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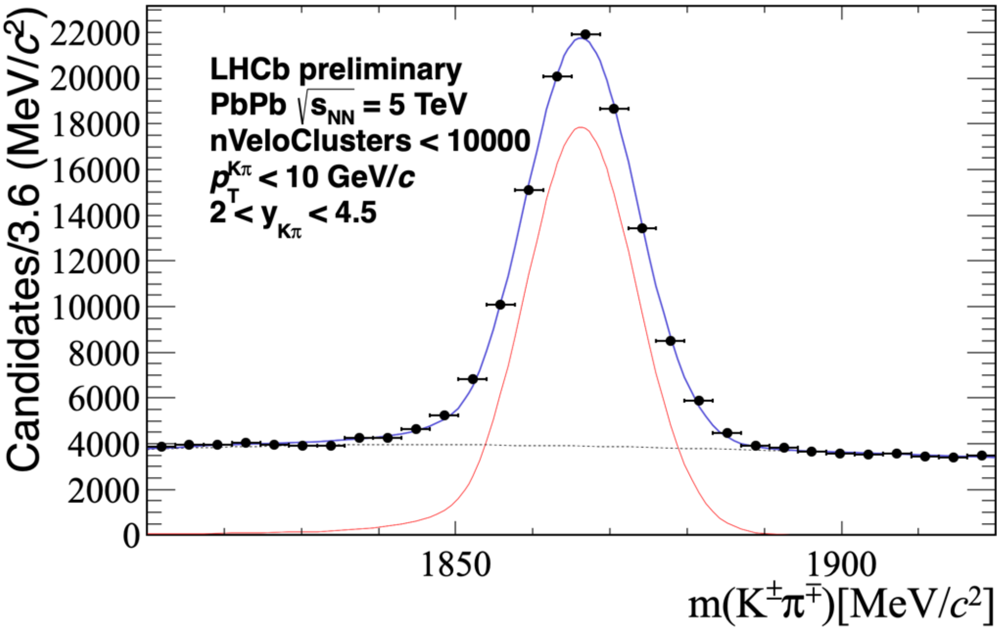
Charm production in PbPb collisions at $\sqrt{s_{\rm NN}} = 5$ TeV and in pPb collisions at $\sqrt{s_{\rm NN}} = 8$ TeV

LHCb collaboration

Abstract

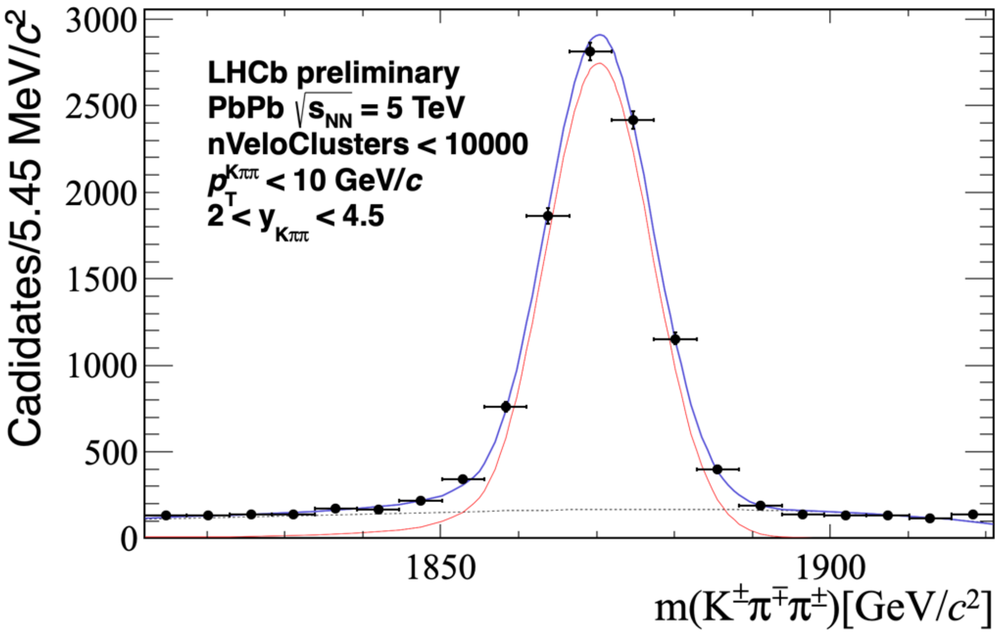
THis document presents performance plots for the full PbPb dataset at $\sqrt{s_{\rm NN}} = 5$ TeV recorded in 2018 by the LHCb Collaboration as well as new performance plot in pPb collisions at $\sqrt{s_{\rm NN}} = 8.16$ TeV. For the first dataset, a fit of the open-charm mesons D,D_s^+,D^+, the charm baryon Λ_c^+ and the charmonium J/ψ are shown, with a fit of the $log(p_T^2)$ distribution of the J/ψ meson. We also present fits of χ_{c1} and χ_{c2} at forward (p-going) and backward (Pb-going) rapidity in pPb collisions.

