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Supplemental Figures: Direct photon production in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76\,\mathrm{TeV}$

ALICE Collaboration*

Abstract

In this short note we present supplemental figures for the analysis “Direct photon production in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76\,\mathrm{TeV}$” described in arXiv:1509.07324.

*The author list is given in arXiv:1509.07324

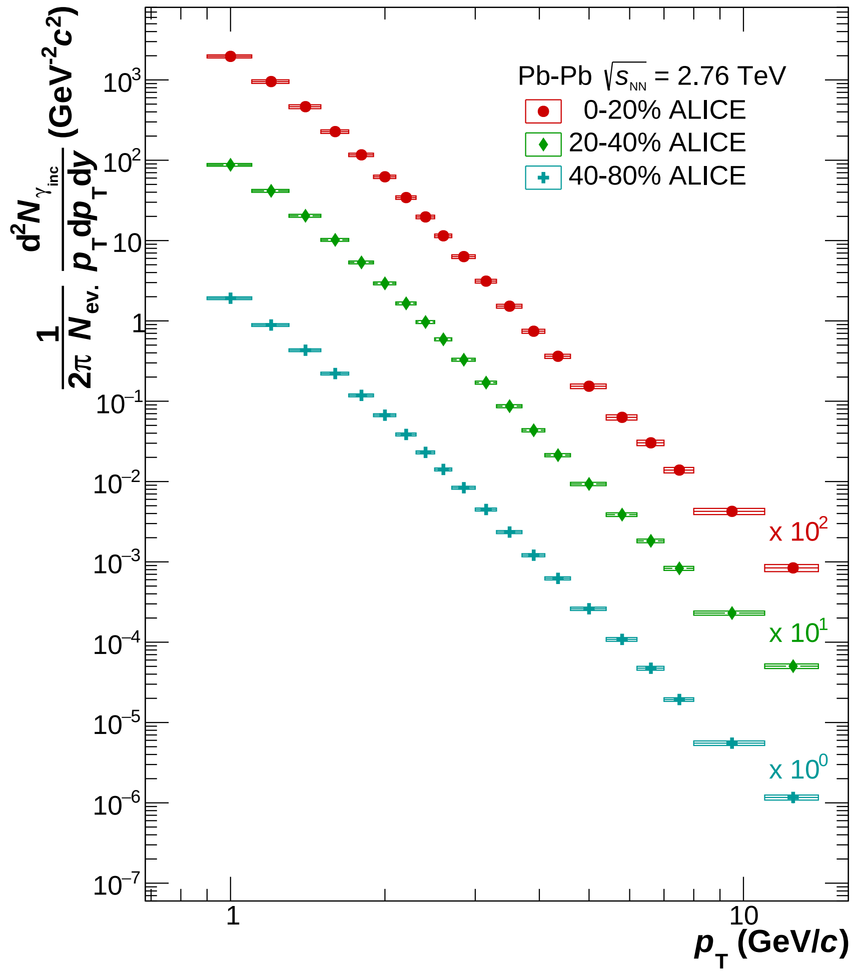

Fig. 1: Inclusive photon (γ_{incl}) spectra in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV for the 0–20% (scaled by a factor 100), the 20–40% (scaled by a factor 10) and 40–80% centrality classes.

