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Rediscovery of η and η' mesons in early phase 3 Belle II data

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Abstract

This note contains approved plots of rediscovery η and η' mesons decay with early phase 3 data, corresponding to an integrated luminosity $\int Ldt = 5.18\,\text{fb}^{-1}$. More details on BELLE2-NOTE-PH-2018-038.

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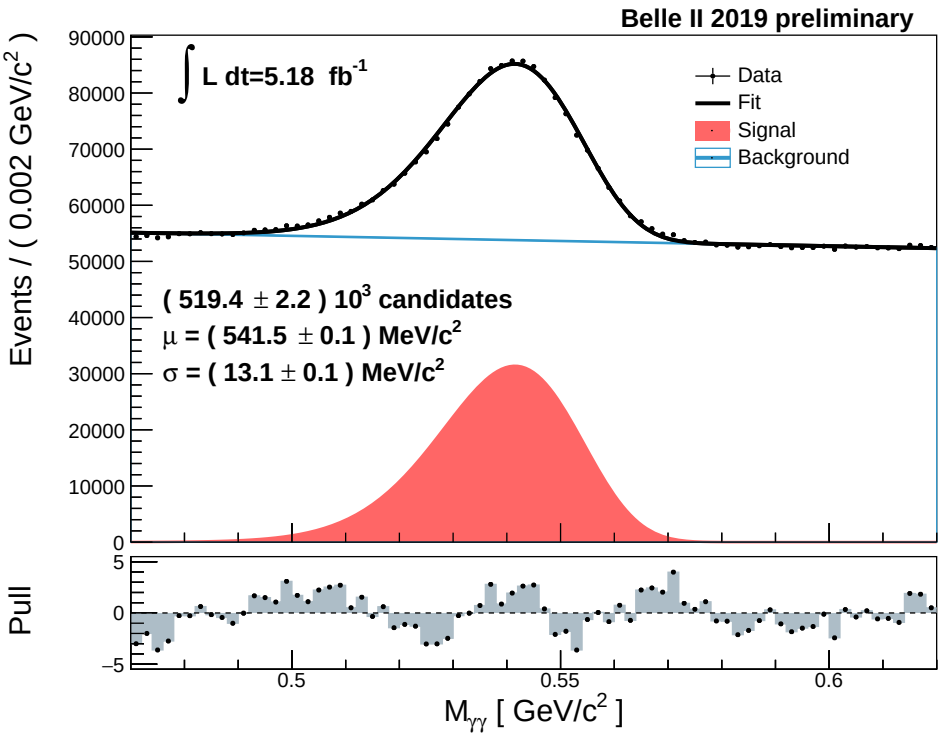

FIG. 1: Invariant mass distribution for $\gamma\gamma$ candidates for Belle II 2019 data, corresponding to 5.18 fb^{-1}. A clear peak corresponding to the decay $\eta \to \gamma\gamma$ is visible. A fit with a Crystal Ball function for signal plus a linear function for background is superimposed. The selection requires $E_\gamma > 400\,\text{GeV}$. The decay chain is fitted using `TreeFitter` algorithm. The uncertainties on fit parameters are statistical only. Further details can be found in internal note BELLE2-NOTE-PH-2018-038.

