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Exotic $h \rightarrow Za$ Higgs decays into τ leptons

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Exotic Higgs decays are among the most promising areas to be explored at the High Luminosity Large Hadron Collider, given the unprecedentedly large amount of the Standard Model-like Higgs bosons that will be produced. In this context, we introduce a new search channel where a Higgs boson with a mass of 125 GeV decays to a Z boson and a light pseudoscalar (a), in the final state with two muons and two τ leptons ($h \rightarrow Za \rightarrow \mu\mu\tau\tau$). In the preliminary analysis, performed at a center-of-mass energy of $\sqrt{s} = 14$ TeV, masses of the pseudoscalar boson between 14 and 30 GeV are probed, focusing on the kinematic region where the $h \rightarrow Za$ decay is on-shell. We analyze several collider variables to propose a suitable signal region and consider the different decay channels for the di-tau system, as sensitivity is strongly influenced by the $\tau\tau$ reconstruction efficiency. Model-independent limits are set at the 95% confidence level as a function of m_a . Upper limits are also established within the Axion-Like Particle (ALP) framework, based on a specific model motivated by the anomalous $g - 2$ measurement.

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