transverse momentum intervals around the π^0 (left) and η (right) meson rest mass for PCM, PCM-EMC, EMC and PHOS from top to bottom. The raw invariant mass distribution is shown in black, the scaled event mixing background including an additional linear correction in gray and the signal is given by red points together with a fit function shown in blue. Integration ranges for the raw yield extraction are indicated by the vertical dashed lines.

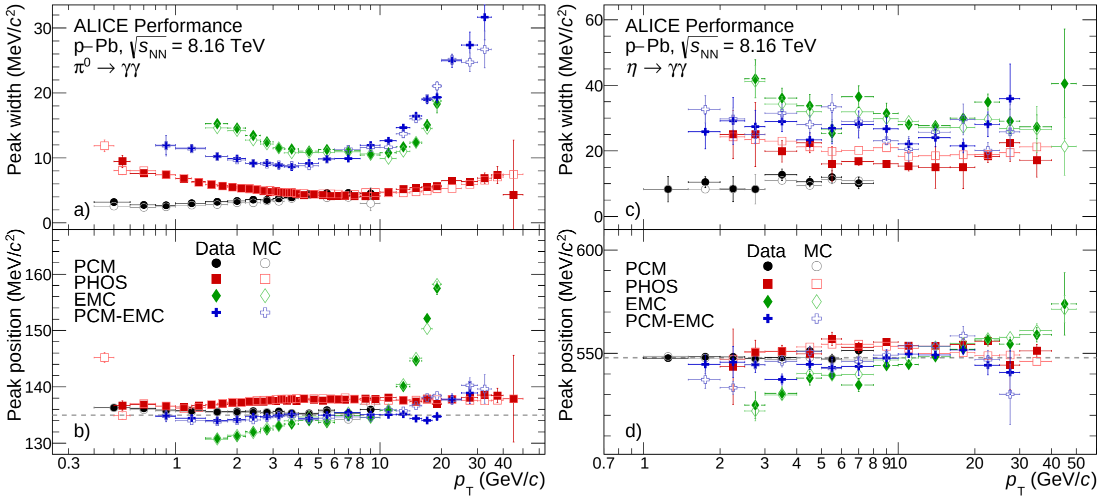

Fig. 3: Invariant mass peak width, shown in panels a) and c), and position, shown in panels b) and d), for π^0 (left) and η (right), obtained from the fits on the invariant mass distributions, versus transverse momentum for PCM, PCM-EMC, EMC and PHOS in p–Pb collisions at $\sqrt{s_{\rm NN}} = 8.16$ TeV. Data is presented with full markers while Monte Carlo simulation parameters are given by open markers. Vertical error bars represent statistical uncertainties. The gray dashed line in panels b) and d) indicates the respective meson rest mass.

