

# Measurement of the muon anomalous magnetic moment at Fermilab

Thursday, 20 May 2021 14:45 (30 minutes)

Magnetic moments of light charged leptons ( $\ell$ ), the electron and the muon, have figured prominently in the early development and evolution of the Standard Model (SM) of elementary particles and interactions. The magnetic anomaly,  $a_\ell \equiv (g_\ell - 2)/2$ , continues to provide unique sensitivity to contributions from virtual heavy particle loops. This coupling typically scales as the lepton mass squared, giving the muon an advantage of a factor of  $(m_\mu/m_e)^2 \simeq 43,000$  over the electron, thus more than compensating for the greater precision achieved in measurements of  $a_e$ . Consequently,  $a_\mu$  provides one of the most sensitive experimental probes into the realm of particles that may exist in nature, but are not included, nor described in the SM.

For almost 20 years a tantalizing discrepancy of  $\sim 3-4\sigma$  has persisted between the measurements of  $a_\mu$ , dominated in precision by BNL experiment E821 [1], and the SM calculations, most recently updated by the Muon  $g-2$  Theory Initiative in [2]. This discrepancy has been just large enough to leave room for new, non-SM phenomena. In response, the Fermilab Muon  $g-2$  collaboration has set out to improve the precision of  $a_\mu$  by a factor of four, down to 0.14 ppm. The Fermilab experiment uses the same basic approach as the BNL E821, using the same superconducting muon storage ring, but with significant improvements. This talk will discuss the experimental technique, and present the first results from Muon  $g-2$  Run-1 at Fermilab, comprising about 6% of the planned full data set for the experiment [3].

1. G.W. Bennett, et al. (BNL Muon  $g-2$  Collaboration), *Final report of the muon E821 anomalous magnetic moment measurement at BNL*, Phys. Rev. D **73** (2006) 072003.
2. T. Aoyama, et al., *The anomalous magnetic moment of the muon in the standard model*, Phys. Rep. **887** (2020) 1.
3. B. Abi et al. (Muon  $g-2$  Collaboration), *Measurement of the positive muon anomalous magnetic moment to 0.46 ppm*, Phys. Rev. Lett. **126** (2021) 141801.

## Collaboration

Muon  $g-2$  Collaboration

**Primary author:** POCANIC, Dinko (University of Virginia)

**Presenter:** POCANIC, Dinko (University of Virginia)

**Session Classification:** Plenary Session