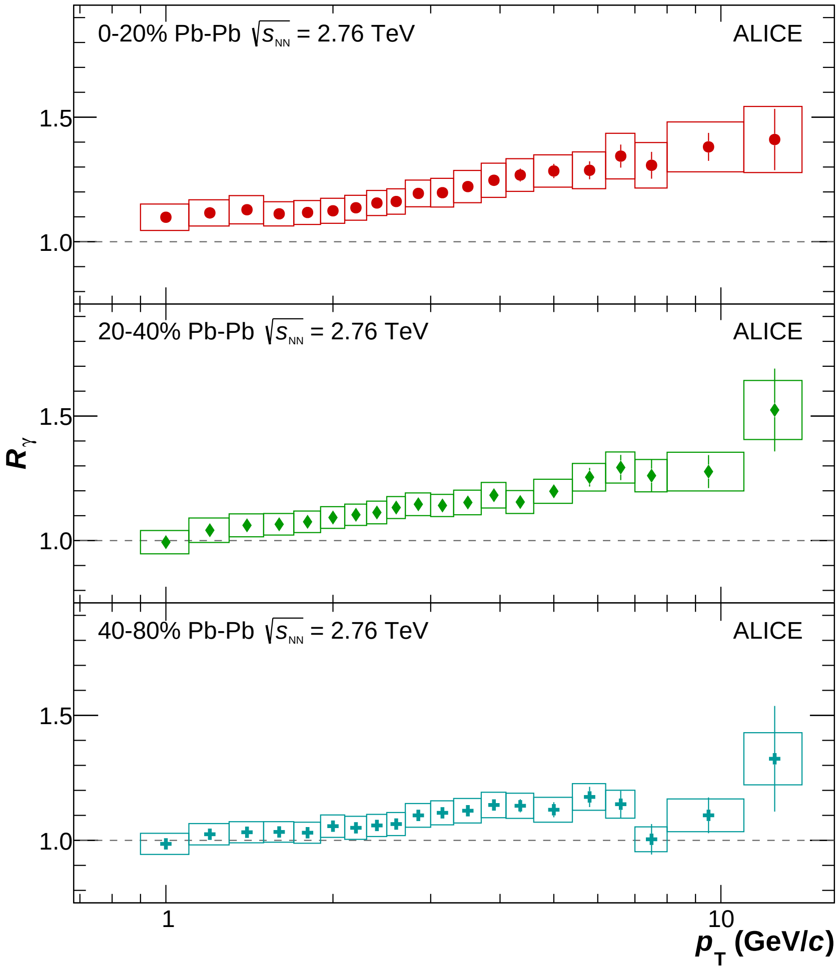

Fig. 2: Combined PCM and PHOS double ratio R_γ in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV for the 0–20%, 20–40%, and 40–80% centrality classes.

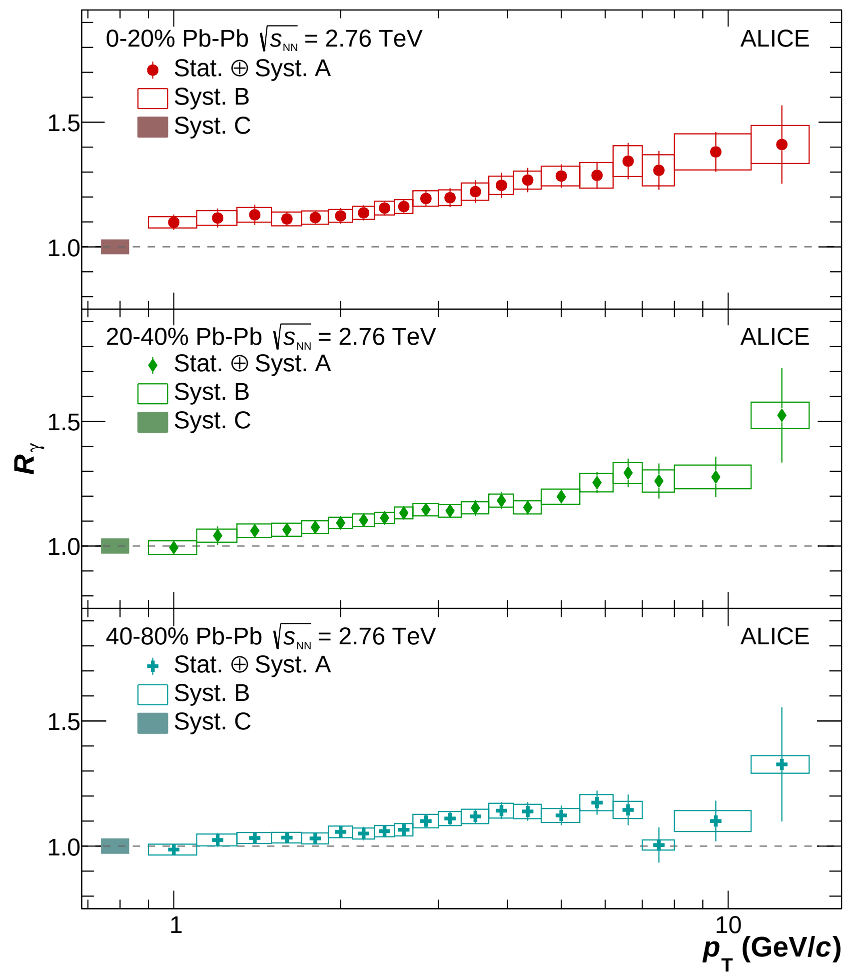

Fig. 3: Combined PCM and PHOS double ratio R_γ in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV for the 0–20%, 20–40%, and 40–80% centrality classes. The errors in this plot are split into fully uncorrelated errors (stat. ⊕ syst. A), displayed as error bars, systematic uncertainties correlated in p_T (syst. B), shown as empty boxes around the points, and a normalization uncertainty (syst. C), shown as filled boxes around 1.

