

The Muon $g-2$ experiment at Fermilab is under construction in the new Muon Campus. We aim to measure the muon anomalous magnetic moment with an unprecedented precision of 140 parts-per-billion a significant improvement compared to the BNL experiment that concluded more than 10 years ago. The motivation for the new experiment is the persistent 3 – 4 standard deviation difference between the experimental value and the Standard Model prediction, which represents an interesting hint of new physics, but certainly not a discovery. Our new experiment is designed to achieve the statistical and systematic sensitivity necessary to either refute the claim or confirm it with a confidence level exceeding discovery threshold. In practice, the muon anomaly is determined by measuring the precession rate of muons in a highly uniform magnetic field. The precession rate is determined by measuring the time distribution for the higher-energy positrons emitted in muon decay as the muons circulate in the storage ring. Twenty-four electromagnetic calorimeter stations placed on the inside radius of the muon storage ring are used to record energy and time of arrival of the positrons. The calorimeters are non-magnetic segmented detectors based on a Cerenkov radiator with light read out by novel silicon photomultipliers. Our design – now published -- achieves excellent energy and time resolution, both parameters exceeding the required specifications for the experiment.

An Intensity Frontier Fellowship will the PI to provide crucial leadership for assembling and installing the calorimeters at Fermilab, for integrating them with the rest of the detector, electronics and data acquisition systems, and for initiating the analysis of the first muon data. Based on lessons learned from early data analysis, the detector performance will be optimized and dedicated systematics studies will be performed. This plan will ensure that Muon $g-2$ will achieve our goal of measuring the muon anomalous magnetic moment with a 4-times better accuracy than the previous effort.