1 Figures



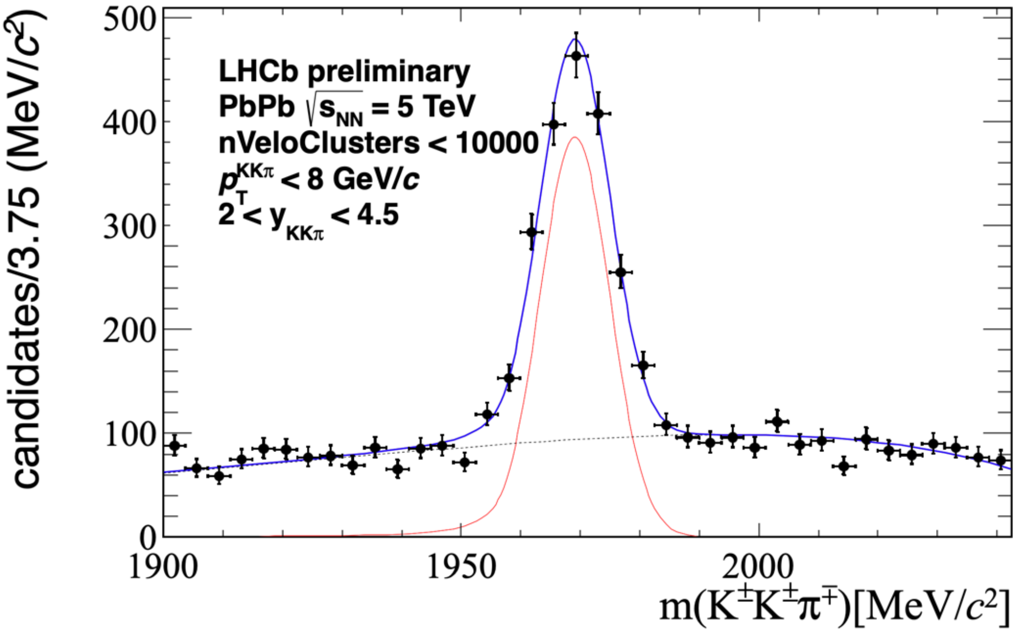
(a)

Figure 1: Invariant mass distribution of $K^{\pm}\pi^{\mp}$ in 2018 PbPb collisions (integrated luminosity $\mathcal{L} \sim 210\ \mu b^{-1}$). Data are reconstructed up to 10000 nVeloClusters which correspond to a lower bound of $\sim 60\%$ in centrality. A selection is applied to increase the signal over background ratio around the D^0 mass, together with a cut on the luminous region in order to reduce SMOG contamination. There are around 83000 D^0 signal candidates



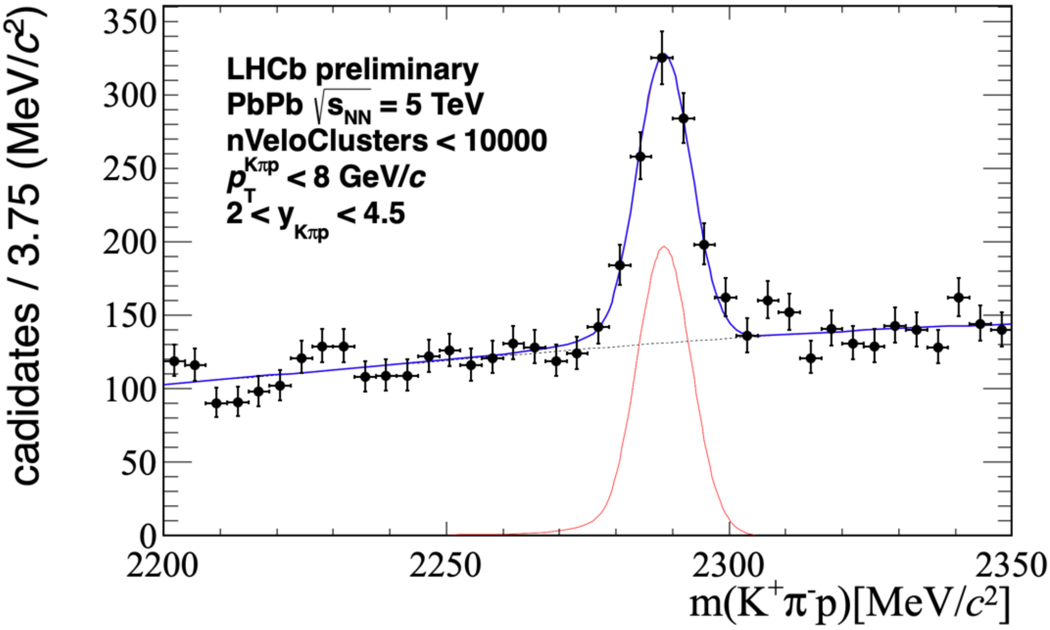
(a)

