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Muon g-2 Experiment

By studying the properties of muons, scientists at Fermilab hope to learn whether there are elementary particles beyond the ones we know.

The experiment

Muon g-2 (pronounced gee-minus-two) is an international collaboration between U.S. universities, Fermilab in Illinois, Brookhaven National Laboratory in New York and nine international labs and universities. The experiment is designed to probe the magnetic properties of the muon—a heavy sibling of the electron that lives for about two microseconds—in greater detail than ever before.

The Muon g-2 experiment will study the rotation (wobble) of muons when placed in a magnetic field. Based on what we already know about muons and other particles, scientists can predict with great precision the value of the muons' "wobble." If the experiment comes up with something different, it means that our current understanding of physics is incomplete, and it may indicate the presence of additional particles or hidden subatomic forces. It would open the door to exciting new realms of science.

A similar experiment at Brookhaven collected data between 1998 and 2001. That experiment provided evidence for—but not definitive proof of—a departure from the expected value of the muons' wobble. That's where the Fermilab Muon g-2 experiment will come in, conducting a next-generation probe with much greater precision.

The Muon g-2 team transported this 50-foot-wide electromagnet 3,200 miles over land and sea, a 35-day journey to Fermilab from Brookhaven National Laboratory in New York.

What are muons?

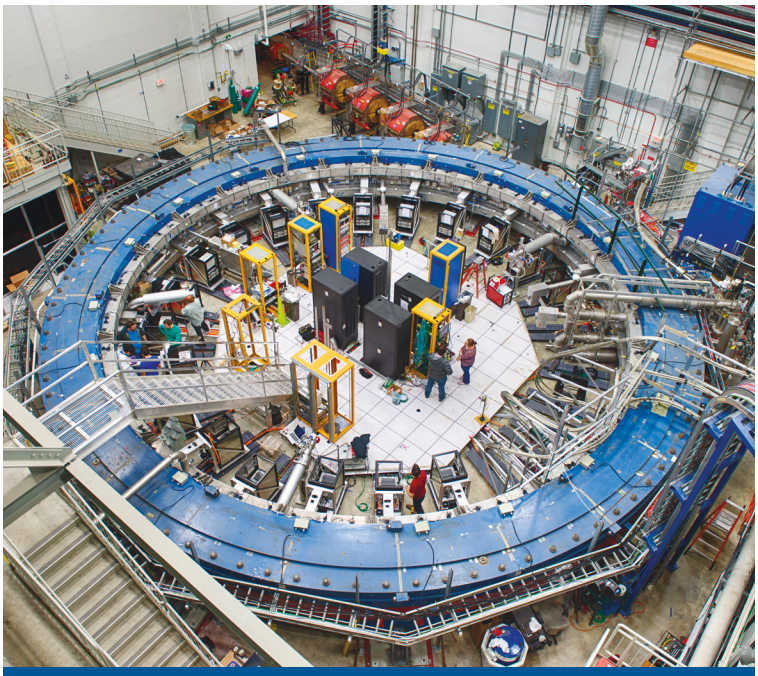
Muons are subatomic particles similar to electrons, but 207 times heavier.

They carry the same electrical charge (negative) as an electron.

They are very easy to make and store at Fermilab.

They exist for only about 2.2 millionths of a second.

When placed in a magnetic field, they spin like a gyroscope, and it is this property that the Muon g-2 experiment will measure.



The Muon g-2 experiment, built around the 50-foot-wide magnet from Brookhaven, began taking data in May 2017.

The machine

The centerpiece of the Muon g-2 experiment is a particle storage ring made of steel, aluminum and superconducting wire. It measures 50 feet in diameter and was built at Brookhaven in New York, where it was the heart of the 1990s experiment.

With its upgraded accelerator complex, Fermilab now has the ability to generate more muons than any other laboratory in the United States, making it the prime location for studying those muons. Since it was 10 times cheaper to move the existing magnetic ring from Brookhaven than to build a new one, researchers transported the ring by specially prepared barge and truck from the east coast to Fermilab in the summer of 2013. The 3,200-mile journey took just over a month to complete.

Scientists installed the massive ring in Fermilab's new muon campus over the last few years. The Muon g-2 experiment began taking data in May 2017.

More information

Muon g-2 experiment website:
muon-g-2.fnal.gov

If you have questions about this project, please contact: Fermilab Office of Communication, 630-840-3351, or send email to fermilab@fnal.gov.

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