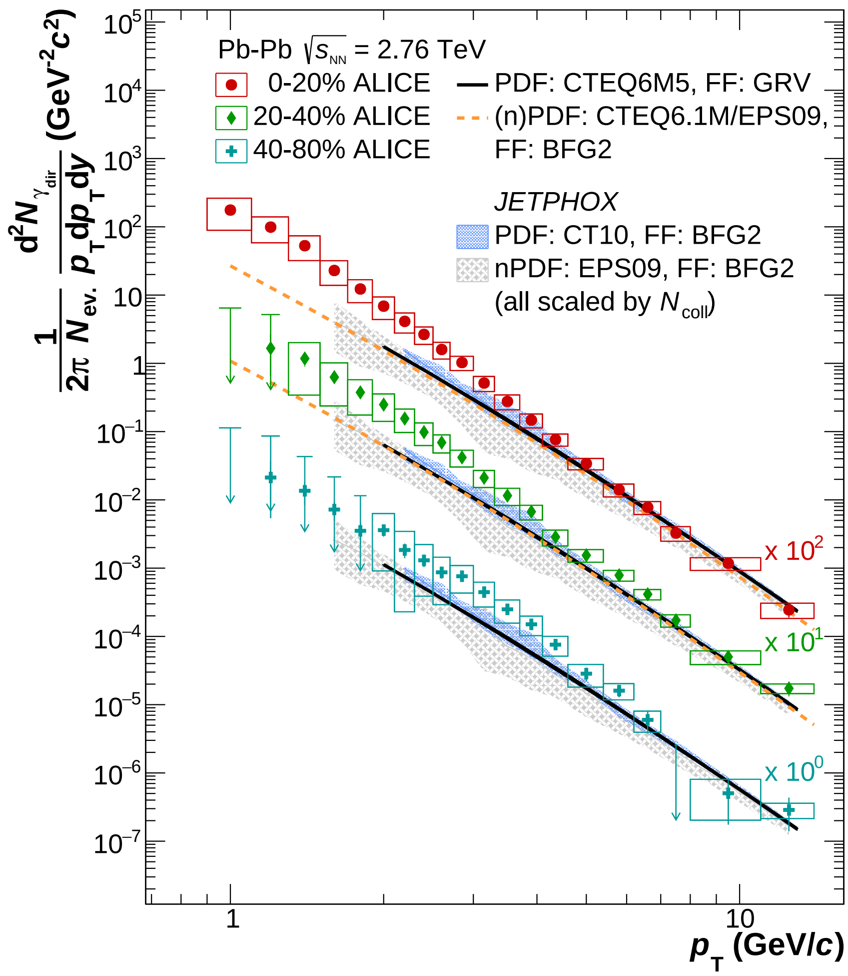

Fig. 4: Direct photon spectra in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV for the 0–20% (scaled by a factor 100), the 20–40% (scaled by a factor 10) and 40–80% centrality classes compared to NLO pQCD predictions for the direct photon yield in pp collisions at the same energy, scaled by the number of binary nucleon collisions for each centrality class.