Figure 2: Invariant mass distribution of $K^{\pm}\pi^{\mp}\pi^{\mp}$ in 2018 PbPb collisions (integrated luminosity $\mathcal{L} \sim 210\ \mu b^{-1}$). Data are reconstructed up to 10000 nVeloClusters which correspond to a lower bound of $\sim 60\%$ in centrality. A selection is applied to increase the signal over background ratio around the D^+ mass, together with a cut on the luminous region in order to reduce SMOG contamination. There are around 8900 D^+ signal candidates



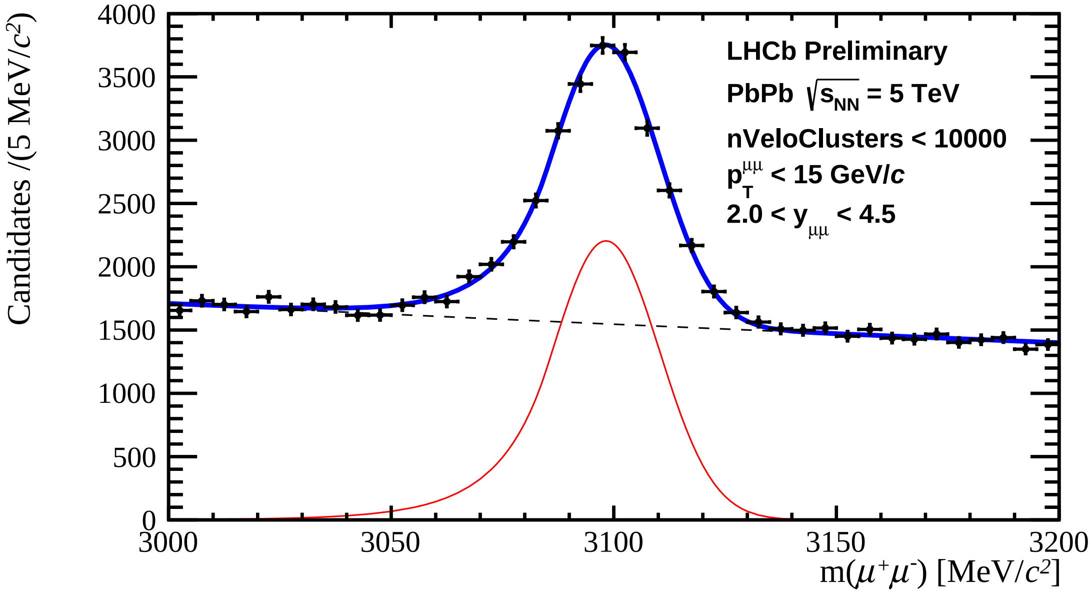
(a)

Figure 3: Invariant mass distribution of $K^{\pm}K^{\mp}\pi^{\mp}$ in 2018 PbPb collisions (integrated luminosity $\mathcal{L} \sim 210\ \mu b^{-1}$). Data are reconstructed up to 10000 nVeloClusters which correspond to a lower bound of $\sim 60\%$ in centrality. A selection is applied to increase the signal over background ratio around the D_s^+ mass, together with a cut on the luminous region in order to reduce SMOG contamination. There are around 1700 D_s^+ signal candidates



(a)

Figure 4: Invariant mass distribution of $K^+\pi^-p$ (and charge-conjugate) in 2018 PbPb collisions (integrated luminosity $\mathcal{L} \sim 210\ \ \mu b^{-1}$). Data are reconstructed up to 10000 nVeloClusters which correspond to a lower bound of $\sim 60\%$ in centrality. A selection is applied to increase the signal over background ratio around the Λ_c^+ mass, together with a cut on the luminous region in order to reduce SMOG contamination. There are around 600 Λ_c^+ signal candidates



