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Implications of X17 boson to \(D\) meson, Charmonium, and \(\phi\) meson decays

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The recent ATOMKI experiments provided evidence pointing towards the existence of an X17 boson in the anomalous nuclear transitions of Beryllium-8, Helium-4, and Carbon-12. The favored ranges for the couplings between the X17 boson and the first-generation quarks, denoted as ϵ_u and ϵ_d, are determined through fittings to the above nuclear transitions.
In this work, we consider X17 boson contributions to the previously measured D meson decays which include $D_s^{*+} \to D_s^+ e^+ e^-$, $D_s^{*+} \to D_s^+ \gamma$, $D^{*0} \to D^0 e^+ e^-$, and $D^{*0} \to D^0 \gamma$, as well as the measured decays of $\psi(2S) \to \eta_c e^+ e^-$, $\psi(2S) \to \eta_c \gamma$, $\phi \to \eta e^+ e^-$, and $\phi \to \eta\gamma$. In addition to the dependence on ϵ_u, these decays also depend on X17 boson couplings to the second-generation quarks, denoted as ϵ_c and ϵ_s. Using the data of the above meson decays, we perform an independent fitting to the coupling parameters ϵ_u, ϵ_c, and ϵ_s while keeping the X17 boson mass at the best-fit value obtained by ATOMKI experiments. In this fitting, we take the scenario that X17 is a vector boson and treat the couplings ϵ_u and ϵ_c as independent from each other rather than assuming the generation universality $\epsilon_u = \epsilon_c$. It is found that the above fitting renders a huge magnitude for ϵ_u, which is in serious tension with ϵ_u determined from the ATOMKI measurements of Beryllium-8, Helium-4, and Carbon-12 nuclear transitions. Implications of our findings are discussed.

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