Mu2e Experiment

Scientists at Fermilab hope to capture a never-before-seen interaction between two ordinary particles. Observing the rare event could help them find new particles or new forces underlying the universe.

A subtle transformation

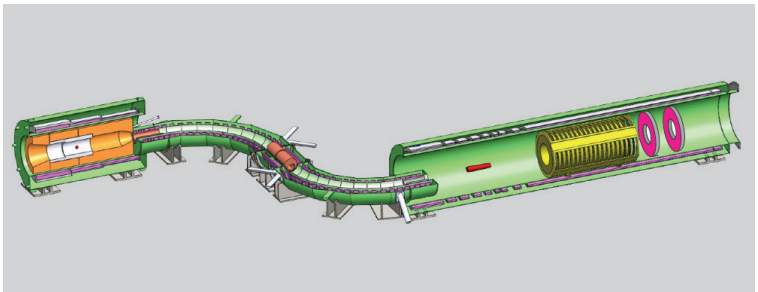
The goal of the Mu2e experiment is right in the name.

Mu2e (pronounced “mew-to-ee”) is shorthand for “muon to electron.” Scientists are looking for the one-to-one conversion of a particle called the muon into its more familiar relative, the electron.

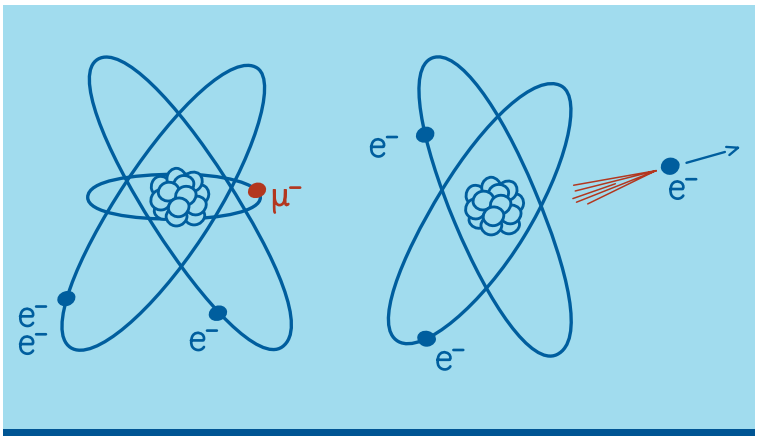
New theories predict this never observed transformation, and Mu2e will be 10,000 times more sensitive than previous attempts to discover it.

A successful sighting could hint at undiscovered particles and potentially illuminate a grand unification theory of nature’s four forces. The experiment complements research at the Large Hadron Collider in Europe, potentially clarifying the origins of new particles.

Inside Mu2e’s particle detector, about 23,000 metalized-Mylar straws are arranged in panels and filled with gas to record particle tracks.



In the Mu2e experiment, muons will be produced in the left section. They will then move through the S-shaped path to the final destination, on the right, where the detector sits. There scientists will look for the telltale sign of a muon converting directly into an electron.



The Mu2e collaboration will capture muons produced by Fermilab’s particle accelerators. If the Mu2e detector records electrons escaping with the precise energy of 105 MeV, scientists will have discovered the elusive transformation of a muon converting directly into an electron — and signs of new physics.

Rare or forbidden?

The muon and electron are both members of the family called the charged leptons.

Unlike other particle families, the charged leptons have never been seen converting exclusively into other charged leptons. Is it forbidden by laws of nature we don’t yet understand? Or have we just missed seeing it?

It might be that it’s so rare we haven’t spotted it yet. Theorists liken the chance of observing the muon-to-electron conversion to finding a penny with a scratch on Lincoln’s head hidden in one of 415 piles of pristine pennies—with each pile worth one trillion dollars.

How Mu2e works

Fermilab’s particle accelerators make muons by smashing a beam of protons into a pencil-sized tungsten target, creating a shower of particles. Superconducting magnets create magnetic fields that whisk the muons away on a curved path to their final stop: a two-stage detector that looks for the telltale sign of a muon transforming directly into an electron.

That sign is the appearance of an electron with an energy of 105 million electronvolts. The magic number, 105 MeV, indicates a muon has decayed into only an electron instead of into the commonly seen lower-energy electron plus two neutrinos.

Mu2e began construction in 2015 and will start up in 2020.

More information

Mu2e website: http://mu2e.fnal.gov