Department of Physics
Particle Physics
The Denys Wilkinson Building, Keble Road, Oxford OX1 3RH

UNIVERSITY OF OXFORD

Experimental Particle Physics Seminar

at 3.30 pm
Dennis Sciama Lecture Theatre

Wednesday 4th October 2017

Dr Robert H Bernstein
Fermilab

Mu2e: A Search for Charged Lepton Flavor Violation With Sensitiviy < 10^{-16}

Abstract

The Mu2e experiment will search for the charged-lepton flavor violating (CLFV) neutrino-less conversion of a negative muon into an electron in the field of a nucleus. The conversion process results in a monochromatic electron with an energy (104.97 MeV) slightly below the muon rest mass. The goal of the experiment is to improve the previous measurement by four orders of magnitude and reach of a SES (single event sensitivity) of 2.5 x 10^{-17} on the conversion rate, a, a 90\% CL of 8 x 10^{-17}, and a 5σ discovery reach of 2 x 10^{-16}.

Although the SM is very well tested in many regimes, it appears likely to be incomplete. In many of the Beyond the Standard Model (BSM) scenarios, rates for CLFV processes are within the reach of the next generation of experiments. In particular, if SUSY particles have masses and couplings within the discovery reach of the LHC, CLFV rates will be observable. On the contrary, many CLFV searches have a sensitivity to new physics that exceeds the LHC reach, bringing the reach of new mass scale up to 10^4 TeV. In this context, indirect measurements of CLFV will be crucial evidence of new physics. The complementarity of muon to conversion experiments, the MEG and Mu3e experiments, and searches at colliders are complementary and reinforcing.

The experiment goal is obtained with a very intense pulsed negative muon beam sent to an Aluminum target for a total number of ~10^{18} stopped muons in three years of running. A sophisticated magnetic system composed of a production, a transport and a detector solenoid. I will discuss this highly efficient system for the production and transport of the muons.

The improvement with respect to previous conversion experiments is based on four elements: the muon intensity, the beam structure layout, the extinction of out of time particles, and excellent momentum resolution and particle identification. The conversion electron will be reconstructed and separated by the Decay in Orbit (DIO) background by a very high resolution (120 keV) straw-tube tracking system. The crystal calorimeter system will confirm that the candidates are indeed electrons by performing a powerful mu/e rejection. A Cosmic Ray Veto system surrounds the detector solenoid and will minimize the cosmic-ray based background.

The Mu2e experiment is under design and construction at the Fermilab Muon Campus. We expect to begin the experiment near the end of 2020 with 3 years of running from 2021 to 2023. I will also discuss upgrades already being planned for an additional order of magnitude reach in searches or a program to explore a signal.