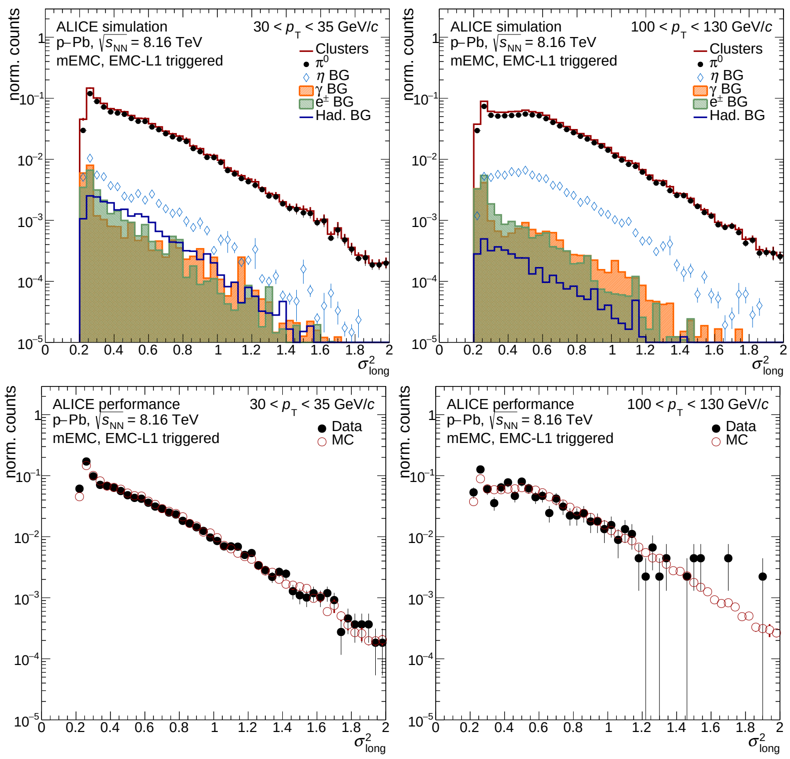

Fig. 4: Shower shape distribution for the elongation $\sigma^2_{\rm long}$ in PYTHIA 8 Monte Carlo simulations (top) showing the various contributions to the full cluster sample for two example $p_{\rm T}$ intervals. The bottom panels show a comparison of the $\sigma^2_{\rm long}$ distributions in data and simulation in the same $p_{\rm T}$ intervals.

3 Total correction factors

The p_{T}-dependent total correction factors for the PCM, PHOS, EMC, PCM-EMC, and mEMC neutral meson reconstruction are shown in Figure 5. They are composed of the reconstruction efficiency ($\varepsilon_{\mathrm{rec}}$), the geometrical acceptance (A), the purity correction (P), and normalization factors for each reconstruction technique.

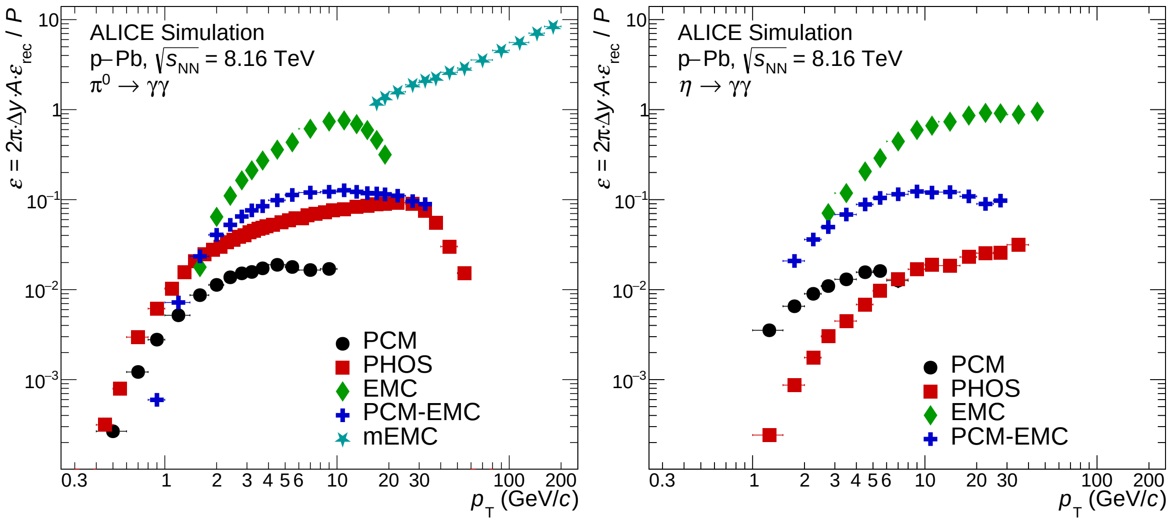

Fig. 5: Total correction factor comprised of reconstruction efficiency $\varepsilon_{\mathrm{rec}}$, kinematic acceptance A, purity P and normalization factors based on the analyzed rapidity window of each reconstruction method as a function of the meson transverse momentum.

4 Systematic uncertainties

An overview of the detailed systematic uncertainties for each reconstruction technique for example $p_{\rm T}$-intervals is provided in Table 2 to Table 6 for the π^0 and η meson spectra, the η/π^0 ratio, as well as the respective nuclear modification factors. The combined statistical and systematic uncertainties according to the BLUE method [4, 5] are listed, excluding the normalization uncertainty of the minimum bias trigger cross section ($\sigma_{\rm MB}$).

