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Wave-Packet Effects: A Solution for Isospin Anomalies in Vector-Meson Decay

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There is a long-standing anomaly in the ratio of the decay width for $\psi(3770) \rightarrow D^0 \bar{D}^0$ to that for $\psi(3770) \rightarrow D^+ D^-$ at the level of 9.5σ . A similar anomaly exists for the ratio of $\phi(1020) \rightarrow K_L^0 K_S^0$ to $\phi(1020) \rightarrow K^+ K^-$ at 2.1σ . In this study, we reassess the anomaly through the lens of Gaussian wave-packet formalism. Our comprehensive calculations include the localisation of the overlap of the wave packets near the mass thresholds as well as the composite nature of the initial-state vector mesons. The results align within $\sim 1 \sigma$ confidence level with the Particle Data Group's central values for a physically reasonable value of the form-factor parameter, indicating a resolution to these anomalies. We also check the deviation of a wave-packet resonance from the Breit-Wigner shape and find that wide ranges of the wave-packet size are consistent with the experimental data.

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