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The Mu2e Experiment: A Search for Charged Lepton Flavor Violation

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The goal of the Mu2e experiment is to test the conservation of charged lepton flavor with a search for neutrinoless muon to electron conversion in the Coulomb field of a nucleus. To extend the sensitivity of this measurement by four orders of magnitude beyond present limits, the Mu2e design incorporates several innovations to produce an intense muon beam, detect signal electrons, and reduce sources of background. This talk will give an overview of the theory and physical significance of the conversion measurement, and will discuss the physics concepts implemented in the beam sequence and primary detector components. Particle progression through the Mu2e apparatus begins with a pulsed proton beam that interacts with nuclei to produce pions, which decay to muons as they travel through the production and transport solenoids, guided by strong magnetic fields. When particles from the resulting muon beam are stopped by a target in the detector solenoid and trapped in atomic orbitals, decay via neutrinoless muon-to-electron conversion would violate charged lepton flavor and indicate the involvement of physics beyond the Standard Model. The Mu2e tracker, a low-mass array of straw drift cells, will identify high-energy signal electrons against a background of electrons from muon decay in orbit by precisely measuring their trajectories through a magnetic field, with additional energy and timing measurements made by the electromagnetic calorimeter. Besides decay in orbit electrons, the other dominant source of background comes from cosmic ray particle interactions, identified and vetoed by layers of active shielding covering the detector. Components of the Mu2e experiment are at various stages of construction and testing, and this talk will conclude with an overview of the current status.

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