

Investigation of a Diphoton Excess Near 152 GeV in Association with Dijets Using Run 3 Data at the LHC

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The multi-lepton anomalies observed at the LHC have motivated models with new scalar resonances, predicting a scalar at 150 ± 5 GeV. A narrow excess near $m_S = 152 \pm 1$ GeV was observed in Run 2 data in the $\gamma\gamma$, $Z\gamma$, and W^+W^- channels with a significance surpassing 5σ . In this work, we investigate a new excess in the ATLAS Run 3 data using diphoton production in association with two jets, focusing on event topologies similar to vector-boson fusion (VBF). The excess is studied using two simplified models, a singlet extension of the two-Higgs-doublet model (2HDM+S) and the Higgs Triplet Model (HTM). Following the recent ATLAS publication, a three-class neural network is used to separate VBF, gluon-gluon fusion, and non-resonant $\gamma\gamma + jj$ production. The published ATLAS analysis is recast by fitting the $m_{\gamma\gamma}$ spectrum near 152 GeV, giving a combined significance of 2.5σ using a part of the Run 3 dataset. The corresponding fiducial cross sections for HTM and 2HDM+S are 9.44 ± 4.74 fb and 7.41 ± 3.54 fb, respectively. The observed Run 3 excess is consistent and serves as further confirmation of the scalar candidate identified in Run 2, motivating further investigation with the full Run 3 dataset.

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