

Mu2e

Description: Mu2e is an international project currently in the advanced design phase, having obtained CD-1 approval from the DOE in July of 2012. Mu2e will design and construct a new facility to study Charged Lepton Flavor Violation (CLFV), exploiting the existing investment in the Fermilab accelerator complex by repurposing the antiproton facility into a high intensity muon source. Mu2e is absolutely central to the development of the Intensity Frontier program in the US in this decade and a continuation of the Mu2e physics program into the Project X era is part of Fermilab's longer-range plans. This program has broad interest that spans both the High Energy and Nuclear Physics communities.

Science: Mu2e will measure the rate of coherent muon conversion to an electron in the field of a nucleus, relative to ordinary muon capture. Mu2e will have a single event sensitivity of 2×10^{-17} , a factor of 10,000 improvement that opens up a significant window of opportunity for a program of world leading physics. The Standard Model predicts negligible rates for CLFV processes while many models for new physics predict rates accessible to Mu2e. CLFV processes can be sensitive to new physics well above the TeV scale that are beyond the direct reach of any current or future accelerator. They are also affected by the mechanism responsible for neutrino mass generation, thus searches for CLFV are bound to play a key role in uncovering the origin of neutrino masses. Because of the unique physics reach and potential impact of Mu2e, the 2008 P5 panel strongly encouraged the DOE to proceed with Mu2e in all budget scenarios considered by the panel.

Competition: There is significant interest in CLFV in Europe, Asia and North America. The MEG experiment at PSI is searching for the related process $\mu^+ \rightarrow e^+ \gamma$, which is sensitive to new physics that appears in loops with an emitted photon. The muon-to-electron conversion process is sensitive to any potential physics mechanism and is sensitive to significantly higher mass scales than $\mu^+ \rightarrow e^+ \gamma$. Taken together, the two processes are a powerful discriminator of new physics models and are entirely complementary. The proposed COMET experiment at JPARC is potentially direct competition to Mu2e, though only the first phase, reaching a sensitivity of about 3×10^{-15} , is currently approved.

Collaboration and Funding: The Mu2e Collaboration currently numbers about 140 physicists from 26 institutions in the US (19), Italy (5) and Russia (2). The Collaboration continues to grow. The DOE funds the majority of the Project and discussions with INFN regarding funding of a significant fraction of the calorimeter are at an advanced stage. The DOE and NSF are providing research funds for US institutions who are members of the Collaboration.

Science Classification and Readiness: Charged Lepton Flavor Violation has generated intense interest on three continents. Members of the Energy and Intensity Frontiers as well as the theoretical community are actively engaged in this topic. Because of the importance that flavor physics plays in determining the nature of our universe, the window into detailed characteristics of potential new physics provided by studies of CLFV and the extraordinary mass scale accessible to muon-to-electron conversion, Mu2e is *absolutely central* to the goals of particle physics over the next decade. This is consistent with the evaluation of the P5 panel in 2008. Mu2e is currently in the advanced design phase and will be *ready to initiate construction* in early FY14.