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Search for $H \rightarrow c\bar{c}b\bar{a}$ at a Multi-TeV Muon Collider

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A Multi-TeV ($\sqrt{s}=1.5-10\text{TeV}$) muon collider providing $O(1/\text{ab})$ integrated luminosity will be a great opportunity to probe the most intimate nature of the Standard Model (SM) and the Electroweak Symmetry Breaking mechanism, allowing the precise measurement of the Higgs couplings to several SM particles. The study of the Higgs boson couplings to the second generations of fermions is of particular interest due to sensitivity to a whole class of new physics models. On the other end, this measurement is extremely challenging, because of the small branching ratio. We explored, for the first time, the search for $H \rightarrow c\bar{c}b\bar{a}$ at a multi-TeV muon collider. The $\mu^+\mu^- \rightarrow H\nu\nu^- \rightarrow c\bar{c}b\bar{a}$ signal process has been fully simulated and reconstructed with a preliminary detector design, along with the main backgrounds. A c quark-tagging algorithm has been developed, combining several observables in a single discriminator using Machine Learning techniques, with the goal to improve the rejection of jets coming from b -quark and u - d - s - g hadronization. A first estimate of the precision on the Higgs coupling with c -quark reachable with a muon collider machine will be presented.

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