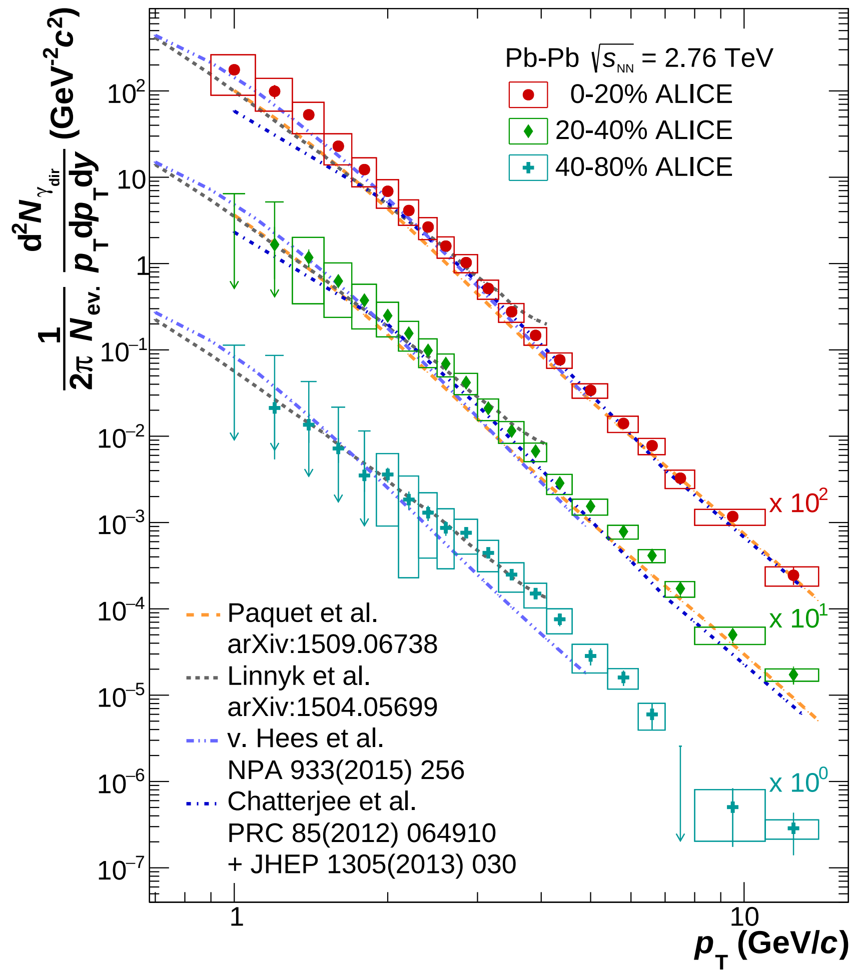

Fig. 5: Comparison of model calculations from Refs. [1–4] with the direct photon spectra in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV for the 0–20% (scaled by a factor 100), the 20–40% (scaled by a factor 10) and 40–80% centrality classes. All models include a contribution from pQCD photons.

