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Kicker Transient Field Measurements for Muon g-2

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The Muon $g-2$ experiment measures the muon magnetic moment anomaly a_μ by relating the precession frequencies of muons inside a magnetic storage ring to the strength of the magnetic field that they experience. A series of NMR instruments map the primary magnetic field, but some short-lived transient magnetic fields require alternative approaches to measure with sufficient precision. The kicker transient field is a magnetic perturbation created by eddy currents induced in metal inside the ring when the primary kicker field is pulsed. To measure the kicker transient field without altering its strength, three teams developed Faraday magnetometers that function without adding any metal into the system. These magnetometers send laser light through TGG crystals, where the polarization of light rotates proportionally to the strength of the surrounding magnetic field. This technique allowed the kicker transient field to be measured with milligauss-level sensitivity and megahertz-level bandwidth for the first time. Subsequent measurements have seen further improvements, with upgrades to the magnetometers reducing noise from mechanical vibrations. We present results from the UMass team's Fiber Optic Faraday Magnetometer, with an analysis of the kicker transient field and its newly reduced contribution to $g-2$'s overall uncertainty.

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