Investigation of the magnetic properties of muons and their application

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Abstract

By measuring the precession frequency of the magnetic moment of a muon, and comparing it to the theoretical value, Muon g-2 experiment at Fermilab aims to confirm the hint of discrepancy between the Standard Model prediction and the experimental measurement shown at the Brookhaven National Laboratory (BNL) around 20 years ago. If a discrepancy in the anomalous magnetic dipole moment of a muon was to be uncovered, it would not only suggest the existence of unknown particles or uncharacterized forces but also imply the possible existence of New Physics (NP). Even though Muon g-2 is using an artifically produced muon beam which injects longitudinally polarised muons into the storage ring, adapted Cherenkhov detectors could also be used to study magnetic properties of muons. For that purpose, our research will design a Cherenkov photodiode detector, which will be located entirely among Helmholtz coils on three axes. Through comparison of the energies, direction, precession and decay of horizontal and vertical muons within the detector, with and without the Helmholtz coil construction, we will aim to quantify the magnetic field's influence on muons. Not only should this be an interesting experiment towards delineating muon's magnetic anomaly, but it should also prove valuable in quantifying the possible containment potential of magnetic fields on muons and their further use in medicine in the form of radiation therapy.

Keywords— muon, magnetism, Cherenkhov detector, Helmholtz coils, radiation therapy