Muon (g-2); Beyond or within the Standard Model?
The new Fermilab experiment E989

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Measurements of the magnetic moments of the electron and muon were intertwined with the development of the "modern physics" of the 20th century. The measurements are expressed in terms of the g-value, $\vec{\mu} = g\frac{Qe\hbar}{2m}\vec{s}$. Dirac theory predicts that $g = 2$, but experimentally $g > 2$; $g = 2(1+a)$. For point-like particles, the anomaly $a = (g-2)/2$ arises from loops containing all virtual particles that couple to the lepton. The muon anomaly was measured to 0.54 parts per million by E821 at Brookhaven Lab, and at present there is a 3.2 to 4-standard deviation difference between the SM and experimental values. A new muon (g - 2) experiment, E989 is being prepared at Fermilab that will improve the experimental error by at least a factor of four to clarify this difference. I will review the SM value along with the "magic-γ" technique used in E821, and then focus on the challenges that must be solved to improve the measurement by a factor of four.