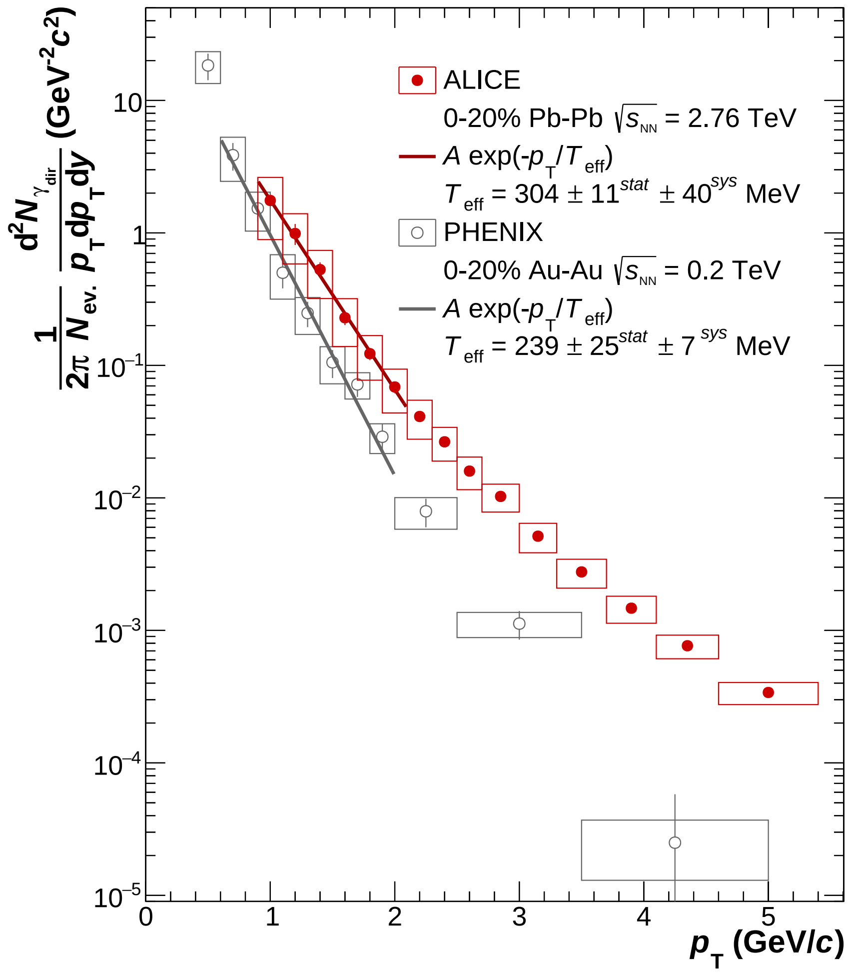

Fig. 6: Direct photon spectra in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV and $\sqrt{s_{NN}} = 0.2$ TeV [5], in both cases for the 0–20% centrality class. The spectra in both cases are the measured direct photon spectra, i.e., the contribution of pQCD photons was not subtracted. In case of the ALICE data, the slope of the exponential shown in the figure was determined without the subtraction of a pQCD contribution, while in the PHENIX case, the slope was determined after subtracting a pQCD contribution. In PHENIX, the pQCD contribution was determined by parameterizing a direct photon measurement in pp collisions.

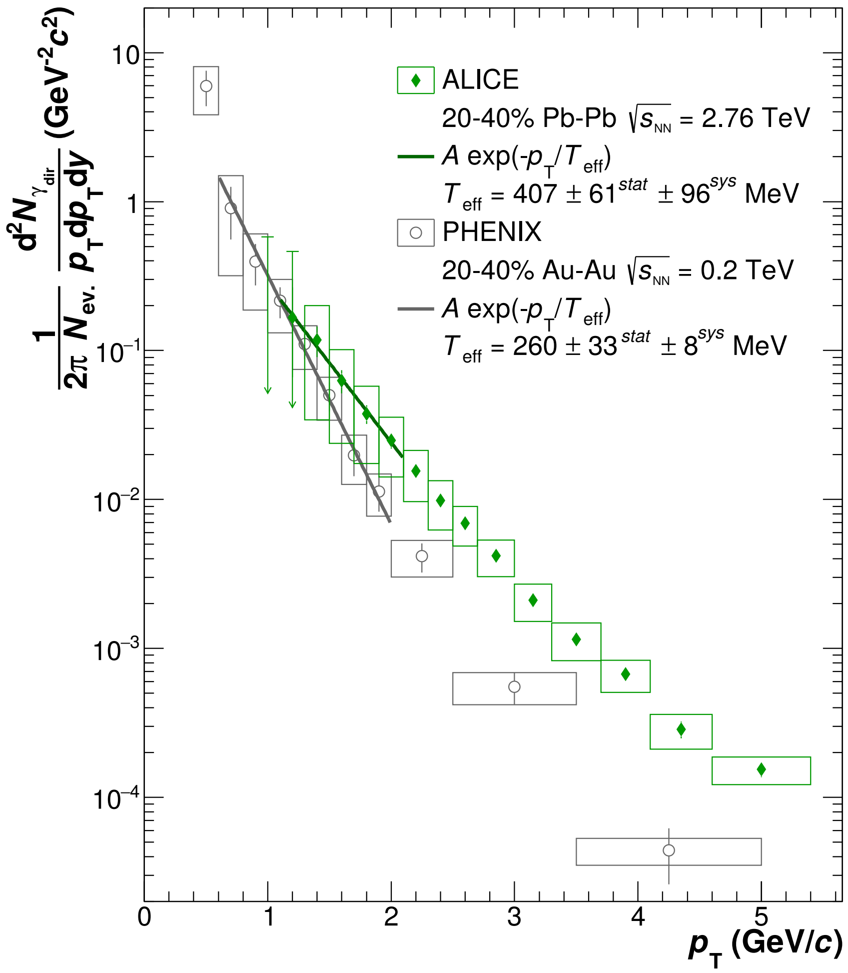

Fig. 7: Direct photon spectra in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV and $\sqrt{s_{\mathrm{NN}}} = 0.2$ TeV [5], in both cases for the 20–40% centrality class. Both spectra reflect the data without the subtraction of a contribution from pQCD photons. In case of the ALICE data, the slope of the exponential shown in the figure was determined without the subtraction of a pQCD contribution, while in the PHENIX case, the slope was determined after subtracting a pQCD contribution. In PHENIX, the pQCD contribution was determined by parameterizing a direct photon measurement in pp collisions.

