SEARCH FOR HEAVY RESONANCES DECAYING TO TWO HIGGS BOSONS IN FINAL STATES WITH 4 b QUARKS

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OVERVIEW

Several beyond the standard model studies postulate the existence of warped extra dimensions considering a scalar radion with mass in the TeV scale. In this analysis we search for a spin-0 radion $X$ resonance analyzing a decay chain of $X \rightarrow HH \rightarrow b\bar{b}b\bar{b}$ with boosted Higgs bosons.

BOOSTED TOPOLOGY

The present study considers predictions of warped extra dimensions with radion resonance of masses between 1 and 3 TeV. In a boosted regime, the Higgs bosons ($H$) in the topology $X \rightarrow HH \rightarrow b\bar{b}b\bar{b}$ have large momentum. The decay product of each $H$ boson is a pair of $b$ quarks, whose hadronization turns out to be jets very close to each other, being identified as a single large jet. Then the final state appears with 2, 3 or 4 jets, depending on how merged is each b-jet pair after the reconstruction of events.

Multijet and $t\bar{t}$ are the dominant backgrounds, but are significantly removed after selecting events based on the flavor of jets (from b-tagging technique), its mass and substructure. The spectrum of a single jet $p_T$ for signal of radion appears in the failing tail of observed and background events.

BACKGROUND MODELING

The background is estimated fitting the dijet mass of observed events using a modified exponential function with normalization $N_B$ considering $100 < m_j < 135$ GeV and slope $a$ based on $60 < m_j < 100$ GeV:

$$dN_{\text{Background}} = N_B \cdot a \cdot e^{-a(m_j-1000 \text{GeV})}$$

Events are categorized according to the “jet-purity”:

- HPHP: two “high-purity” jets
- HLP and LPHP: one “high-purity” jet

RESULTS

No excess of data is found. Exclusion limits at 95% confidence level on the production cross section are computed for $m_X$ between 1.15 and 3.0 TeV, extending significantly beyond 1.5 TeV the reach of previous searches. A radion with scale parameter $\Lambda_X = 1$ TeV decaying into $HH$ is excluded for $1.15 < m_X < 1.55$ TeV for the first time in direct searches.

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REFERENCES