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Search for a susy heavy neutral Higgs boson at the LHC in the BLSSM

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The Higgs sector of the supersymmetric $B - L$ extension of the Standard Model (BLSSM) consists of 4 neutral CP -even bosons, 2 neutral CP -odd bosons and one charged Higgs boson. In this model, We show that the lightest CP -even Higgs boson, which is like the standard model Higgs boson, and the next lightest Higgs boson are generated from the neutral components of the two electroweak Higgs doublets. We also show that the mass of the next lightest Higgs boson can be of an order of a few hundred GeVs. We analyze the detection of the next lightest Higgs boson, h' , at the Large Hadron Collider (LHC) for a center-of-mass energy $\sqrt{s} = 14$ TeV and integrated luminosity $L_{\text{int}} = 300 \text{ fb}^{-1}$ via di-Higgs channel: $h' \rightarrow hh \rightarrow b\bar{b} + 2\gamma$ and also in both, the ZZ channel: $h' \rightarrow ZZ \rightarrow 4\ell$ and WW -channel with missing energy (MET) in the final state: $h' \rightarrow WW \rightarrow 2\ell + \text{MET}$ ($\ell = e, \mu$). We consider three benchmark points for this analysis in the quite low, moderate and high scale of mass ranges with $m_{h'} = 250, 400$ GeV, and $m_{h'} = 600$ GeV. We show that promising signals with good statistical significances can be obtained in di-Higgs channel, with diphoton and $2b$ -jets final states and the final leptonic decay ZZ - and WW -channels.

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