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Higher-Order Electroweak Contributions to Indirect CP Violation

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The parameter ϵ_K is an important measure of the imbalance between matter and antimatter in the neutral kaon $(K^0 \text{ and } \bar{K}^0)$ system. In particular, ϵ_K provides a highly sensitive probe of new physics and plays a critical role in the global fit of the Cabibbo-Kobayashi-Maskawa matrix. As one of the first discovered sources of CP violation, it has been extensively measured in experiment to per-mil precision. The theoretical calculation of ϵ_K , however, has historically been plagued by large perturbative errors arising from charm-quark corrections. These errors were larger than the expected magnitude of higher-order electroweak corrections in perturbation theory, rendering these contributions irrelevant. Recently, it was discovered that a simple re-parameterization of the effective Hamiltonian drastically reduces perturbative errors, making these higher-order electroweak calculations to ϵ_K .

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