Table 2: Summary of relative systematic uncertainties in percent for selected $p_{\rm T}$ intervals for the reconstruction of π^0 mesons in p–Pb collisions at $\sqrt{s_{\rm NN}} = 8.16$ TeV. The statistical uncertainties are given in addition to the total systematic uncertainties for each bin. The combined statistical and systematic uncertainties are also listed, obtained by applying the BLUE method [4, 5] for all reconstruction methods available in the given $p_{\rm T}$ bin, considering the uncertainty correlations for the different methods. The uncertainty from $\sigma_{\rm MB}$ determination of 1.9%, see Ref. [2], is independent of the reported measurements and is separately indicated in the figures appearing in the main body of the letter.

$p_{\rm T}$ interval	1.4 – 1.8 GeV/c				5 – 6 GeV/c				16 – 18 GeV/c				100 – 130 GeV/c
Method	PCM	PCM-EMC	EMC	PHOS	PCM	PCM-EMC	EMC	PHOS	PCM-EMC	EMC	PHOS	mEMC	mEMC
Signal extraction	4.1	2.4	3.5	2.1	6.9	1.0	4.1	2.9	1.5	7.3	4.9	8.3	9.5
Inner material	9.0	4.5	-	-	9.0	4.5	-	-	4.5	-	-	-	-
Outer material	-	2.8	4.2	2.0	-	2.8	4.2	2.0	2.8	4.2	2.0	2.1	2.1
PCM track rec.	0.2	0.9	-	-	0.4	0.8	-	-	0.4	-	-	-	-
PCM electron PID	0.7	0.4	-	-	0.6	0.5	-	-	0.7	-	-	-	-
PCM photon PID	0.7	0.9	-	-	1.0	2.0	-	-	2.1	-	-	-	-
Cluster description	-	1.5	5.5	1.1	-	2.0	3.6	0.1	2.9	5.2	-	3.8	4.3
Cluster energy calib.	-	1.5	1.9	2.3	-	1.5	1.9	3.1	1.5	1.9	3.2	3.3	3.3
Track match to cluster	-	0.2	0.2	-	-	0.7	0.3	-	0.5	1.1	-	-	-
Efficiency	-	1.0	2.3	1.9	-	1.0	2.3	1.9	1.0	3.0	2.0	3.6	3.6
Trigg. norm.&pileup	4.7	-	-	2.0	3.3	-	-	2.0	2.8	2.8	2.8	1.9	1.9
Total syst. uncertainty	11.0	6.4	8.3	5.5	11.9	6.5	7.6	5.2	7.4	10.9	7.0	10.7	11.9
Statistical uncertainty	2.2	2.2	3.1	1.1	6.7	3.7	2.0	3.1	3.6	4.2	3.6	2.4	5.7
Combined stat. unc.	1.0				1.8				2.2				5.7
Combined syst. unc.	3.6				3.9				4.9				11.9

Table 3: Summary of relative systematic uncertainties in percent for selected $p_{\rm T}$ intervals for the reconstruction of η mesons, see Tab. 2 for further explanations that also apply here.

$p_{\rm T}$ interval	2.5 – 3.0 GeV/c				6 – 8 GeV/c				20 – 25 GeV/c		
Method	PCM	PCM-EMC	EMC	PHOS	PCM	PCM-EMC	EMC	PHOS	PCM-EMC	EMC	PHOS
Signal extraction	3.8	3.3	23.7	18.0	5.0	4.7	7.3	4.5	14.4	3.0	7.0
Inner material	9.0	4.5	-	-	9.0	4.5	-	-	4.5	-	-
Outer material	-	2.8	4.2	1.8	-	2.8	4.2	1.8	2.8	4.2	1.8
PCM track rec.	1.2	1.9	-	-	2.0	2.8	-	-	1.3	-	-
PCM electron PID	1.3	4.2	-	-	3.2	1.9	-	-	2.9	-	-
PCM photon PID	2.6	3.9	-	-	4.1	4.7	-	-	6.0	-	-
Cluster description	-	3.3	5.1	2.0	-	3.6	5.9	2.0	5.2	7.5	2.0
Cluster energy calib.	-	1.5	6.7	3.1	-	1.5	4.2	3.2	1.5	3.3	3.2
Track match to cluster	-	1.4	0.8	-	-	1.6	0.9	-	2.3	2.3	-
Efficiency	-	1.0	2.3	1.6	-	1.0	2.5	1.6	1.0	2.6	1.6
Trigg. norm.&pileup	4.9	-	-	-	4.1	1.7	1.7	1.9	2.8	2.8	1.9
Total syst. uncertainty	11.4	9.6	25.6	19.1	12.4	10.3	11.6	6.8	18.0	10.7	8.5
Statistical uncertainty	12.0	14.2	20.8	29.7	25.9	11.4	7.9	6.5	16.4	6.9	15.9
Combined stat. unc.	8.6				4.5				8.2		
Combined syst. unc.	5.6				5.3				6.1		

