The Search for tb Resonances with the CMS Experiment

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Introduction

Many theories of physics beyond the Standard Model predict the existence of a new charged gauge boson [1-3], which is often referred to as a W'. A hypothetical heavy W' boson can decay in different ways, including a top and bottom quark pair. The CMS experiment at CERN has carried out a search for a W' boson in this channel using the 2011 [4] and 2012 [5] datasets. No significant excess over the Standard Model expectation is observed, and limits are set on the particle’s mass, cross section, as well as its left- and right-handed coupling strengths.

Theory

The lowest order effective Lagrangian describing a W' boson's interaction with fermions can be written as [6]:

\[ \mathcal{L} = \frac{\sqrt{2}}{2} g_{w} f_{ij}^{R} \left[ d_{R}^{i} f_{j} (1 + \gamma^{5}) + d_{L}^{i} f_{j} (1 - \gamma^{5}) \right] W^{\mu} f_{j} + \text{h.c.} \]

The W' may couple to right-handed fermions, left-handed fermions, or both. If the left-handed coupling is non-zero, there will be interference with the Standard Model s-channel single top production. The effect of the interference is significant, and is accounted for in the search.

Event Selection

The search is performed by selecting events with an electron or muon, missing energy, and at least two jets, one of which is tagged as a b-jet. The main backgrounds are Standard Model W+jets and top pair production which are simulated using monte carlo generators. The simulation is validated in control regions in data. Additional kinematic cuts are applied to enhance the signal.

References