(a)

Figure 5: Invariant mass distribution of $\mu^+\mu^-$ in 2018 PbPb collisions (integrated luminosity $\mathcal{L} \sim 210\ \ \mu b^{-1}$). Data are reconstructed up to 10000 nVeloClusters which correspond to a lower bound of $\sim 60\%$ in centrality. A selection is applied to increase the signal over background ratio around the J/ψ mass, together with a cut on the luminous region in order to reduce SMOG contamination. There are around 15000 J/ψ signal candidates

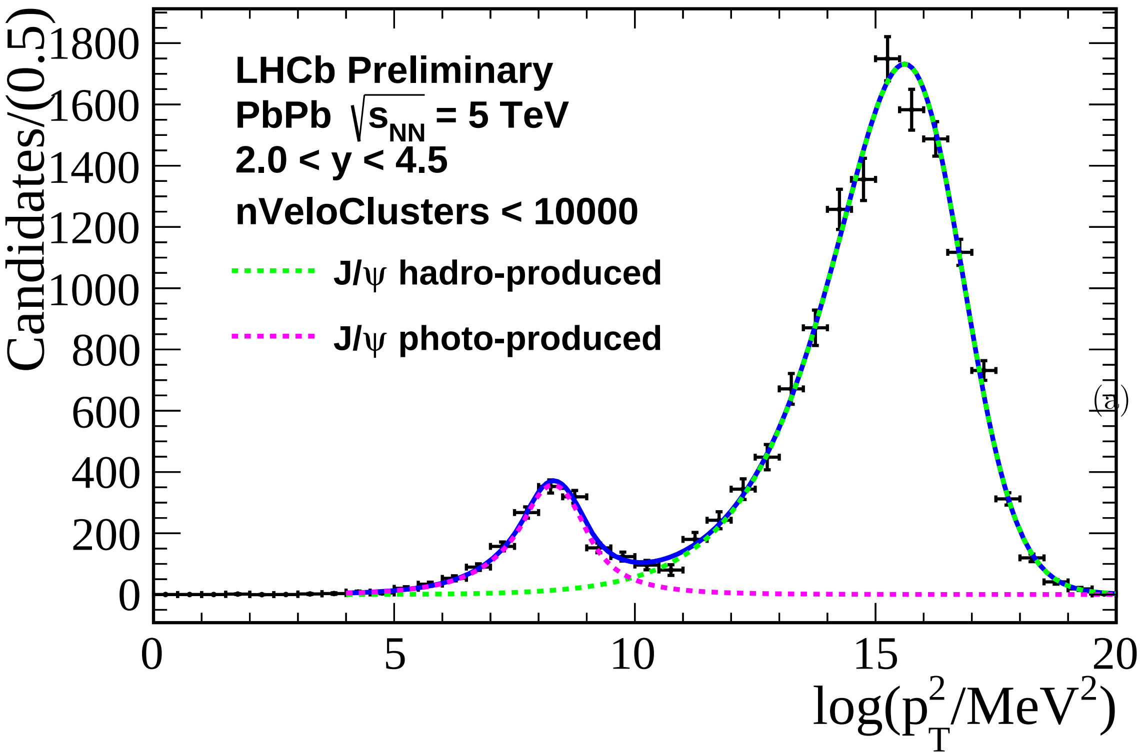


Figure 6: Fit to $log(p_T^2)$ to differentiate the coherently photoproduced J/ψ (left peak) from the hadronically produced J/ψ (right peak). The p_T spectrum of the J/ψ is extracted from the dimuon invariant mass distribution 5 using the sPlot method [1].

