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$K \to \mu^+\mu^-$ as a clean probe of short distance physics

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The $K \to \mu^+\mu^-$ decay is often considered to be uninformative of fundamental theory parameters since the decay is polluted by long-distance hadronic effects. We demonstrate that, using very mild assumptions and utilizing time-dependent interference effects, $\mathcal{B}(K_S \to \mu^+\mu^-)_{=0}$ can be experimentally determined without the need to separate the $\ell = 0$ and $\ell = 1$ final states. This quantity is very clean theoretically and can be used to test the Standard Model. In particular, it can be used to extract the CKM matrix element combination $|V_{ts}V_{td}\sin(\beta+\beta_s)|$ $|A^2\lambda^5\bar{\eta}|$ with hadronic uncertainties below 1%. Additionally, simple New Physics models can significantly enhance $\mathcal{B}(K_S \to \mu^+\mu^-)_{=0}$, making this mode a very promising probe of physics beyond the standard model in the kaon sector. Based on arXiv:2104.06427.

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