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Muon Collider Progress: Accelerators

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A muon collider would be a powerful tool for exploring the energy-frontier with leptons, and would complement the studies now under way at the LHC. Such a device would offer several important benefits. Muons, like electrons, are point particles so the full center-of-mass energy is available for particle production. Moreover, on account of their higher mass, muons give rise to very little synchrotron radiation and produce very little beamstrahlung. The first feature permits the use of a circular collider that can make efficient use of the expensive RF system and whose footprint is compatible with an existing laboratory site. The second feature leads to a relatively narrow energy spread at the collision point. Designing an accelerator complex for a muon collider is a challenging task. Firstly, the muons are produced as a tertiary beam, so a high-power proton beam and a target that can withstand it are needed to provide the required luminosity of ˜1 x 10ˆ34 cmˆ−2sˆ−1. Secondly, the beam is initially produced with a large 6D phase space, which necessitates a scheme for reducing the muon beam emittance ("cooling"). Finally, the muon has a short lifetime so all beam manipulations must be done very rapidly. The Muon Accelerator Program, led by Fermilab and including a number of U.S. national laboratories and universities, has undertaken design and R&D activities aimed toward the eventual construction of a muon collider. Design features of such a facility and the supporting R&D program will be described.

Summary

Advantages and challenges of a muon collider are presented, along with a description of the ingredients of such a facility. We also briefly describe the R&D program under way at various U.S. national laboratories and universities in support of a muon collider design.

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