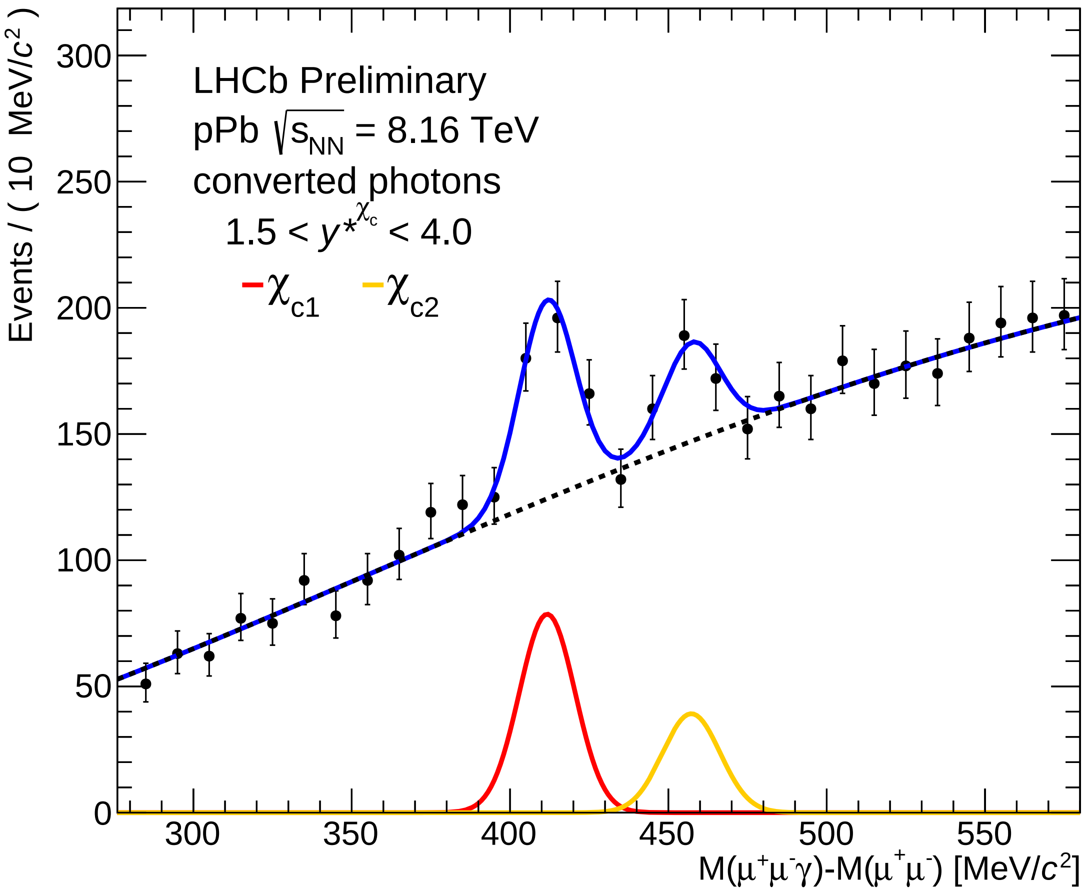


Figure 7: Distribution of the mass difference $\Delta M \equiv M(\mu^+\mu^-\gamma) - M(\mu^+\mu^-)$ for converted photons reconstructed from downstream track electrons in 2016 pPb collisions at forward rapidity (integrated luminosity $\mathcal{L} = 13.6 \pm 0.3$ μb^{-1}), integrated in $p_{\rm T}$ and over $1.5 < y* < 4.0$. The distribution is fitted with a combination of Gaussian functions for the signal peaks and a 3rd degree Chebyshev polynomial for background. The following χ_{cJ} selection was applied: HeavyIonDiMuonJpsi2MuMuLine stripping line (S30r3), mass of the electron-positron pair $M_{ee} < 200$ MeV$/c^2$, transverse momentum of the electron-positron pair $p_{\rm T}^{ee} > 50$ MeV$/c$; χ_{cJ}, J/ψ, and $\mu^{\pm}$ required to be within $2.0 < \eta < 4.0$; $e^{\pm}$ and γ within $2.0 < \eta < 5.0$. The shown distribution also satisfies $p_{\rm T}^{\gamma} > 600$ MeV$/c$ and $3054 < M_{J/\psi} < 3138$ MeV$/c^2$. Only events with at least one primary vertex were considered.

