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Magnetic Field Analysis in the Muon g-2 Experiment

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In the Muon g-2 Experiment at Fermilab, the muon magnetic moment anomaly is measured by observing muon decays inside a magnetic storage ring, in order to test a potential discrepancy between past experiments and the Standard Model prediction. Precise knowledge of the magnetic field experienced by muons in the ring is necessary in order to reach the experiment's unprecedented uncertainty goal of 140 ppb. Sets of nuclear magnetic resonance probes, recording the magnetic field through its impact on proton precession frequencies in their measurement samples, mapped and tracked the storage ring field during Muon g-2 operations. A series of calibration measurements were performed to correct for perturbations to the field imposed by the presence of the probes, relating their frequencies to those of a hypothetical shielded proton. The shielded-proton precession frequencies are averaged over the muon beam distribution in space and time, and corrected for additional transient fields measured by higher-bandwidth alternate probes, to provide the final magnetic-field input for the muon magnetic moment anomaly calculation. This presentation will provide an overview of the techniques used in Muon g-2's magnetic field analysis, and how these techniques have evolved and improved over the course of the experiment.

Working Group

WG 4: Muon Physics

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