Mu2e in ∼10 min.

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on behalf of
the Mu2e Collaboration

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What's Mu2e?

At the Mu2e experiment, we seek to observe the process :

$$\mu^- + Al(A, Z) \rightarrow e^- + Al(A, Z)$$

an example of Charged Lepton Flavor Violation (CLFV). In the Standard Model (SM), these processes would be practically impossible to observe (single-event-sensitivity 10^{-54} required).

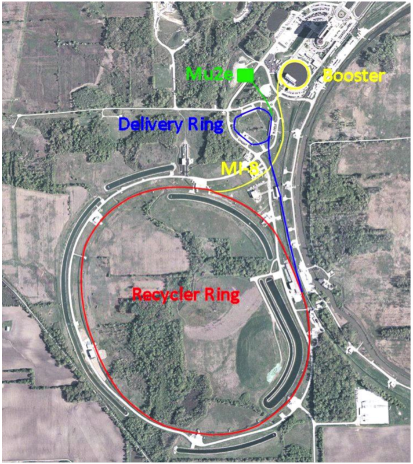
Oh ok...so why Mu2e?

If this process happened with more probability than the SM prediction, it would indicate a propagator that doesn't exist in the SM.

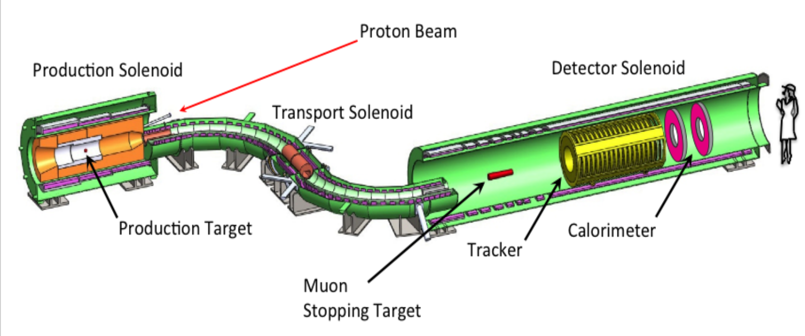
Mu2e aims to achieve a single-event-sensitivity of 2.87×10^{-17}, which is allowed by some beyond-standard-model (BSM) theories, like some Supersymmetry models.

Accelerator System

- 8 GeV beam of primary protons
- conditions beam into pulse shapes with radio-frequency sequence
- further conditioning of beam pulses and delivery to Mu2e experiment
- pulses interact with Production Target in Mu2e building

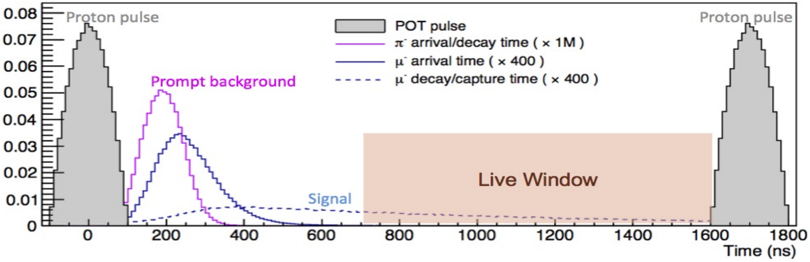


Protons to Muons

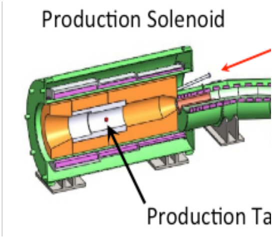


Why pulses?

This is a key design factor for Mu2e: it provides a periodic behavior in time for all the physics in the experiment, the interval of which is precisely selected to allow very prompt backgrounds to dissipate while retaining significant fractions of the signal.

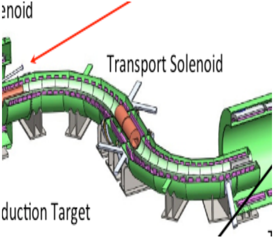


Production & Transport Solenoids



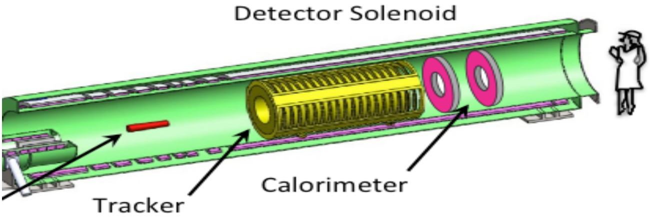
The production solenoid provides a strong magnetic field and gradient, from $\sim 4.6T - 2.5T$, upstream end to downstream end.

The transport solenoid ranges from $2.5T - 2.0T$, but, more importantly, has the prominent S-shape. This is a momentum control, maximizing muon capture at the stopping target while minimizing background particles.



Detector Solenoid

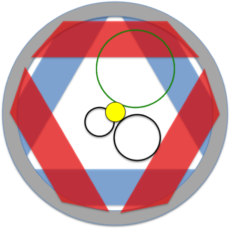
The detector solenoid ranges from $2.0T - 1.0T$, and the stopping target is just inside the upstream end, with the primary detectors downstream. The field gradient helps to direct conversion electrons towards the tracker and calorimeter region.

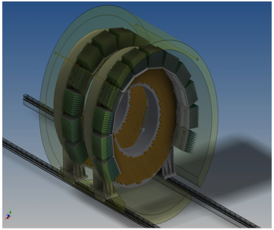


Tracker & Calorimeter

The tracker:

- primary momentum measurement for signal electrons having $\sim 105 Mev/c$
- consists of tranverse (to beam line), straw-drift tubes



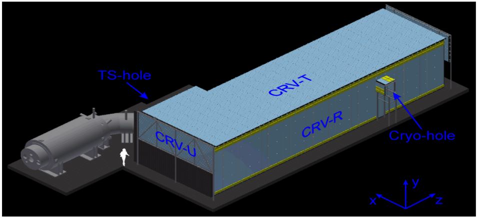


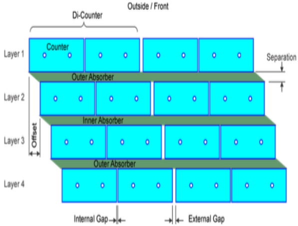
The calorimeter:

- important check on misreconstructed tracks
- independent energy/momentum measurement for charged particles
- consists of CsI scintillating crystals

Cosmic Ray Veto (CRV)

Cosmic rays can come in at any time and cause secondaries which look very much like a signal electron. The CRV helps identify those backgrounds.





Stopping Target Monitor & Extinction Monitor

The stopping target monitor[1] and extinction monitor[2]:

1. accurately measure number of stopped muons in the stopping target
2. monitor the pulse timing and shape to aid in triggering the livegate window

- CLFV, and specifically $\mu^- + Al(A, Z) \rightarrow e^- + Al(A, Z)$, is practically impossible to observe in SM
- Some BSM theories predict probabilities within Mu2e's sensitivity ($\sim 2.87 \times 10^{-17}$)
- Precision is the mantra of the experiment: from the proton beam to the detector system