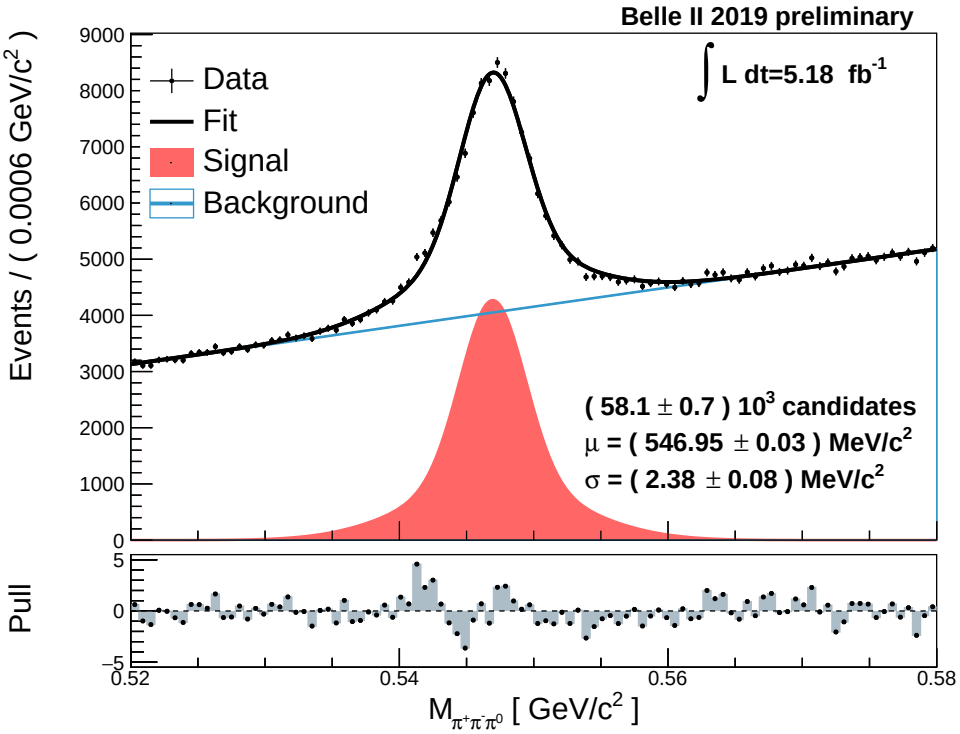

FIG. 2: Invariant mass distribution for $\pi^+\pi^-\pi^0$ candidates for Belle II 2019 data, corresponding to 5.18 fb^{-1}. A clear peak corresponding to the decay $\eta \to \pi^+\pi^-\pi^0$ is visible. A fit with a double Gaussian function with common mean for signal plus a linear function for background is superimposed. The selection requires: $E_\gamma > 200\,\text{MeV}$, $110 < M_{\gamma\gamma} < 150\,\text{MeV}$, and $p_\pi > 300\,\text{MeV}$ for all three pions. The decay chain is fitted using `TreeFitter` algorithm, constraining the mass of the two γ to that of π^0. The uncertainties on fit parameters are statistical only. Further details can be found in internal note BELLE2-NOTE-PH-2018-038.