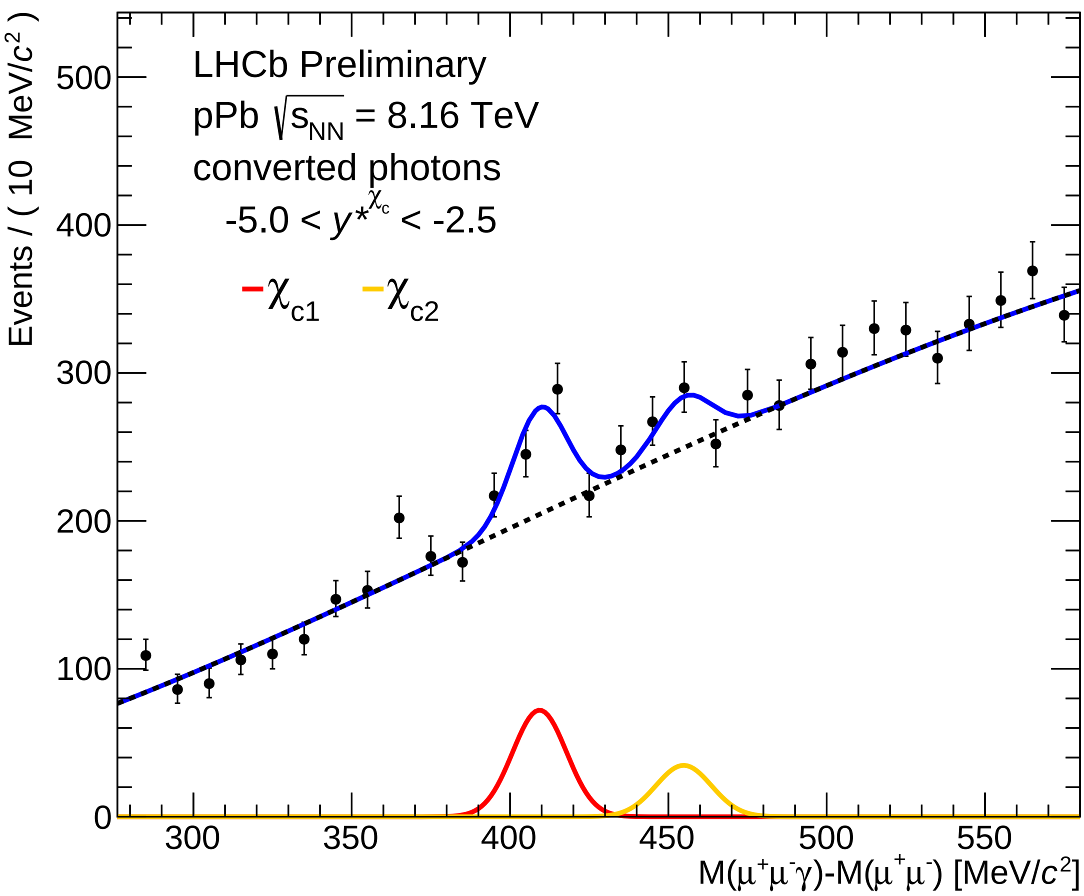


Figure 8: Distribution of the mass difference $\Delta M \equiv M(\mu^+\mu^-\gamma) - M(\mu^+\mu^-)$ for converted photons reconstructed from downstream track electrons in 2016 pPb collisions at backward rapidity (integrated luminosity $\mathcal{L} = 20.8 \pm 0.5\ \mu b^{-1}$), integrated in p_T and over $-5.0 < y* < -2.5$. The distribution is fitted with a combination of Gaussian functions for the signal peaks and a 3rd degree Chebyshev polynomial for background. The following χ_{cJ} selection was applied: HeavyIonDiMuonJpsi2MuMuLine stripping line (S30r3), mass of the electron-positron pair $M_{ee} < 200$ MeV/c^2, transverse momentum of the electron-positron pair $p_T^{ee} > 50$ MeV/c; χ_{cJ}, J/ψ, and $\mu^{\pm}$ required to be within $2.0 < \eta < 4.0$; $e^{\pm}$ and γ within $2.0 < \eta < 5.0$. The following χ_{cJ} selection was applied: HeavyIonDiMuonJpsi2MuMuLine stripping line (S30r2), mass of the electron-positron pair $M_{ee} < 200$ MeV/c^2, transverse momentum of the electron-positron pair $p_T^{ee} > 50$ MeV/c; χ_{cJ}, J/ψ, and $\mu^{\pm}$ required to be within $2.0 < \eta < 4.0$; $e^{\pm}$ and γ within $2.0 < \eta < 5.0$. The shown distribution also satisfies $p_T^{\gamma} > 600$ MeV/c and $3054 < M_{J/\psi} < 3138$ MeV/c^2. Only events with at least one primary vertex were considered.

