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Structure-dependent form factors in radiative leptonic decays of the D_s meson with Domain Wall fermions

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In the region of hard photon energies, radiative leptonic decays represent important probes of the internal structure of hadrons. Moreover, radiative decays can provide independent determinations of Cabibbo-Kobayashi-Maskawa matrix elements with respect to purely leptonic or semileptonic channels. Prospects for a precise determination of leptonic decay rates with emission of a hard photon are particularly interesting, especially for the decays of heavy mesons for which currently only model-dependent predictions, based on QCD factorization and sum rules, are available to compare with existing experimental data.
We present a non-perturbative lattice calculation of the structure-dependent form factors which contribute to the amplitudes for radiative leptonic decays of the D_s meson, $D_s^+ \to \ell^+ \nu_\ell \gamma$, using a domain-wall action for all quark flavors. We show how to best control two sources of systematic error inherent in the calculation, specifically the unwanted excited states created by the meson interpolating field, and unwanted exponentials in the sum over intermediate states.
With moderate statistics, thanks to the use of an infinite-volume approximation method and improved estimators, we are able to provide rather precise, first-principles results for the structure-dependent vector and axial form factors in the full kinematical (photon-energy) range. Our continuum-extrapolated lattice determinations may then be employed to compute the differential decay rate and the corresponding branching fraction and make comparisons with existing experimental data.

Topical area

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