

The Precision Magnetic Field for the Muon $g - 2$ Experiment at Fermilab

D. Flay, University of Massachusetts, Amherst
on Behalf of the Muon $g - 2$ Collaboration

Abstract

Precision measurements of the anomalous magnetic moment of the muon, $a_\mu \equiv (g_\mu - 2)/2$, provide an excellent test of the Standard Model with sensitivity to physics beyond the Standard Model. The most recent measurement of a_μ at Brookhaven National Laboratory (E821) differs from the Standard Model prediction by roughly 3.5 standard deviations. A new experiment at Fermilab, E989, has been constructed with the aim of improving the precision on a_μ by a factor of four to 140 parts per billion, and is currently in its commissioning phase. E989 uses a magnetic storage ring into which polarized muons are injected and two frequencies are measured: the rate at which the muon polarization rotates relative to its momentum, ω_a , and the magnetic field normalized to the free-proton Larmor-precession frequency, ω_p .

In this talk, a brief overview of the previous a_μ measurements and the E989 experiment will be presented. The main focus of the discussion will be centered on the magnetic field hardware, comprised of 400 NMR probes deployed around the 45-ft diameter magnet. The calibration of the magnetic field to the free-proton Larmor-precession frequency, accomplished by a water-based NMR probe, will also be presented.