Table 4: Summary of relative systematic uncertainties in percent for selected p_{T} intervals for the determination of the η/π^0 ratio. The p_{T} independent systematic uncertainties associated with the material budget and the trigger normalization, as given in Tab. 2 and Tab. 3, are canceled in the ratio. The statistical uncertainties are given in addition to the total systematic uncertainties for each bin. The combined statistical and systematic uncertainties are also listed, see explanation in caption of Tab. 2.

p_{T} interval	2.5 – 3.0 GeV/c				6 – 8 GeV/c				20 – 25 GeV/c		
Method	PCM	PCM-EMC	EMC	PHOS	PCM	PCM-EMC	EMC	PHOS	PCM-EMC	EMC	PHOS
Signal extraction	3.9	11.5	23.9	34.6	5.2	6.3	7.9	7.9	14.4	8.6	12.4
PCM track rec.	1.2	2.4	-	-	2.0	1.2	-	-	1.6	-	-
PCM electron PID	0.6	5.1	-	-	1.3	1.6	-	-	3.0	-	-
PCM photon PID	2.4	3.9	-	-	4.0	4.0	-	-	7.0	-	-
Cluster description	-	2.9	6.6	-	-	3.1	6.2	-	3.9	7.8	-
Cluster energy calib.	-	1.5	3.0	-	-	1.5	3.0	-	1.5	3.0	-
Track match to cluster	-	1.4	0.6	-	-	1.4	0.7	-	2.7	2.1	-
Efficiency & pileup	2.5	1.4	2.0	1.0	1.8	1.4	2.5	1.0	1.4	2.5	1.0
Total syst. uncertainty	5.6	13.9	25.1	34.7	7.2	8.7	10.8	8.0	17.2	12.4	12.5
Statistical uncertainty	12.9	14.1	20.9	17.5	25.9	14.0	8.1	5.8	16.9	12.5	12.9
Combined stat. unc.	8.6				4.5				8.2		
Combined syst. unc.	5.6				5.3				6.1		

Table 5: Summary of relative systematic uncertainties in percent for selected p_{T} intervals for the determination of the π^0 meson nuclear modification factor R_{pPb}. The p_{T} independent systematic uncertainty associated with the material budget is canceled in the ratio. The statistical uncertainties are given in addition to the total systematic uncertainties for each bin. The combined statistical and systematic uncertainties are also listed, see explanation in caption of Tab. 2. The uncertainties from the σ_{MB} determination in both collision systems are independent of the reported measurements and their quadratic sum of 3.4% is separately indicated in the figures appearing in the main body of the letter.

p_{T} interval	1.4 – 1.8 GeV/c				5 – 6 GeV/c				16 – 18 GeV/c				100 – 130 GeV/c
Method	PCM	PCM-EMC	EMC	PHOS	PCM	PCM-EMC	EMC	PHOS	PCM-EMC	EMC	PHOS	mEMC	mEMC
Signal extraction	2.6	2.9	5.1	3.5	6.9	1.6	4.7	3.3	2.2	7.0	5.2	1.0	1.0
PCM track rec.	0.2	0.2	-	-	0.5	0.2	-	-	1.5	-	-	-	-
PCM electron PID	0.3	0.9	-	-	0.5	0.9	-	-	1.0	-	-	-	-
PCM photon PID	0.7	0.9	-	-	1.4	1.9	-	-	2.7	-	-	-	-
Cluster description	-	1.0	4.7	0.1	-	1.5	2.5	0.1	1.8	4.1	0.1	2.0	3.1
Cluster energy calib.	-	1.5	0.8	2.0	-	1.5	0.8	2.0	1.5	0.8	2.0	1.0	1.0
Track match to cluster	-	0.2	0.2	-	-	0.4	0.3	-	2.9	1.1	-	0.5	1.5
Efficiency	-	0.5	1.7	7.3	-	0.5	1.7	7.3	0.5	1.7	7.3	0.9	0.9
Trigg. norm.&pileup	5.2	-	-	1.2	6.3	3.2	-	1.2	4.9	4.2	12.6	3.7	3.7
Total syst. uncertainty	6.5	3.7	7.2	8.9	9.5	5.7	5.6	8.7	7.3	9.3	15.6	4.6	5.4
Statistical uncertainty	3.0	2.6	4.4	5.4	9.2	5.7	3.1	6.9	5.1	5.3	11.7	2.7	10.8
Combined stat. unc.	1.8				2.7				2.2				10.8
Combined syst. unc.	2.7				2.9				2.9				5.4

