Contribution ID: **4** Type: **not specified**

The magnetic field measurement for the Muon g-2 experiment with precision NMR

Wednesday, 19 February 2020 09:45 (40 minutes)

The Muon g-2 experiment E989 at Fermilab will measure the anomalous magnetic moment of the muon, a_μ, with about four times better precision than former experiments. The aim is to resolve the discrepancy of more than 3 standard deviations between the previous measurements dominated by the Brookhaven E821 result and the Standard Model calculation of a_μ.
The experimental concept uses a polarized muon beam at the magic momentum which is stored in the extremely homogeneous magnetic field of the storage ring. Parity violation in the weak decay is used as a spin analyzer; the detected rate of the decay electrons oscillates with the frequency, ω_a, in the magnetic field expressed in terms of the equivalent free proton Larmor frequency, ω_p. Since a_μ is derived from the ratio of ω_a and ω_p, both are equally important and systematic uncertainties must be kept below 70 ppb for each observable.
A magnetic field measurement system was developed to measure the magnetic field experienced by the muons. A set of 378 new Nuclear Magnetic Resonance (NMR) probes constantly monitor the field at all times around the storage ring. An upgraded in-vacuum field mapping system scans the muon storage region over the full azimuth of the magnet. A special water-based NMR probe which has a well-measured geometry and low magnetic perturbation was designed to calibrate the probes of the field mapping system. All systems were successfully commissioned, and were in full operation for the first physics data taking runs in 2018 and 2019. This presentation will provide details of the challenging measurement and analysis of the averaged magnetic field and discuss aspects that will be relevant for the future muon EDM measurement. The special challenges of the radial field measurement will be discussed in a separate talk at this workshop.

Primary author: Dr WINTER, Peter (Argonne National Laboratory)

Presenter: Dr WINTER, Peter (Argonne National Laboratory)

Session Classification: Storage ring dynamics