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Higgs to charm quarks in vector boson fusion plus a photon

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Experimentally probing the charm-Yukawa coupling in the LHC experiments is important, but very challenging due to an enormous QCD background. We study a new channel that can be used to search for the Higgs decay $H \rightarrow c\bar{c}$, using the vector boson fusion (VBF) mechanism with an associated photon. In addition to suppressing the QCD background, the photon gives an effective trigger handle. We discuss the trigger implications of this final state that can be utilized in ATLAS and CMS. We propose a novel search strategy for $H \rightarrow c\bar{c}$ in association with VBF jets and a photon, where we find a projected sensitivity of about 5 times the SM charm-Yukawa coupling at 95% CL_s at High Luminosity LHC (HL-LHC). Our result is comparable and complementary to existing projections at the HL-LHC. We also discuss the implications of increasing the center of mass collision energy to 30 TeV and 100 TeV.

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