Department of Physics
Particle Physics
The Denys Wilkinson Building, Keble Road, Oxford OX1 3RH

UNIVERSITY OF OXFORD

Experimental Particle Physics Seminar

at 2.15 pm
Dennis Sciama Lecture Theatre

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Muon (g-2) at Fermilab: Run 1 Status

Abstract
Measurements of the magnetic moments of the electron and muon were intertwined with the development of the "modern physics" of the 20th century. For the muon, this trend continues, perhaps pointing to New Physics beyond the Standard Model (BSM). The magnetic moment is along the spin,

$$\vec{\mu} = g\frac{Qe}{2m}\vec{s}.$$

For leptons, the factor g is greater than the Dirac value of 2 because of radiative corrections, so g =2(1+ *a*), or equivalently *a* = (g-2)/2, where *a* is the magnetic anomaly. While the value of the muon anomaly is dominated by the lowest-order Schwinger term /2≃ 0.00116, it is necessary to include higher order contributions from QED, as well as contributions from the strong interaction and electroweak gauge bosons, to compare with the experimental value. The SM value now has an uncertainty of 0.3 ppm, and the experimental value has an uncertainty of ± 0.54 parts per million (ppm). The experimental value is larger than the Standard Model value by ≃ 3.7 standard deviations, which could come from new, as yet undiscovered, BSM physics. To clarify this situation, a new experiment, E989, with the total error budget of ±0.14 ppm has been mounted at Fermilab. E989 had an engineering run in June 2017, and finished the first production run in July 2018, where we collected 17 × 10^9 high-energy e^+ from μ^+ decay. The total number of events from Brookhaven E821 was 9.4 × 10^9. In Run 2, which begins in October 2018, we expect to accumulate 10 times the BNL statistics. The total systematic error budget for E989 is ± 0.1 ppm as is the statistical error budget of ± 0.1 ppm. This goal will require 2 × 10^{11} high-energy positrons detected, 21 times the BNL statistics. The systematic errors will be improved by a factor of 3 over BNL. Thus the final result should have equal statistical and systematic errors, for total error budget of ± 0.14 ppm (140 ppb). In this talk I will discuss the present status of the SM value, and then describe the experiment and show (blinded) data from Run 1 of E989.