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Higgs Boson Production at μ+ μ+ Colliders

Motivated by recent advancements in antimuon cooling, we study Higgs boson production at $\mu^+\mu^+$ colliders at high energy. Since both initial-state particles are positively charged, there is no W boson fusion at the leading order, as it requires a W^+W^- pair. However, we find that the cross section of the higher-order, γ- and Z-mediated W boson fusion process is large at high center-of-mass energies $\sqrt{s}$, growing as $(\log s)^3$. This is in contrast to the $(\log s)$ behavior of the leading-order W boson fusion. Thus, even though it is a higher-order process, the rate of Higgs boson production for 10 TeV energies at $\mu^+\mu^+$ colliders with polarized beams can be as high as about half of the one at $\mu^+\mu^-$ colliders, assuming the same integrated luminosity. To calculate the cross section of this process accurately, we carefully treat the collinear emission of the photon in the intermediate state. The thereby obtained large cross section furthermore shows the significance of Higgs boson production with an extra W boson in the final state also at $\mu^+\mu^-$ and e^+e^- colliders.

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