Table 6: Summary of relative systematic uncertainties in percent for selected p_{T} intervals for the determination of the η meson nuclear modification factor R_{pPb}. The statistical uncertainties are given in addition to the total systematic uncertainties for each bin. The combined statistical and systematic uncertainties are also listed, see explanation in caption of Tab. 2. The uncertainty from σ_{MB} determination in both collision systems is independent of the reported measurements and is added in quadrature and separately indicated in the figures appearing in the main body of the letter.

p_{T} interval	$2.5-3.0$ GeV/c			$6-8$ GeV/c			$20-25$ GeV/c	
Method	PCM	PCM-EMC	EMC	PCM	PCM-EMC	EMC	PCM-EMC	EMC
Signal extraction	4.2	5.5	29.4	6.3	5.4	8.3	8.3	4.8
PCM track rec.	0.5	0.7	-	0.5	0.7	-	0.7	-
PCM electron PID	0.4	1.2	-	0.7	1.9	-	3.4	-
PCM photon PID	1.9	4.8	-	2.9	5.1	-	5.1	-
Cluster description	-	2.4	6.6	-	2.8	6.2	9.1	7.6
Cluster energy calib.	-	1.5	2.0	-	1.5	2.0	1.5	2.0
Track match to cluster	-	0.5	0.8	-	0.7	0.9	2.9	2.3
Efficiency	-	0.2	2.6	-	0.2	2.6	0.2	2.9
Trigg. norm.&pileup	6.1	-	-	6.1	3.2	-	4.9	4.2
Total syst. uncertainty	7.7	8.0	30.3	9.3	9.0	10.9	15.0	10.8
Statistical uncertainty	18.7	18.2	23.9	37.3	19.8	15.4	21.9	27.8
Combined stat. unc.	11.9			11.6			17.2	
Combined syst. unc.	5.9			6.8			11.5	

5 Comparison of neutral meson spectra from different reconstruction techniques

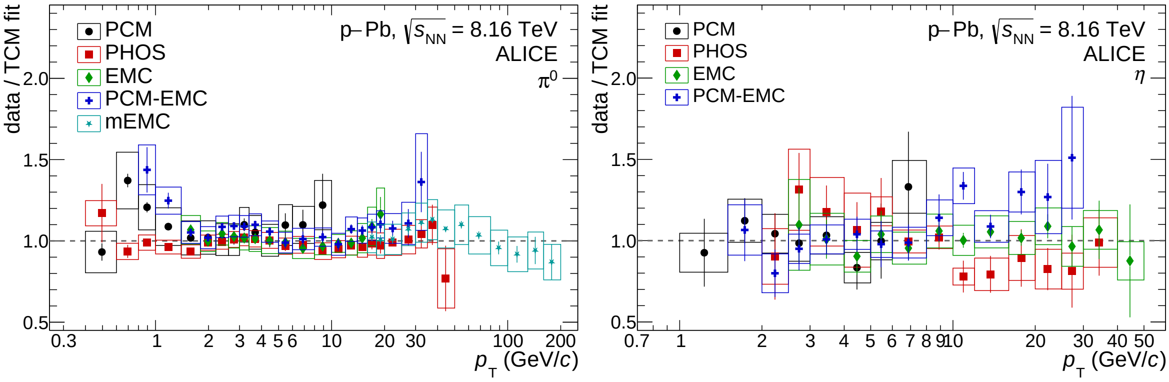

Fig. 6: Ratio of the neutral pion (left) and η meson (right) invariant differential cross sections to the two-component model (TCM) fit of the combined spectrum for the different reconstruction techniques PCM, PCM-EMC, EMC, PHOS and mEMC in p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV. Statistical uncertainties are given by the vertical error bars while systematic uncertainties are shown as boxes.

