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Data Acquisition with GPUs for the Muon g-2 Experiment at Fermilab

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A new measurement of the anomalous magnetic moment of the muon, $a_\mu \equiv (g-2)/2$, will be performed at the Fermi National Accelerator Laboratory. The most recent measurement, performed at Brookhaven National Laboratory from 1999 to 2001, shows a 3.3-3.6 standard deviation discrepancy with the standard model value of g-2. The new measurement will accumulate 21 times those statistics, measuring g-2 to 140 ppb and improving the uncertainty by a factor of 4 over that of the previous measurement.

The data acquisition system for this experiment must have the ability to create deadtime-free records from 700 μs muon spills at a raw data rate 18.6 GB per second. Data will be collected using 1296 channels of μTCA-based 800 MSPS, 12 bit waveform digitizers and processed in a layered array of networked commodity processors with 24 GPUs working in parallel to perform a fast recording of the muon decays during the spill. The system will be controlled using the MIDAS data acquisition software package. The described data acquisition system is currently being commissioned, and will be fully operational before the start of the experiment in 2017.

Author: Dr GOHN, Wesley (University of Kentucky)

Presenter: Dr GOHN, Wesley (University of Kentucky)

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