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Muon detector for a Muon Collider

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A muon collider has a great potential for high energy physics. It combines the high precision of electron-positron machines, with a low level of beamstrahlung and synchrotron radiation, and the high centre-of-mass energy and luminosity of hadron colliders. The main challenges, that impact both the machine and detector design, arise from the short muon lifetime and the harsh Beam Induced Background (BIB). This is due to electrons and positrons from muons decay and to photons radiated by them that interact with the machine generating secondary and tertiary particles that eventually reach the detector.
A full simulation is crucial to understand the feasibility of the experiment implementation. Focusing in particular on the muon system, the geometry inherited from CLIC foresees layers of track sensitive chambers interleaved with iron yoke plates. Currently, the CLIC adopted technology is glass Resistive Plate Chambers (GRPC) both for the barrel and endcap regions. However, a preliminary simulation of sensitivity and hit rate in a muon collider reveals that GRPC are already at the limit of their rate capability, and, therefore, alternative MicroPattern Gaseous Detector (MPGD) solutions are under investigation to try to match the required performance.
In parallel, studies of muon reconstruction are ongoing. The low BIB occupancy in the muon system with respect to the other detectors, tracker and electromagnetic calorimeter in particular, suggests using standalone muon objects to seed the global muon track reconstruction.
Results of the muon reconstruction efficiency, BIB sensitivity and background mitigation will be presented for single muon and multimuon final state processes at a centre-of-mass energy of 1.5 TeV. Besides, new technologies based on a Micromegas detector coupled to a Cherenkov radiator and equipped with a photocathode, such as PICOSEC, will also be discussed.

Collaboration

Muon Collider Physics and Detector working group

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