Contribution ID: **10** Type: **Oral Presentation**

Magnetic Field Status of the Muon g-2 Experiment

Tuesday, 19 June 2018 10:15 (15 minutes)

The muon g-2 experiment at Fermilab (E989) aims to measure the anomalous magnetic moment of the muon a_μ to a precision of 140 parts per billion (ppb). This new measurement will shed light on the 3.5 sigma deviation between Standard Model calculations and the previous measurement (E821) at Brookhaven National Laboratory, and will test Standard Model extensions. The muon g-2 experiment measures the difference between the cyclotron and spin precession frequencies of muons in a highly uniform magnetic field, where the magnetic field over a muon's trajectory must be known to 70 ppb.
The magnetic field in the muon storage region is mapped by a trolley carrying a circular array of 17 nuclear magnetic resonance (NMR) probes, but because the trolley can not be present while muons are being stored, the magnetic field drift is tracked using a suite of 378 NMR probes embedded in the top and bottom of the vacuum chambers.
The trolley NMR probes use a petroleum jelly sample and, in order to measure the field absolutely, must be calibrated against a water filled probe with very well understood characteristics. The calibration process is underway to calibrate all 17 trolley probes to a 30 ppb precision, with the inner ring of trolley probes now calibrated.
The other important step in achieving the desired precision is making the magnetic field in the storage region as homogeneous as possible. The last passive step in achieving the required field homogeneity was the adjustment and installation of over 10,000 iron shims in and around the muon storage region. Higher order multipole moments of the magnetic field distribution across the storage region are controlled using 100 concentric coils located above and below the vacuum chambers. The current distribution in these so called surface coils is adjusted to reduce magnetic field variations across the storage region to less than 2 parts per million.
An overview of the magnetic field hardware, calibration, and shimming status will be presented.

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Session Classification: Muon Physics