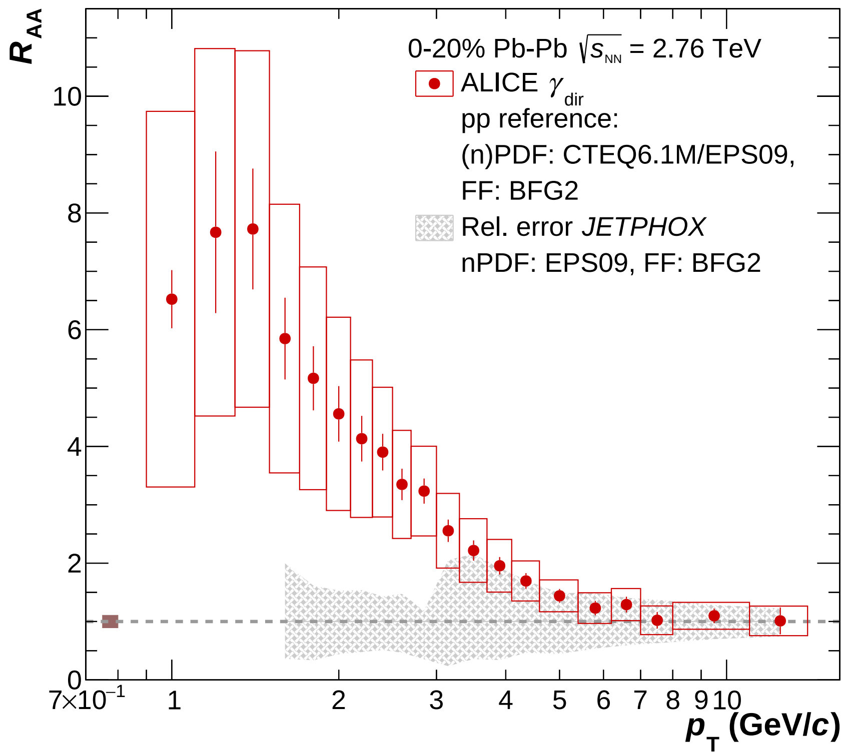

Fig. 8: Direct photon nuclear modification factor R_{AA} in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV for the 0–20% centrality class. As a measured direct photon spectrum is not available at $\sqrt{s} = 2.76$ TeV, the pQCD calculation by the McGill group was taken as pp reference. The gray band indicates the error of the *JETPHOX* calculation with similar PDF and FF.

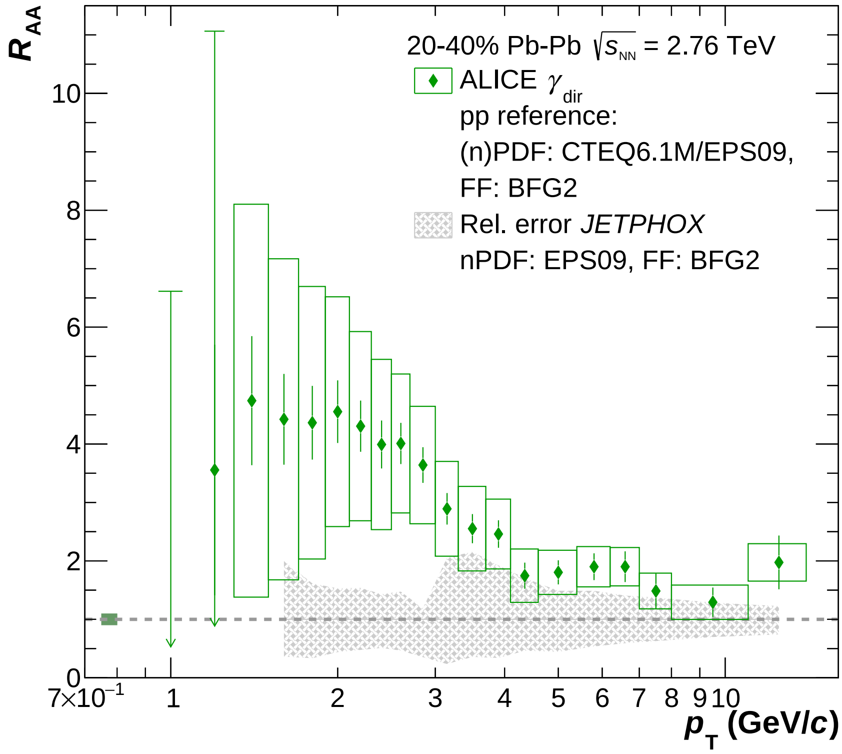

Fig. 9: Direct photon nuclear modification factor R_{AA} in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV for the 20–40% centrality class. As a measured direct photon spectrum is not available at $\sqrt{s} = 2.76$ TeV, the pQCD calculation by the McGill group was taken as pp reference. The gray band indicated the error of the *JETPHOX* calculation with similar PDF and FF.