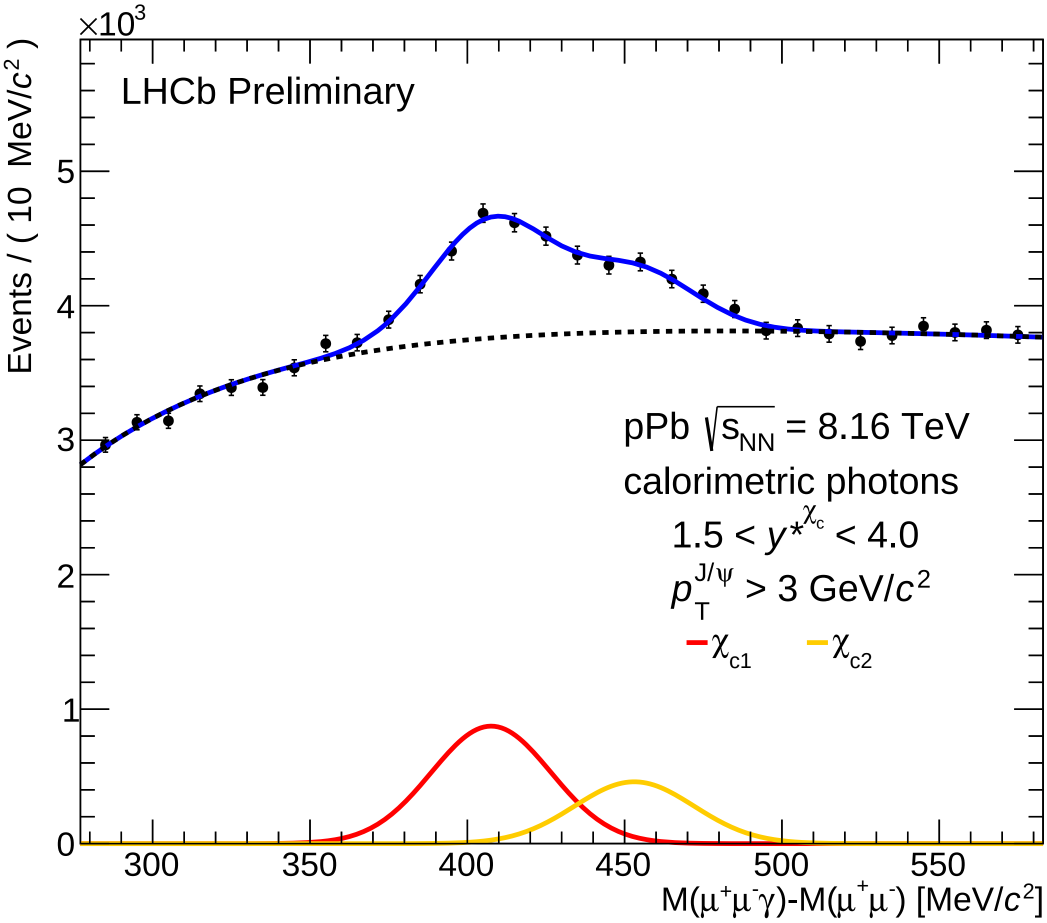


Figure 9: Distribution of the mass difference $\Delta M \equiv M(\mu^+\mu^-\gamma) - M(\mu^+\mu^-)$ for calorimetric photons in 2016 pPb collisions at forward rapidity (integrated luminosity $\mathcal{L} = 13.6 \pm 0.3\ \mu b^{-1}$). The distribution is integrated over $1.5 < y* < 4.0$ and for $p_{\mathrm{T}}^{J/\psi} > 3$ GeV/c. The distribution is fitted with a combination of Gaussian functions describing the signal and a Mass-Difference Background Distribution. The following χ_{cJ} selection was applied: HeavyIonDiMuonJpsi2MuMuLine stripping line (S30r3), ECAL selection $E_{\mathrm{HCAL}}/E_{\mathrm{ECAL}} < 0.3$, CL$> 0.5$, and measured transverse momentum of the photon $p_{\mathrm{T}}^{\gamma} > 300$ MeV/c; χ_{cJ}, J/ψ, and $\mu^{\pm}$ required to be within $2.0 < \eta < 4.0$; γ within $2.0 < \eta < 5.0$. The shown distribution also satisfies $p_{\mathrm{T}}^{\gamma} > 600$ MeV/c, $3054 < M_{J/\psi} < 3138$ MeV/c^2, and $p_{\mathrm{T}}^{J/\psi} > 3$ GeV/c. Only events with at least one primary vertex were considered.

