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Exploring Charm Quark Dynamics: Lifetimes and Mixing Phenomena

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In this talk, we explore the dynamics of charm quarks through two key observables: charmed hadron lifetimes and neutral D-meson mixing. For lifetimes, we review the application of the Heavy Quark Expansion (HQE) to charm hadrons, examining recent theoretical efforts to quantify the convergence of the expansion at the charm scale, including the impact of higher-dimensional operators and subleading corrections and discuss limitations due to the relatively low charm mass scale. We then turn to the phenomenon of D-meson mixing, where long-distance contributions dominate and challenge the theory.

We explore the long-distance contributions arising from nonlocal QCD condensates. Our results demonstrate an improvement in the predicted values of the D0–D0 mixing parameter by more then an order of magnitude, providing insights into the role of nonperturbative QCD dynamics in the charm sector.

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