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Development of the time-of-flight particle identification for future Higgs factories

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With the emergence of advanced Si sensor technologies such as LGADs, it is now possible to achieve exceptional time measurement precision below 50 ps. As a result, the implementation of time-of-flight (TOF) particle identification for charged hadrons at future e^+e^- Higgs factory detectors has gained an increasing attention. Other particle identification techniques require a gaseous tracker with excellent dE/dx (or dN/dx) resolution, or a RICH, which adds additional material in front of the calorimeter.
TOF measurements can be implemented either in the outer layers of the tracker or in the electromagnetic calorimeter, and are thus particularly interesting as a PID method for detector concepts based on all-silicon trackers and optimised for particle-flow reconstruction.
In this presentation, we will explore potential integration scenarios of TOF measurement in a future Higgs factory detector, using the International Large Detector (ILD) as an example. We will focus on the challenges associated with crucial components of TOF particle identification, namely track length reconstruction and TOF measurements. The subsequent discussion will highlight the vital impact of precise track length reconstruction and various TOF measurement techniques, including recently developed machine learning approaches. We will evaluate the performance in terms of kaon-pion and kaon-proton separation as a function of momentum, and discuss potential physics applications.

Collaboration / Activity

ILD

Primary author: DUDAR, Bohdan (FTX (FTX Fachgruppe SLB))

Co-authors: GAEDE, Frank (FTX (FTX Fachgruppe SFT)); LIST, Jenny (FTX (FTX-SLB)); HELMS, Konrad (FTX (Technol. zukuenft. Teilchenph. Experim.)); EINHAUS, Ulrich (FTX (Fachgruppe SLB))

Presenter: DUDAR, Bohdan (FTX (FTX Fachgruppe SLB))

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