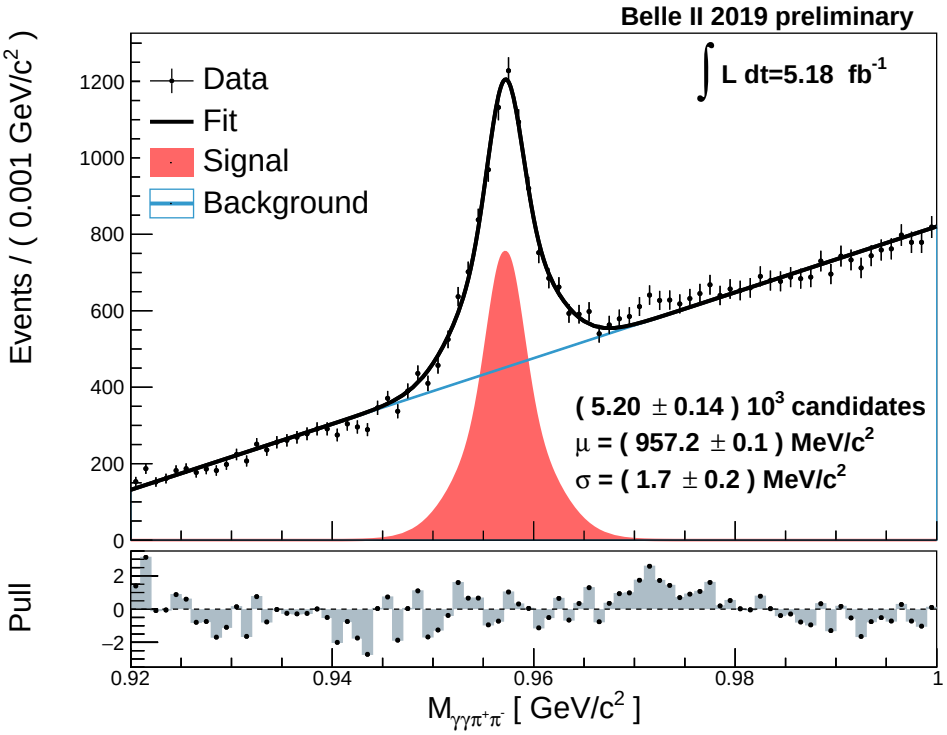

FIG. 3: Invariant mass distribution for $\eta(\to \gamma\gamma)\pi^-\pi^+$ candidates for Belle II 2019 data, corresponding to 5.18 fb^{-1}. A clear peak corresponding to the decay $\eta' \to \eta\pi^+\pi^-$ with $\eta \to \gamma\gamma$ is visible. A fit is superimposed, with a double Gaussian function with a common mean for signal plus a linear function for background. The selection requires: $E_\gamma > 400\,\text{MeV}$, $0.48 < M_{\gamma\gamma} < 0.58\,\text{GeV}$, $p_\pi > 400\,\text{MeV}$, and $p_\eta > 400\,\text{MeV}$. The decay chain is fitted using `TreeFitter` algorithm, constraining the mass of the two γ to that of η. The uncertainties on fit parameters are statistical only. Further details can be found in internal note BELLE2-NOTE-PH-2018-038.

