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Searching for massless Dark Photons at LHC via Higgs boson production

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Dark photons¯mediating long-range forces in a dark sector are predicted by various new physics scenarios, and are being intensively searched for in experiments. Thanks to the non-decoupling properties of the Higgs boson, BR values of Higgs decaying into a photon plus darkphoton $H \to \gamma\bar{\gamma}$ up to a few percent are possible for a massless dark photon, even for heavy dark-sector scenarios. The corresponding signature consists (for a Higgs boson at rest) of a striking monochromatic photon with energy $E_\gamma = m_H/2$, and similar amount of missing energy. We perform a model independent analysis at the LHC of both the gluon-fusion and VBF Higgs production mechanisms at 14 TeV, including parton-shower effects, and updating our previous parton-level analysis at 8 TeV in the gluon-fusion channel by a more realistic background modeling. We find that a 5σ sensitivity can be reached in the gluon-fusion channel for $BR(H \to \gamma\bar{\gamma})$ 0.1% with an integrated luminosity of L300fb^{-1}. The corresponding VBF reach is instead restricted to 1%. Such decay rates can be naturally obtained in dark-photon scenarios arising from unbroken $U(1)_F$ models explaining the origin and hierarchy of the Yukawa couplings, strongly motivating the search for this exotic Higgs decay at the LHC.

Experimental Collaboration

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