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Exploring new physics with Muon g-2

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Precision measurements of the static properties of leptons and baryons are increasingly important in an era where signatures of beyond the Standard Model (SM) physics remain conspicuously absent from experiments operating at the energy frontier. The anomalous magnetic moment of the muon $a_\mu \equiv \frac{(g-2)}{2}$ can be calculated and measured to extraordinary precision, permitting a unique sensitivity to contributions from new particles and forces. To date, the most precise measurement of a_μ, made by the E821 experiment at Brookhaven National Laboratory (BNL), disagrees with the SM calculation by more than three standard deviations. This fact has motivated the development of two new and complementary muon $g-2$ experiments, which are sited at Fermilab and J-PARC. Similarly, the theoretical community has made significant progress towards its goal of reducing the error on the SM prediction for a_μ by at least a factor of two.

Fermilab experiment E989 aims to measure a_μ to 0.14 parts per million (ppm), a factor of four improvement compared to E821. The relocation, installation, and commissioning of the BNL storage ring is complete, and the magnetic field uniformity has been improved threefold compared that achieved at BNL. A completely new instrumentation suite needed to measure the muon precession frequency has been designed, built, and installed. The experimental beamlines are finished and commissioning of the overall experiment is ongoing. A first physics run begins in early 2018 with the initial goal of making a sub-ppm measurement. The J-PARC experiment is pursuing a unique approach, using a low-energy, ultra-cold muon beam injected into a compact, high-field magnet. They aim in their first phase for a sub-ppm measurement comparable to that achieved by BNL. I will provide the context for the measurements and report on the status of the running experiment at Fermilab.