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Sensitivity study on $H \to b\bar{b}$, $H \to WW^*$ and $HH \to b\bar{b}b\bar{b}$ cross sections and trilinear Higgs self-coupling with the MUSIC detector in $\sqrt{s} = 10$ TeV muon collisions

This study investigates the physics reach in the Higgs sector of muon-antimuon collisions at a center-of-mass energy of 10 TeV. The statistical sensitivity of the production cross sections for $H \to b\bar{b}$, $H \to WW^*$, and $HH \to b\bar{b}b\bar{b}$, as well as the measurement of the Higgs boson trilinear self-coupling, is evaluated using a detailed detector simulation that includes the dominant contributions of the machine-induced background. The studies utilize MUSIC, a detector concept specifically designed and optimized for the muon collision environment at 10 TeV, and assume a dataset of 10 ab^{-1} collected over a five-years period by a single experiment. The results highlight the exceptional potential of a high-energy muon collider for exploring the Higgs sector, in particular for determining the Higgs potential. A multi-TeV muon collider offers a level of precision that cannot be achieved by any other proposed future collider within a comparable time frame.

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