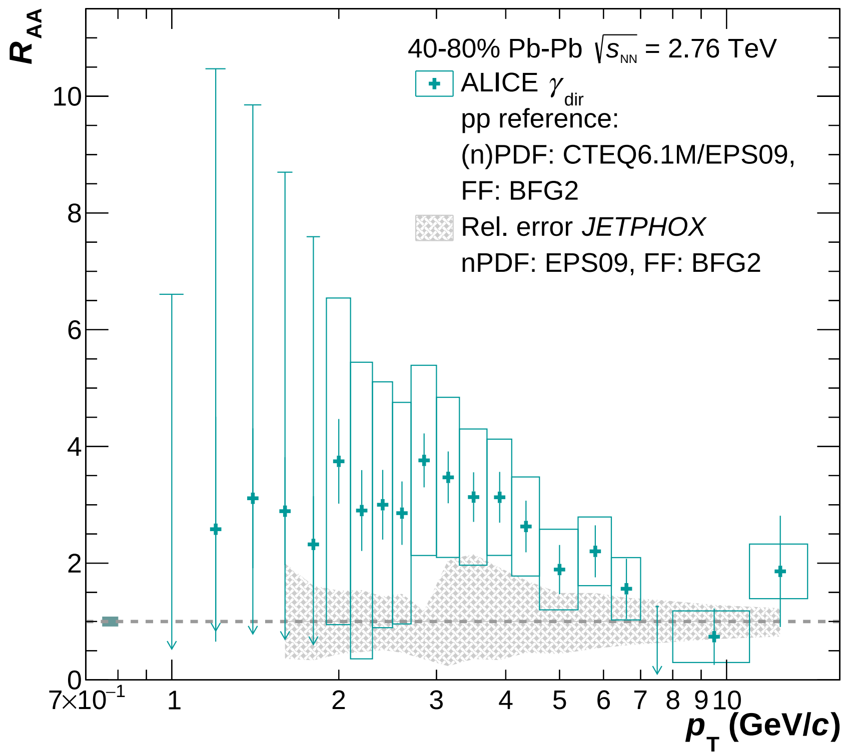

Fig. 10: Direct photon nuclear modification factor R_{AA} in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV for the 40–80% centrality class. As a measured direct photon spectrum is not available at $\sqrt{s} = 2.76$ TeV, the pQCD calculation by the McGill group was taken as pp reference. The gray band indicated the error of the *JETPHOX* calculation with similar PDF and FF.