6 Fit parameters

The combined spectra of both neutral mesons are fitted with a two-component model (TCM), proposed in Ref. [6], by using the total uncertainties for each p_{T} interval, which are obtained via a quadratic sum of the statistical and systematic uncertainties. The fit function is able to describe the spectra over the full p_{T} range and is defined as:

$$E\frac{\mathrm{d}^3\sigma}{\mathrm{d}p^3} = A_{\mathrm{e}}\exp\left(-E_{\mathrm{T,kin}}/T_{\mathrm{e}}\right) + A\left(1+\frac{p_{\mathrm{T}}^2}{T^2 n}\right)^{-n}, \tag{3}$$

where $E_{\mathrm{T,kin}} = \sqrt{p_{\mathrm{T}}^2+m^2} - m$ is the transverse kinematic energy with the meson rest mass m, and A_{e}, A, T_{e}, T, and n are the free parameters. The fit parameters extracted from the TCM fit are summarized in Tab. 7 for p–Pb and pp collisions.

Table 7: Parameters of the fits to the π^0 and η invariant differential cross sections using the TCM fit [6] from Eq. 3 for pp collisions at $\sqrt{s} = 8$ TeV and p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV.

	TCM	A_{e} (pb GeV$^{-2}c^3$)	T_{e} (GeV)	A (pb GeV$^{-2}c^3$)	T (GeV)	n	χ^2/NDF
p–Pb	π^0	$(2.47\pm1.82)\times10^{11}$	0.094 ± 0.015	$(4.38\pm0.38)\times10^{12}$	0.649 ± 0.012	3.034 ± 0.008	0.36
	η	$(2.01\pm2.82)\times10^{10}$	0.685 ± 0.183	$(4.73\pm2.69)\times10^{11}$	0.781 ± 0.095	2.917 ± 0.053	0.31
pp	π^0	$(4.98\pm2.09)\times10^{11}$	0.146 ± 0.020	$(3.73\pm0.67)\times10^{10}$	0.597 ± 0.021	3.042 ± 0.010	0.25
	η	$(0.52\pm3.24)\times10^{9}$	0.217 ± 0.211	$(2.95\pm1.10)\times10^{9}$	0.801 ± 0.069	3.012 ± 0.036	0.38

Furthermore, the region $p_{\mathrm{T}} > 3.5$ GeV/c of the spectra can be fitted with a pure power-law function given by $f_{\mathrm{pow}} = A/x^n$ in order to compare the spectral slope between different collision systems and collision energies. The fit parameters for the power-law functions on the π^0 and η meson spectra are given in Tab. 8. The power n of the fits in pp and p–Pb show compatible values within uncertainties.

In addition, the high-p_{T} plateau regions of the η/π^0 ratios in pp and p–Pb collisions are fitted with constant values for $p_{\mathrm{T}} > 4$ GeV/c. The values obtained from these fits are $C^{\eta/\pi^0}_{\mathrm{pPb}} = 0.479\pm0.009(\mathrm{stat})\pm0.010(\mathrm{sys})$ for p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV and $C^{\eta/\pi^0}_{\mathrm{pp}} = 0.473\pm0.006(\mathrm{stat})\pm0.011(\mathrm{sys})$ for pp collisions at $\sqrt{s} = 8$ TeV.

Table 8: Parameters of the fits to the π^0 and η invariant differential cross sections using a pure power-law fit for pp collisions at $\sqrt{s} = 8$ TeV and p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV.

	Power-law	A (pb GeV$^{-2}c^3$)	n	χ^2/NDF
p–Pb	π^0	(6.95±0.26)×10^{12}	5.985±0.015	0.82
	η	(2.26±0.55)×10^{12}	5.800±0.091	0.34
pp	π^0	(3.74±0.12)×10^{10}	6.006±0.015	0.90
	η	(1.38±0.15)×10^{10}	5.876±0.047	0.32

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