

S -wave contribution to rare $D^0 \rightarrow \pi^+ \pi^- \ell^+ \ell^-$ decays in the Standard Model and sensitivity to New Physics

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Physics of the up-type flavour offers unique possibilities of testing the Standard Model (SM) compared to the down-type flavour sector. Here, I discuss SM and New Physics (NP) contributions to the rare charm-meson decay $D^0 \rightarrow \pi^+ \pi^- \ell^+ \ell^-$. In particular, I discuss the effect of including the lightest scalar isoscalar resonance in the SM picture, namely, the $f_0(500)$, which manifests in a big portion of the allowed phase space. Other than showing in the total branching ratio at an observable level of about 20%, the $f_0(500)$ resonance manifests as interference terms with the vector resonances, such as at high invariant mass of the leptonic pair in distinct angular observables. Recent data from LHCb optimize the sensitivity to P -wave contributions, that I analyse in view of the inclusion of vector resonances. I propose the measurement of alternative observables which are sensitive to the S -wave and are straightforward to implement experimentally. This leads to a new set of null observables, that vanish in the SM due to its gauge and flavour structures. Finally, I study observables that depend on the SM interference with generic NP contributions from semi-leptonic four-fermion operators in the presence of the S -wave.

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