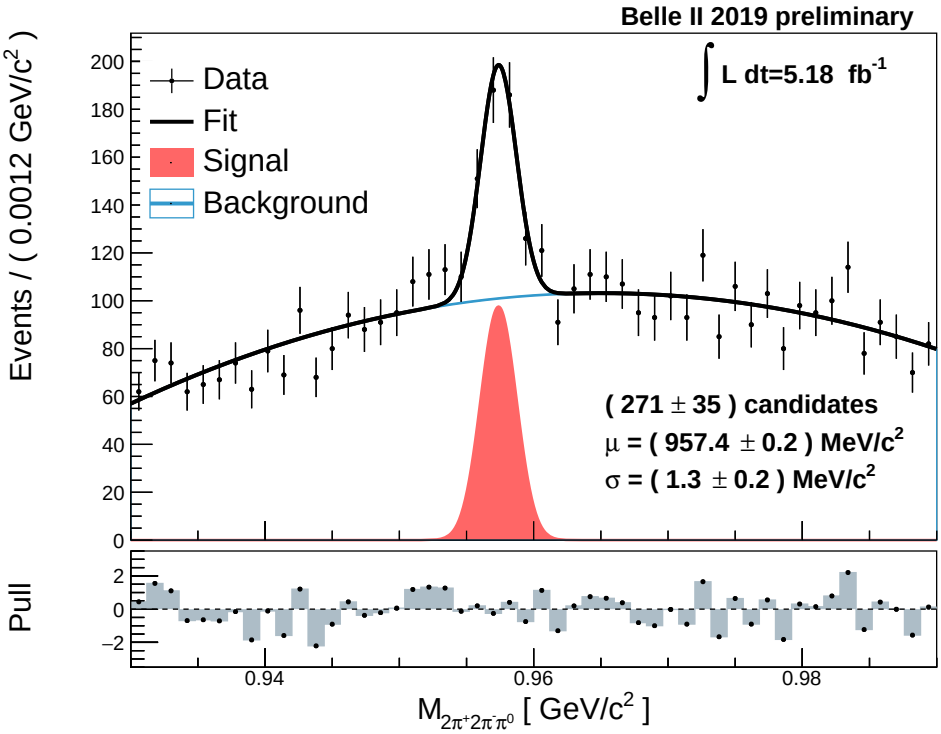

FIG. 4: Invariant mass distribution for $\eta(\to \pi^+\pi^-\pi^0)\pi^+\pi^-$ candidates for Belle II 2019 data, corresponding to 5.18 fb^{-1}. A clear peak corresponding to the decay $\eta' \to \eta\pi^+\pi^-$ with $\eta \to \pi^+\pi^-\pi^0$ is visible. A fit with a Gaussian function for signal plus a second degree polynomial function for background is superimposed. The selection requires: $E_\gamma > 200\,\text{MeV}$, $110 < M_{\gamma\gamma} < 150\,\text{MeV}$, $p_{\pi^0} > 400\,\text{MeV}$, $0.51 < M_{\gamma\gamma} < 0.58\,\text{GeV}$, $p_\pi > 400\,\text{MeV}$, and $p_\eta > 400\,\text{MeV}$. The decay chain is fitted using `TreeFitter` algorithm, constraining the mass of the two γ to that of η. The uncertainties on fit parameters are statistical only. Further details can be found in internal note BELLE2-NOTE-PH-2018-038.

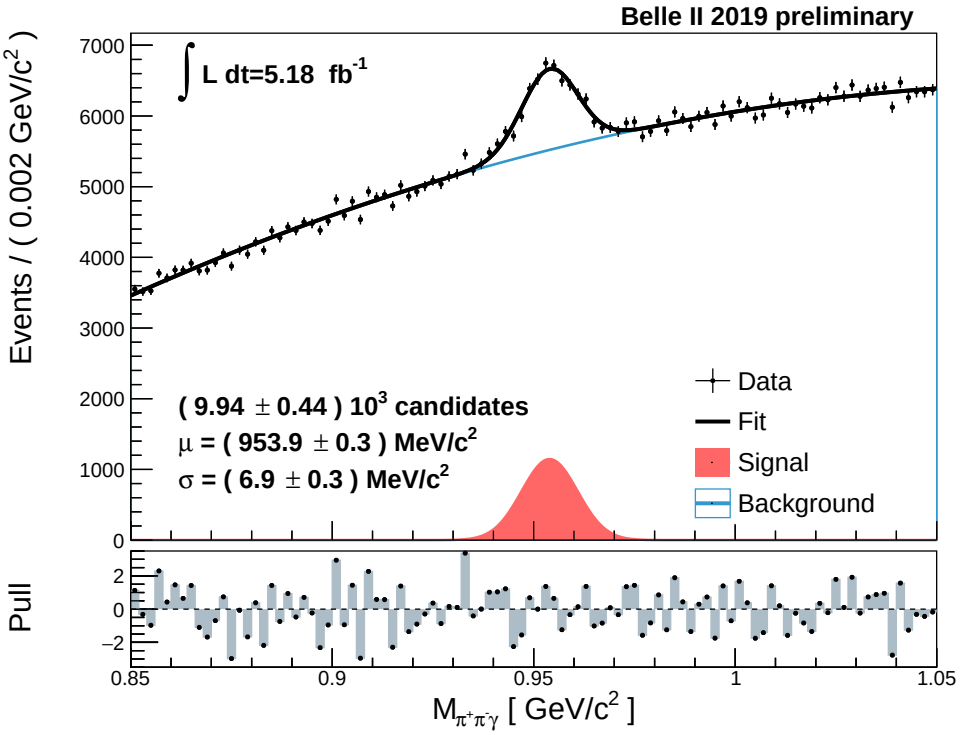

FIG. 5: Invariant mass distribution for $\rho(\to \pi^+\pi^-)\gamma$ candidates for Belle II 2019 data, phase 3, corresponding to 5.18 fb^{-1}. A clear peak corresponding to the decay $\eta' \to \rho\gamma$ with $\rho \to \pi^+\pi^-$ is visible. A fit with a Gaussian function for signal plus a second degree polynomial function for background is superimposed. The selection requires: $E_\gamma > 600\,\text{MeV}$, $p_\rho > 600\,\text{MeV}$, and $0.57 < M_{\pi^+\pi^-} < 0.95\,\text{GeV}$. Furthermore a π^0 veto is applied, to reject candidates where invariant mass of the signal γ with any other γ in the event form an invariant mass $120 < M_{\gamma\gamma} < 145\,\text{MeV}$. The decay chain is fitted using `TreeFitter` algorithm, with no constraint on the mass of the ρ. The uncertainties on fit parameters are statistical only. Further details can be found in internal note BELLE2-NOTE-PH-2018-038.