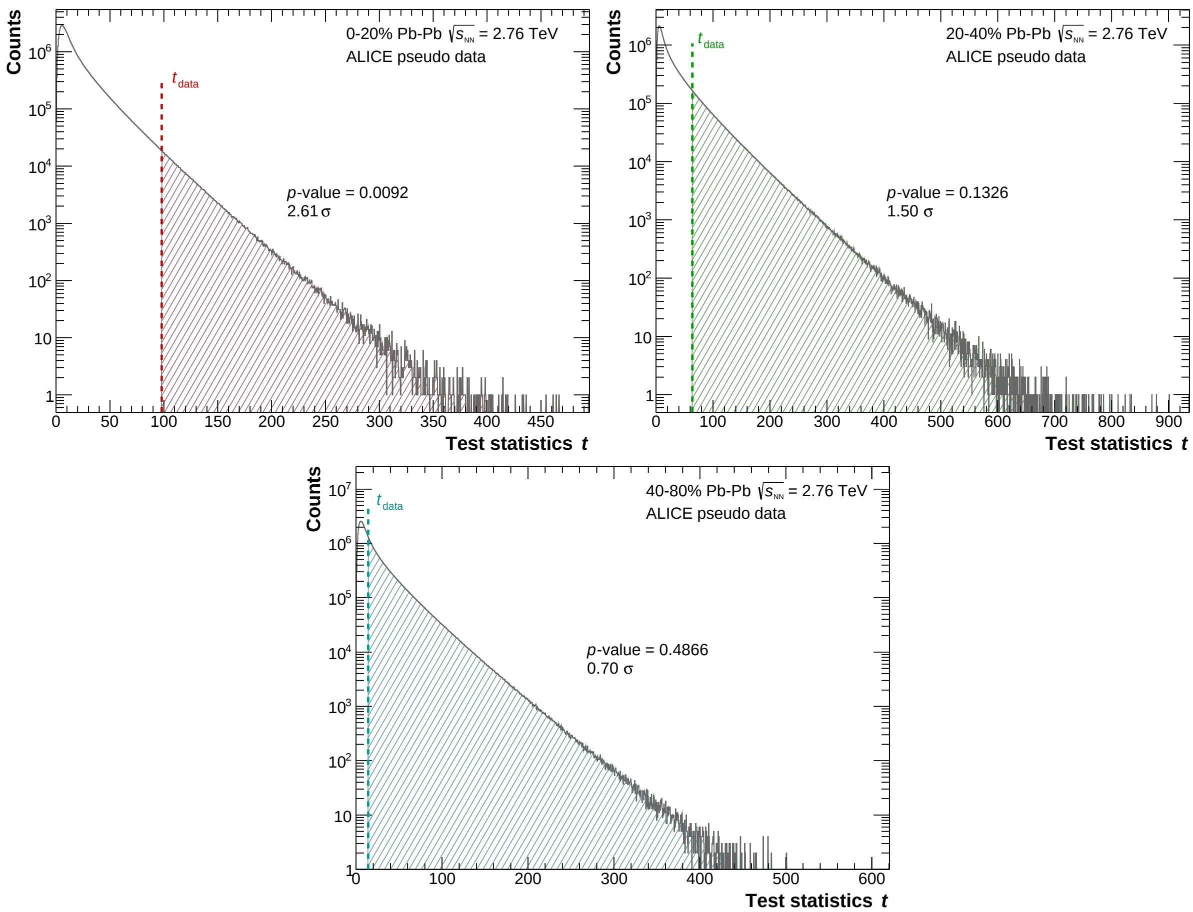

Fig. 11: Distribution of the test statistic t for the direct-photon excess R_γ in $0.9 < p_T < 2.1$ GeV$/c$ in the w 0–20%, 20–40% & 40–80% classes for pseudo-experiments performed under the null hypothesis that there is no direct photon excess. The model of the measurement of the direct-photon excess R_γ is based on the type A, B, C systematic uncertainties. It is assumed that the actual measurement can be described by certain values of nuisance parameters ε_B and ε_C. Our limited knowledge of the actual values of these parameters is parameterized by Gaussian distributions with mean $\mu = 0$ and standard deviations $\sigma = 1$ ($N_{0,1}$), i.e., ε_B and ε_C are deviations from a central value in units of the standard deviation. We now perform pseudo-experiments by randomly drawing ε_B and ε_C from $N_{0,1}$. Suppose that R_0 is the true value of the photon excess. The actual measurement in the p_T interval i will now fluctuate around $R_{\mathrm{mod},i} = R_0(1+\varepsilon_B\sigma_{B,i,rel})(1+\varepsilon_C\sigma_{C,rel})$ as given by the statistical and type A systematic uncertainties added in quadrature. The uncertainties $\sigma_{B,i,rel}$ are the relative systematic type B uncertainties and $\sigma_{C,rel}$ is the relative normalization uncertainty. A given pseudo data point in the p_T interval i is denoted by $R_{pd,i}$. The test statistic is defined by the following sum over pseudo-measurements in the different p_T intervals i: $t = \sum_{i=1}^{n_{\mathrm{data\ points}}} \left(\frac{R_{pd,i}-R_0}{\sigma_{0,i}}\right)^2$ where $R_0 = 1$, $\sigma_{0,i} = R_{\mathrm{mod},i}\sigma_{i,stat+A,rel}$. The line indicates the value t_{data} of the test statistic for the real data (Photon Conversion Method and PHOS combined). The p-values (number of pseudo-experiments with $t > t_{\mathrm{data}}$ divided by the total number of pseudo-experiments) is indicated in the plot. The p-value is expressed in terms of the significance in units of the standard deviation of a Gaussian ($a \cdot \sigma$) by solving $2\int_a^\infty N_{0,1}(x)\,\mathrm{d}x = p$-value for a (two-tailed test).

References

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