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Search for tZ' associated production induced by tcZ' couplings at the LHC

The P_5' and R_K anomalies, recently observed by the LHCb collaboration in $B \to K^{(*)}$ transitions, may indicate the existence of a new Z' boson, which may arise from gauged $L_\mu - L_\tau$ symmetry. Flavor-changing neutral current Z' couplings, such as tcZ', can be induced by the presence of extra vector-like quarks. In this paper we study the LHC signatures of the induced right-handed tcZ' coupling that is inspired by, but not directly linked to, the $B \to K^{(*)}$ anomalies. The specific processes studied are $cg \to tZ'$ and its conjugate process each followed by $Z' \to \mu^+\mu^-$. By constructing an effective theory for the tcZ' coupling, we first explore model-independently the discovery potential of such a Z' at the 14 TeV LHC with 300 and 3000 fb^{-1} integrated luminosities. We then reinterpret the model-independent results within the gauged $L_\mu - L_\tau$ model. In connection with tcZ', the model also implies the existence of a flavor-conserving ccZ' coupling, which can drive the $c\bar{c} \to Z' \to \mu^+\mu^-$ process. Our study shows that existing LHC results for dimuon resonance searches already constrain the ccZ' coupling, and that the Z' can be discovered in either or both of the $cg \to tZ'$ and $c\bar{c} \to Z'$ processes. We further discuss the sensitivity to the left-handed tcZ' coupling and find that the coupling values favored by the $B \to K^{(*)}$ anomalies lie slightly below the LHC discovery reach even with 3000 fb^{-1}.

Experimental Collaboration

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