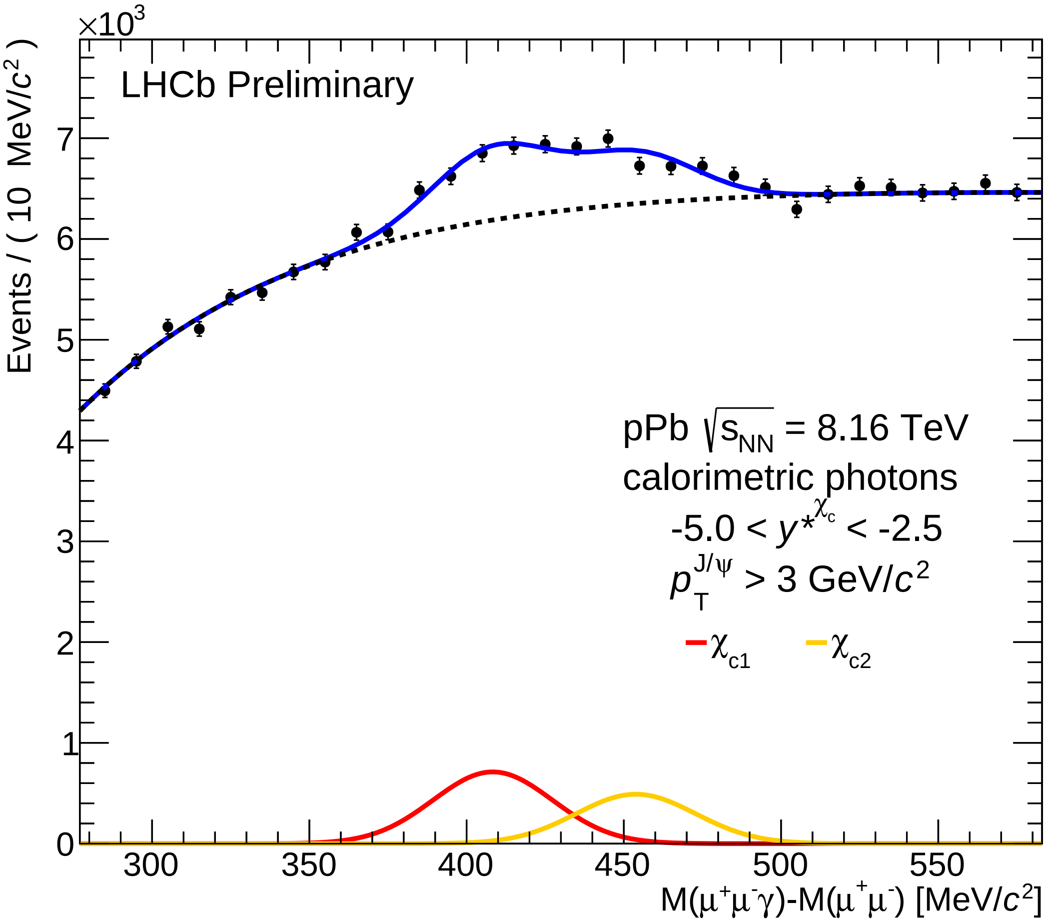


Figure 10: Distribution of the mass difference $\Delta M \equiv M(\mu^+\mu^-\gamma) - M(\mu^+\mu^-)$ for calorimetric photons in 2016 pPb collisions at backward rapidity (integrated luminosity $\mathcal{L} = 20.8 \pm 0.5\ \mu b^{-1}$), integrated over $-5.0 < y* < -2.5$ and for $p_{\mathrm{T}}^{J/\psi} > 3$ GeV/c. The distribution is fitted with a combination of Gaussian functions describing the signal and a Mass-Difference Background Distribution. The following χ_{cJ} selection was applied: HeavyIonDiMuonJpsi2MuMuLine stripping line (S30r2), ECAL selection $E_{\mathrm{HCAL}}/E_{\mathrm{ECAL}} < 0.3$, CL$> 0.5$, and measured transverse momentum of the photon $p_{\mathrm{T}}^{\gamma} > 300$ MeV/c; χ_{cJ}, J/ψ, and $\mu^{\pm}$ required to be within $2.0 < \eta < 4.0$; γ within $2.0 < \eta < 5.0$. The shown distribution also satisfies $p_{\mathrm{T}}^{\gamma} > 600$ MeV/c, $3054 < M_{J/\psi} < 3138$ MeV/c^2, and $p_{\mathrm{T}}^{J/\psi} > 3$ GeV/c. Only events with at least one primary vertex were considered.

References

[1] M. Pivk and F. R. Le Diberder, *sPlot: A statistical tool to unfold data distributions*, Nucl. Instrum. Meth. **A555** (2005) 356, `arXiv:physics/0402083`.

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