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Three-Body Unitary Coupled-Channel Analysis on eta(1405/1475)

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The recent BESIII data on $J/\psi \to \gamma(K_S K_S \pi^0)$, which is significantly more precise than earlier $\eta(1405/1475)$-related data, enables quantitative discussions on $\eta(1405/1475)$ at the previously unreachable level. We conduct a three-body unitary coupled-channel analysis of experimental Monte-Carlo outputs for radiative J/ψ decays via $\eta(1405/1475)$: $K_S K_S \pi^0$ Dalitz plot distributions from the BESIII, and branching ratios of $\gamma(\eta\pi^+\pi^-)$ and $\gamma(\gamma\pi^+\pi^-)$ final states relative to that of $\gamma(K\bar{K}\pi)$. Our model systematically considers (multi-)loop diagrams and an associated triangle singularity, which is critical in making excellent predictions on $\eta(1405/1475) \to \pi\pi\pi$ lineshapes and branching ratios. The $\eta(1405/1475)$ pole locations are revealed for the first time. Two poles for $\eta(1405)$ are found on different Riemann sheets of the $K^*\bar{K}$ channel, while one pole for $\eta(1475)$. The $\eta(1405/1475)$ states are described with two bare states dressed by continuum states. The lower bare state would be an excited η', while the higher one could be an excited $\eta^{(\prime)}$, hybrid, glueball, or their mixture. This work presents the first-ever pole determination based on a manifestly three-body unitary coupled-channel framework applied to experimental three-body final state distributions (Dalitz plots). This presentation is based on arXiv:2212.07904 to appear in Phys. Rev. D.

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