

Probing Scalar-Mediator Quark Couplings via CLFV Lepton-Nucleon Scattering

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We investigate charged lepton flavor violating (CLFV) deep-inelastic scattering, focusing on the gluon-initiated subprocess $\ell_i g \rightarrow \ell_j g$ via the gluon effective operator $\phi G_{\mu\nu}^a G_a^{\mu\nu}$, and demonstrate how to probe the nature of the CLFV mediator ϕ , specifically its mass and interaction with quarks.

We consider two benchmark scenarios for the mediator-quark coupling: (i) h -like scenario, in which the mediator couples to heavy quarks in proportion to their masses, and (ii) b -only scenario, where the coupling is restricted to bottom quark only. We demonstrate that these scenarios can be discriminated by examining the dependence of the differential cross section on the momentum transfer. Furthermore, we show that the peak position of the differential cross section exhibits a pronounced sensitivity to both the mass of the mediator and the coupling strengths with quarks.

Presenter: YAMANAKA, Masato

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