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Strange Quark as a probe for new physics in the Higgs sector

Content

One of the most interesting yet-to-be answered questions in Particle Physics is the nature of the Higgs Yukawa couplings and their universality. Key information in our understanding of this question arises from studying the coupling of the Higgs boson to second generation quarks. Some puzzles in the flavor sector and potential additional sources of CP violation could also have their origins in an extended Higgs sector.
Rare Higgs decay modes to charm or strange quarks are very challenging or nearly impossible to detect with the current experiments at the Large Hadron Collider, where the large multi-jet backgrounds inhibits the study of light quark couplings with inclusive H->qqbar decays. Future e+e- machines are thus the perfect avenue to pursue this research.
Studies were initiated in the context of Snowmass2021 (https://arxiv.org/abs/2203.07535) with particular emphasis on the Higgs coupling to strange quarks and the related flavour tagging challenges.

This gave light to the development of a novel algorithm for tagging jets originating from the hadronisation of strange quarks (strange-tagging) and the first application of such a strange-tagger to a direct Higgs to strange (h->ssbar) analysis.

The analysis is performed with the future International Large Detector (ILD) at the International Linear Collider (ILC), but it is easily applicable to other Higgs factories. The $P(e^-, e^+) = (-80\%, +30\%)$ polarisation scenario was used for this preliminary result, corresponding to 900 fb^{-1} of the initial proposed 2000 fb^{-1} of data which will be collected by ILD during its first 10~years of data taking at $\sqrt{s}$ = 250 GeV. The study includes as well a preliminary investigation of a Ring Imaging Cerenkov system (RICH) capable of maximising strange-tagging performance in future Higgs factory detectors.

Your main area of your contribution

Future e+e- collider experiment

Primary authors: BASSO, Matthew (University of Toronto (CA)); CAIRO, Valentina (CERN)

Presenters: BASSO, Matthew (University of Toronto (CA)); CAIRO, Valentina (CERN)

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Submitted by **CAIRO, Valentina** on **Friday, 18 March 2022**