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Lam-Tung relation breaking in Z boson production as a probe of SMEFT effects

The violation of Lam-Tung relation in the high-$p_T^{\ell\ell}$ region of the Drell-Yan process at the LHC presents a long-standing discrepancy with the standard model prediction at $\mathcal{O}(\alpha_s^3)$ accuracy. In this talk, we employed a model-independent analysis to investigate this anomaly within the framework of the Standard Model Effective Field Theory (SMEFT). Our findings revealed that the leading contributions from SMEFT to this violation appear at the $1/\Lambda^4$ order with $\mathcal{O}(\alpha_s)$ accuracy in QCD interaction. Notably, we demonstrated that the quadratic effect of dimension-6 dipole operators, associated with the Z boson, dominates the breaking effects induced by various dimension-6 and dimension-8 operators. This provides a compelling explanation for the observed discrepancy with the Standard Model predictions at the LHC without assuming other new physics operators, and thereby offers the potential to extract valuable information about the underlying physics at the TeV scale.

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